Quantitative Strategy
North America United States

Deutsche Bank

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Signal Processing

A Quant Handbook on REIT Investing

Research Summary
The purpose of this research is to provide a rigorous, systematic, and practical guide on how to invest in the REIT market using a quantitative approach. It should be of value to both quantitative and fundamental investors in REITs.

Innovative, rigorous, and practical quantitative research

REITs are different
Many of the common quant factors behave very differently for REITs versus non-REITs. REITs are required to pay out most of their taxable income to avoid double taxation; therefore, they offer higher yield. On the other hand, growth heavily depends on external financing; therefore, the ability to access debt and equity market is critical for REITs.

Unique REIT-specific data
In this research, we test both traditional factors, but also a new data source –SNL, the *de facto* standard on REIT industry data. Our factors are structured around the unique characteristics of REITs.

QCD-REIT model
We build a multi-factor model following a similar methodology as our QCD model, using both traditional and REIT-specific factors. The QCD-REIT model has significantly outperformed the generic REIT model, by boosting portfolio IR (Sharpe ratio) by 81% in the past 11 years and 240% in the past three years.

Source: gettyimages.com

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A letter to our readers

Building REIT stock selection models

In June 2010, we studied 164 factors in 12 industries using industry-specific data[1]. We found that industry-specific factors tend to have stronger predictive power to future stock returns (alphas) than traditional factors, with reasonably slow performance decay, low turnover, and low correlation with other common factors.

In this research, we further extend our research to the REIT (real estate investment trust) sector. REIT is a unique sector with about 120-130 investable securities and a total market capitalization around $800 billion.

Most of the published books and articles on REIT investing are about investing in REITs as a separate asset class[2]. There are few books on REIT investing for professional investors – at least to our knowledge. Likewise, there is very limited academic research about REIT security selection[3]. The focus of our research is on how to select the best (and worst) REIT stocks. We discuss the unique features of REITs and how to model this interesting market segment.

In this research, we study a wide range of databases on REITs, from the more traditional Compustat, Datastream, IBES, to REIT-specific data using SNL, to some data sources discussed in our latest research, e.g., options, high frequency data, and securities lending data. We try to tie in the unique features of REITs with how to build REIT security selection factors around these characteristics.

In the end, we address the most important question – how to build a multi-factor REIT selection model. We develop an optimized model (QCD-REIT) that uses both traditional and REIT-specific data, with a similar methodology as our flagship stock selection QCD model. A simulated real-world REIT portfolio using the QCD-REIT model has outperformed the portfolio using the generic QCD model by 81% in the past 11 years and 240% in the past three years, as measured by IR (Sharpe ratio).

Yin, Rocky, Miguel, Javed, and John

Deutsche Bank US/Global Quantitative Equity Strategy

[1] See Luo, Y., Cahan, R., Jussa, J., and Alvarez, M. [2010]. "Industry specific factors", *Signal Processing*, Deutsche Bank Quantitative Strategy, June 7, 2010.

[2] Actually, most published books and papers are more like explaining what REITs are and promoting REITs.

[3] Actually, there is very limited research of stock selection on just about any particular industry. The vast majority of asset pricing research is about market anomalies of broad investment universes (e.g., all US stocks, all Japanese stocks, all European stocks, etc.), but very limited research on REITs or banks or technology stocks. Please refer to Luo, Y., Cahan, R., Jussa, J., and Alvarez, M. [2010]. "Industry specific factors", *Signal Processing,* Deutsche Bank Quantitative Strategy, June 7, 2010, for an example of research on specific industries.

Introduction

In this research, we study an interesting and specialized industry, REITs or real estate investment trusts.

Smaller breadth but better skill

Based on the fundamental law of active management, a manager's performance mostly depends on two factors: skill and breadth[4]. Traditionally, we think of quant managers as having less skill but higher breadth than fundamental managers. However, in our previous research[5], we find, for some factors, skill is more concentrated in certain segments, rather than uniformly distributed, which suggests that we may not have as much breadth as we originally thought.

Because quant managers are investing across the entire universe of stocks, the only way to gain additional alpha is to increase skill. By diving into industry specific data, we sacrifice breadth for better skill. The question, of course, is whether this trade-off actually adds alpha.

Industry specific data

Traditional data vendors like Compustat, Worldscope, or Factset provide standardized financial statement data across all industries, so analysts can compare companies in different industries. In addition, the typical financial statement items have been thoroughly studied by academics and practitioners and it is difficult to find new factors. On the other hand, there are many interesting data points that are disclosed in companies' 10K or 10Q fillings (e.g., in the Management's Discussion and Analysis or footnote disclosures), but not in the three main financial statements (balance sheet, income statement, and statement of cash flow). Fundamental analysts typically collect these data items manually and use them extensively in their research.

In this paper, we try to supplement the more traditional and generic databases like Compustat, Worldscope, Datastream with SNL's REIT data. Our REIT universe comprises all REITs that are in the Russell 3000 universe with some minimum market capitalization and liquidity requirements.

SNL data

SNL analysts mine through all publicly available data, including 10Ks, 10Qs, press releases, earnings releases, and financial supplements. All data is checked for accuracy and standardized for comparison across the REIT industry.

The SNL data is comprehensive – it is probably the best data source for industry-specific data. However, it is mainly designed for fundamental analysts/PMs to use. SNL provides a series of user-friendly data download functionalities and spreadsheet analysis tools. Conducting backtesting using SNL data is, however, challenging. Not only do we need to map the symbols point-in-time for the past 20 years of history, but also we need to match dates properly to avoid look-ahead bias. SNL provides a long list of data items in the REIT database. However, only a small fraction of data has meaningful history and coverage to warrant more in-depth analysis.

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[4] See Grinold, R., and Kahn, R. [1999]. *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk*, McGraw-Hill, 2nd edition and Qian, E.E., Hua, R.H., and Sorense, E.H. [2007]. *Quantitative Equity Portfolio Management: Modern Techniques and Applications*, Chapman & Hall/CRC.

[5] See Luo, Y. Cahan, R., Jussa, J., and Alvarez, M. [2010]. "Quantiles versus mean variance", *Portfolios Under Construction*, Deutsche Bank Quantitative Strategy, April 23, 2010

SNL's REIT database has eight categories of data: property aggregate, property details, property financial details, corporate data, corporate fundamentals, market data, and estimates. For our purposes, the most interesting data points are property aggregate, property details, and property financial details.

A brief guide to REITs

The REIT industry body, NAREIT (the National Association of Real Estate Investment Trusts) defines a REIT as[6]:

"A real estate investment trust, or REIT, is a company that owns, and in most cases, operates income-producing real estate. Some REITs also engage in financing real estate. The shares of many REITs are traded on major stock exchanges."

Most of the published books and articles on REITs are about investing in REITs as a separate asset class and promoting the benefits of REITs. The focus of our research is on how to select the best (and worst) REIT stocks. Nevertheless, in this section, we give a brief overview of the REIT industry[7]. Understanding the basic features of REITs will help investors who are not familiar with this market segment better appreciate some of the factors to be addressed in the next few sections.

Fundamentals of REITs

A common misconception about REITs is that they are passive funds simply holding some real estate properties. The reality, however, is that REITs are just like other public companies – actively investing and managing properties, trading on major stock exchanges, having similar disclosure requirements, and regulated by the same corporate governance rules.

Types of REITS

REITs can be classified as equity REITs, mortgage REITs, and hybrid REITs.

- **Equity REITs.** This is our primary interest in this research. It is also the largest segment of the REIT market. This type of REIT directly invests in and develops real estate properties. The majority of their revenue comes from rents. They are designed to protect themselves from inflation and interest-rate fluctuation through their lease structures, dividend policy, and corporate growth strategies.
- **Mortgage REITs.** The second largest type of REIT, mortgage REITs, provide debt capital for housing and commercial real estate by lending to real estate developers or investing in mortgages and mortgage-backed securities. The majority of revenue for mortgage REITs comes from the principal and interest payments on their investment. Their profit is directly tied to interest rates. As a result, mortgage REITs often have more volatile returns. Mortgage REITs have many debt-type features. We mostly exclude mortgage REITs from our research universe.
- **Hybrid REITs.** Hybrid REITs combine the investment strategies of both equity and mortgage REITs.

[6] http://www.reit.com/AboutREITs/WhatisaREIT.aspx

[7] Investors can find a more detailed overview in "The Investor's Guide to REITs", NAREIT (www.reit.com) and "2010 REIT Industry Overview Guide", SNL (www.snl.com).

Unique features about REITs

There are a few unique features about REITs and many of the factors we will address in the next few sections are built on these features.

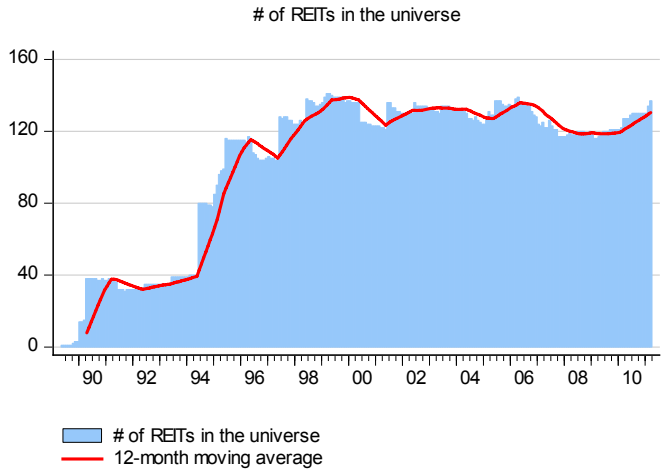
- At least 75% of a REIT's assets must be real estate.
- A REIT cannot own more than 10% of another company, other than another REIT, a qualified REIT subsidiary (or QRS) or a taxable REIT subsidiary (TRS), in which case only 20% or less of a REIT's total assets may reside in one or more TRS.
- A REIT must earn at least 75% of its gross income from rents from real property or interest on mortgages on real property.
- At least 90% of taxable income, excluding capital gains, must be distributed annually to shareholders. This means that a REIT's ability to grow and acquire mostly relies on external financing; therefore, it is essential to have access to capital markets with low costs.
- High dividend yield. Because REITs are required to generate at least 75% of gross income from rents or mortgage income, and pay out most of their taxable income, dividend yields from REITs tend to be in the high range. In REIT investing, higher dividend yield is, however, not necessarily always better. Having a more sustainable dividend stream is far more important.
- REITs are allowed to deduct dividends paid to shareholders from their taxable income; thus REITs can avoid corporate tax entirely by paying out 100% of taxable earnings.
- Predictable Revenue Stream. REITs' reliable income is derived from rents paid to the owners of commercial properties whose tenants often sign leases for long periods of time, or from interest payments from the financing of those properties.
- Earnings Transparency. Most REITs operate along a straightforward and easily understandable business model: By increasing property occupancy rates and rents over time, higher levels of income may be produced. When reporting financial results, REITs, like other public companies, must report earnings per share based on net income as defined by generally accepted accounting principles (GAAP).

Investable universe

Our combined SNL and DB Quant databases has total 27,318 REITs x months. Our REIT database includes all REITs that are in the Russell 3000 index with some minimum size and liquidity requirements.

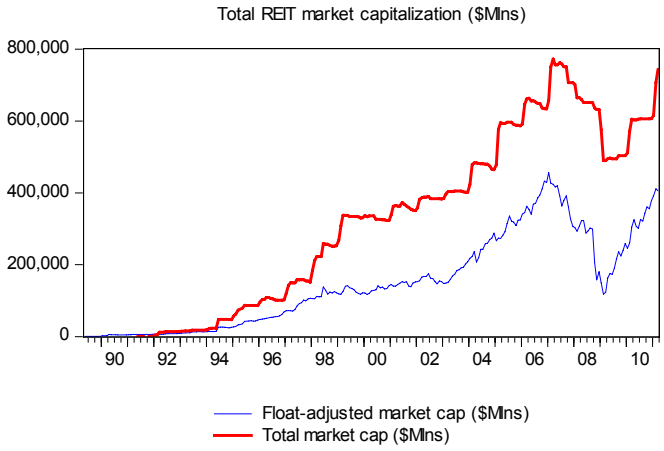
Our REIT data starts from May 1989, but high quality data is not available until early 1990s (see Figure 1). In the past 15 years, on average, we have about 120 REITs in our universe at any given point of time. The total market capitalization of all investable REITs has grown significantly over the years (see Figure 2). Currently, the total market cap of all investable REITs has reached to about $800 billion.

Figure 1: Total # of REITs in our universe



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 2: Total market cap of investable REITs



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

The main performance metrics for REITs

Due to the unique nature of REITs, cash flows play a more dominant role than earnings in the REIT space. REIT investors also prefer their own accounting rules and terminology. The equivalent of EPS for REITs is probably FFO or AFFO.

FFO

FFO or funds from operations is the main metric used by REIT investors. FFO differs from net income by excluding depreciation and amortization of real estate assets and gains and losses from most property sales. EPS is generally considered as inferior to FFO, as it assumes depreciation on real estate assets over time; however, many properties will actually increase in value over time.

AFFO

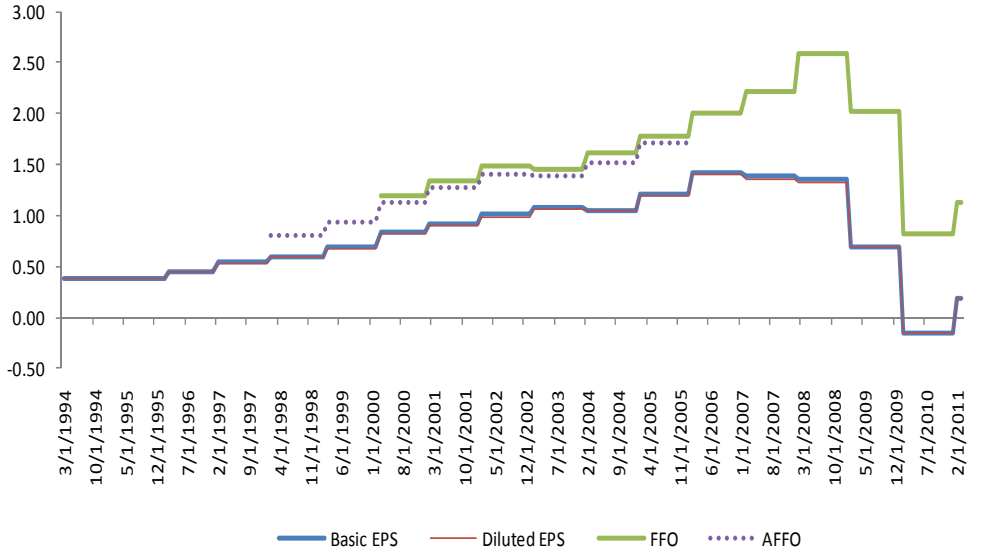
AFFO or adjusted funds from operations is another common metric used by REIT investors. AFFO is typically calculated as FFO minus recurring capital expenditures, amortization of tenant improvements, amortization of leasing commission, and adjustment for straight-line rent. AFFO is also often called FAD (funds available for distribution) or CAD (cash available for distribution).

EPS, FFO, or AFFO – does the distinction even matter?

EPS, FFO, and AFFO roughly move together. Figure 3 shows an example for KIMCO Realty Corp. In our database, EPS numbers have the least missing values. The coverage of FFO seems to be reasonable, while AFFO (provided by SNL) has limited coverage and history (see Figure 3).

As will be demonstrated in later sections, in most cases, FFO or AFFO based factors do appear to have stronger predictive power about future stock returns than EPS based factors.

Figure 3: KIMCO Realty Corp: EPS, FFO, and AFFO



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Net asset value (or NAV)

Many REIT analysts look at net asset value (NAV) as a reference point for the valuation of a company. NAV equals the estimated market value of a REIT's total assets (mostly real properties) minus the value of all liabilities. When divided by the number of common shares outstanding, the net asset value per share is viewed by some as a useful guideline for determining the appropriate level of share price.

NAV is generally preferred to book value, as book value does not accurately reflect the REIT's earning capacity. GAAP accounting rules assume property value will decrease over time, due to depreciation. Well maintained properties generally would appreciate in value. Therefore, NAV tends to measure the real underlying value better than book value. In the value factor section, we will discuss the relative merits of price-to-book versus price-to-NAV.

Operating partnership

Another key component that separates REITs from other companies is the existence of Operating Partnership units, or a form of stock distributed to partners in an operating partnership. In these instances, a REIT joins with an existing partnership and typically will receive properties in exchange for operating "units". The number of Convertible Partnership Units, or the number of common share equivalents represented by operating partnership (OP) units that can be converted into shares of common stock and are held by the minority shareholders of any operating partnership or any other non-wholly owned subsidiary can be added to the total number of shares outstanding. Often analysts will want to include these OP units in their calculation of market cap.

As of March 31, 2011, about 70% of all REITs in our universe have one or more downREIT structure[8].

[8] DownREIT is one of the three legal structures a REIT can adopt.

Property portfolio enhancements

The value of a REIT's property portfolio can be maintained or enhanced through consistent capital expenditures. This is significant because strategic property portfolio enhancements help to maintain or increase NAVs and can provide the basis for price appreciation of a REIT's shares.

Financial leverage

Due to the tightened credit markets, many in the REIT space are evaluating debt closely. A key area of emphasis is a REIT's debt maturity schedule. The debt maturity schedule captures the principal amount of debt maturing during the next 5 fiscal years, and thereafter; the principal payment schedule presents the principal balance, net of unamortized discounts, to be paid in the next 5 fiscal years, and thereafter. Investors also need to pay attention to credit facilities and debt rating by the major rating agencies (e.g., S&P, Moody's, and Fitch).

Legal structure

The legal structure of REITs can be complex and it has little to do with our models. Therefore, we will only outline the three basic structures below without going into any details.

