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QUANTITATIVE RESEARCH / MAY 2011

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Topical Papers that Caught Our Interest:

Favorite Papers on a Few Favorite Topics – Regime Switching and Minimum Variance

Two current topics of significant interest and frequent discussion to investors are regime switching, or a strategy's sensitivity to the current environment, and minimum variance portfolios.

In this piece our team highlights academic articles of note on each of these two topics. We found these papers to provide unique insights that would be of broad interest to practitioners. We provide analyst notes for each article which summarize the main points. Our hope is that by sharing this with you, you may gain new perspective and generate new ideas that will help you as much as this research has helped us. For each research piece we provide a link to the article, the abstract, and a brief summary and discussion of why the article was chosen, and the analyst notes highlighting key insights in the work.

REGIME SWITCHING

New Approach to the Economic Analysis of Nonstationary Time Series (1987) - James D. Hamilton

http://schwert.ssb.rochester.edu/f533/econ89_jh.pdf

Abstract:
This paper proposes a very tractable approach to modeling changes in regime. The parameters of an autoregression are viewed as the outcome of a discrete-state Markov process. For example, the mean growth rate of a nonstationary series may be subject to occasional, discrete shifts. The econometrician is presumed not to observe these shifts directly, but instead must draw probabilistic inference about whether and when they may have occurred based on the observed behavior of the series. The paper presents an algorithm for drawing such probabilistic inference in the form of a nonlinear iterative filter. The filter also permits estimation of population parameters by the method of maximum likelihood and provides the foundation for forecasting future values of the series. An empirical application of this technique to postwar U.S. real GNP suggests that the periodic shift from a positive growth rate to a negative growth rate is a recurrent feature of the U.S. business cycle, and indeed could be used as an objective criterion for defining and measuring economic recessions. The estimated parameter values suggest that a typical economic recession is associated with a 3% permanent drop in the level of GNP.

CIQ Analyst Notes:

- Early empirical work in applying hidden state Markov models to economic processes
- Provides an explicit outline for implementation of this statistical regime switching technique
- Presents encouraging results for this technique when modeling an appropriately behaved (discrete regimes) environmental time series

Predicting Cycles in Economic Activity (2008) - Jane Haltmaier

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1118978

Abstract:
Predicting cycles in economic activity is one of the more challenging but important aspects of economic forecasting. This paper reports the results from estimation of binary probit models that predict the probability of an economy being in a recession using a variety of financial and real activity indicators. The models are estimated for eight countries, both individually and using a panel regression. Although the success of the models varies, they are all able to identify a significant number of recessionary periods correctly.

CIQ Analyst Notes:

- Author tests eight countries, US, Canada, Japan, Germany, UK, Mexico, Korea and Taiwan, using financial and economic market data over 1- to 3-month lagged periods.
- McFadden R^2 shows increasing significance for more developed markets (range was .4 for Mexico to .8 for UK)
- Oil Prices and stock momentum are the most significant variables for US economy in predicting expansions and recessions.
- This relatively straightforward paper serves as a nice primer for those looking to investigate regime switching or economic classification.

Bayesian Model Averaging: A Tutorial (1999) - J. A. Hoeting, D. Madlgan, A. E. Raftery and C. T. Vollnsky

http://www.stat.colostate.edu/research/Technical%20Reports/1998/98-14%20Hoeting%20Madigan%20Raftery%20Volinsky.pdf

Abstract:
Standard statistical practice ignores model uncertainty. Data analysts typically select a model from some class of models and then proceed as if the selected model had generated the data. This approach ignores the uncertainty in model selection, leading to over-confident inferences and decisions that are more risky than one thinks they are. Bayesian model averaging (BMA) provides a coherent mechanism for accounting for this model uncertainty. Several methods for implementing BMA have recently emerged. We discuss these methods and present a number of examples. In these examples, BMA provides improved out-of sample predictive performance. We also provide a catalogue of currently available BMA software.

CIQ Analyst Notes:

- Equity models use statistics extensively. However, those models ignore uncertainties coming from the standard statistical practice. Choosing just one model from a class of possible models will possibly lead to people to over confidence and cause them to take more risk than they intended.
- Bayesian Model Averaging (BMA) provides a framework to reduce model uncertainty and improve the out-of-sample predictive performance.
- With the benefit of ever increasing computing power, it is possible to envision a BMA quant model based on Monte Carlo simulation that will be able to include the most updated market condition and reflect the changes in the model. This could be a new approach to implementing regime switching models.

