The short of it: Investor sentiment and anomalies

by*

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Abstract

This study explores the role of investor sentiment in a broad set of anomalies in cross-sectional stock returns. We consider a setting in which the presence of market-wide sentiment is combined with the argument that overpricing should be more prevalent than underpricing, due to short-sale impediments. Long-short strategies that exploit the anomalies exhibit profits consistent with this setting. First, each anomaly is stronger (its long-short strategy is more profitable) following high levels of sentiment. Second, the short leg of each strategy is more profitable following high sentiment. Finally, sentiment exhibits no relation to returns on the long legs of the strategies.

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1. Introduction

Whether investor sentiment affects stock prices is a question of long-standing interest to economists. At least as early as Keynes (1936), numerous authors have considered the possibility that a significant presence of sentiment-driven investors can cause prices to depart from fundamental values. The classic argument against sentiment effects is that they would be eliminated by rational traders seeking to exploit the profit opportunities created by mispricing. If rational traders cannot fully exploit such opportunities, however, then sentiment effects become more likely.

This study investigates the presence of sentiment effects by combining two concepts that are prominent, separately, in the related literature. The first concept is that investor sentiment contains a market-wide component with the potential to influence prices on many securities in the same direction at the same time.[1] The second concept, which traces to Miller (1977), is that impediments to short selling play a significant role in limiting the ability of rational traders to exploit overpricing.[2] As Miller argues (p. 1154):

> A market with a large number of well informed investors may not have any grossly undervalued securities, but if those investors are unwilling to sell short (as they often are) their presence is consistent with a few investments being overvalued.

Combining Miller's argument with the presence of market-wide sentiment replaces the "few" overpriced investments with potentially many such investments when market-wide sentiment is high. In contrast, periods of low market-wide sentiment, by Miller's reasoning, should not be accompanied by substantial underpricing.

We explore sentiment-related overpricing as at least a partial explanation for 11 asset-pricing anomalies that survive adjustments for exposure to the three factors of Fama and French (1993). These anomalies reflect sorts on measures that include financial distress, net stock issues, composite equity issues, total accruals, net operating assets, momentum, gross profit-to-assets, asset growth, return-on-assets (ROA), and investment-to-assets.[3] For each anomaly, we examine the strategy that goes long the stocks in the highest-performing decile and short those in the lowest-performing decile. We then use the market-wide investor sentiment index constructed by Baker and Wurgler (2006) to explore sentiment effects.

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[1] Studies addressing market-wide sentiment include Delong, Shleifer, Summers, and Waldman (1990), Shleifer and Summers (1990), Lee, Shleifer, and Thaler (1991), Barberis, Shleifer, and Vishny (1998), Shiller (2001), Brown and Cliff (2004, 2005), Yuan (2005), Baker and Wurgler (2006, 2007), Kaniel, Saar, and Titman (2008), Kumar and Lee (2006), Lemmon and Portniaguina (2006), Bergman and Roychowdhury (2008), Frazzini and Lamont (2008), Livnat and Petrovic (2008), Yu (2009), Antoniou, Doukas, and Subrahmanyam (2010), Chung, Hung, and Yeh (2010), Gao, Yu, and Yuan (2010), Baker, Wurgler, and Yuan (2011), and Yu and Yuan (2011).

[2] Studies that investigate the role of short-sale constraints in overpricing include Figlewski (1981), Chen, Hong, and Stein (2002), Diether, Malloy, and Scherbina (2002), Duffie, Garleanu and Pedersen (2002), Jones and Lamont (2002), Scheinkman and Xiong (2003), Lamont (2004), Lamont and Stein (2004), Ofek, Richardson, and Whitelaw (2004), Nagel (2005), and Avramov, Chordia, Jostova, and Philipov (2010).

We investigate three hypotheses that result from combining the presence of market-wide sentiment with the Miller short-sale argument. The first hypothesis is that the anomalies, to the extent they reflect mispricing, should be stronger following high sentiment. If the primary form of mispricing is overpricing, then mispricing should be more prevalent when sentiment is high. We find that each of the 11 anomalies is stronger following high levels of investor sentiment (i.e., levels of sentiment above the median value). When averaged across anomalies, 70% of the benchmark adjusted profits from a long-short strategy occur in months following levels of investor sentiment above its median value. Time series regressions confirm a significant positive relation between investor sentiment and the long-short anomaly profits.

The second hypothesis is that the returns on the short-leg portfolio of each anomaly should be lower when sentiment is high. The stocks in the short leg are relatively overpriced compared to the stocks in the long leg, to the extent the anomaly reflects mispricing. Moreover, the stocks in the short leg should be more overpriced when sentiment is high. For each of the 11 anomalies, we find that the return on the short leg is lower following high sentiment. When averaged across anomalies, 78% of the benchmark-adjusted profits from shorting that leg occur in months following high sentiment. Time series regressions confirm a significant negative relation between investor sentiment and the returns on the short leg.