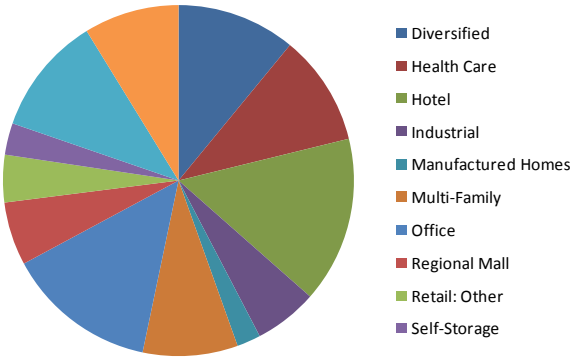
- **Traditional REITs** own their own assets directly.
- **Umbrella Partnership (UPREIT).** The UPREIT structure was created in the early 1990s to allow REITs the possibility of not owning the underlying real estate assets. Currently, over half of the largest REITs are organized as UPREITs. An UPREIT involves an operating partnership between a limited real estate partnership and a newly formed REIT. In this structure, the REIT raises and provides the investment capital, while the real estate partnership contributes the real estate portfolio to the partnership. While both groups garner ownership units in the UPREIT, the partnership owners can exchange their units for cash or stock in the REIT after a set period of time, typically a year.
- **DownREIT.** DownREITs are similar to UPREITs, except this structure directly owns some of its properties unlike an UPREIT, which holds its properties in the operating partnerships. A DownREIT allows a REIT to acquire and hold real estate properties in an operating partnership that remains separate and apart from the REIT's other properties. The REIT acts as a general partner in a partnership with the parties from whom it acquires the actual properties. In exchange for the properties, the owners acquire ownership units in the partnership as part of a tax-free swap. These units are not taxable until the partnership units are converted into stock or the partnership assets are sold.

Property sectors

Many REITs specialize in one property type, while others (diversified REITs) opt to own a mix of properties. Each property sector is affected by different economic cycles and measures. For example, the office sector benefits from high employment numbers, while the retail sector reaps the benefits of increased consumer spending. In our REIT database, we classify all REITs into: diversified, health care, hotel, industrial, manufactured homes, multi-family, office, regional mall, retail – other, and self-storage.

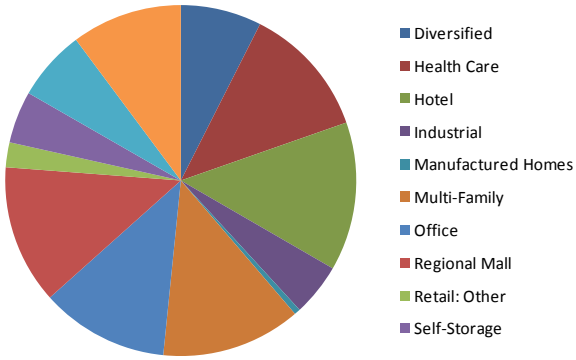
As shown in Figure 4, currently hotel, office, shopping center, and diversified REITs account for the most number of REITs. On the other hand (see Figure 5), hotel, multi-family, regional mall, and healthcare REITs have the largest market cap.

Figure 4: # of REITs by property type



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 5: Market cap by property type



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Are REITs stocks really that different?

By building a separate model for REITs, we make an implicit assumption that REIT stocks behave differently from other common equities, but are they really that different?

Statistical test of equal mean and variance

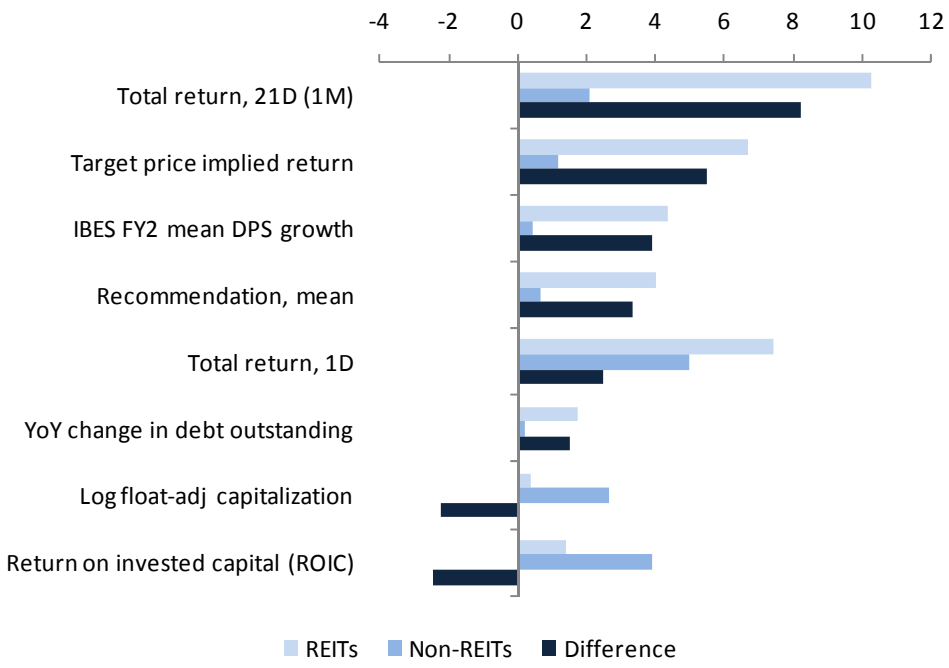
To answer the above question from a quantitative perspective, we backtest the performance of our 81 representative factors[9] for both REITs and non-REIT securities from 1987 until present. Among the 81 factors, we have reasonable data coverage for 75 factors for our REIT universe. A test of equal mean suggests that only eight of the 75 factors reject the null hypothesis of equal mean or 11% (see Figure 6). On the surface, it seems that most factors work similarly for REITs and non-REITs. A statistical test of equal variance, however, finds that 71 (or 95%) factors have different variance for REITs and non-REITs.

It is interesting to note that reversal type of factors work much better in REITs than non-REITs, which is consistent with our prior findings[10]. We also find that dividend growth factor proves to be much more powerful in REITs, as REIT-investors do pay more attention to dividends. In addition, as REITs tend to be more heavily dependent on debt financing, REITs that are able to reduce their outstanding debt are likely to provide superior returns.

[9] Please note that these 80 factors are only a small fraction of our quant factor library, which includes over 1200 factors in the US.

[10] See Cahan *et al* [2010]. *Academic Insights*, Deutsche Bank Quantitative Strategy, October 27, 2010.

Figure 6: Eight representative quant factors with different performance for REITs and non-REITs, Spearman rank IC



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

The sign of the factors

The simple statistical test above, however, misses a very important point – the direction of the factors. In our backtesting, we always adjust the direction of the factor based on its long-term performance; therefore, in our factor database, the long-term performance is always positive. The reason is that we do not want to impose an artificial assumption on the sign of the factor. For some factors, the signs might be obvious. For many others, the "correct" direction is unclear. For example, the classic finance theory suggests a positive relationship between risk and return (expected return, as least), e.g., stocks with higher risk should be compensated with higher (expected) returns. Empirically, of course, across almost all countries/regions in the long term, stocks with higher risk tend to produce *lower* (realized) returns. Letting the long term performance determine the sign of the factor helps us avoid this philosophical argument.

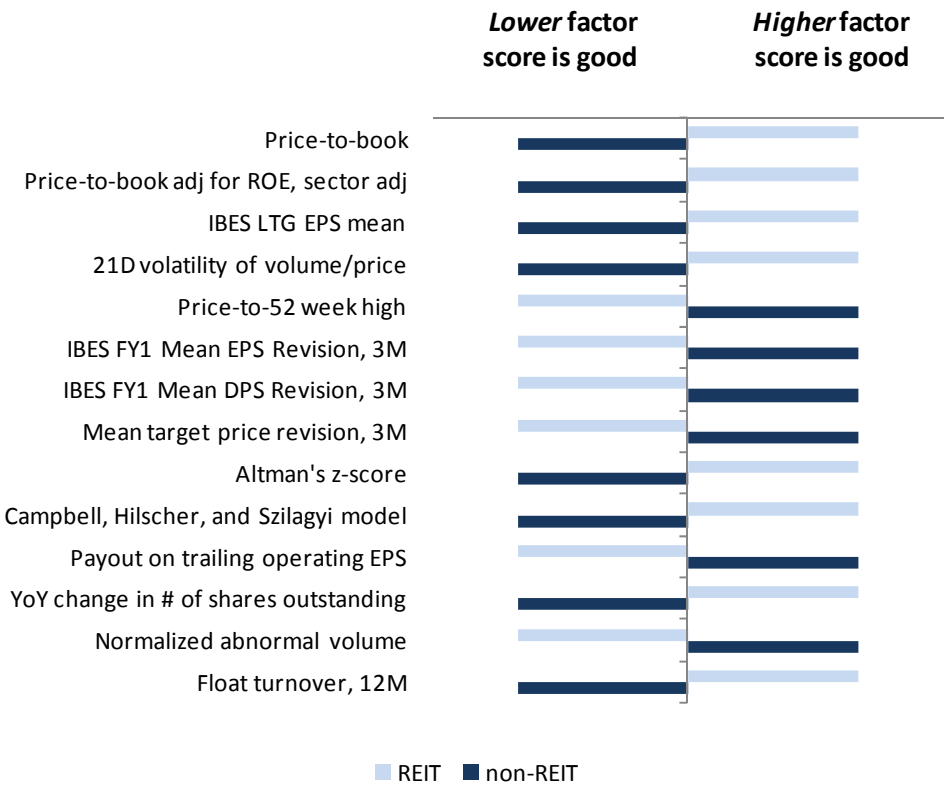
Among the 75 common quant factors, 14 factors have different signs for the REIT versus non-REIT universes, or almost 20% (see Figure 7). For non-REIT, stocks that are more expensive (as measured by price-to-book) underperform, but for REITs, it is the opposite[11]. The Fama-French's HML (high book-to-market minus low book-to-market) factor has the opposite sign in the REIT space. More interestingly, price momentum, as measured by price-to-52 week high, becomes a mid-term reversal signal in the REIT space.

In addition, because REITs distribute most their cash flow (to satisfy the tax regulation and attract potential investors), their growth heavily depends on external financing by accessing

[11] One of the possible explanations is that book value does not accurately reflect the true property value of REITs. For most well maintained properties, the value increases with time, rather than decreases with deprecation as measured by GAAP accounting rules. On the other hand, NAV or net asset value, should provides a far more accurate picture. As shown in a later section, the price-to-NAV factor does have the expected sign, i.e., REITs with higher price-to-NAV are more likely to underperform.

the debt and equity markets. The simple long-term growth expectation factor in other industries is likely to have a negative sign, due to the agency argument, but it is positive for REITs (growth is a scarce property in REITs). Similarly, dividend payout and year-over-year share change factors also have the opposite signs in the REIT universe.

Figure 7: Fourteen representative quant factors with different signs for REITs and non-REITs



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Univariate backtesting

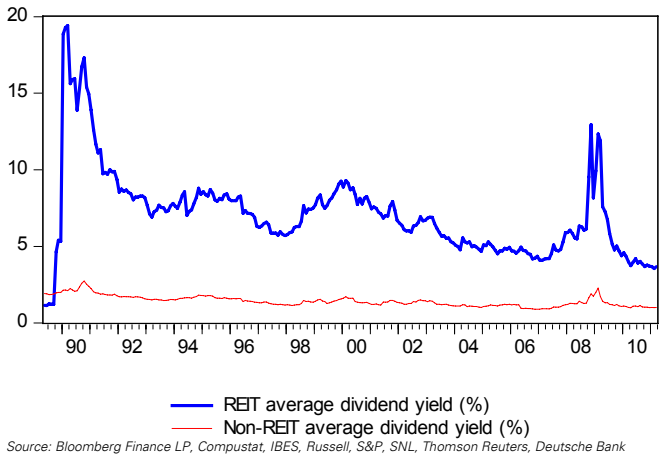
There are some unique data points that are specific to REITs and arguably more meaningful than other commonly used financial statement factors, e.g., FFO, AFO based factors are more applicable than EPS based signals[12]. However, more specialized and meaningful factors do not necessarily have better predictive power of future stock returns.

In this section, we test both factors unique to REITs and some common factors. We build our REIT-related factors along some of the unique attributes of REITs as discussed in the previous section.

Are investors paying for higher yields?

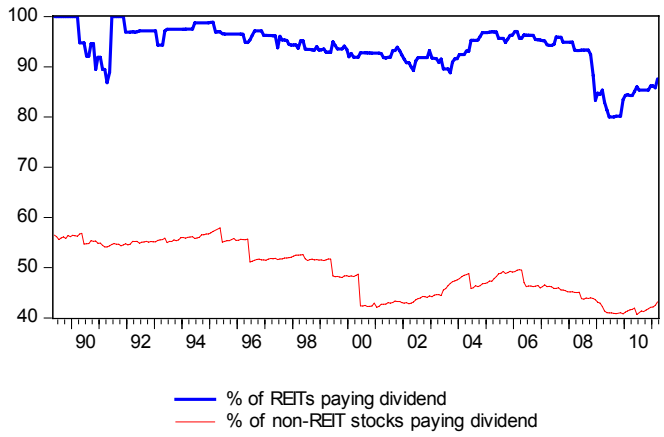
REITs are by all means high yield securities. On average, REITs offer almost five times higher dividend yield than non-REIT stocks (Figure 8). Over the entire history, about 94% of REITs pay dividends, compared to only 49% for non-REITs (Figure 9).

Figure 8: Average dividend yield



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 9: % of stocks paying dividend



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

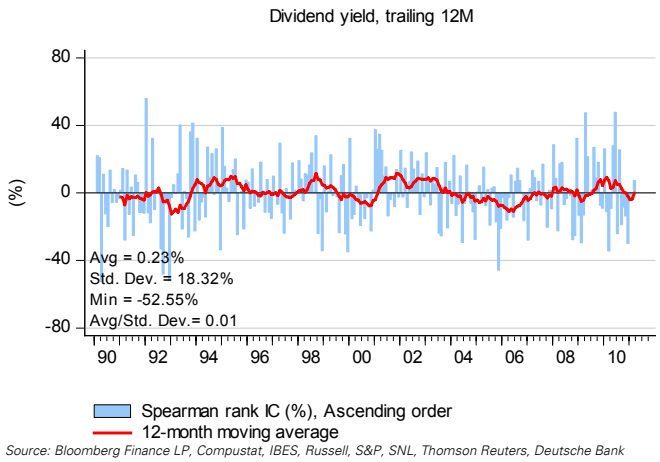
Dividend yield is, however, not a great factor…

Being high-yield securities, however, does not necessarily mean that higher yielding REITs will always deliver higher returns. As shown in Figure 10 and Figure 11, the directions of trailing dividend yield and expected yield, are positive, although neither seem to be great factors. On the other hand, based on FY1 and FY2 consensus dividend estimates, forward dividend yield factors have the "wrong" sign[13], i.e., REITs with higher yields actually underperform (Figure 12 and Figure 13). Drilling down deeper, we find the payoff pattern on dividend yield is nonlinear and irregular (Figure 14 and Figure 15), which once again disputes the idea of using yield as the sole decision factor.

[12] We collect most of these REIT-specific data from SNL.

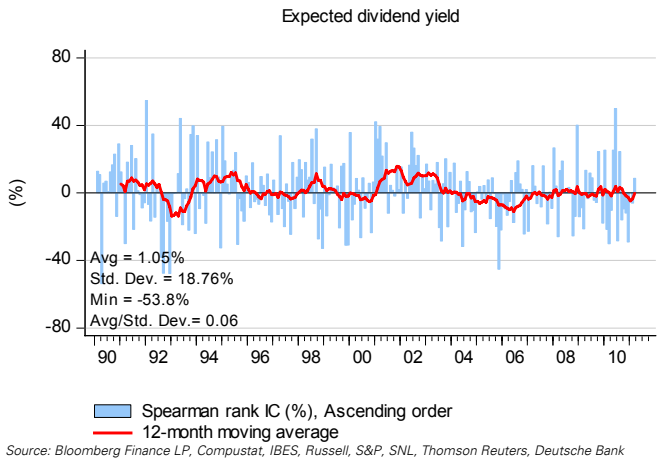
[13] This is mostly because of the specific data history used. Due to the short history with estimate data, the forward dividend yield factors are backtested from 2007 to present, while dividend yield factors had mostly negative performance in this period.