Contextual Fundamentals, Models, and Active Management – Sorensen, Hua, and Qian

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=683904

Abstract:
Applying a multifactor alpha model across a diverse range of stocks is a popular approach to forecast securities' expected returns. This approach assumes that one single return-generating equation provides adequate alpha forecasts – that is, one-size-fits-all. In this paper, we extend prior empirical research by introducing an alternative alpha-modeling approach. Our approach presents a parsimonious way of modeling securities individually in order to capture the idiosyncratic return behavior pertaining to different security contexts.

Our investment objective is information ratio maximization, through optimal alpha factor weights. Our modeling technique demonstrates the importance of different factor categories (cheapness, quality, and sentiment) that vary significantly across various security contexts. These contexts span typical dimensions of risk characteristics (value, growth, or earnings variability). We illustrate how practitioners can apply our technique in their security selection process, and document to what extent our approach improves the ex post information ratio when compared with a one-size-fits-all approach.

CIQ Analyst Notes:

- Select contextual dimension, set optimal factor weights, classify stocks according to context.
- To select optimal factor weights the authors propose a distance from a security and each context approach.
- A model of static weights is most similar to the high variability contextual model and least like the value contextual model implying varying weights is more important for value signals.
- Incremental benefits of including a context survives in a Fama-MacBeth framework.

Long Memory and Regime Switching (2001) – Francis X. Diebold and Atsushi Inoue

http://www.long-memory.com/volatility/DieboldInoue2001.pdf

Abstract:
The theoretical and empirical econometric literatures on long memory and regime switching have evolved largely independently, as the phenomena appear distinct. We argue, in contrast, that they are intimately related, and we substantiate our claim in several environments, including a simple mixture model, Engle and Lee's (1999) stochastic permanent break model, and Hamilton's (1989) Markov switching model. In particular, we show analytically that stochastic regime switching is easily confused with long memory, even asymptotically, so long as only a small' amount of regime switching occurs, in a sense that we make precise. A Monte Carlo analysis supports the relevance of the theory and produces additional insights.

CIQ Analyst Notes:

- The authors show that long memory and stochastic regime switching are very closely related, not just theoretically, but also in practice.
- They analyze several different models, such as Markov-switching, a stochastic permanent break model, and a simple mixture model. They also perform a series of Monte Carlo experiments in their analysis.
- This suggests that long memory may be inferred incorrectly for a series of relatively level regime shifts in the mean.

The Effect of Market Regimes on Style Allocation (2006) – Manuel Ammann and Michael Verhofen

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1322278

Abstract:
We analyze time-varying risk premia and the implications for portfolio choice. Using Markov Chain Monte Carlo (MCMC) methods, we estimate a multivariate regime-switching model for the Carhart (1997) four-factor model. We find two clearly separable regimes with different mean returns, volatilities and correlations. In the High-Variance Regime, only value stocks deliver a good performance, whereas in the Low-Variance Regime, the market portfolio and momentum stocks promise high returns. Regime-switching induces investors to change their portfolio style over time depending on the investment horizon, the risk aversion, and the prevailing regime. Value investing seems to be a rational strategy in the High-Variance Regime, momentum investing in the Low-Variance Regime. An empirical out-of-sample backtest indicates that this switching strategy can be profitable, but the overall forecasting ability for the regime-switching model seems to be weak compared to the iid model

CIQ Analyst Notes:

- The authors identify a high-variance regime and a low-variance regime by estimating a multivariate regime-switching model using Markov Chain Monte Carlo methods.
- The implication of regime-switching for portfolio choice is that in the high-variance regime value investing seems to be a rational strategy, while in the low-variance regime, momentum following is most rational.
- The familiarity of investors with these styles (value and momentum) and the straightforward regime definitions (low and high variance) could help practitioners to put these methods into practice.