The third hypothesis is that investor sentiment should not greatly affect returns on the long-leg portfolio of each anomaly. If, as in the Miller argument, there is no underpricing, then the returns on the long leg should not be higher following low sentiment than following high sentiment. When market-wide sentiment is high, the stocks in the long leg could be overpriced, but the long leg should contain the least degree of overpricing. Overall, we should not expect to see sentiment playing much of a role in the long-leg returns. This hypothesis is also confirmed. None of the 11 long legs exhibits a significant difference between high- and low-sentiment periods. When averaged across anomalies, the benchmark-adjusted returns on the long leg exhibit only a 4-basis-point monthly difference between high- and low-sentiment periods. Time series regressions confirm the absence of a relation between benchmark-adjusted long-leg returns and investor sentiment.

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[3] Chen, Novy-Marx, and Zhang (2010) report that these anomalies are especially hard to explain using traditional asset pricing models such as the Capital Asset Pricing Model (CAPM) or the Fama and French three-factor model.

We also extend our exploration of sentiment effects by examining four long-short spreads often associated with systematic risk. We find that spreads based on either market beta or firm size exhibit relations to sentiment very similar to those of the 11 anomalies, suggesting that these return spreads at least partially reflect sentiment-related mispricing along the lines hypothesized. In contrast, we do not find the same sentiment relations for spreads based on book-to-market ratios or betas with respect to market-wide liquidity.

Perhaps the study most closely related to ours is that of Baker and Wurgler (2006), who argue that market-wide sentiment should exert stronger impacts on stocks that are difficult to value and hard to arbitrage. They examine returns on stocks judged most likely to possess both characteristics, as proxied by a number of observable variables. They conclude that market-wide sentiment is associated with cross-sectional return differences that are consistent with the importance of those characteristics. A key difference between our study and theirs is that we consider impediments to short selling as the major obstacle to eliminating sentiment-driven mispricing. To the extent such mispricing exists, overpricing should then be more prevalent than underpricing, and overpricing should be more prevalent when market-wide sentiment is high. To explore the presence of such mispricing effects on a market-wide basis, we examine a broad set of well-documented anomalies relative to the Fama and French three-factor model. None of these anomalies is examined by Baker and Wurgler.

Another related study is Yu and Yuan (2011), who show that the correlation between the market's expected return and its conditional volatility is positive during low-sentiment periods and nearly flat during high-sentiment periods. Their study envisions a setting similar in spirit to ours, in that they argue the market is less rational during high-sentiment periods, due to higher participation by noise traders in such periods.

The rest of the paper is organized as follows. Section 2 develops our hypotheses. Section 3 discusses the investor-sentiment data and describes returns on the long-short strategies constructed for each of the 11 anomalies. Sections 4 reports the main empirical results. Section 5 investigates the robustness of our results to macroeconomic effects. Section 6 concludes.

2. Motivation

2.1. Market-wide sentiment and short-sale impediments

For many years, researchers in finance have argued that empirical evidence supports the notion that the beliefs of many stock market investors include a common time-varying sentiment component that exerts market-wide effects on equity prices.[4] Lee, Shleifer, and Thaler (1991), for example, conclude that market-wide sentiment contributes to the differences between prices of close-end funds and their net asset values. Ritter (1991) reports evidence of long-run reversals in returns on initial public offering (IPO) stocks, and he concludes that the evidence is consistent with periodic waves of optimism that especially impact the prices of young growth stocks.

Numerous studies have argued that there exist short-sale impediments in the stock market, due to institutional constraints, arbitrage risk, behavioral biases of traders, and trading costs. First, many institutional investors, such as mutual funds, are simply prohibited by their charters from taking short positions. Second, even investors who do not face institutional constraints or high shorting costs can nevertheless be deterred by the risks in arbitrage, as discussed by Shleifer and Vishny (1997). Traders who short a security in the belief that its price is too high can be correct, in that the price will eventually fall, but they face the risk that the price will go up before it goes down. Such a price move, requiring additional capital, can force the traders to liquidate at a loss. A similar risk does not arise for long positions without leverage. Shleifer and Vishny (1997) further argue that such arbitrage risk looms particularly large for institutional managers, whose career paths depend heavily on recent performance. Third, individual investors, due to limited knowledge or behavioral biases, are reluctant to take short positions. For example, Barber and Odean (2008) show that only 0.29% of positions of individual investors are short positions. Finally, shorting can be costly. D'Avolio (2002), for example, finds that many stocks are costly to short due to low supplies of stock loans from institutional investors.

Miller (1977) argues that, with short-sale impediments, overpricing should be more prevalent than underpricing. Investors with the most optimistic views about a stock, relative to the views of other investors, exert the greatest effect on the stock's price, because their views are not counterbalanced by the valuations of the relatively less optimistic investors. The latter investors are inclined to take no position if they view the stock as undervalued, rather than take a short position. When the most optimistic investors are too optimistic and overvalue the stock, overpricing results. In contrast, underpricing is less likely. As long as the cross section of views includes the view of rational investors, the most optimistic investors do not undervalue the stock.