Figure 10: Trailing dividend yield



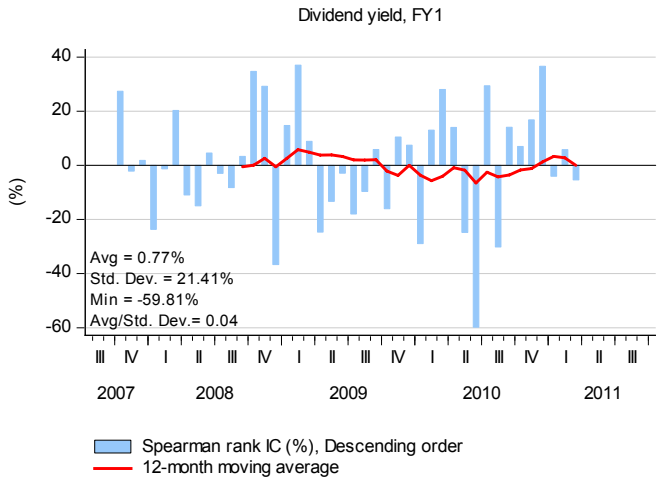
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 11: Expected dividend yield



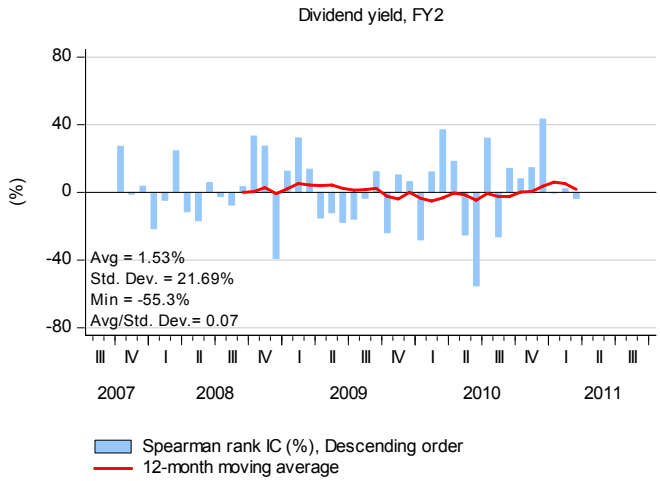
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 12: FY1 dividend yield



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 13: FY2 dividend yield

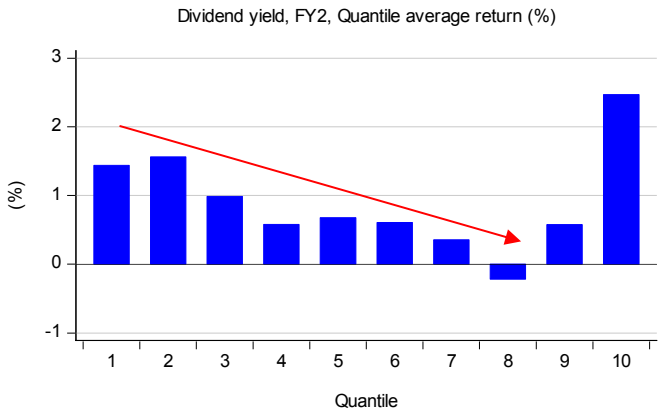


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 14: Decile portfolio returns, exp dividend yield

Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 15: Decile portfolio returns, FY2 dividend yield

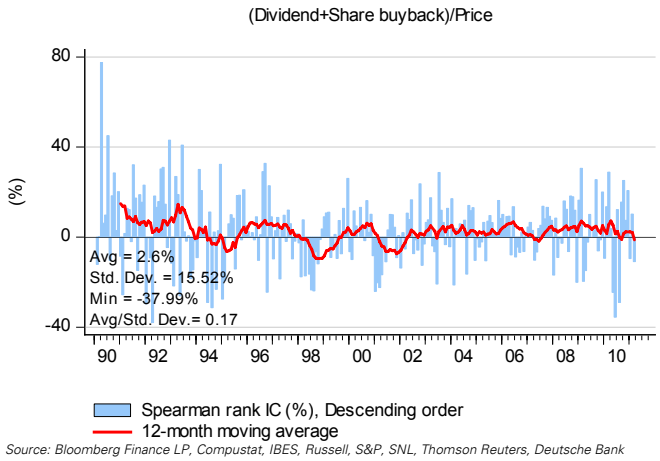


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Share buyback adds marginal value, but in the "wrong" direction

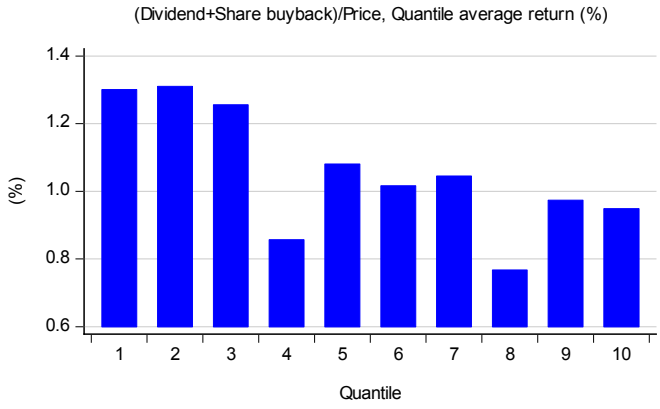
Our next question is whether share buybacks matter or whether it is really the overall external financing that drives REIT performance. The results are again surprising. REITs that are paying lower dividend yield and less aggressively buying back shares end up performing better (Figure 16 and Figure 17). As we will see in later sections, REITs pay out most of their cash flow, they heavily depend on external financing to grow. Paying out most of their cash flows associated with aggressive share buybacks can hurt a REIT's long term growth potential and force it to finance further growth with more debt[14].

Figure 16: IC, dividend + share buyback



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 17: Decile portfolio returns, dividend + buyback

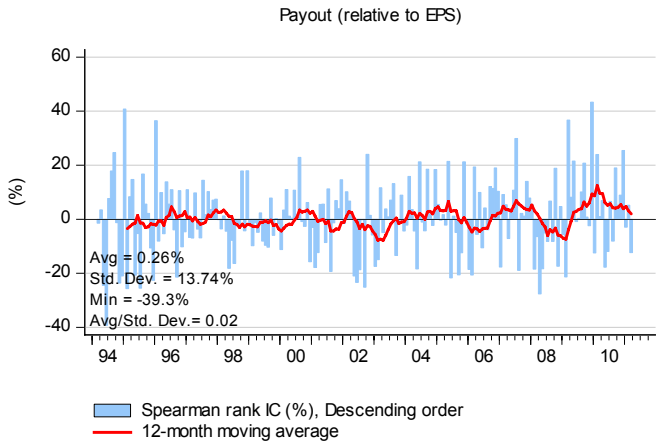


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Conservative payout = sustainable dividend?

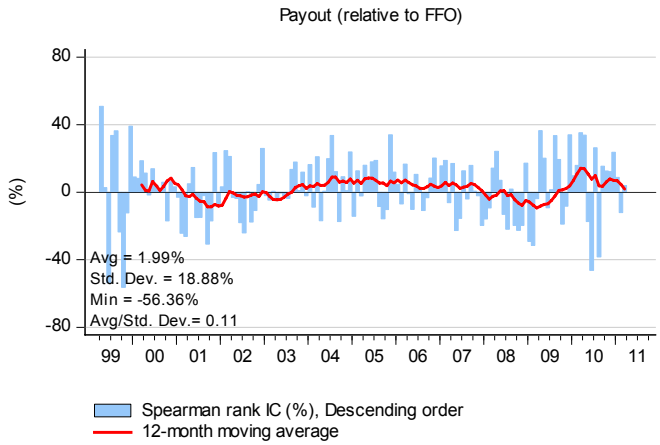
Dividend payout ratios, on the other hand, seem to be better predictors of future REIT returns than dividend yield factors. REITs with conservative payout policies are perceived as REITs with more sustainable dividend stream; and therefore, are likely to be rewarded. In the REIT space, we also know that FFO is a better indicator than EPS; therefore, we find payout based on FFO (see Figure 19) has stronger performance than payout ratio based on EPS (see Figure 18).

Figure 18: Dividend payout ratio (based on EPS)



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 19: Dividend payout ratio (based on FFO)



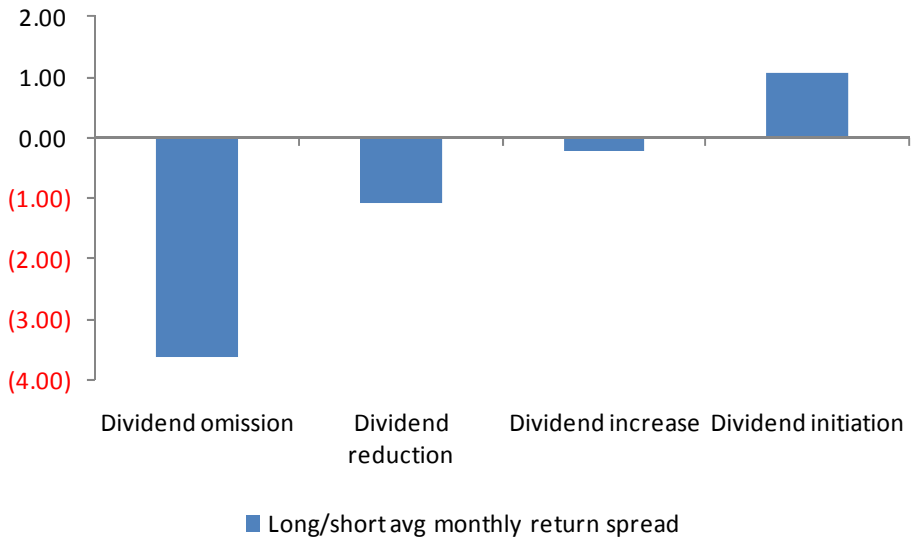
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

[14] As we will show in the next section, increase in debt financing is a strong negative signal of future returns.

Dividend omission, reduction, increase, and initiation

Lastly, we want to study the more extreme cases: dividend omission, reduction, increase, and initiation. Intuitively, we know that REITs omitting dividends tend to suffer severe temporary losses, while initiating new dividends is likely to be rewarded. In this section, we compute the monthly long/short strategy of buying REITs that terminate their dividend payment and shorting the other REITs, rebalancing monthly (and similarly for dividend decrease, increase, and initiation). As shown in Figure 20, REITs that omit their dividends tend to underperform their peers by -3.6% in the following month, while dividend reduction results in a more moderate underperformance of -1.1%. REITs that initiate new dividend payment outperform their peers by 1.1% in the subsequent month.

Figure 20: Dividend omission, decrease, increase, and initiation



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

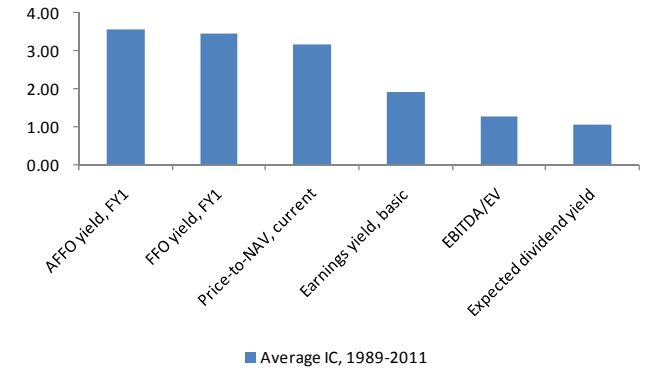
Valuation – what really matters for REITs?

We know in the REIT space, investors focus more on FFO/AFFO than EPS, but do valuation ratios based on FFO/AFFO actually predict future REIT returns better? Fortunately, the backtesting seems to be in line with our expectation. Value factors based on AFFO, FFO, NAV are generally better than ratios based on EPS or dividend (see Figure 21), especially in recent years[15] (see Figure 22).

NAV is generally preferred to book value, as book value does not accurately reflect the REIT's earning capacity. As shown in Figure 23 and Figure 24, price-to-NAV proves to be far more useful than price-to-book in REITs. The problem with price-to-book is that it also has the "wrong" sign, meaning that in the long term, REITs with more expensive price-to-book actually delivered (slightly) higher returns. The reason is that the most important asset for most REITs is real properties. GAAP accounting assumes depreciation; and therefore, property value would decrease over time. In reality, well maintained properties typically increase value over time. NAV generally reflects the real value of REITs, while book values do not.

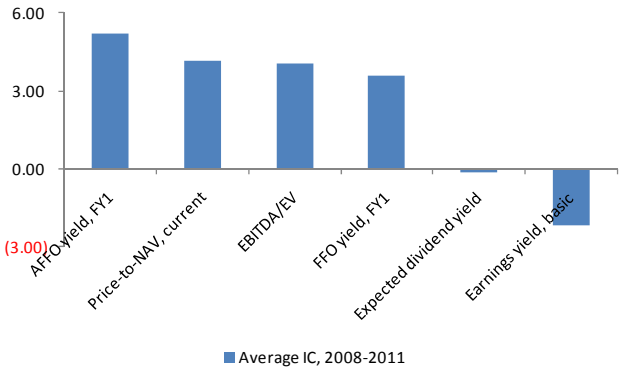
[15] The coverage of these factors is different. Generally speaking, dividends and earnings data have better coverage than FFO/AFFO and NAV.

Figure 21: Ranking of value factors, 1989 – 2011



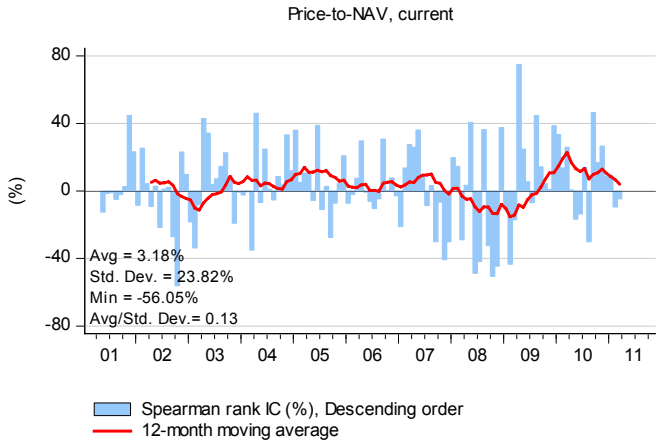
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 22: Ranking of value factors, 2008 – 2011



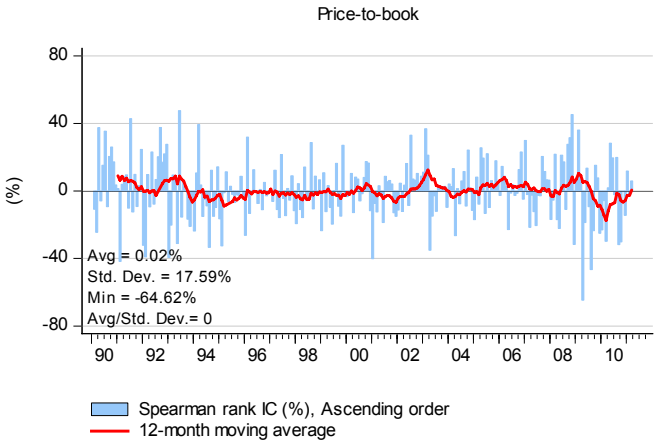
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 23: Price-to-NAV



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 24: Price-to-book



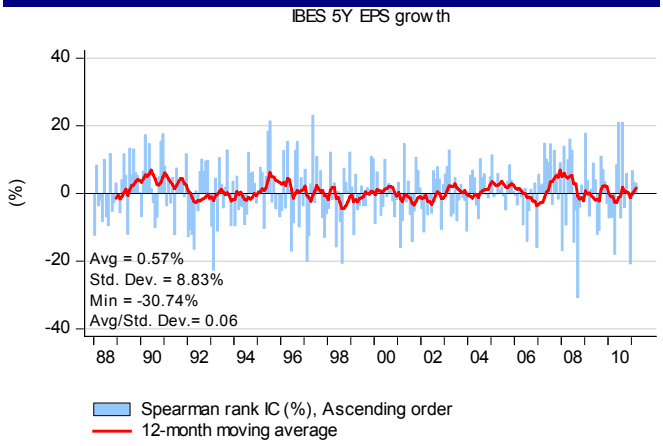
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Do investors care about growth for an industry that pays out most of its earnings and cash flow?

Due to tax regulation, REITs must pay out most of their earnings and cash flow to avoid double taxation. This, however, severely limits a REIT's ability to grow (via new acquisition or property improvement). Most REITs heavily depend on external financing to make acquisitions. Therefore, having access to the debt and equity market is critical. We will discuss some of the factors related to debt and equity financing in the next section. In this section, we concentrate on the growth aspects of a REIT.

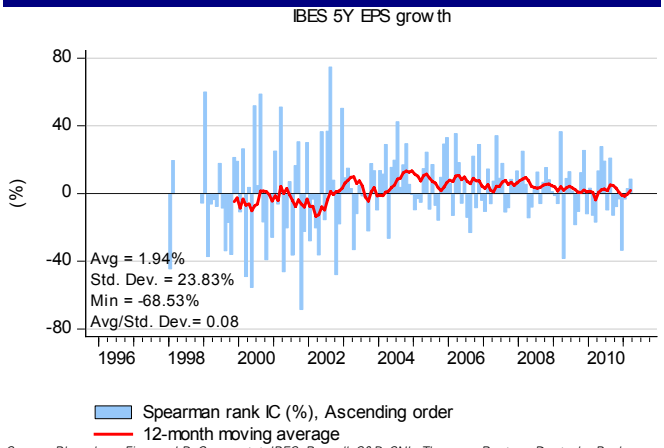
Let's take a look at IBES five-year expected EPS growth factor. We know, in the US market, it is not a great factor by itself (see Figure 25 for the factor performance in the non-REIT universe). In the REIT space, however, expected ability to growth long-term earnings is being rewarded more handsomely (see Figure 26).

Figure 25: IBES long-term growth factor performance in non-REIT universe



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

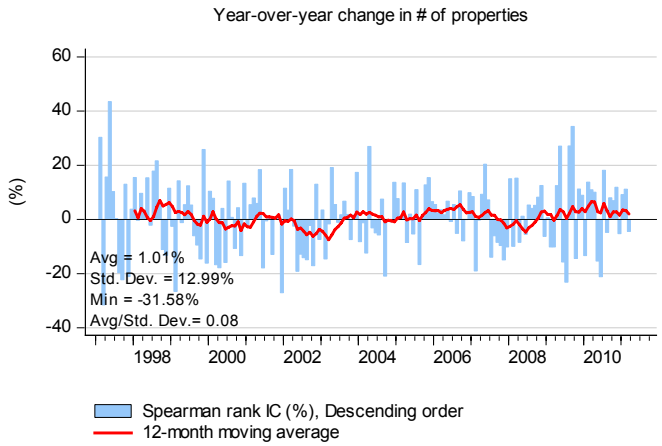
Figure 26: IBES long-term growth factor performance in REIT universe



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

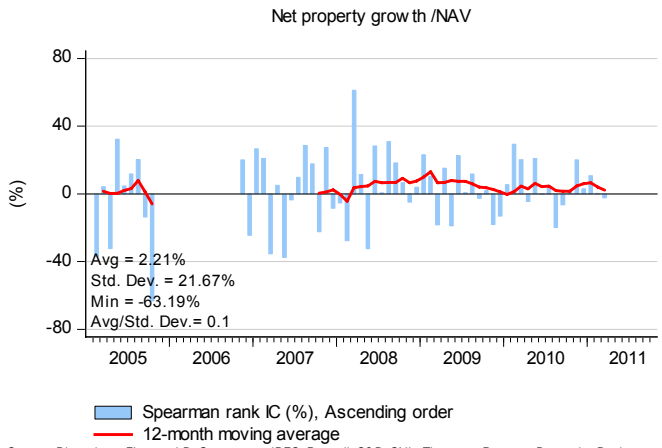
Simply buying new properties may not always have accretive impact on FFO and therefore, may hurt performance (see Figure 27). Making acquisitions/dispositions relative to NAV is more meaningful (see Figure 28)[16].