Markov-switching Asset Allocation: Do Profitable Strategies Exist? (2010) – J. Bulla, S. Mergner, I. Bulla, A. Sesbo üé, and C. Chesneau

http://econpapers.repec.org/paper/pramprapa/21154.htm

Abstract:
This paper proposes a straightforward Markov-switching asset allocation model, which reduces the market exposure to periods of high volatility. The main purpose of the study is to examine the performance of a regime-based asset allocation strategy under realistic assumptions, compared to a buy and hold strategy. An empirical study, utilizing daily return series of major equity indices in the US, Japan, and Germany over the last 40 years, investigates the performance of the model. In an out-of-sample context, the strategy proves profitable after taking transaction costs into account. For the regional markets under consideration, the volatility reduces on average by 41%. Additionally, annualized excess returns attain 18.5 to 201.6 basis points.

CIQ Analyst Notes:

- Previous work largely focuses on monthly returns, and substantial parts of the excess returns disappear after deduction of transaction cost.
- This study utilizes daily return series of major equity indices in the US, Japan and Germany over the last 40 years. This increases the amount of data available for markets with short history. Most importantly, the impact of wrong regime forecasts reduces from an entire month to a single trading day.
- The strategy takes transaction costs explicitly into account – which is more important to the practical applicability of regime switching model because frequent rebalancing of the portfolio is likely eat up much of the potential excess returns.
- An asset allocation strategy based upon Markov-switching approach does generate profit considering out-of-sample performance and transactions.
- A robust technique is employed to reduce the number of regime switches and thus transaction costs. For all analyzed stock market indices, the strategy is found to be profitable after transaction costs.

Style Timing: Value versus Growth (2000). - Clifford S. Asness, Jacques A. Friedman, Robert J. Krail, John M. Liew

http://www.iijournals.com/doi/abs/10.3905/jpm.2000.319724

Abstract:
Both academic and industry research supports the long–term efficacy of value strategies is far from riskless, however. They can have long periods of poor performance. In an effort to improve upon these strategies, the authors have tried to forecast these returns with mixed results. Most of these "style timing" models are based on macroeconomic factors. The authors take a different approach considering two simple factors: 1) the spread in valuation multiples between a value portfolio and a growth portfolio (the value spread), and 2) the spread in expected earnings growth between a growth portfolio and a value portfolio (the earnings growth spread). They find that the greater the value spread and the smaller the earnings growth spread, the better their forecast for value versus growth going forward. These results are statistically and economically strong.

CIQ Analysts Notes:

- Asness takes a different approach from other types of regime switching analysis where most of them are using micro-economic and financial signals to define regimes.
- He argues that those signals are harder to observe in real time.
- Asness proposes a more intuitive way to define regimes as observed value and growth spreads. The larger the spreads, the more likely the market is in a state of uncertainty, so the pay offs are hopefully larger.
- They find the forecasting power is strong from both a statistical and economic perspective.

Share Issuance and Factor Timing (2010) – Robin Greenwood and Samuel Hanson

http://www.q-group.org/pdf/Greenwood-Paper-SIFT.pdf

Abstract:
We show that characteristics of stock issuers can be used to forecast important common factors in stocks returns such as those associated with book-to-market, size, and industry. Specifically, we use differences between the attributes of stock issuers and repurchasers to forecast characteristic-related factor returns. For example, we show that large firms underperform following years when issuing firms are large relative to repurchasing firms. While our strongest results are for portfolios based on book-to-market, size (i.e., we forecast the *HML* and *SMB* factors), and industry, our approach is also useful for forecasting factor returns associated with distress, payout policy, and profitability.

CIQ Analyst Notes:

- The authors believe that companies have private information about whether their firms are under or over-valued, so it's a good timing indicator when firms choose to issue or repurchase shares among all the other motivations. The paper uses a measure called "Issuer-Repurchase Spread" to capture the tilts of firm characteristics based on the timing of those actions.
- The authors then choose a large number of characteristics and run the univariate regressions to discover what characteristics can predict characteristic-based factor returns better, given the stock issuance timing information. The strongest results that came out of the exercises are from portfolios based on B/P, Size and industry.
- As the results tend to be a little "data-mining" like but the original title of this paper is "Characteristic Timing". So essentially we can use this as a framework to identify corporate events and characteristics that are associated with those events. One can think of the dividend payout policy as a potential candidate for this approach.