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[4] Sentiment is typically defined as the difference between the beliefs of sentiment-driven traders and correct objective beliefs conditional on available information (e.g., Delong, Shleifer, Summers, and Waldman, 1990). Individual investors are natural candidates for sentiment-driven investors. Kumar and Lee (2006) analyze 1.85 million individual-investor transactions and interpret systematic factors in the investors' trades as being consistent with the influence of sentiment. Institutional investors can also participate in sentiment-driven trading. Brunnermeier and Nagel (2004) show that hedge funds profitably rode the tech bubble during the late 1990s.

2.2. Empirical implications

We entertain the possibility that each of the anomalies we consider at least partially reflects mispricing that is related to market-wide investor sentiment. Combining market-wide sentiment with Miller's argument about the effect of short-sale impediments leads to three hypotheses that guide us in exploring empirically whether mispricing could be at least a partial explanation for the broad set of anomalies we consider.

The first hypotheses is that the anomalies should be stronger following periods of high investor sentiment. During such periods, the most optimistic views about many stocks tend to be overly optimistic, and many stocks tend to be overpriced. During low-sentiment periods, the most optimistic views about many stocks tend to be those of the rational investors, and thus mispricing during those periods is less likely. Therefore, mispricing is more likely during high-sentiment periods than during low-sentiment periods.

The second hypothesis is that the short leg of each long-short anomaly strategy should have lower returns (greater profits) following high sentiment than following low sentiment. The positive average profit on each long-short strategy reflects the unexplained cross-sectional difference in average returns that constitutes an anomaly. To the extent that an anomaly represents mispricing, the profits of the long-short strategy can reflect relatively greater overpricing of stocks in the short leg, relatively greater underpricing of stocks in the long leg, or both. In our hypothesized setting, overpricing should be the prevalent form of mispricing. Thus, the profits of the long-short strategy should arise primarily from overpricing of stocks in the short leg, and such overpricing should be greater during high-sentiment periods.

The third hypothesis is that the long legs of the long-short strategies should have similar returns following high and low investor sentiment. The stocks in the long leg are unlikely to be underpriced in our simple scenario. They could be overpriced, and overpricing would be more likely when sentiment is high. If the anomaly's sorting variable is related to mispricing, however, the overpricing of the stocks in the long leg should be the smallest in the cross section. Taking this reasoning to its limit, we entertain the possibility that any sentiment-related overpricing of the long-leg stocks is minimal.

It is useful to clarify in our setting the role of cross-sectional dispersion in investors' views. Arguing that underpricing is unlikely requires the view of rational investors to lie within the cross section of views across all investors. When sentiment is low, investors' views must be sufficiently disperse to include rational valuations, even if the latter views are then the most optimistic views. To that extent, cross-sectional dispersion of views is a necessary ingredient of our hypothesized setting.

Our setting does not assign a role for variation over time in the cross-sectional dispersion of views. We simply assume that the views of the most optimistic investors in the cross-section are more likely to be too optimistic when our empirical measure of investor sentiment is high than when it is low. That can happen in various ways. As our sentiment measure increases, the cross-sectional mean of investors' views can remain close to a rational valuation level while the cross-sectional dispersion of views increases. Alternatively, as our sentiment measure increases, the dispersion of views can remain relatively constant, or even decline, while the mean of investors' views increases significantly above a rational valuation level. Distinguishing among such scenarios is beyond the scope of our study.

3. Data: Investor sentiment and anomalies

3.1. Investor sentiment

We measure investor sentiment using the monthly market-based sentiment series constructed by Baker and Wurgler (2006). The BW sentiment index spans over 42 years, from July 1965 to December 2007. Baker and Wurgler form their composite index by taking the first principal component of six measures of investor sentiment. The principal component analysis filters out idiosyncratic noise in the six measures and captures their common component. The six measures are the closed-end fund discount, the number and the first-day returns of IPOs, NYSE turnover, the equity share in total new issues, and the dividend premium.

The BW sentiment index is plotted in Fig. 1. It appears to capture most anecdotal accounts of fluctuations in sentiment. Immediately after the 1961 crash of growth stocks, investor sentiment was low but rose to a subsequent peak in the 1968 and 1969 electronics bubble. Sentiment fell again by the mid-1970s, but it picked up and reached a peak in the biotech bubble of the early 1980s. In the late 1980s, sentiment dropped but rose again in the early 1990s, reaching its most recent peak during the Internet bubble.

[Insert Fig. 1 near here.]

3.2. Anomalies

We explore previously documented differences in cross-sectional average returns that survive adjustment for exposures to the three factors defined by Fama and French (1993). Using the Fama and French model as the benchmark against which to define the set of anomalies imposes a higher hurdle than the single-factor Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965) while still providing a broad set. With the CAPM as the benchmark, the set of documented anomalies would expand to an unmanageable size.