Figure 27: Increase in # of properties



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 28: New property growth/NAV

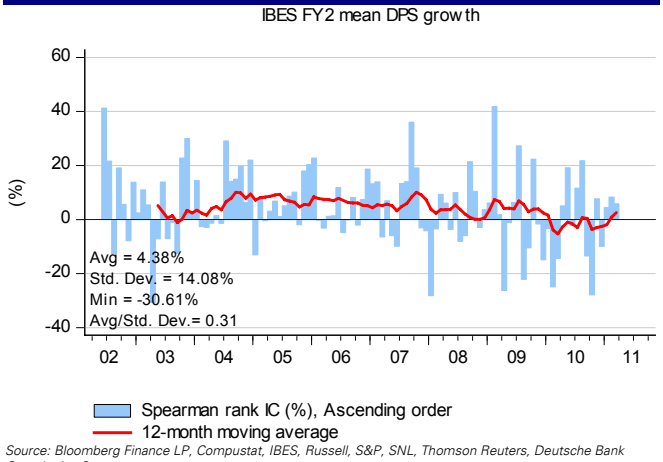


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

In previous sections, we showed that dividend yield does not help us much to differentiate REITs, but payout ratios do. In Figure 29 and Figure 30, we also see that dividend growth matters far more for REITs than non-REITs.

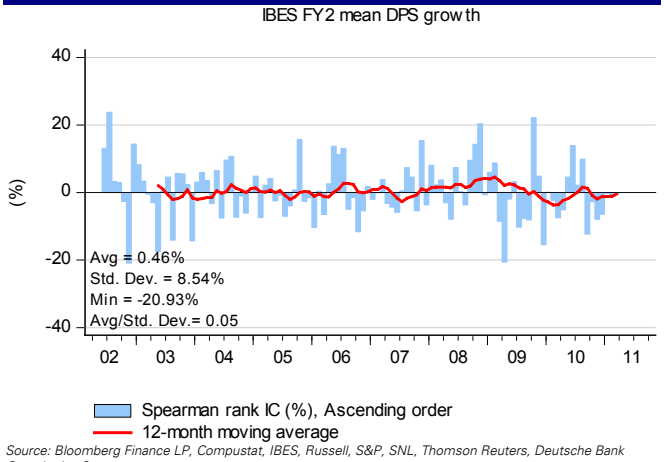
[16] The coverage of the signal is limited, as can be seen in the gaps in the performance chart.

Figure 29: Dividend growth factor performance in the REIT universe



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 30: Dividend growth factor performance in the non-REIT universe

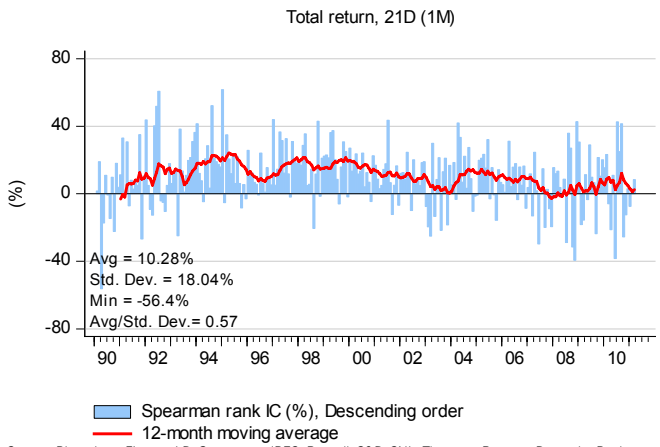


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Momentum and reversal

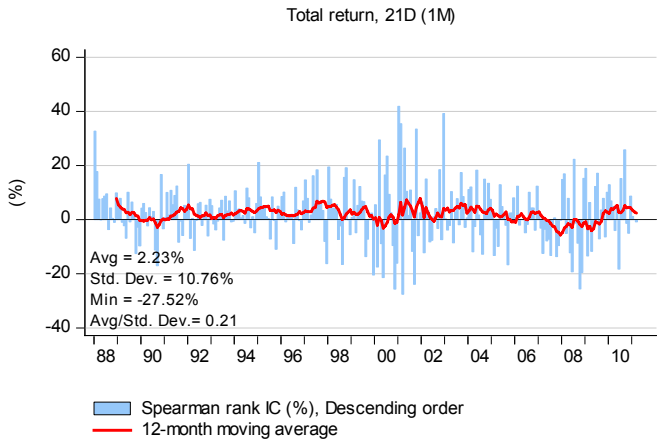
Based on our previous research[17], we find momentum factors work better for the high-volatility universe of stocks, while reversal factors work better for the low-volatility universe of stocks. Since REITs are more yield oriented and are commonly deemed as low volatility stocks, we expect reversal factors to work better in the REIT space than in non-REITs. The results are astonishing – reversal factor has an average monthly IC of 10% versus 2% in the non-REIT universe[18] (Figure 31 and Figure 32). What is also interesting, however, is that simple price momentum factors also perform well in the REIT space compared to non-REITs (Figure 33 and Figure 34).

Figure 31: Reversal in REITs



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 32: Reversal in non-REITs

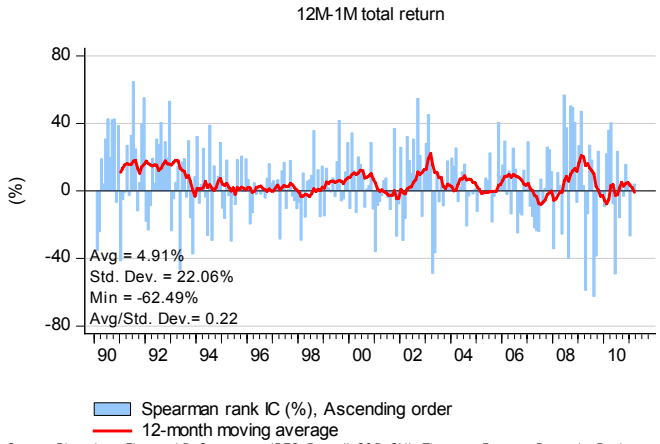


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

[17] See Cahan *et al* [2010]. *Academic insights*, Deutsche Bank Quantitative Strategy, October 27, 2010.

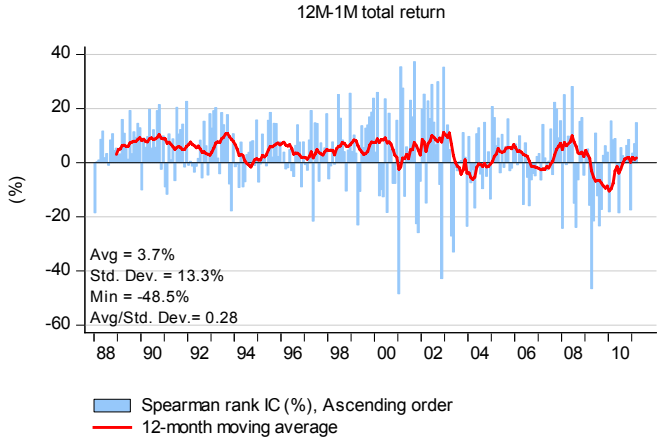
[18] The downside of reversal factors is, of course, the high turnover nature of the factors (and fast decay and high trading costs). In Alvarez, M., Luo, Y., Cahan, R., Jussa, J., and Chen, J. [2011]. "Learning to drive in the fast lane", Portfolios Under Construction, Deutsche Bank Quantitative Strategy, April 26, 2011, we discuss various ways to incorporate fast decay/high turnover factors in a tightly turnover constrained portfolio in a systematic fashion.

Figure 33: Momentum in REITs



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 34: Momentum in non-REITs

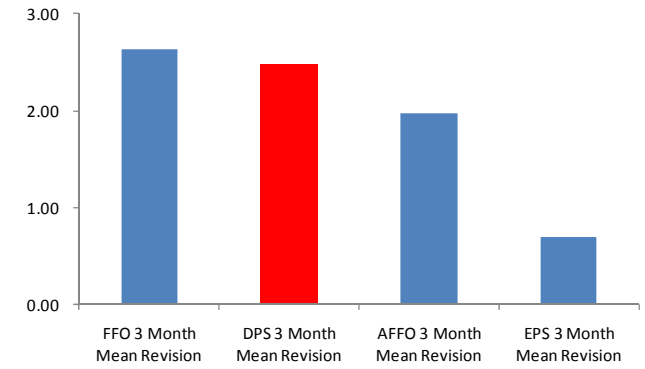


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Analyst revision

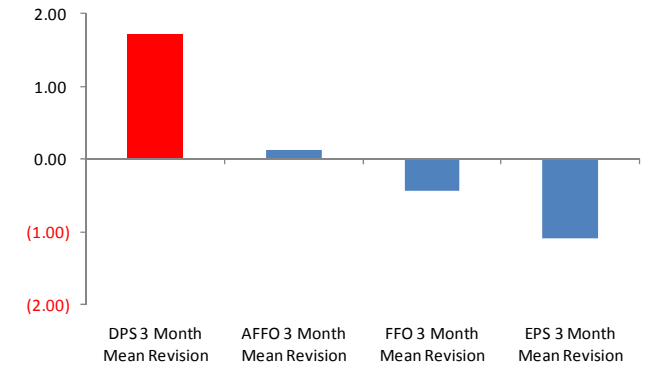
Consistent with what we state in the previous sections, analyst revision factors based on FFO/AFFO have stronger predictive power than earnings revisions (see Figure 35). However, as shown in most of our research for analyst revision factors in the broad US investable universe, almost all analyst revision factors have seen significant performance decay (see Figure 36). The red bar for the dividend revision factor in Figure 35 and Figure 36 indicates that the direction of the factor is "counter-intuitive", meaning REITs with positive dividend revisions actually underperform.

Figure 35: Ranking of analyst revision factors, 2001 – 2011



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 36: Ranking of analyst revision factors, 2008 – 2011



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

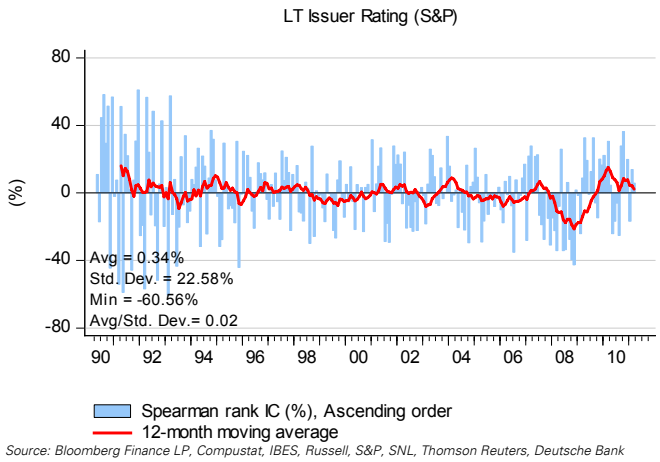
Quality

Because REITs heavily depend on the capital market to finance their growth projects, our hypothesis is that those factors giving REITs easier access to the capital market should have predictive power.

Debt rating data is confusing, but…

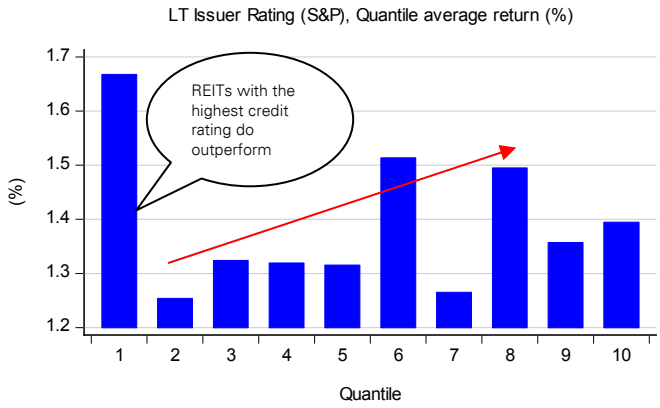
Debt rating related factors seem to have the "wrong" sign, indicating that REITs with lower credit rating actually deliver higher returns (see Figure 37), but Figure 38 does prove that REITs with the highest credit rating generate consistent highest returns.

Figure 37: Long-term issuer debt rating by S&P



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 38: Decile portfolio returns

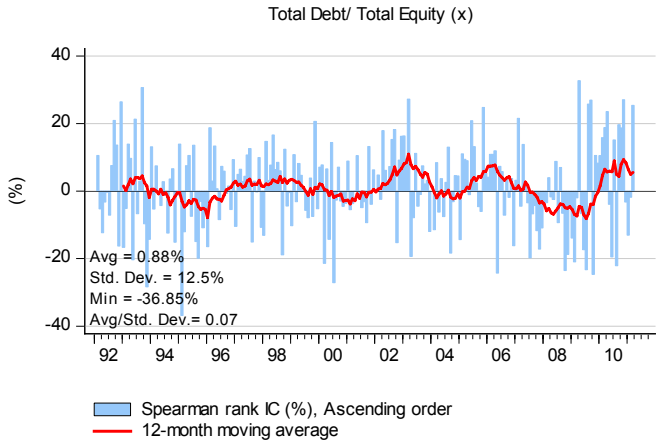


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Debt/equity ratio favors higher leverage, but Merton's distance to default model suggests otherwise

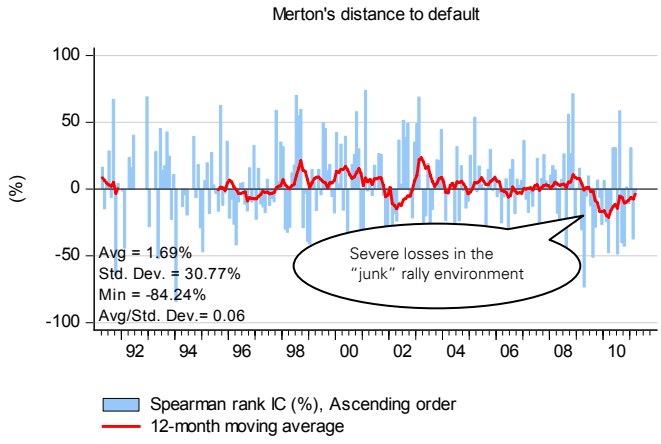
In the long run, recessions and credit crises are rare, while economic expansion is more common place. REITs taking on higher financial leverage are likely to have higher ROE in the long term, and therefore higher returns (see Figure 39). In our previous research, we find the performance of Merton's distance to default is more consistent than other typical balance sheet ratios, which is also the case in the REIT space (see Figure 40).

Figure 39: Debt/equity ratio



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 40: Merton's distance to default

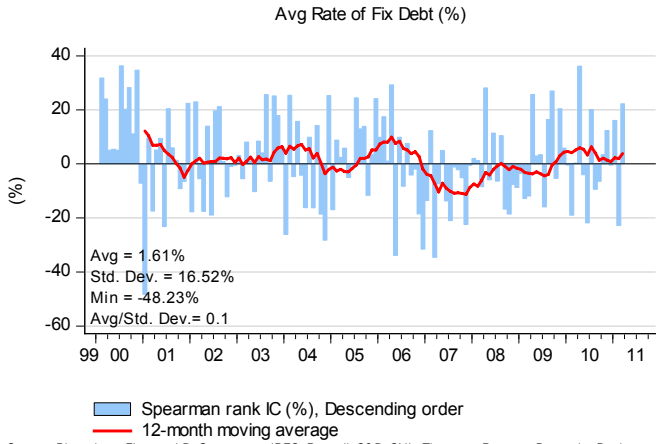


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

A better financing mix does matter

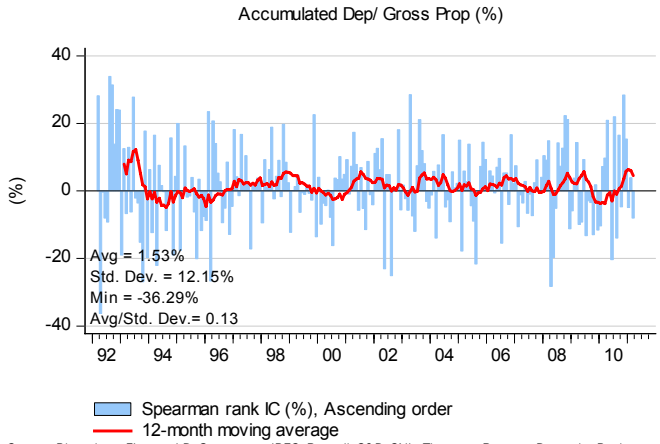
Although credit rating and leverage ratios have conflicting signs, a better financing mix does matter. As shown in Figure 41 and Figure 42, REITs that have lower interest cost and take advantage of tax-exempt financing do benefit in the long term.

Figure 41: Average rate of fix debt



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 42: Tax-exempt debt/total debt

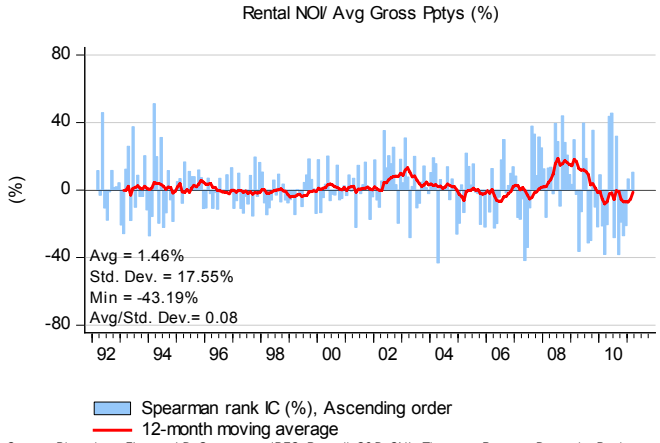


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Property-related statistics could also be useful, but the incremental value is limited

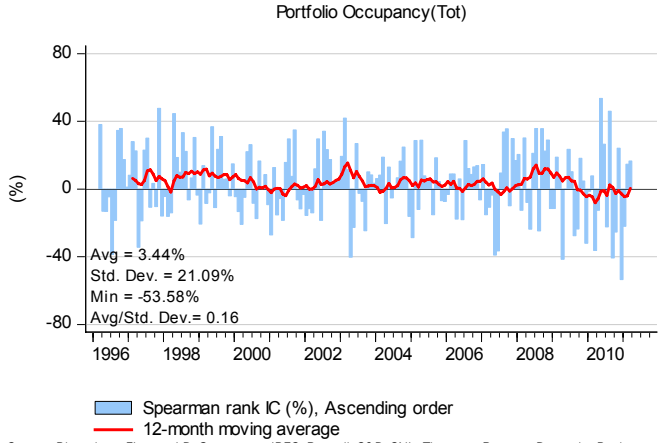
Property-level statistics are supposed to be valuable, as they are not widely published in other traditional data sources. As shown in Figure 43 and Figure 44, rental NOI/properties and portfolio occupancy factors do work well in the long term, but recent performance has been challenging.