Comparing Regime-Switching Models in Time Series: Logistic Mixtures vs. Markov Switching (2007) - Dimitrios V. Paliouras

http://drum.lib.umd.edu/bitstream/1903/6978/1/umi-umd-4486.pdf

Abstract:
The purpose of this thesis is to review several related regime-switching time series models. Specifically, we use simulated data to compare models where the unobserved state vector follows a Markov process against an independent logistic mixture process. We apply these techniques to crude oil and heating oil futures prices using several explanatory variables to estimate the unobserved regimes. We find that crude oil is characterized by regime switching, where prices alternate between a high volatility state with low returns and significant mean reversion and a low volatility state with positive returns and some trending. The spread between one-month and three-month futures prices is an important determinant in the dynamics of crude oil prices.

CIQ Analyst Notes:

- This paper reviews several regime shifting models, including Markov shifting with fixed or time-varying transition probabilities and logistic mixture model.
- It discusses the techniques for estimating these models, including EM algorithm, nonlinear filter, smoothing and numerical maximization.
- It compares the performance of these models using simulated data. Generally, the correctly specified model has a light edge in its corresponding simulated data. All methods are able to identify hidden states/regimes with high probability.
- It applies these models on crude oil and heating oil futures and finds some evidence of switching between two regimes in crude oil markets, but not for heating oil.

MINIMUM VARIANCE

Minimum-Variance Portfolio Composition (2010) - Roger Clarke, Harindra de Silva, and Steven Thorley

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1549949

Abstract:
Empirical studies document that equity portfolios constructed to have the lowest possible risk have surprisingly high average returns. We derive an analytic solution for the long-only minimum variance portfolio under the assumption of a single-factor covariance matrix. The equation for optimal security weights has a simple and intuitive form that provides several insights on minimum variance portfolio composition. While high idiosyncratic risk can lead to a low security weight, high systematic risk takes the large majority of investable securities out of long-only solutions. The relatively small set of securities that remain have market betas below an analytically specified threshold beta. The math also shows that the ratio of portfolio beta to the threshold beta dictates the portion of ex-ante portfolio variance that is market-factor related. We verify and illustrate the portfolio mathematics using historical data on the U.S. equity market and explore how the single-factor analytic results compare to numerical optimization under a generalized covariance matrix. The analytic and empirical results of this study suggest that minimum variance portfolio performance is largely a function of the long-standing empirical critique of the traditional CAPM that low beta stocks have relatively high average returns.

CIQ Analyst Notes:

- The cumulative excess return of the minimum-variance portfolio (5.37% p.a.) has been slightly higher than that of the market (4.88% p.a.) from 1968 through 2009, with significantly lower realized risk (11.90% vs. 15.56%)
- This represents a puzzling violation of risk-return principles in financial economics
- The paper examines the composition of minimum-variance portfolio with focus on the analytical form and parameter values of individual security weights
- The assumption of a single-factor risk model allows for a simple and intuitive equation for security weights under the long-only constraint. This, in turn, shows that
    - While high estimated idiosyncratic risk can lead to a low security weight, high systematic risk takes the large majority of investable securities completely out of the long-only solution
    - Minimum variance portfolios are strictly populated by stocks with betas lower than a specified threshold whereas security weight is less sensitive to idiosyncratic risk
    - 80% to 90% of long-only minimum variance portfolio risk is systematic in the single factor model
- More general numerical optimizations on a full covariance matrix suggest that systematic risk considerations continue to dominate the construction of minimum-variance portfolios
- The strong performance of the minimum-variance portfolio is closely related to the long-standing empirical critique of the CAPM that low-beta stocks have relatively high returns
- Although the CAPM critique is a key driver, the dynamic nature of equity risk over time makes it unlikely that simply purchasing a collection of low-beta stocks will perform as well as an explicitly optimized portfolio
- Numerical generalizations beyond the single factor model suggest that some of the remaining risk is eliminated in portfolios optimized with a full covariance matrix

Benchmarks as Limits to Arbitrage: Understanding the Low-Volatility Anomaly (2011) - Malcolm Baker, Brendan Bradley, and Jeffrey Wurgler

http://archive.nyu.edu/bitstream/2451/29593/2/Benchmarks15.pdf

Abstract:
Over the past 41 years, high volatility and high beta stocks have substantially underperformed low volatility and low beta stocks in U.S. markets. We propose an explanation that combines the average

investor's preference for risk and the typical institutional investors mandate to maximize the ratio of excess returns and tracking error relative to a fixed benchmark (the information ratio) without resorting to leverage. Models of delegated asset management show that such mandates discourage arbitrage activity in both high alpha, low beta stocks and low alpha, high beta stocks. This explanation is consistent with several aspects of the low volatility anomaly including why it has strengthened in recent years even as institutional investors have become more dominant.