We consider 11 well-documented anomalies:

Anomalies 1 and 2: Financial distress. Financial distress is often invoked to explain otherwise anomalous patterns in the cross section of stock returns. However, Campbell, Hilscher, and Szilagyi (2007) find that firms with high failure probability have lower, not higher, subsequent returns (anomaly 1). Campbell, Hilscher, and Szilagyi suggest that their finding is a challenge to standard models of rational asset pricing. The failure probability is estimated by a dynamic logit model with both accounting and equity market variables as explanatory variables. Using the Ohlson (1980) O-score as the distress measure yields similar results (anomaly 2). The Ohlson O-score is calculated as the probability of bankruptcy in a static model using accounting variables, such as net income divided by assets, working capital divided by market assets, current liability divided by current assets, etc. The failure probability is different from the O-score in that it is estimated by a dynamic, rather than a static model, and that the model uses several equity market variables, such as stock prices, book-to-market, stock volatility, relative size to the Standard and Poor's (S&P) 500, and cumulative excess return relative to S&P 500.

Anomalies 3 and 4: Net stock issues and composite equity issues. The stock issuing market has been long viewed as producing an anomaly arising from sentiment-driven mispricing: Smart managers issue shares when sentiment-driven traders push prices to overvalued levels.

Ritter (1991) and Loughran and Ritter (1995) show that, in post-issue years, equity issuers under-perform matching nonissuers with similar characteristics (anomaly 3). We measure net stock issues as the growth rate of the split-adjusted shares outstanding in the previous fiscal year. Daniel and Titman (2006) study an alternative measure, composite equity issuance, defined as the amount of equity a firm issues (or retires) in exchange for cash or services. Under this measure, seasoned issues and share-based acquisitions increase the issuance measure, while repurchases, dividends, and other actions that take cash out of the firm reduce this issuance measure. They also find that issuers under-perform nonissuers (anomaly 4).

Anomaly 5: Total accruals. Sloan (1996) shows that firms with high accruals earn abnormal lower returns on average than firms with low accruals and suggests that investors overestimate the persistence of the accrual component of earnings when forming earnings expectations. Here, total accruals are calculated as changes in noncash working capital minus depreciation expense scaled by average total assets for the previous two fiscal years.

Anomaly 6: Net operating assets. Hirshleifer, Hou, Teoh, and Zhang (2004) find that net operating assets, defined as the difference on the balance sheet between all operating assets and all operating liabilities scaled by total assets, is a strong negative predictor of long-run stock returns. They suggest that investors with limited attention tend to focus on accounting profitability, neglecting information about cash profitability, in which case net operating assets, equivalently measured as the cumulative difference between operating income and free cash flow, captures such a bias.

Anomaly 7: Momentum. The momentum effect, discovered by Jegadeesh and Titman (1993), is one of the most robust anomalies in asset pricing. It refers to the phenomenon that high past recent recent returns forecast high future returns. In a contemporaneous study, Antoniou, Doukas, and Subrahmanyam (2010) find that the momentum effect is stronger when sentiment is high, and they suggest this result is consistent with the slow spread of bad news during high-sentiment periods. The portfolios we use are ranked on cumulative returns from month -7 to month -2, and the holding period for each portfolio is six months. That is, a momentum return for a given month is the equally weighted average return on six portfolios in that month.

Anomaly 8: Gross profitability premium. Novy-Marx (2010) discovers that sorting on gross profit-to-assets creates abnormal benchmark-adjusted returns, with more profitable firms having higher returns than less profitable ones. Novy-Marx argues that gross profits (item GP) scaled by assets (item AT) are the cleanest accounting measure of true economic profitability. The farther down the income statement one goes, the more polluted profitability measures become, and the less related they are to true economic profitability.

Anomaly 9: Asset growth. Cooper, Gulen, and Schill (2008) find companies that grow their total asset more earn lower subsequent returns. They suggest that this phenomenon is due to investors' initial overreaction to changes in future business prospects implied by asset expansions. Asset growth is measured as the growth rate of the total assets (item AT) in the previous fiscal year.

Anomaly 10: Return on assets. Fama and French (2006) find that more profitable firms have higher expected returns than less profitable firms. Chen, Novy-Marx, and Zhang (2010) show that firms with higher past return on assets earn abnormally higher subsequent returns. Return on assets is measured as the ratio of the quarterly earnings (item IBQ) to last quarter's assets (item ATQ). Wang and Yu (2010) find that the anomaly exists primarily among firms with high arbitrage costs and high information uncertainty, suggesting that mispricing is a culprit.

Anomaly 11: Investment-to-assets. Titman, Wei, and Xie (2004) and Xing (2008) show that higher past investment predicts abnormally lower future returns. Titman, Wei, and Xie (2004) attribute this anomaly to investors' initial underreactions to the overinvestment caused by managers' empire-building behavior. Here, investment-to-assets is measured as the annual change in gross property, plant, and equipment plus the annual change in inventories scaled by the lagged book value of assets.