Figure 43: Rental NOI/properties



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 44: Portfolio occupancy



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Better earnings quality measure using FFO

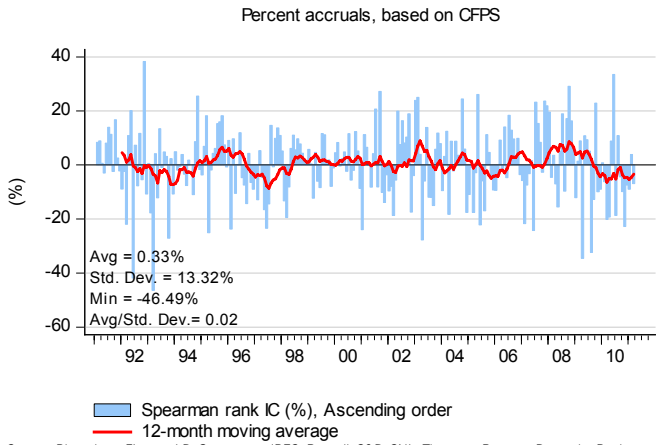
The standard accruals factors cannot be calculated using statement of cash flow data, because in Compustat database, cash flow data are mostly missing for financials companies. Our preferred accruals factor called percent accruals[19] also has the "wrong" sign, meaning REITs with more aggressive accounting policies as defined by percent accruals actually outperform (see Figure 45).

Different REITs have different financial reporting policies, despite the fact that NAREIT issues a guidance on FFO calculation (similar the GAAP but for the REIT industry). Following the same argument used to define percent accruals, we define a factor as the difference of SNL

[19] See Luo, Y., Cahan, R., Jussa, J., and Alvarez, M. [2010]. "Launching US quantitative strategy", *Signal Processing*, Deutsche Bank Quantitative Strategy, April 12, 2010.

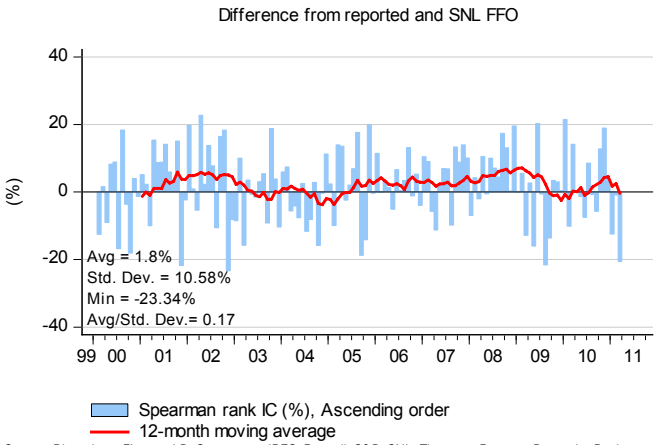
calculated FFO (supposed to be more conservative and consistent across all REITs) and each company's own reported FFO. The more negative the factor, the more "aggressive" the company's financial reporting, and therefore, the lower expected return. Our backtesting seems to suggest that this is a factor with decent performance (see Figure 46).

Figure 45: Percent accruals



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 46: SNL accruals



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Technical

In recent months, we have explored a wide range of unconventional data sources and built factors using options data[20], high frequency tick-by-tick transaction data[21], and securities lending data[22]. We find the more innovative and less crowded factors tend to have better and less correlated performance than the traditional factors, especially in recent years. In this section, we also want to assess their value added in the REIT space. It could also serve as a quasi out-of-sample backtest of these factors.

The results are promising. It appears that these unconventional factors also have strong predictive power in the REIT universe and the signs of these factors remain the same (see Figure 47 to Figure 50). The coverage of these factors are also reasonable, especially for our high frequency and securities lending signals.

Lastly, REIT investors buy REITs mostly for current income, defensive nature of the sector; therefore, we expect anti-risk types of factors to do better. To prove our hypothesis, we test the idiosyncratic volatility surprise[23] and kurtosis factors in the REIT space. Both factors have shown strong performance, albeit the idiosyncratic volatility surprise factor suffered in the risk rally environment post March 2009 (see Figure 51), while the unconventional risk metric, kurtosis survives much better (see Figure 52).

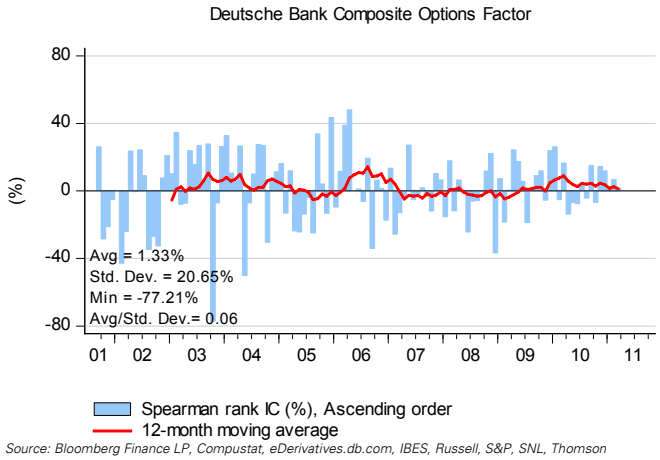
[20] See Cahan, R., Luo, Y., Jussa, J., Alvarez, M. [2010]. "The options issue", *Signal Processing*, Deutsche Bank Quantitative Strategy, May 12, 2010.

[21] See Cahan, R. Luo, Y., Alvarez, M., Jussa, J., and Chen, J. [2010]. "Frequency arbitrage", *Signal Processing* , Deutsche Bank Quantitative Strategy, November 10, 2010.

[22] See Cahan, R. Luo, Y., Alvarez, M., Jussa, J., and Chen, J. [2011]. "The long and the short of it", *Signal Processing* , Deutsche Bank Quantitative Strategy, January 18, 2010.

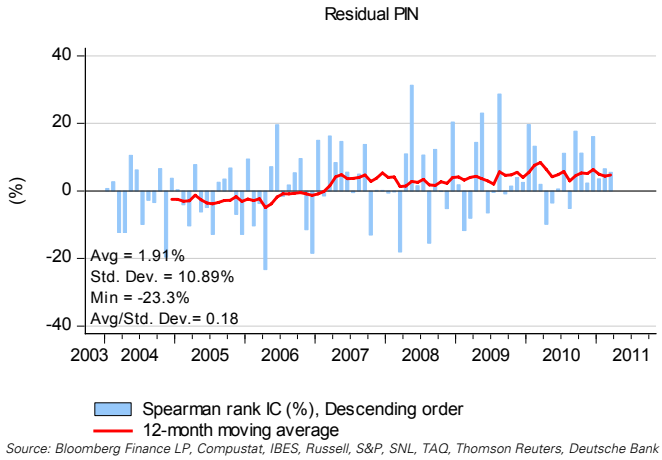
[23] The motivation is that volatility can be predicted. We calculate the idiosyncratic volatility surprise factor as the difference between realized idiosyncratic volatility and our model prediction. REITs showing higher than expected idiosyncratic volatility are more risky and therefore are likely to underperform.

Figure 47: The composite options factor



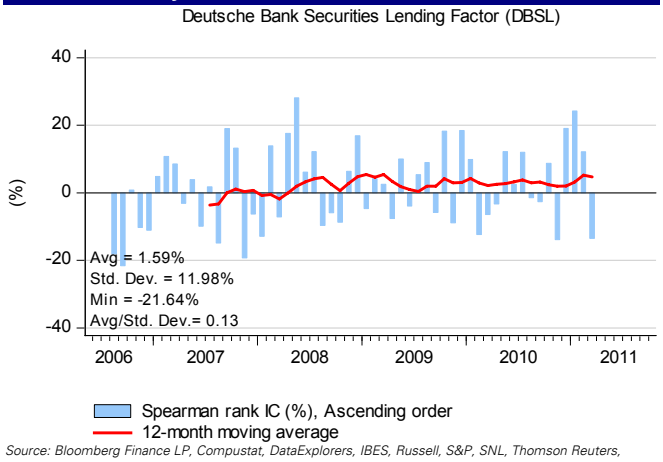
Source: Bloomberg Finance LP, Compustat, eDerivatives.db.com, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 48: Residual probability of informed trading



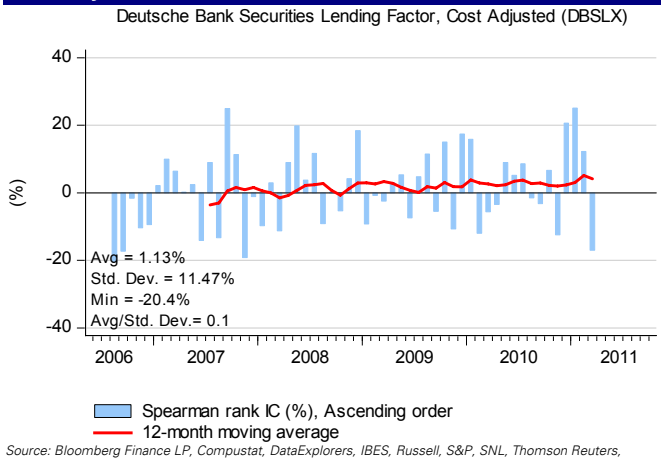
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, TAQ, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 49: The composite securities lending factor, before cost adjustment



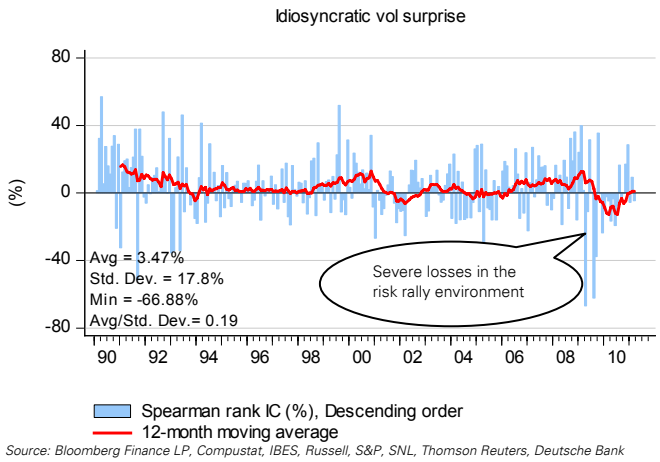
Source: Bloomberg Finance LP, Compustat, DataExplorers, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 50: The composite securities lending factor, after cost adjustment



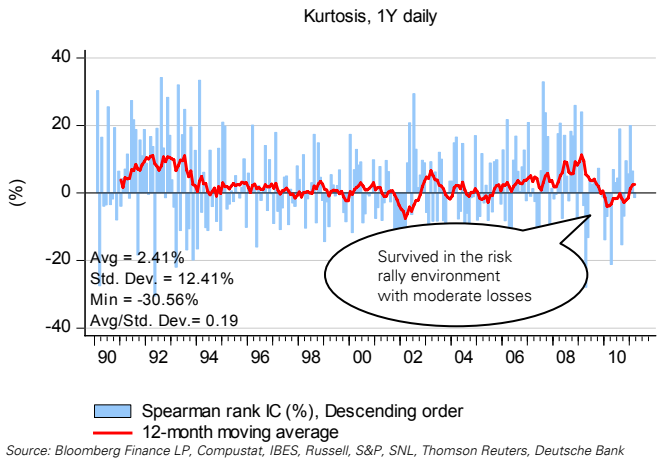
Source: Bloomberg Finance LP, Compustat, DataExplorers, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 51: Idiosyncratic volatility surprise



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 52: Kurtosis

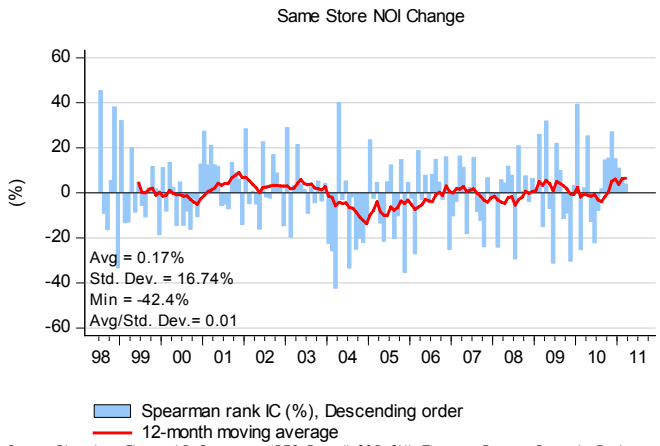


Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Same store metrics

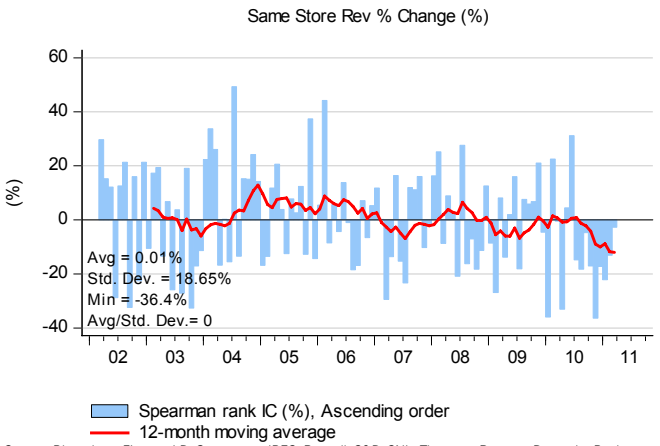
In addition, SNL tracks same store metrics so that analysts can see how well a company is operating excluding acquisition/disposition. Same store properties are those properties that are held for the entirety of the current and prior financial periods. SNL tracks revenues, expenses, occupancy and number of properties for reported same-store data. Many REIT analysts focus on same store NOI change, but we find the factor has the "wrong" sign. Further analysis finds that the issue is mostly on the expense sides. If we focus our efforts on the top line, revenue growth, we find same store revenue growth proves to be more useful and has the "correct" sign. Neither factors, however are statistically significant.

Figure 53: Same store NOI growth



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 54: Same store revenue growth



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Multi-factor backtesting

Based on the previous section, it appears that REIT–specific factors contain useful information that cannot be captured using the traditional databases. However, the breadth is limited for a universe of 120-130 REITs. The question is, of course, whether adding industry-specific factors to a multi-factor model can enhance performance.

In this section, we try two multi-factor approaches to assess the incremental value of REIT-specific data and factors. In our first model, we use the same generic factors as in our all US investable universe, but we try to optimize the factor selection and weighting decision to the REIT universe. In our second model, we optimize our factor selection to both generic and REIT-specific factors.

Optimizing generic factors for the REIT universe

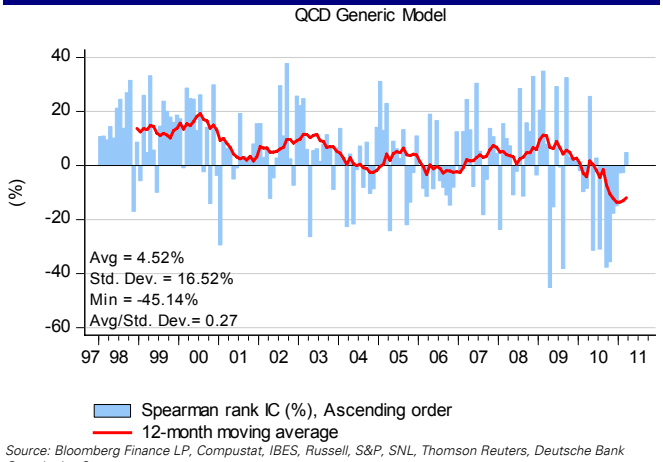
First, we want to see whether optimizing factors for the REIT universe would enhance model performance. We use our QCD model[24] developed for the broad investable US universe as our benchmark.

The common perception is that industry-specific models should have better predictive power of future stock returns than generic models built for a broad investable universe of stocks. We want to test this hypothesis by deploying a similar automated factor selection algorithm as in our QCD model, but on the REIT universe only – we call this model QCD-GREIT (QCD model optimized for generic factors). It does show a significant performance boost – monthly model IR is increased by almost 60% (see Figure 55 and Figure 56). The contrast in the last three years is even more striking – the generic QCD model generated a negative performance in the REIT universe, while the QCD model optimized for the REIT universe (even though it only uses the same generic factors) performed well (see Figure 57 and Figure 58). Both models suffered significant extreme downside performance in recent years[25].

[24] See Luo, Y., Cahan, R., Jussa, J., and Alvarez, M. [2010]. "DB Quant Handbook", *QCD Model*, Deutsche Bank Quantitative Strategy, July 22, 2010, for our model methodology.

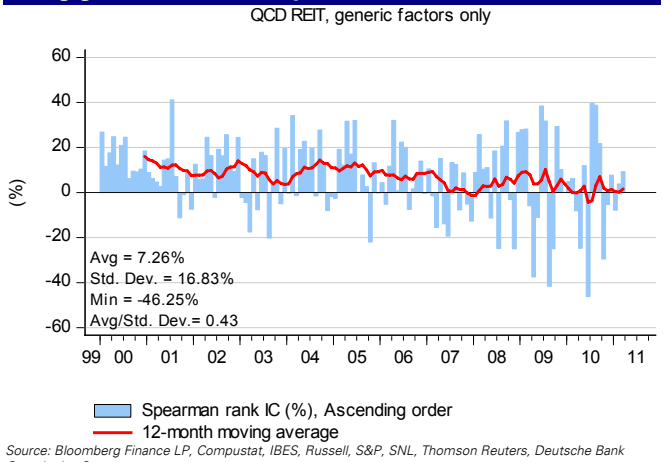
[25] As we argued in our recent research, we believe there are two reasons for the challenges faced by most quant models in recent years: 1) market efficiency, i.e., traditional factors have been gradually arbitraged away; and 2) economic environment, i.e., macroeconomic environment (especially the risk-on and risk-off behaviors) has dominated bottom-up stock selection since the financial crisis started in 2008.