CIQ Analyst Notes:

- The Low–volatility anomaly (higher abnormal returns for low-volatility stocks) flies in the face of established Modern Portfolio Theory.
- This paper does an excellent job of explaining the observed anomaly caused by irrational market participants. It moves beyond a re-description of the anomaly and brings relevance with a recap of various behavioral explanations for the existence of the anomaly, and it focuses on drivers for its persistence into the future.
- It shows how the goal of maximizing IR discourages investing in low Beta / high Alpha assets and encourages high beta / low alpha bets. The goal of maximizing IR, rather than Sharpe ratio, leads to a flattening of the CAPM relationship.
- A puzzling question has always been "Why doesn't smart money arbitrage away the low-volatility, low-beta mispricing?". The authors provide an answer to this conundrum – leverage constraints and fixed benchmarks imposed on investment managers do not incentivize them suitably to arbitrage away the anomaly.

Using Industry Momentum to Improve the Performance of Minimum-Variance Portfolios (2011) – Fabian Trübenbach

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1756164

Abstract:
In portfolio optimization minimum-variance portfolios that ignore the mean and solely focus on the (co-)variances of asset returns have proven to outperform mean-variance approaches in out-of-sample applications. However, minimum-variance policies also fail to outperform the naive 1/N rule that serves as an important benchmark. In this paper, we propose a parametric portfolio policy that makes use of industry return momentum to improve the performance of minimum-variance policies. We are able to beat the 1/N policy, in many cases significantly, in terms of Sharpe ratio and certainty equivalents. Additionally, the improved performance can be attained with similar low portfolio volatilities than the pure minimum-variance policies and the results are accompanied with only a moderate increase in portfolio turnover.

CIQ Analyst Notes:
Paper uses industry momentum strategy to improve the performance of minimum variance portfolios. This paper provides an interesting approach to enhancing returns from min variance strategies, which we have also done some previous research - **"Variations on Minimum Variance" (Falk 2011)**

- *Simplicity:* This paper adopts an easily implementable process in enhancing the returns from traditional min variance strategies.
- This paper also addresses 2 issues associated with min variance portfolios:
  - The strategy adopted in the paper outperforms most 1/N portfolios, unlike most traditional min variance strategies.
  - The strategy performs well during both up and down markets (unlike most min variance portfolios that only perform well during market downturns)
- *Performance:* The strategy yields portfolio risk-adjusted returns that are better than their min variance equivalents
- *Turnover:* The author claims that the strategy's turnover is similar to that from a traditional min variance strategy.

Martingale Asset Management LP in 2008, 130/30 Funds, and a Low-Volatility Strategy (2009) - Luis M. Viceira, Helen H. Tung

http://cb.hbsp.harvard.edu/cb/product/209047-PDF-ENG

Description:
In early July of 2008, William (Bill) Jacques, Chief Investment Officer at Martingale Asset Management, a quantitative value-oriented investment manager in Boston, Massachusetts, was busy preparing for an upcoming meeting with the group that made new product decisions within the firm. The objective of the meeting was to review the backtesting and real-time investment results of a new minimum-variance strategy within the framework of a 130/30 fund. The performance results were very encouraging, but Bill still wondered if they were a fluke of the data, a result of data mining rather than the reflection of a true market anomaly. He wanted to discuss several possible explanations of the phenomenon, and to decide whether Martingale should offer the strategy to its clients.

Objective:
To discuss the mechanics and the economic implications of leverage and short-selling for investment strategies. To discuss minimum volatility stock investment strategies and quantitative investing in general. To discuss the management of quantitative funds, especially in the context of new product development and client offerings.

CIQ Analyst Notes:

- Most notable is that this HBS case exists, and is now being studied by second year HBS students to as an alternative to the traditional CAPM.
- The case provides classroom discussion material for with an overview of a quantitative investment management firm, describes the low-volatility anomaly, and explores the issues surrounding launching a fund to exploit it.