3.3. Long-short strategies

For each of the 11 anomalies, we obtain value-weighted portfolio returns within each decile of the anomaly's sorting variable. We then construct a long-short strategy using the extreme deciles, 1 and 10, with the long leg being the higher-performing decile (as reported by previous studies and confirmed in our sample period). For all but one of the anomalies, our decile portfolio returns are also used in Chen, Novy-Marx, and Zhang (2010).[5] For the remaining anomaly gross profit to assets, we construct portfolios following the procedure in Novy-Marx (2010). We also construct a combination strategy that takes equal positions across the long-short strategies constructed in any given month. Most of the portfolio returns cover the period from August 1965 through January 2008. Due to more stringent data requirements, the portfolios sorted by O-score (anomaly 2) and ROA (anomaly 10) are available beginning in January 1972, while the failure-probability portfolios (anomaly 1) start in December 1974.

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[5] We thank Long Chen for providing these data.

Table 1 reports properties of monthly returns on the long-short strategies across all months in our sample period. Panel A reports correlations among the long-short benchmark-adjusted returns, which in this study we define as returns net of what is attributable to exposures to the market, size, and value factors constructed by Fama and French (1993): the excess return on the stock market (MKT), a return spread between small and large firms (SMB), and a return spread between stocks with high and low book-to-market ratios (HML).[6] That is, the benchmark-adjusted return is defined as the sum of a_i and the fitted value of $\epsilon_{i,t}$ in the regression

$$R_{i,t} = a_i + bMKT_t + cSMB_t + dHML_t + \epsilon_{i,t}. \tag{1}$$

[Insert Table 1 near here.]

Overall, the strategies are not highly correlated with each other. This observation is supported by computing the principal components. Fig. 2 shows the percentages of overall variance of the long-short benchmark-adjusted returns explained by each of the 11 principal components (as implied by the corresponding 11 eigenvalues). If the 11 individual strategies were completely independent, we would observe a horizontal line at 9.1 % ($\frac{1}{11}$). The first four principal components each explain more than 9.1 % of overall variance (27.1, 19.1, 10.1, 9.2), because their eigenvalues exceed 1 (2.99, 2.10, 1.11, 1.01). The percentages explained by the remaining seven components decay slowly, and even the last component still explains 2.61 % of overall variance. Of the 11 strategies, the first one listed—failure probability—exhibits the highest correlations with the other strategies, and its correlation with the combination strategy is 0.77. The composite equity issues and investment-to-assets strategies exhibit the lowest correlations with the other strategies.

[Insert Fig. 2 near here.]

Panel B of Table 1 reports averages and accompanying t-statistics for the excess monthly returns (returns in excess of the monthly Treasury bill rate) on the long and short legs of each strategy as well as the long-short return spreads. Panel C reports the corresponding values for benchmark-adjusted returns, which are the estimates of a_i in the regression

$$R_{i,t} = a_i + bMKT_t + cSMB_t + dHML_t + \epsilon_{i,t}. \tag{2}$$

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[6] We thank Ken French for supplying updated series of these factors.

where $R_{i,t}$ is the strategy's excess return in month t. All 11 of the long-short strategies produce significant positive average return spreads in both Panels B and C, consistent with their being identified as anomalies for this study. The average benchmark-adjusted return spread for the combined strategy is 87 basis points (bps) per month, with the individual strategies ranging from 43 bps (composite equity issues) to 177 bps (momentum).

4. Empirical analysis: sentiment and returns

4.1. Average returns: low versus high sentiment

We first classify returns each month as following either a high-sentiment month or a low-sentiment month. A high-sentiment month is one in which the value of the BW sentiment index in the previous month is above the median value for the sample period, and the low-sentiment months are those with below-median values. We then compute average returns separately for the high- and low-sentiment months. Table 2 reports results for excess returns, and Table 3 reports results for returns adjusted by the three Fama and French benchmarks.[7]

[Insert Tables 2 and 3 near here.]

Consider the first hypothesis, which is that the anomalies should be stronger following high sentiment than following low sentiment. Tables 2 and 3 reveal that each of the long-short spreads exhibits higher average profits following high sentiment. All of the values in the last column of each table are positive. In Table 2, the t-statistics for 8 of the 11 anomalies reject, at a 0.05 significance level, the null hypothesis of no sentiment-related difference in favor of the (one-sided) alternative represented by the first hypothesis. The combined long-short spread earns 93 bps more per month following high sentiment, with a t-statistic equal to 4.25. In Table 3, with benchmark-adjustment returns, 7 of the 11 individual t-statistics reject the null in favor of Hypothesis 1, and the combined long-short spread earns 70 bps more per month following high sentiment (t-statistic: 3.74). In Table 2, the long/short profits on the combined strategy in high-sentiment months account for 80% of that strategy's profits earned across all months. In Table 3, the corresponding share is 70%. Overall, the results in Tables 2 and 3 provide strong support for Hypothesis 1.