Figure 55: Generic QCD model performance in selecting REITs



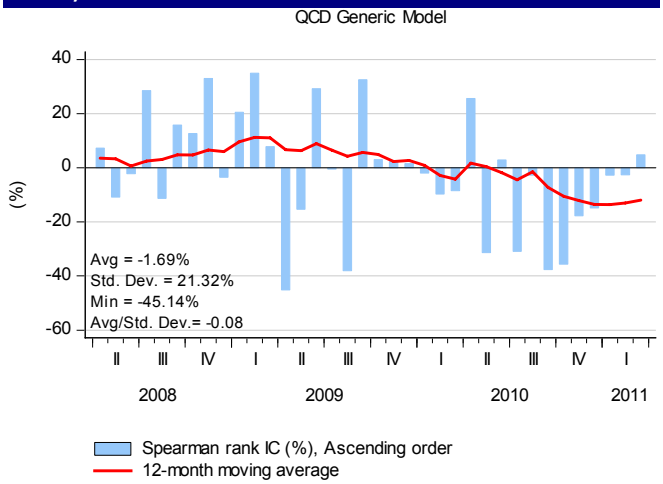
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 56: QCD model optimized for the REIT universe, using generic factors only



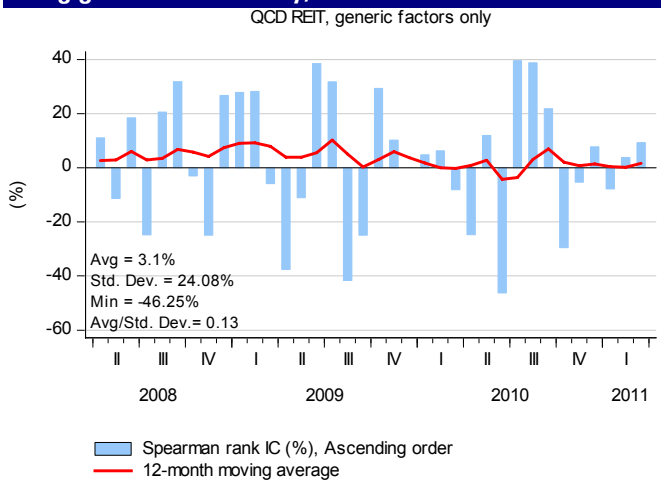
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 57: Generic QCD model performance in selecting REITs, 2008 – 2011



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 58: QCD model optimized for the REIT universe, using generic factors only, 2008 – 2011



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Can REIT-specific data and factors add anything incremental?

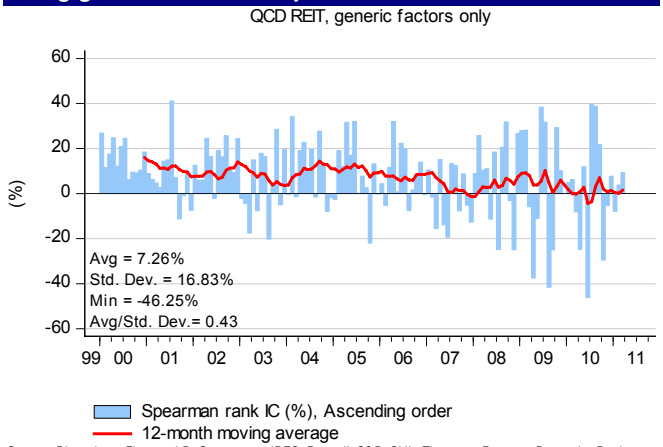
In the previous section, we saw that the optimized QCD model to the REIT universe with generic factors has significantly improved our model performance. The next question is whether we need to go through the painful exercise of integrating SNL REIT data and what the increment alpha is with REIT-specific data and factors.

As shown in Figure 59 and Figure 60, by adding REIT-specific factors to our QCD model algorithm[26], we further improve our model (monthly) IR by 7%. More importantly, the model drawdown is reduced from -46% to -32%, a 14% reduction. Therefore, it does appear that there is value in using REIT-specific data and factors. The performance enhancement in recent year is even stronger. In the past three years, our QCD model optimized by both REIT-specific and generic factors has outperformed the model without REIT-specific factors by 15% (see Figure 61 and Figure 62).

[26] We call this model, QCD-REIT. This is our main REIT stock selection model.

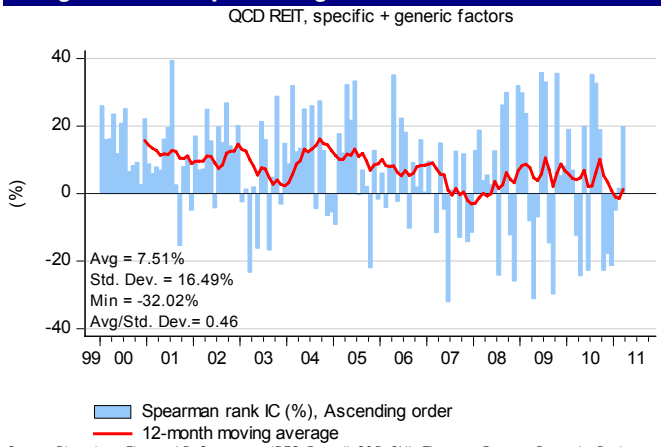
We find adding REIT-specific data can significantly improve model performance and reduce downside risk, especially in recent years, which is also consistent with our previous findings in other industries[27].

Figure 59: QCD model optimized for the REIT universe, using generic factors only



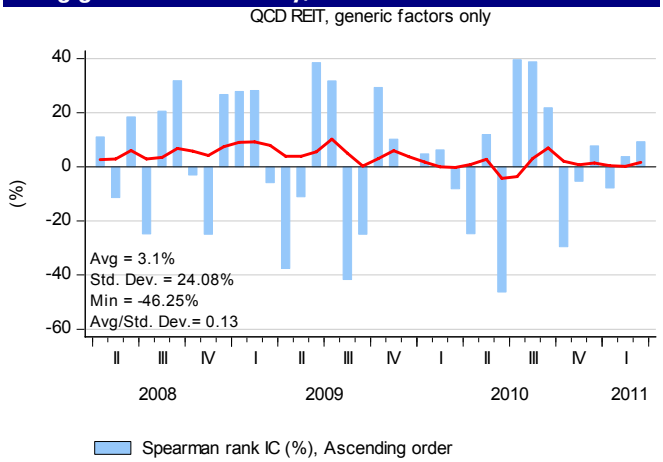
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 60: QCD model optimized for the REIT universe, using both REIT-specific + generic factors



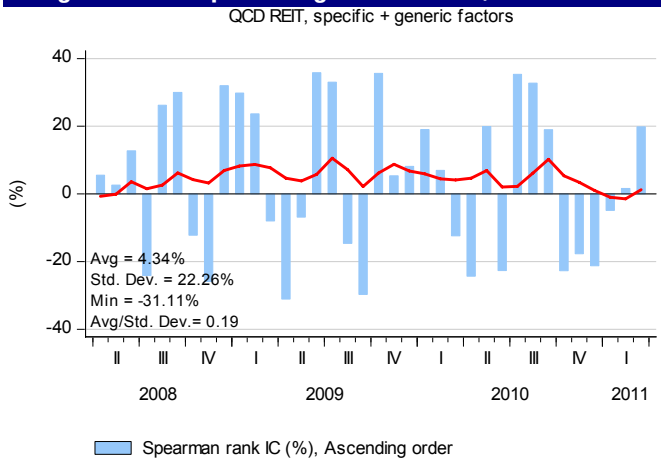
Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 61: QCD model optimized for the REIT universe, using generic factors only, 2008 – 2011



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 62: QCD model optimized for the REIT universe, using both REIT-specific + generic factors, 2008 – 2011



Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

[27] See Luo, Y., Cahan, R., Jussa, J., and Alvarez, M. [2010]. "Industry specific factors", *Signal Processing* , Deutsche Bank Quantitative Strategy, June 7, 2010.

Portfolio simulation

Generating higher model IC and IR is a necessary but not sufficient condition for portfolio outperformance. The ultimate test is whether the new model can still add alpha after all the typical institutional constraints and transaction costs.

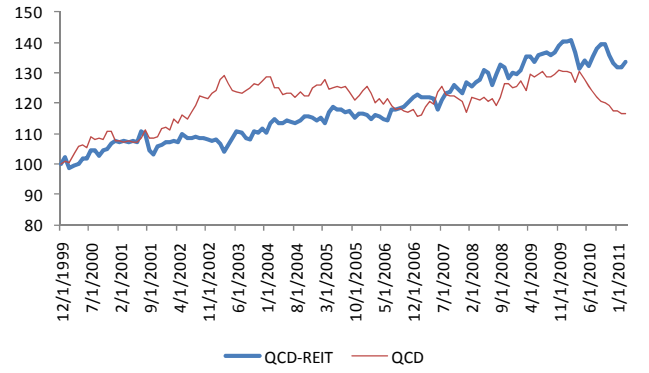
In this section, we perform a real-world portfolio simulation. We build two real portfolios: one based on our QCD model and one based on the optimized QCD-REIT model.

For our portfolio simulation, we try to maximize expected return with the following constraints, rebalanced monthly since 1999 until present:

- Long/short market neutral strategy that only invests in REITs
- Maximize expected returns
- Dollar neutral
- Target annualized volatility of 5% per year
- Beta neutral
- Turnover constrained at 30% one-way per month

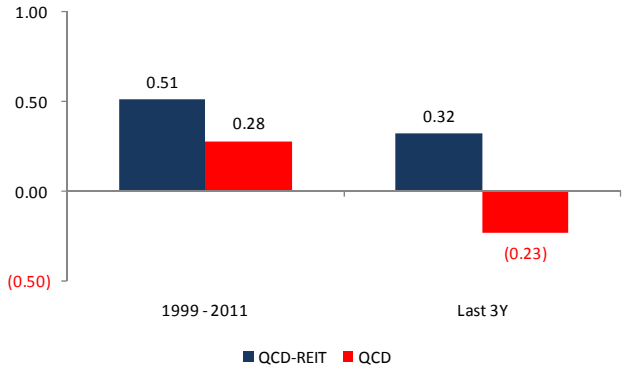
As shown in Figure 63 and Figure 64, our QCD-REIT model outperformed the generic QCD model by 81% in IR (Sharpe ratio), after transaction costs. In the past three years, the improvement in IR (Sharpe ratio) is 240%. It appears that the QCD model (optimized for the broad US investable universe) has done well until early 2002, then starts to underperform the QCD-REIT model ever since.

Figure 63: Cumulative performance, QCD-REIT versus QCD



Source: Axioma, Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 64: Portfolio information ratio (IR) comparison, QCD-REIT versus QCD



Source: Axioma, Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Factor performance review

Every month, we review the performance of about 80 factors from our factor library. Please note that this is only a tiny fraction of our factor library, which includes over 1,200 factors for the US market. We choose these 80 factors to provide a balanced view for each broad factor category.

We measure factor performance in five standard analyses: long/short hedged portfolio, Pearson information coefficient, Spearman rank IC, sector-neutral IC, and risk-adjusted IC. For simplicity, we only present Spearman rank IC in this report.

Due to space limitation, we will only present the results for the broad investable universe, two size (Russell 1000 and Russell 2000), two style (Russell 3000 Value and Russell 3000 Growth) universes, and 10 GICS sectors on a monthly basis. However, we perform factor backtesting for more sub-universes on a daily basis, e.g., S&P index family, GICS industry groups, etc. Please contact us for customized factor backtesting.

Broad US investable universe (Figure 65 and Figure 66)

Our investment universe is defined as the union of Russell 3000, S&P 1500, and MSCI USA indices.

Size and style universe (Figure 67)

We further break down our analysis into: 1) size, large cap (measured by Russell 1000 index) and small cap (Russell 2000); and 2) style, value (Russell 3000 Value) and growth (Russell 3000 Growth).

10 GICS sectors (Figure 68)

Lastly, we report factor performance by the 10 GICS sectors: energy, materials, industrials, consumer discretionary, consumer staples, health care, financials, information technology, telecom services, and utilities.

Figure 65: US factor performance, Spearman rank IC

Factor Name	Direction[1]	Current # of Stocks	Average (%) Last M	12M Avg	3Y Avg	Since Inception Avg	Std Dev	Max	Min	p-value[2]	# of Months	Avg # of Stocks	%Positive	Avg in Up Mkt (%)	Avg in Dn Mkt (%)	Serial Corr (%)[3]
1. Value																
1 Dividend yield, trailing 12M	Ascending	2,920	(5.37)	(1.34)	(0.68)	2.60	14.85	42.94	(32.82)	0.00	279	2,812	54.12	(2.63)	11.97	99.30
2 Expected dividend yield	Ascending	2,920	(4.75)	(1.01)	(0.50)	2.84	15.18	43.93	(33.33)	0.00	279	2,812	53.41	(2.60)	12.57	99.31
3 Price-to-operating EPS, trailing 12M, Basic	Descending	2,306	(6.40)	0.04	1.53	2.97	10.86	30.94	(31.04)	0.00	194	2,378	58.25	0.92	6.69	95.10
4 Operating earnings yield, trailing 12M, Basic	Ascending	2,894	0.94	2.50	1.99	4.69	13.62	46.16	(33.51)	0.00	194	2,884	60.31	(0.32)	13.76	96.19
5 Earnings yield, forecast FY1 mean	Ascending	2,766	1.55	3.11	1.36	4.39	12.62	47.84	(34.42)	0.00	279	2,526	62.37	0.92	10.61	94.98
6 Earnings yield, forecast FY2 mean	Ascending	2,746	(0.20)	3.88	2.18	4.06	12.10	46.02	(33.88)	0.00	279	2,421	64.52	1.76	8.18	94.20
7 Earnings yield x IBES 5Y growth	Ascending	1,825	(0.29)	2.04	1.60	1.91	10.39	41.21	(27.73)	0.01	194	1,970	61.34	4.14	(2.12)	93.46
8 Sector-rel Operating earnings yield, trailing 12M, Basic	Ascending	2,894	0.93	2.93	2.24	4.01	8.64	28.35	(15.75)	0.00	194	2,884	66.49	1.14	9.22	95.70
9 Hist-rel Operating earnings yield, trailing 12M, Basic	Ascending	2,678	(7.54)	0.02	0.45	0.74	7.03	16.98	(17.43)	0.18	159	2,497	52.20	0.43	1.24	93.25
10 Operating cash flow yield (income stmt def)	Ascending	2,895	2.71	3.49	1.81	4.09	11.42	46.14	(32.97)	0.00	279	2,767	64.52	0.98	9.67	95.68
11 Cash flow yield, FY1 mean	Ascending	1,611	3.01	2.90	1.67	1.74	13.73	35.60	(48.02)	0.07	201	854	56.72	1.05	2.99	96.32
12 Free cash flow yield	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13 Price-to-sales, trailing 12M	Descending	2,866	1.57	0.57	2.32	2.07	11.13	40.42	(29.59)	0.00	279	2,745	57.35	1.74	2.67	99.06
14 Price-to-book	Descending	2,819	(13.96)	(2.00)	0.39	1.09	10.98	34.72	(25.65)	0.10	279	2,728	50.54	(0.08)	3.18	97.47
15 EBITDA/EV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16 Price-to-book adj for ROE, sector adj	Descending	2,670	(8.24)	(0.74)	1.47	0.74	8.82	32.64	(21.81)	0.16	279	2,451	50.90	1.09	0.11	95.28
2. Growth																
17 Hist 5Y operating EPS growth	Descending	2,807	6.00	1.16	0.09	0.46	7.38	19.32	(20.84)	0.39	187	2,647	52.94	(1.25)	3.40	97.11
18 Hist 5Y operating EPS acceleration	Ascending	2,807	(4.21)	(1.51)	(1.00)	1.05	6.32	14.11	(17.05)	0.02	187	2,647	59.36	0.20	2.50	94.30
19 IBES 5Y EPS growth	Ascending	1,918	3.28	1.47	0.17	0.56	8.83	23.07	(30.49)	0.29	279	1,884	53.76	1.90	(1.85)	98.21
20 IBES 5Y EPS growth/stability	Ascending	1,918	4.21	1.47	0.35	1.04	8.08	21.69	(21.19)	0.03	279	1,884	55.56	0.90	1.29	98.59
21 IBES LTG EPS mean	Descending	2,132	(9.98)	(3.78)	(1.51)	1.80	16.38	52.32	(37.37)	0.07	279	2,158	48.39	(3.84)	11.88	98.02
22 IBES FY2 mean DPS growth	Ascending	2,003	(1.93)	(0.62)	(0.10)	0.50	8.59	23.79	(20.93)	0.55	106	1,375	50.00	(3.13)	7.26	87.88
23 IBES FY1 mean EPS growth	Ascending	2,102	0.89	1.90	(1.27)	0.82	8.42	21.45	(29.20)	0.11	279	2,141	59.86	2.22	(1.69)	88.75
24 Year-over-year quarterly EPS growth	Ascending	2,905	4.60	2.96	0.38	2.36	7.19	24.43	(21.04)	0.00	194	2,893	68.04	2.32	2.43	81.22
25 IBES FY1 mean CFPS growth	Descending	988	1.64	(2.32)	1.21	0.09	10.88	41.86	(26.89)	0.92	151	538	50.33	(0.44)	1.07	92.58
26 IBES SUE, amortized	Ascending	2,588	2.34	1.56	(0.32)	1.27	6.23	19.90	(15.73)	0.00	217	2,278	59.91	1.98	0.01	73.42
3. Price momentum and reversal																
27 Total return, 1D	Descending	2,920	7.88	2.22	2.74	5.10	7.13	34.12	(15.48)	0.00	279	2,769	78.85	5.08	5.13	1.64
28 Total return, 21D (1M)	Descending	2,920	0.23	2.51	1.42	2.23	10.78	41.89	(27.52)	0.00	279	2,768	60.22	3.86	(0.69)	0.13
29 Maximum daily return in last 1M (lottery factor)	Descending	2,914	(3.05)	0.06	1.49	4.87	15.02	55.37	(38.40)	0.00	279	2,643	63.44	(1.19)	15.70	52.00
30 21D volatility of volume/price	Descending	2,914	(2.84)	1.19	0.61	0.33	6.93	17.85	(24.70)	0.43	279	2,643	50.54	1.14	(1.14)	55.80
31 Total return, 252D (12M)	Ascending	2,841	12.69	0.92	(2.05)	2.78	14.15	38.82	(55.94)	0.00	279	2,690	60.93	1.30	5.41	89.10
32 12M-1M total return	Ascending	2,841	13.53	1.74	(1.22)	3.70	13.32	37.32	(48.50)	0.00	279	2,690	64.52	2.75	5.39	87.64
33 Price-to-52 week high	Ascending	2,866	3.44	(0.99)	(2.58)	2.96	16.52	48.51	(58.32)	0.00	279	2,705	62.01	(2.48)	12.70	82.83
34 Total return, 1260D (60M)	Ascending	2,487	12.06	2.90	(1.61)	0.67	10.74	23.93	(34.21)	0.31	267	2,131	54.68	0.22	1.48	97.17

Note

1 Direction indicates how the factor scores are sorted. Ascending order means higher factor scores are likely to be associated with higher subsequent stock returns, and vice versa for descending order.
2 P-value indicates the statistical significance of a factor's performance. A smaller p-value suggests that it is more likely the factor's performance is different from zero.
3 This is the autocorrelation of a factor's scores over time. Higher serial correlation is likely to have lower portfolio turnover based on the factor.

Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 66: US factor performance, Spearman rank IC, cont'd

Factor Name	Direction[1]	Current # of Stocks	Average (%) Last M	12M Avg	3Y Avg	Since Inception Avg	Std Dev	Max	Min	p-value[2]	# of Months	Avg # of Stocks	%Positive	Avg in Up Mkt (%)	Avg in Dn Mkt (%)	Serial Corr (%)[3]
4. Sentiment																
35 IBES LTG Mean EPS Revision, 3M	Ascending	2,026	2.33	1.21	(0.62)	0.85	3.92	12.12	(12.34)	0.00	279	2,082	61.65	0.63	1.23	59.19
36 IBES FY1 Mean EPS Revision, 3M	Ascending	2,706	6.36	1.43	(0.37)	2.83	8.66	26.40	(32.94)	0.00	279	2,465	65.59	2.52	3.39	76.11
37 IBES FY1 EPS up/down ratio, 3M	Ascending	2,485	6.40	1.04	(0.02)	3.05	7.97	24.04	(24.72)	0.00	279	2,322	65.59	3.36	2.49	79.68
38 Expectation gap, short-term - long-term	Ascending	2,098	(1.02)	0.99	(1.34)	1.28	5.18	15.56	(22.92)	0.00	279	2,139	65.95	1.34	1.18	87.33
39 IBES FY1 Mean CFPS Revision, 3M	Ascending	1,473	3.60	0.94	(0.54)	0.80	10.39	29.49	(37.12)	0.29	193	787	61.66	(0.13)	2.46	65.22
40 IBES FY1 Mean SAL Revision, 3M	Ascending	2,684	5.64	2.20	(0.16)	1.03	7.99	27.84	(24.26)	0.09	177	2,126	59.89	0.61	1.73	71.24
41 IBES FY1 Mean FFO Revision, 3M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
42 IBES FY1 Mean DPS Revision, 3M	Ascending	1,105	3.71	0.91	0.19	0.42	5.42	15.47	(16.80)	0.43	103	964	56.31	0.33	0.61	61.21
43 IBES FY1 Mean ROE Revision, 3M	Ascending	2,016	4.34	1.47	0.73	0.64	6.87	21.25	(21.54)	0.35	103	1,677	58.25	0.02	1.84	66.12
44 Recommendation, mean	Descending	2,132	11.16	3.40	0.91	0.81	8.43	21.79	(23.43)	0.17	208	2,279	56.25	2.59	(2.42)	94.22
45 Mean recommendation revision, 3M	Descending	2,032	(0.94)	0.26	0.49	1.31	4.29	11.94	(19.64)	0.00	205	2,202	63.41	1.15	1.59	60.00
46 Target price implied return	Ascending	2,121	8.09	4.46	3.83	1.14	16.60	61.55	(38.23)	0.41	144	2,093	55.56	8.80	(10.21)	78.34
47 Mean target price revision, 3M	Ascending	2,025	9.70	(0.85)	(1.10)	1.90	13.75	30.54	(43.72)	0.10	141	2,003	62.41	(0.57)	5.55	75.54
5. Quality																
48 ROE, trailing 12M	Ascending	2,800	8.89	3.16	1.71	4.02	11.23	35.75	(31.88)	0.00	194	2,814	63.40	0.23	10.89	97.90
49 Return on invested capital (ROIC)	Ascending	2,881	8.45	3.13	2.06	3.86	10.24	31.84	(29.71)	0.00	194	2,876	63.92	0.49	9.96	98.10
50 Sales to total assets (asset turnover)	Ascending	2,894	13.87	3.46	3.73	1.60	8.96	22.73	(22.20)	0.00	279	2,764	57.35	2.49	0.01	99.44
51 Operating profit margin	Ascending	2,850	(2.16)	0.87	0.88	1.06	5.38	16.03	(14.20)	0.00	279	2,598	59.50	0.68	1.73	98.42
52 Current ratio	Descending	2,319	(1.39)	0.30	(0.51)	1.94	10.60	38.65	(31.28)	0.00	279	2,230	54.12	(0.98)	7.16	97.85
53 Long-term debt/equity	Ascending	2,787	(3.13)	0.19	(0.69)	0.64	9.79	35.23	(27.70)	0.28	279	2,705	47.31	(1.26)	4.05	98.49
54 Altman's z-score	Descending	2,282	(5.91)	(0.30)	(0.12)	0.04	9.39	30.09	(31.80)	0.95	279	2,159	51.25	(0.70)	1.36	98.21
55 Merton's distance to default	Ascending	2,151	6.52	0.92	0.75	2.91	11.51	30.20	(42.82)	0.00	279	2,125	64.52	(0.88)	9.69	94.73
56 Ohlson default model	Descending	2,263	(0.73)	1.49	0.95	2.05	6.24	18.41	(15.74)	0.00	242	2,106	65.29	1.47	3.11	98.09
57 Campbell, Hilscher, and Szilagyi model	Descending	2,574	9.73	2.71	1.13	2.38	11.81	26.10	(36.79)	0.01	195	2,534	56.41	(1.18)	8.87	96.98
58 Accruals (Sloan 1996 def)	Descending	1,546	1.74	(0.13)	0.18	0.62	4.39	13.92	(11.24)	0.02	279	1,401	56.99	0.69	0.51	89.09
59 Firm-specific discretionary accruals	Descending	1,469	(3.00)	0.58	0.83	0.45	4.23	13.79	(12.29)	0.15	186	1,344	51.08	0.08	1.06	98.52
60 Hist 5Y operating EPS stability, coef of determination	Ascending	2,807	2.71	(1.62)	(0.89)	0.46	4.96	13.24	(12.23)	0.20	187	2,647	51.87	0.30	0.75	96.61
61 IBES 5Y EPS stability	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
62 IBES FY1 EPS dispersion	Descending	2,561	10.30	2.81	0.74	2.16	10.32	25.49	(35.86)	0.00	279	2,305	60.57	(0.67)	7.22	84.78
63 Payout on trailing operating EPS	Ascending	2,234	(6.75)	(3.07)	(1.60)	0.58	13.81	39.04	(30.71)	0.49	279	2,197	49.46	(4.23)	9.19	99.23
64 YoY change in # of shares outstanding	Descending	2,866	6.17	1.17	1.38	2.50	9.05	45.71	(18.78)	0.00	279	2,714	58.42	(0.88)	8.55	93.87
65 YoY change in debt outstanding	Descending	2,208	(1.05)	(1.69)	(0.34)	0.33	4.12	10.41	(12.60)	0.19	279	2,173	56.27	1.05	(0.98)	89.69
66 Net external financing/net operating assets	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
67 Piotroski's F-score	Ascending	2,190	1.72	1.86	(0.56)	3.02	11.11	36.09	(30.81)	0.00	194	2,150	59.28	(1.22)	10.71	90.35
68 Mohanram's G-score	Ascending	574	6.24	0.48	1.17	2.00	8.81	23.26	(28.73)	0.00	194	446	57.73	(0.06)	5.73	94.84
6. Technicals																
69 # of days to cover short	Descending	2,921	(3.44)	1.16	2.19	2.56	9.69	25.32	(33.83)	0.01	96	2,890	55.21	3.30	1.01	93.07
70 CAPM beta, 5Y monthly	Descending	2,625	3.88	(3.45)	(3.41)	0.63	17.21	47.46	(46.56)	0.59	219	2,272	46.12	(7.47)	15.27	98.67
71 CAPM idosyncratic vol, 1Y daily	Descending	2,829	0.22	0.89	1.09	4.58	17.98	57.95	(39.76)	0.00	279	2,662	60.22	(2.05)	16.45	99.14
72 Realized vol, 1Y daily	Descending	2,840	0.92	(0.61)	0.51	4.45	18.60	59.25	(40.19)	0.00	279	2,662	59.50	(2.75)	17.34	99.08
73 Skewness, 1Y daily	Descending	2,840	(2.78)	0.37	0.92	1.14	5.42	20.19	(14.35)	0.00	279	2,662	57.35	0.54	2.22	89.61
74 Kurtosis, 1Y daily	Descending	2,840	1.14	1.77	0.53	1.33	5.70	16.79	(15.25)	0.00	279	2,662	62.72	0.94	2.03	91.27
75 Idiosyncratic vol surprise	Descending	2,819	(2.51)	0.82	0.64	2.66	7.44	26.30	(26.52)	0.00	278	2,649	65.47	0.84	5.91	86.96
76 Normalized abnormal volume	Ascending	2,916	1.68	2.58	1.14	1.03	6.91	20.07	(20.69)	0.01	279	2,806	58.78	2.44	(1.49)	81.61
77 Float turnover, 12M	Descending	2,921	6.48	(0.67)	(1.58)	2.00	16.06	55.09	(36.72)	0.04	279	2,817	49.82	(5.00)	14.54	99.19
78 Moving average crossover, 15W-36W	Ascending	2,840	10.85	(1.22)	(1.18)	2.08	13.30	44.28	(52.57)	0.01	279	2,391	59.14	0.71	4.53	90.77
79 Log float-adj capitalization	Ascending	2,920	0.68	1.81	1.41	2.90	10.97	26.57	(38.48)	0.00	279	2,812	60.57	2.50	3.61	99.35
80 # of month in the database	Ascending	2,921	1.43	0.22	1.12	2.56	8.82	35.28	(21.03)	0.00	219	2,817	58.45	(0.28)	7.71	98.10
81 DB composite options factor	Ascending	1,505	(1.81)	2.32	1.49	1.92	4.77	14.75	(18.90)	0.00	116	1,466	67.24	0.89	3.67	2.34

Note

1 Direction indicates how the factor scores are sorted. Ascending order means higher factor scores are likely to be associated with higher subsequent stock returns, and vice versa for descending order.
2 P-value indicates the statistical significance of a factor's performance. A smaller p-value suggests that it is more likely the factor's performance is different from zero.
3 This is the autocorrelation of a factor's scores over time. Higher serial correlation is likely to have lower portfolio turnover based on the factor.

Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 67: Factor performance by size and style indices

Factor Name	Last Month					Three-year				
	Universe	Russell 1000	Russell 2000	Russell 3K Value	Russell 3K Growth	Universe	Russell 1000	Russell 2000	Russell 3K Value	Russell 3K Growth
1. Value										
1 Dividend yield, trailing 12M	(5.37)	(7.03)	(4.40)	(6.88)	1.22	(0.68)	(0.48)	(1.08)	(0.92)	0.41
2 Expected dividend yield	(4.75)	(7.64)	(3.31)	(6.19)	0.76	(0.50)	(0.89)	(0.73)	(0.75)	0.36
3 Price-to-operating EPS, trailing 12M, Basic	(6.40)	(1.19)	(8.47)	(4.25)	(6.61)	1.53	0.97	1.53	2.04	1.19
4 Operating earnings yield, trailing 12M, Basic	0.94	1.10	2.13	4.21	(1.22)	1.99	0.82	2.15	1.96	1.89
5 Earnings yield, forecast FY1 mean	1.55	1.87	2.81	6.38	(1.31)	1.36	(0.72)	1.90	1.45	1.48
6 Earnings yield, forecast FY2 mean	(0.20)	2.56	(0.24)	5.42	(3.11)	2.18	0.43	2.69	2.81	1.98
7 Earnings yield x IBES 5Y growth	(0.29)	0.84	(0.59)	1.96	(2.64)	1.60	1.40	1.68	2.47	1.08
8 Sector-rel Operating earnings yield, trailing 12M, Basic	0.93	0.48	2.21	4.45	(2.21)	2.24	1.29	2.43	1.93	2.58
9 Hist-rel Operating earnings yield, trailing 12M, Basic	(7.54)	(19.38)	(4.15)	(8.16)	7.12	0.45	(0.62)	0.61	0.66	0.19
10 Operating cash flow yield (income stmt def)	2.71	8.76	1.35	8.78	(1.20)	1.81	1.48	1.79	2.19	1.32
11 Cash flow yield, FY1 mean	3.01	6.89	2.02	9.45	(2.79)	1.67	1.74	1.80	2.55	0.96
12 Free cash flow yield	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13 Price-to-sales, trailing 12M	1.57	11.41	(2.32)	7.48	(0.83)	2.32	2.43	2.45	3.00	2.49
14 Price-to-book	(13.96)	(9.39)	(16.65)	(13.72)	(8.37)	0.39	0.34	0.57	0.31	1.65
15 EBITDA/EV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16 Price-to-book adj for ROE, sector adj	(8.24)	(2.06)	(12.02)	(1.61)	(7.48)	1.47	1.67	1.49	2.24	1.59
2. Growth										
17 Hist 5Y operating EPS growth	6.00	(9.65)	5.15	6.84	(1.85)	0.09	1.74	0.67	0.11	1.19
18 Hist 5Y operating EPS acceleration	(4.21)	(8.92)	(2.11)	(5.73)	(0.25)	(1.00)	(1.72)	(0.59)	(0.69)	(1.72)
19 IBES 5Y EPS growth	3.28	6.33	1.69	4.44	(1.60)	0.17	(0.87)	0.71	(0.02)	(1.29)
20 IBES 5Y EPS growth/stability	4.21	5.68	4.05	5.05	(0.01)	0.35	(0.53)	0.91	0.10	(0.98)
21 IBES LTG EPS mean	(9.98)	(4.99)	(11.72)	(7.55)	(6.46)	(1.51)	(1.09)	(1.83)	(1.89)	(0.55)
22 IBES FY2 mean DPS growth	(1.93)	1.88	(1.05)	(3.45)	(1.18)	(0.10)	0.36	0.04	(0.04)	0.59
23 IBES FY1 mean EPS growth	0.89	(2.41)	1.99	1.41	1.54	(1.27)	(2.02)	(1.10)	(0.94)	(1.92)
24 Year-over-year quarterly EPS growth	4.60	(1.34)	7.02	5.82	4.11	0.38	(0.99)	0.90	0.82	(0.27)
25 IBES FY1 mean CFPS growth	1.64	6.59	1.84	(2.33)	(0.45)	1.21	2.24	(0.97)	(0.93)	(1.63)
26 IBES SUE, amortized	2.34	1.63	3.08	(1.71)	1.08	(0.32)	(1.47)	0.13	(0.72)	(0.24)
3. Price momentum and reversal										
27 Total return, 1D	7.88	4.57	8.95	7.52	6.54	2.74	2.02	3.01	2.70	2.91
28 Total return, 21D (1M)	0.23	(2.79)	1.03	3.84	0.28	1.42	0.05	1.85	1.03	2.66
29 Maximum daily return in last 1M (lottery factor)	(3.05)	(5.30)	(0.38)	(2.64)	(0.53)	1.49	(1.11)	2.38	1.08	2.09
30 21D volatility of volume/price	(2.84)	9.28	(0.66)	(2.08)	3.06	0.61	1.18	(0.73)	0.57	(0.23)
31 Total return, 252D (12M)	12.69	12.95	13.34	8.32	14.06	(2.05)	(2.08)	(1.98)	(1.74)	(2.75)
32 12M-1M total return	13.53	13.18	14.33	9.89	14.85	(1.22)	(1.64)	(0.98)	(0.93)	(1.55)
33 Price-to-52 week high	3.44	(3.05)	5.09	1.66	4.07	(2.58)	4.21	(2.00)	(2.99)	(2.48)
34 Total return, 1260D (60M)	12.06	(19.73)	10.37	9.48	10.93	(1.61)	2.69	(1.45)	(1.89)	(2.78)
4. Sentiment										
35 IBES LTG Mean EPS Revision, 3M	2.33	(0.88)	4.28	0.28	3.33	(0.62)	(1.12)	0.06	(0.70)	(0.06)
36 IBES FY1 Mean EPS Revision, 3M	6.36	2.08	8.97	5.36	4.48	(0.37)	(1.89)	0.26	(0.33)	(0.70)
37 IBES FY1 EPS up/down ratio, 3M	6.40	4.60	7.45	5.18	5.86	(0.02)	(1.62)	0.64	(0.14)	0.00
38 Expectation gap, short-term - long-term	(1.02)	(3.87)	0.35	0.46	(1.45)	(1.34)	(2.16)	(1.10)	(0.94)	(1.88)
39 IBES FY1 Mean CFPS Revision, 3M	3.60	2.66	6.29	6.00	2.10	(0.54)	(1.26)	0.23	(0.45)	(1.01)
40 IBES FY1 Mean SAL Revision, 3M	5.64	(2.84)	7.54	2.01	6.48	(0.16)	1.95	0.68	(0.15)	(0.17)
41 IBES FY1 Mean FFO Revision, 3M	NA	NA	NA	13.26	NA	NA	NA	NA	5.27	NA
42 IBES FY1 Mean DPS Revision, 3M	3.71	(1.00)	8.04	2.22	(3.37)	0.19	0.92	1.42	0.70	1.26
43 IBES FY1 Mean ROE Revision, 3M	4.34	(5.37)	4.38	5.07	0.66	0.73	1.13	2.20	0.82	0.25
44 Recommendation, mean	11.16	9.22	12.20	10.47	9.84	0.91	(0.21)	1.41	1.52	(0.27)
45 Mean recommendation revision, 3M	(0.94)	(0.05)	(1.42)	(3.00)	0.10	0.49	(0.31)	0.75	0.49	0.02
46 Target price implied return	8.09	7.54	7.38	8.94	6.82	3.83	3.77	3.81	4.65	3.16
47 Mean target price revision, 3M	9.70	8.23	11.49	7.36	9.27	(1.10)	(1.61)	(0.52)	(1.13)	(0.95)
5. Quality										
48 ROE, trailing 12M	8.89	10.62	9.98	11.31	3.45	1.71	0.93	1.79	1.75	1.07
49 Return on invested capital (ROIC)	8.45	8.36	9.65	11.81	3.35	2.06	1.33	2.13	2.03	1.36
50 Sales to total assets (asset turnover)	13.87	21.53	10.98	18.53	6.31	3.73	3.54	3.89	4.45	2.52
51 Operating profit margin	(2.16)	4.65	(1.07)	(2.99)	(3.61)	0.88	0.07	1.21	(0.39)	1.58
52 Current ratio	(1.39)	1.43	(1.59)	(2.77)	(1.10)	(0.51)	(1.35)	(0.49)	(0.79)	(0.58)
53 Long-term debt/equity	(3.13)	(0.74)	(4.09)	(2.00)	(1.74)	(0.69)	1.15	(0.88)	(0.60)	(0.33)
54 Altman's z-score	(5.91)	0.33	(7.88)	5.57	(5.64)	(0.12)	(0.29)	(0.22)	0.26	(0.12)
55 Merton's distance to default	6.52	3.36	9.27	6.85	4.25	0.75	(1.05)	1.10	0.52	0.28
56 Ohlson default model	(0.73)	10.76	3.24	2.39	(1.22)	0.95	0.64	1.59	0.15	1.51
57 Campbell, Hilscher, and Szilagyi model	9.73	8.53	11.42	13.90	3.32	1.13	0.57	1.34	1.30	(0.02)
58 Accruals (Sloan 1996 def)	1.74	1.85	2.14	3.49	0.79	0.18	(0.48)	0.55	(0.47)	0.22
59 Firm-specific discretionary accruals	(3.00)	(0.35)	(3.82)	(5.24)	(1.62)	0.83	(0.65)	0.95	0.55	1.08
60 Hist 5Y operating EPS stability, coef of determination	2.71	0.55	3.87	(0.03)	1.40	(0.89)	(1.52)	(0.64)	(1.29)	(0.96)
61 IBES 5Y EPS stability	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
62 IBES FY1 EPS dispersion	10.30	6.41	12.54	10.30	8.39	0.74	(0.24)	1.17	0.22	0.69
63 Payout on trailing operating EPS	(6.75)	4.74	(6.71)	(9.80)	(0.03)	(1.60)	1.24	(2.04)	(1.72)	(0.56)
64 YoY change in # of shares outstanding	6.17	9.07	6.52	10.85	2.61	1.38	1.42	1.22	0.99	1.62
65 YoY change in debt outstanding	(1.05)	(3.20)	(0.65)	(1.44)	(0.35)	(0.34)	0.01	(0.17)	(0.63)	(0.06)
66 Net external financing/net operating assets	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
67 Piotroski's F-score	1.72	(3.18)	4.18	5.26	1.35	(0.56)	(0.92)	(0.38)	(0.68)	(0.24)
68 Mohanram's G-score	6.24	0.20	10.02	6.76	3.13	1.17	0.87	1.29	0.83	1.15
6. Technicals										
69 # of days to cover short	(3.44)	(5.59)	(0.12)	(1.29)	(6.53)	2.19	0.21	2.75	3.18	1.13
70 CAPM beta, 5Y monthly	3.88	(4.40)	4.07	(4.79)	4.01	(3.41)	4.15	(3.19)	3.87	(2.03)
71 CAPM idosyncratic vol, 1Y daily	0.22	0.85	2.69	(0.21)	1.58	1.09	(0.73)	1.46	0.47	1.51
72 Realized vol, 1Y daily	0.92	2.08	2.78	0.74	1.86	0.51	(1.37)	1.05	(0.15)	1.02
73 Skewness, 1Y daily	(2.78)	(3.91)	(2.21)	1.29	(3.76)	0.92	(1.08)	1.61	0.79	1.03
74 Kurtosis, 1Y daily	1.14	(1.64)	2.33	3.85	2.64	0.53	0.74	0.61	0.66	0.43
75 Idiosyncratic vol surprise	(2.51)	(3.04)	(4.66)	(5.15)	1.31	0.64	(0.10)	1.09	(0.02)	0.72
76 Normalized abnormal volume	1.68	(0.54)	(4.17)	3.38	0.81	1.14	(1.54)	(1.50)	0.92	1.06
77 Float turnover, 12M	6.48	7.84	4.83	6.03	9.58	(1.58)	(0.45)	(1.74)	(1.96)	(0.84)
78 Moving average crossover, 15W-36W	10.85	11.99	11.02	9.28	9.50	(1.18)	(2.15)	(0.51)	(1.33)	(1.08)
79 Log float-adj capitalization	0.68	6.95	6.78	2.03	(2.73)	1.41	3.54	1.77	1.32	1.25
80 # of month in the database	1.43	2.20	3.00	3.66	0.41	1.12	(0.46)	1.24	1.03	1.45
81 DB composite options factor	(1.81)	1.53	(1.88)	1.44	(1.30)	1.49	0.64	1.45	1.79	1.51

Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 68: Factor performance by GICS sectors

Factor Name	Last Month										
	Universe	Energy	Materials	Industrial	Consumer Disc	Consumer Staples	Health Care	Financials	Info Tech	Telecom Services	Utilities
1. Value											
1 Dividend yield, trailing 12M	(5.37)	2.81	4.47	(2.39)	1.87	6.02	(1.11)	(6.40)	(4.82)	14.10	(6.79)
2 Expected dividend yield	(4.75)	0.80	3.87	(0.75)	2.32	7.31	(1.50)	(5.48)	(3.30)	15.59	(4.09)
3 Price-to-operating EPS, trailing 12M, Basic	(6.40)	(6.05)	15.28	(16.31)	(1.18)	6.07	3.43	(2.63)	(17.48)	30.05	(15.39)
4 Operating earnings yield, trailing 12M, Basic	0.94	(7.82)	14.40	(11.67)	4.08	8.10	5.13	7.79	(4.40)	7.92	(7.35)
5 Earnings yield, forecast FY1 mean	1.55	15.80	14.16	(7.67)	7.34	(6.24)	5.11	5.70	(7.63)	5.97	(6.19)
6 Earnings yield, forecast FY2 mean	(0.20)	21.11	9.47	(3.13)	4.81	(10.82)	3.09	1.40	(13.85)	6.07	2.00
7 Earnings yield x IBES 5Y growth	(0.29)	10.92	25.70	(4.57)	1.14	(14.58)	(1.30)	(0.75)	(14.07)	21.17	12.43
8 Hist-rel Operating earnings yield, trailing 12M	(7.54)	(21.09)	7.77	(12.51)	(9.22)	(1.09)	(8.53)	(2.75)	3.45	(28.28)	17.32
9 Operating cash flow yield (income stmt def)	2.71	10.58	5.51	(6.83)	(5.96)	3.68	5.66	6.77	(6.04)	(5.95)	7.37
10 Cash flow yield, FY1 mean	3.01	29.78	(3.84)	(15.32)	(6.04)	(16.57)	2.93	(12.21)	(5.08)	14.51	1.94
11 Free cash flow yield	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12 Price-to-sales, trailing 12M	1.57	18.51	10.11	(10.48)	(11.08)	(17.55)	(0.04)	(1.44)	(11.43)	24.35	23.58
13 Price-to-book	(13.96)	3.47	(3.67)	(16.92)	11.69	(3.53)	(5.48)	(9.85)	13.02	(6.99)	2.80
14 EBITDA/EV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2. Growth											
15 Hist 5Y operating EPS growth	6.00	(14.16)	5.93	7.90	5.23	(11.88)	3.80	14.85	(3.04)	(26.03)	4.84
16 Hist 5Y operating EPS acceleration	(4.21)	(0.09)	8.85	6.47	(0.02)	11.31	3.20	(4.37)	7.87	(14.18)	(15.29)
17 IBES 5Y EPS growth	3.28	(10.61)	(2.49)	8.89	7.03	0.90	0.70	2.06	5.44	3.77	7.01
18 IBES 5Y EPS growth/stability	4.21	(10.19)	4.01	(7.89)	4.78	12.57	2.35	1.85	6.86	10.78	14.51
19 IBES LTG EPS mean	(9.98)	(11.89)	14.71	(7.36)	(14.14)	13.97	(3.73)	0.13	(12.18)	24.61	24.91
20 IBES FY2 mean DPS growth	(1.93)	2.85	0.77	0.79	7.63	7.72	0.71	(4.09)	9.07	(8.35)	5.27
21 IBES FY1 mean EPS growth	0.89	(16.45)	12.43	8.79	7.42	(15.20)	(9.37)	(9.93)	(4.66)	2.78	(1.17)
22 Year-over-year quarterly EPS growth	4.60	17.12	2.89	6.76	6.50	8.70	(5.05)	10.27	1.27	(0.57)	(22.16)
23 IBES FY1 mean CFPS growth	1.64	23.13	(20.00)	(19.46)	(5.07)	19.05	2.82	(25.23)	(4.27)	30.65	0.82
24 IBES SUE, amortized	2.34	3.89	(7.67)	(4.68)	6.90	(9.13)	(2.55)	6.50	5.35	(1.79)	1.55
3. Price momentum and reversal											
25 Total return, 1D	7.88	8.06	6.33	5.54	4.31	17.77	16.00	6.26	10.77	3.26	21.24
26 Total return, 21D (1M)	0.23	(1.96)	11.62	(0.02)	1.66	(26.11)	4.63	8.84	(3.14)	(15.01)	(3.51)
27 Maximum daily return in last 1M (lottery fact	(3.05)	(9.11)	6.30	(2.40)	(4.47)	(12.29)	7.62	(0.86)	(1.88)	(20.83)	6.61
28 21D volatility of volume/price	(2.84)	4.48	8.95	6.18	(6.11)	(1.20)	7.17	(10.94)	7.33	0.28	19.97
29 Total return, 252D (12M)	12.69	0.04	2.92	23.76	16.11	(9.72)	14.24	(6.36)	14.24	10.32	(17.95)
30 12M-1M total return	13.53	(3.57)	7.52	23.79	17.86	2.52	17.42	(3.95)	15.10	9.19	19.10
31 Price-to-52 week high	3.44	(4.60)	6.17	8.51	8.10	0.88	4.72	8.78	6.24	8.63	(7.87)
32 Total return, 1260D (60M)	12.06	10.36	(1.38)	(1.26)	13.09	(13.08)	8.76	(11.23)	15.63	49.03	(11.01)
4. Sentiment											
33 IBES LTG Mean EPS Revision, 3M	2.33	7.61	13.59	0.66	2.88	(19.31)	2.09	10.83	2.26	(3.39)	(9.85)
34 IBES FY1 Mean EPS Revision, 3M	6.36	19.92	(1.91)	7.74	13.59	7.57	2.45	3.17	(0.58)	(26.55)	8.92
35 IBES FY1 EPS up/down ratio, 3M	6.40	8.90	3.53	5.51	14.46	2.56	3.09	9.82	0.14	(6.49)	(0.61)
36 Expectation gap, short-term - long-term	(1.02)	(13.72)	(20.59)	7.50	6.43	19.00	(9.45)	(10.22)	(7.02)	2.11	(0.64)
37 IBES FY1 Mean CFPS Revision, 3M	3.60	(0.33)	3.93	(16.79)	6.64	3.81	0.20	20.05	(3.54)	2.35	(7.44)
38 IBES FY1 Mean SAL Revision, 3M	5.64	8.98	(0.99)	5.55	14.34	8.76	(0.36)	0.15	5.56	(4.92)	(9.22)
39 IBES FY1 Mean FFO Revision, 3M	NA	NA	NA	NA	NA	NA	NA	13.18	NA	NA	NA
40 IBES FY1 Mean DPS Revision, 3M	3.71	12.18	21.59	(4.85)	(4.81)	(15.63)	1.97	2.41	8.62	7.37	(15.03)
41 IBES FY1 Mean ROE Revision, 3M	4.34	(0.47)	(4.58)	(1.35)	13.97	(6.68)	(15.12)	1.58	4.12	13.07	(0.92)
42 Recommendation, mean	11.16	(2.19)	20.61	8.35	13.15	(9.39)	(7.84)	2.64	10.78	(26.68)	7.52
43 Mean recommendation revision, 3M	(0.94)	9.19	1.34	(1.11)	(1.68)	6.95	2.51	(1.62)	(5.54)	(24.01)	6.56
44 Target price implied return	8.09	15.78	33.71	1.51	9.67	(22.21)	7.07	8.59	2.34	(0.73)	12.31
45 Mean target price revision, 3M	9.70	3.08	(2.99)	12.67	6.18	(15.03)	4.34	4.44	7.18	(4.38)	(4.02)
5. Quality											
46 ROE, trailing 12M	8.89	(7.77)	13.96	2.74	7.90	5.37	6.66	15.43	(1.28)	18.28	5.43
47 Return on invested capital (ROIC)	8.45	(4.64)	6.98	0.70	15.36	3.83	4.89	14.10	(1.92)	9.03	7.04
48 Sales to total assets (asset turnover)	13.87	24.96	13.56	6.29	14.00	(24.31)	2.14	(1.42)	(4.78)	5.97	31.61
49 Operating profit margin	(2.16)	19.41	6.80	(2.34)	0.96	8.24	(2.39)	(11.90)	12.58	(5.59)	(25.94)
50 Current ratio	(1.39)	(1.89)	(9.61)	(6.84)	15.84	(12.40)	6.67	(28.48)	7.24	26.02	8.85
51 Long-term debt/equity	(3.13)	(5.66)	7.85	2.47	14.41	(6.70)	0.74	4.87	5.04	16.49	(4.32)
52 Altman's z-score	(5.91)	1.55	1.34	(9.43)	17.23	5.72	(2.80)	40.02	10.60	26.83	(11.25)
53 Merton's distance to default	6.52	(7.18)	(1.99)	3.16	16.64	1.24	1.58	4.76	4.36	(17.71)	(6.54)
54 Ohlson default model	(0.73)	1.46	(15.67)	2.46	12.54	6.82	(2.96)	21.11	(3.15)	(16.42)	11.12
55 Campbell, Hilscher, and Szilagyi model	9.73	(11.87)	(3.56)	10.18	12.66	(1.73)	0.40	1.23	0.15	(1.77)	(2.48)
56 Accruals (Sloan 1996 def)	1.74	(16.56)	1.23	4.49	(1.54)	(3.86)	3.51	22.13	3.57	(14.56)	(2.03)
57 Firm-specific discretionary accruals	(3.00)	(5.00)	(13.02)	(13.51)	(3.42)	21.69	3.62	NA	(8.16)	17.70	43.61
58 Hist 5Y operating EPS stability, coef of dete	2.71	17.40	1.98	(1.03)	(0.39)	(10.13)	0.39	1.00	0.81	1.19	5.61
59 IBES 5Y EPS stability	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
60 IBES FY1 EPS dispersion	10.30	(1.38)	(7.39)	5.48	14.26	23.01	(0.15)	4.73	16.83	(25.66)	(0.03)
61 Payout on trailing operating EPS	(6.75)	7.89	(2.67)	(2.02)	0.82	(1.80)	(3.80)	11.80	(6.16)	26.27	4.05
62 YoY change in # of shares outstanding	6.17	21.04	5.58	9.76	4.27	(5.32)	(7.36)	10.76	(1.68)	3.41	3.46
63 YoY change in debt outstanding	(1.05)	(4.22)	(7.95)	4.33	4.08	(0.19)	(4.55)	0.40	4.73	0.03	5.46
64 Net external financing/net operating assets	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
65 Piotroski's F-score	1.72	1.71	14.87	2.32	(9.95)	5.25	0.62	24.69	3.34	20.89	(9.14)
66 Mohanram's G-score	6.24	NA	NA	(7.08)	30.18	8.26	(8.75)	NA	(1.75)	NA	NA
6. Technicals											
67 # of days to cover short	(3.44)	3.35	(12.84)	(4.99)	2.08	(0.31)	1.92	(22.53)	(16.15)	39.40	(4.13)
68 CAPM beta, 5Y monthly	3.88	(1.91)	(3.69)	0.22	11.50	(4.42)	(0.80)	(12.87)	4.06	9.27	6.55
69 CAPM idosyncratic vol, 1Y daily	0.22	6.72	5.83	(1.04)	4.13	4.84	2.56	(0.22)	2.31	(2.66)	(0.32)
70 Realized vol, 1Y daily	0.92	5.69	3.65	(3.45)	7.52	5.68	1.22	2.11	4.46	(5.95)	(11.28)
71 Skewness, 1Y daily	(2.78)	6.30	4.82	(5.14)	(5.36)	12.95	(10.87)	(6.42)	0.81	(8.46)	18.93
72 Kurtosis, 1Y daily	1.14	27.88	4.46	2.55	(8.54)	(5.12)	5.59	2.45	4.32	(9.62)	(2.71)
73 Idiosyncratic vol surprise	(2.51)	(0.56)	4.50	2.31	(9.12)	(0.22)	3.01	(11.84)	4.97	(3.25)	0.74
74 Normalized abnormal volume	1.68	7.37	(3.89)	(2.44)	(1.43)	(5.59)	4.26	3.28	(0.33)	(7.95)	(5.98)
75 Float turnover, 12M	6.48	(7.23)	11.76	3.69	12.78	(7.39)	(4.11)	(22.45)	15.43	(16.42)	6.02
76 Moving average crossover, 15W-36W	10.85	0.62	(1.63)	18.60	7.07	(4.21)	7.88	(0.98)	11.04	(6.53)	17.58
77 Log float-adj capitalization	0.68	8.25	(17.36)	(0.07)	(1.93)	5.11	5.06	(9.33)	(5.66)	26.00	(12.66)
78 # of month in the database	1.43	14.05	2.52	6.24	(3.09)	(4.25)	(1.96)	(4.11)	(12.28)	13.34	2.35
79 DB composite options factor	(1.81)	(7.02)	(7.78)	(9.24)	(9.27)	22.54	(1.98)	12.74	4.37	27.02	(28.39)

Source: Bloomberg Finance LP, Compustat, IBES, Russell, S&P, SNL, Thomson Reuters, Deutsche Bank Quantitative Strategy

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Appendix 1

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