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OUR RECENT RESEARCH

April 2011 – Can Dividend Policy Changes Yield Alpha?
Investors are acutely sensitive to changes in dividend policy. Literature suggests that dividend change announcements provide information about management's assessment of companies' prospects, and therefore are predictive of future stock returns. The implication for investors is worth noting. In the first quarter of 2011 alone, 105 of the 384 dividend paying S&P 500 companies (27.3%) increased their dividends, while only 1 (0.26%) decreased dividends.

In this paper, we analyze the market reaction to different types of dividend policy changes, specifically initiation, increase, decrease and suspension of dividends.

April 2011: CQA Spring 2011 Conference Notes
Several of our team's members attended the Chicago Quantitative Alliance (CQA) Spring Seminar in Las Vegas. We present our collective notes from the conference in this report.

March 2011: How Much Alpha is in Preliminary Data?
Companies often report financials twice: first, through a preliminary press release and again in their official, i.e., final, SEC filings. In theory, there should be no difference between the numbers reported in a company's preliminary financial filings and their final filings with the SEC. In practice, often significant difference can occur between the preliminary and final filings. In this month's research report, we focus on these observed differences within the Capital IQ Point-In-Time database in order to ascertain the nature and exploitability of these differences.

February 2011: Industry Insights – Biotechnology: FDA Approval Catalyst Strategy
Biotechnology is a challenging sector for investors due to the binary nature of the product cycle. Indeed many biotechnology firms' futures rest upon the success of a single product. A critical stage in the product life-cycle is the FDA approval process. In this report we look at the exploitability of a strategy centered on FDA filings.

January 2011: US Stock Selection Models Introduction
In this report, we launch our four US Stock Selection models -- Value, Growth, Quality, and Price Momentum. Built using Capital IQ's robust data and analytics, these four models are the culmination of over two years of research and development. Each model is intended to be employed as the basis for a stand-alone stock selection strategy or integrated into an existing systematic process as an overlay or new component.

January 2011: Variations on Minimum Variance
Various explanations for why risk is mispriced have been offered; the most common one is that leverage restrictions incite some investors to chase volatility at the individual issue level. In this paper, we explore various methodologies for construction of minimum variance portfolios of US listed equities and analyze the features of these portfolios.

January 2011: Interesting and Influential Papers We Read in 2010
As researchers, we spend a large amount of time trying to generate new ideas. In order to discover and refine these ideas, we find ourselves in a continuous quest for innovative and interesting articles and papers from academics, analysts, and other researchers. There is such a large body of information out there that it can be difficult to wade through all the material to find what is truly of value and interest to us. To assist in sifting through all this information, our group recently took the time to find and discuss articles that recently struck us.

November 2010: Is your Bank Under Stress? Introducing our Dynamic Bank Model
Leveraging Capital IQ's Bank industry data, we have built a stock selection model that encompasses three themes -- Momentum, Value, and Balance Sheet Quality -- and includes a proprietary Markov-regime switching component which dynamically changes the model's weights depending on whether or not banks are in a "stressful" (or crisis) environment. This month, we will review how we built our model and its switching component.

October 2010: Getting the Most from Point-in-Time Data
In this paper, we will examine PIT data's origins, structure, variations, and proper use in implementations from Compustat and Capital IQ. Misusing PIT data, or applying it haphazardly, can discard valuable information and obscure otherwise clear signals.

October 2010: Another Brick in the Wall: The Historic Failure of Price Momentum
In 2009, investors witnessed the cataclysmic failure of Price Momentum strategies. Now that accounts of this failure have been on the books for some time, it is appropriate to place the events in a historical context and further analyze the fundamental relationships that affect this strategy. We look at a number of questions from practitioners interested in the strategy. Within a historical context, how pronounced has this recent failure been? When Price Momentum fails, what is the strategy's subsequent performance? And, what factors are concurrent or predictive of the performance of Price Momentum?

July 2010: Introducing Capital IQ's Fundamental US Equity Risk Model
In this paper we document the process of building and testing of our fundamental US Equity risk model across a number of short to medium term forecast horizons. The paper reviews typical risk model applications; discusses the relative merits of alternative forms of multifactor risk models; documents our data and methodology; 4 describes the chosen test metrics; and presents our results.

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