Next consider the second hypothesis, which predicts that average returns on the short leg should be significantly lower following high sentiment than following low sentiment. The support for this hypothesis is especially strong. In both Tables 2 and 3, the short legs of all 11 anomaly strategies have a lower average return following high sentiment, and 10 of them have t-statistics that reject the no-difference null in favor of Hypothesis 2 at a 0.05 significance level. In Table 2, based on excess returns, the short leg of the combined strategy earns 132 bps less per month following high sentiment (t-statistic: -2.41) than following low sentiment. The short leg of that strategy earns a negative average excess return of -68 bp per month following high sentiment (t-statistic: -1.54). In contrast, the same short leg earns a positive average excess return of 65 bps following low sentiment. In Table 3, adjusting for benchmark exposure shrinks the differences between high- and low-sentiment returns on the short leg, as compared with the excess returns reported in Table 2. Nevertheless, in Table 3, the difference for the combined strategy is still 66 bps per month (t-statistic: -3.89), and 78% of the short-leg profits across all months occur in the months following high sentiment.

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[7] An online Appendix reports results based on returns adjusted for just a single market benchmark, instead of the three Fama and French benchmarks. All conclusions are very similar.

The evidence in Tables 2 and 3 appears to support an inference that sentiment-driven overpricing is at least a partial explanation for all of the anomalies analyzed here. The anomalies are stronger following high investor sentiment, and the short legs are substantially more profitable in months following high sentiment, to the extent that the short-leg portfolios in those months even return less on average than the T-bill rate.

Finally, consider the third hypothesis, which predicts that sentiment should not have an appreciable effect on the long-leg returns. If underpricing driven by market-wide sentiment makes a significant contribution to the profitability of the long legs of the anomaly strategies, there should be greater underpricing, and hence higher long-leg returns, following low sentiment. Alternatively, higher long-leg returns following low sentiment could also reflect overpricing of long-leg stocks during high-sentiment periods, despite those stocks' being in the decile of highest overall performance. Not much evidence emerges of either scenario. In Table 2, the long legs do have higher returns following low sentiment, but only 1 of the 11 anomalies (investment-to-assets) has a t-statistic that rejects the no-difference null in favor of that alternative. The long leg of the combined strategy earns 39 bps less following high sentiment, but the t-statistic is only -0.93. Any evidence for sentiment effects on the long leg becomes even weaker after benchmark adjustment. In Table 3, none of the t-statistics rejects the no-difference null in favor of higher returns following low sentiment. In fact, 8 of the 11 differences go in the opposite direction, although only 1 anomaly (net stock issues) has a significant one-tailed t-statistic (1.69). The benchmark-adjusted return on the long leg of the combined strategy exhibits only a 4 bps difference between high- and low-sentiment periods. Overall, the evidence in Tables 2 and 3 appears to be consistent with the third hypothesis as well.

4.2. Predictive regressions

The results reported above are obtained by averaging within high-sentiment versus low-sentiment months, where the high-to-low classification is simply a binary measure. Here we conduct an alternative analysis, using predictive regressions to investigate whether the level of the BW sentiment index predicts returns in ways consistent with our hypotheses. Table 4 reports results of regressing excess returns on just the lagged sentiment index. Table 5 reports results of regressing excess returns on the lagged sentiment index as well as the contemporaneous returns on the three Fama and French factors.[8] The latter regression thus investigates the ability of sentiment to predict benchmark-adjusted returns.

[Insert Tables 4 and 5 near here.]

The first hypothesis (anomalies are stronger following high sentiment) predicts a positive relation between the profitability of each long-short spread and investor sentiment. Consistent with this prediction, the slope coefficients for the spreads of all 11 anomalies are positive in both Tables 4 and 5. In Table 4, nine of the individual t-statistics are significant at a one-tailed 0.05 significance level, while eight are significant in Table 5. The combination strategy has a t-statistic of 3.79 in Table 4 and 2.98 in Table 5. Returns are measured in percent per month, and the sentiment index is scaled to have zero mean and unit standard deviation. Thus, for example, the slope coefficient of 0.50 for the combination strategy indicates that a 1 standard deviation increase in sentiment is associated with \$0.005 of additional long-short monthly profit on a strategy with \$1 in each leg of the spread.

The second hypothesis (greater short-leg profits following high sentiment) predicts a negative relation between the returns on the short-leg portfolio and the lagged sentiment level. Consistent with this prediction, the slope coefficients for the short-leg returns of all 11 anomalies are negative in both Tables 4 and 5. In Table 4, all 11 individual t-statistics are significant, while 8 are significant in Table 5. The combination strategy has a t-statistic of -2.90 in Table 4 and -3.01 in Table 5. In Table 4, a 1 standard deviation increase in sentiment is associated with nearly a 1% lower monthly excess return on the short-leg portfolio.

The third hypothesis predicts no significant relation between returns on the long leg and lagged sentiment. Here, for essentially the first time, benchmark adjustment makes a noticeable difference. In Table 4, which is based simply on excess returns without benchmark adjustment, the coefficients for the long-leg returns are all negative, and 5 of the 11 are significant at an 0.05 significance level for a one-tailed test—appropriate against an alternative of sentiment-related mispricing. The combination strategy in Table 4 has a slope of -0.43, which is only half the magnitude for the short leg but is nevertheless significant (t-statistic: -1.85). After adjusting for benchmark exposures, however, the results essentially fall right in line with the third hypothesis. In Table 5, which is based on returns adjusted for exposures to the Fama and French benchmarks, 7 of the 11 long-leg slopes are positive, none significantly, and only one of the negative slopes is significant. The combination strategy in Table 5 has a zero slope (to two decimal places) and a t-statistic of 0.15, giving a result that could not be closer to the prediction of the third hypothesis.

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[8] An online Appendix reports results based on regressing excess returns on the lagged sentiment index and just the single market factor, instead of the three Fama and French factors. The conclusions are very similar.

In sum, results from the predictive regressions reported in Tables 4 and 5 deliver the same message as the comparisons of high- and low-sentiment periods in Tables 2 and 3. The data support a scenario in which market-wide sentiment creates overpricing, due to short-sale limitations. Sentiment-driven overpricing appears to be at least a partial explanation for the broad set of anomalies examined here.

Our primary focus is on value-weighted returns, as they better reflect economically significant magnitudes. We also conduct the same analyses using equal-weighted returns for the 11 anomalies, and we obtain essentially the same conclusions (see the online Appendix).

We should also note that the potential bias in predictive regressions, as analyzed by Stambaugh (1999), appears not to be a problem in the results reported. The correlations between the predictive-regression residuals and the innovations in sentiment level obtained from a first-order autoregression are small. Applying Stambaugh's bias correction to the reported slopes in Table 4, for example, produces only small changes in the second decimal place of some of the coefficients and no changes to the others.

4.3. Asymmetry in pricing or asymmetry in sentiment?

Our results support hypotheses motivated by the argument that high sentiment produces overpricing more so than low sentiment produces underpricing. In other words, sentiment has asymmetric effects on prices, with optimism producing greater mispricing than pessimism. An alternative explanation for our results is that sentiment by itself is asymmetric, with periods of high sentiment producing optimism that is felt more strongly than pessimism is felt during low-sentiment periods. Under this alternative explanation, greater mispricing following high-sentiment periods would simply reflect more strongly held sentiment during those periods, not asymmetric pricing effects depending on whether sentiment of a given strength is positive or negative.

Asymmetry in sentiment is suggested by the plot of the Baker and Wurgler index in Fig. 1, in which the largest positive values of the mean-zero series are more extreme than the largest negative values. The skewness of the series is positive (0.19), as can be seen in the histogram in Panel A of Figure 3. This observation alone, however, is not sufficient to conclude that there is asymmetry in sentiment, as opposed to just asymmetry in its pricing effects. Three of the series used in constructing the Baker and Wurgler index contain stock prices: the average first-day returns on IPOs, the negative of the dividend premium, and the negative of the closed-end fund discount. Moreover, one could argue that two of the other three series used in constructing the index—the number of IPO's and the equity share in total new issues—reflect firms' responses to the level of stock prices (e.g., Baker and Wurgler, 2000). Thus, the asymmetry in the BW sentiment index could arise from asymmetry in sentiment-induced mispricing, as opposed to asymmetry in sentiment.

[Insert Fig. 3 near here.]

Some insight into whether our results reflect pricing asymmetry or sentiment asymmetry is provided by considering an alternative measure of sentiment. A number of investor-sentiment studies use the series provided by the University of Michigan Surveys of Consumers (e.g. Lemmon and Portniaguina, 2006, and Bergman and Roychowdhury 2008). The Michigan sentiment index is based on a monthly survey that is mailed to a random set of five hundred households and asks their views about the economy. As such, while the Michigan index is probably less directly tied to the sentiment of stock market investors than is the Baker and Wurgler index, the Michigan index does not share the same stock price influences as the BW index. To remove macro-related information from the Michigan index, we follow a similar approach to Baker and Wurgler (2006). Specifically, we take the residuals from a regression of the index on the six macro-related variables used by Baker and Wurgler.[9] The resulting sentiment index is negatively skewed (-0.30), as can be seen in the histogram in Panel B of Figure 3, so in this respect it seems well suited for exploring whether our results thus far reflect pricing asymmetry or sentiment asymmetry.

Table 6 reports the results of regressing excess returns on the lagged Michigan sentiment index (adjusted as above) as well as the contemporaneous returns on the three Fama and French factors. Our three hypotheses are supported with the Michigan index as a proxy for sentiment, suggesting that our results reflect asymmetry in the pricing effects of sentiment, as opposed to asymmetry in sentiment itself. For the combination strategy of the 11 anomalies, the long-short profit is significantly higher following higher sentiment, the short leg has lower returns following higher sentiment, and sentiment exhibits no significant ability to predict the long-leg returns. The patterns of the results across the 11 individual anomalies are also similar to those reported in Table 5 using the Baker-Wurgler index, although some of them are weaker, as one would expect if the Baker and Wurgler index is a better measure of the sentiment of stock market investors.[10]

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[9] The results are essentially the same if we include the five additional macro variables discussed in Section 5.

4.4. Factor-related long-short spreads

We focus on long-short strategies that have been reported previously to produce anomalous returns with respect to the three Fama and French factors. A key rationale for using this multi-factor benchmark, versus the single-factor CAPM, is to lessen the chances that average profits on the long-short anomaly strategies simply reflect pricing of systematic risk exposures. At least two possible concerns enter here. One is that we could still omit systematic risks that would reduce or eliminate seemingly anomalous profits. While this possibility certainly exists, a challenge for any risk-based story is to explain why it is only following high sentiment that the stocks in the short legs earn low returns—negative average excess returns (cf. Table 2). Nevertheless, to explore robustness along this dimension, we expand the previous analyses to include liquidity risk, which a number of studies find to be an additional source of priced systematic risk in equity returns (e.g., Pástor and Stambaugh, 2003; Acharya and Pedersen, 2005; and Korajczyk and Sadka, 2008). Specifically, we include as a fourth factor the Pástor and Stambaugh long-short spread in stocks having high and low betas with respect to that study's aggregate liquidity measure. The results, reported in the online Appendix, are very similar to those obtained with the three-factor model.

A second concern is that the premiums earned on the factors we use to control for systematic risks also reflect sentiment-driven mispricing, to at least some degree. One could argue that we should, therefore, be examining these factors as well for evidence in support of the mispricing hypotheses our study investigates. The problem here is that if a factor's average return combines both compensation for systematic risk and mispricing, our sentiment story applies only to the mispricing part. Consider, for example, the two additional Fama and French factors: the return spread between small and large firms (SMB), the size factor, and the return spread between firms with high and low book-to-market ratios (HML), the value factor. Baker and Wurgler (2006) show significant effects of investor sentiment on both the size and value factors. They find that, when sentiment is high, subsequent returns are low on stocks judged harder for investors to price: small-cap stocks as well as stocks at both extremes of the value-growth spectrum. Many researchers argue, however, that the size and value factors are not solely the result of mispricing but instead reflect priced systematic risks not captured by the CAPM. In that case, small-cap stocks and value stocks can be relatively overpriced following high sentiment while still delivering higher expected returns than other stocks due to their greater exposure to systematic risks.

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[10] In unreported results, we repeat the same analysis using the Conference Board Consumer Confidence Index as a proxy for sentiment, and the results are largely the same as obtained using the Michigan sentiment index. The results can be provided upon request.

Despite the potential difficulty with interpreting the results, we also extend our analysis to factor-related spreads. Tables 7 and 8 repeat the analyses in Tables 2 through 5 for four long-short spreads related to factors often associated with systematic risk. In all cases, the long legs of these spreads contain the stocks identified as having greater exposure to the underlying risk factor. The first spread (beta) goes long stocks in the highest decile of traditional market beta and goes short the stocks in the lowest decile. The second spread (size) goes long stocks in the lowest decile of market capitalization and short those in highest decile. The third spread (book to market) goes long stocks in the highest decile of book-to-market ratio and short those in the lowest. The fourth spread (liquidity beta) is the same liquidity-beta spread described earlier.

[Insert Tables 7 and 8 near here.]

The first two spreads, beta and size, produce results that are very similar to those for the 11 anomaly spreads examined earlier, but with the long and short legs reversed. That is, in Tables 7 and 8, for both spreads, the profit is significantly lower following high sentiment, the long leg performs significantly worse following high sentiment, and the short leg's performance is not significantly related to sentiment. Thus, if the long and short legs are reversed, in opposition to the systematic-risk ordering, both spreads produce results that support our three hypotheses in the same manner as the 11 anomaly spreads.

The natural temptation is to reverse long and short ex post for the beta and size spreads and thereby increase the number of anomalies examined from 11 to 13. One could even argue that such a reversal is justified ex ante, at least for the beta spread, given previous discussion of the low-beta anomaly (e.g., Baker, Bradley, and Wurgler, 2011). Our finding that high-beta stocks perform significantly worse following high sentiment than following low sentiment seems consistent with a simple story that says investors are too optimistic about improvement in the economy when sentiment is high. Thus, the stocks they most overvalue are those that would be expected to benefit the most from that improvement—high-beta stocks. As for the size spread, our results point to significant effects of high sentiment on small stocks, consistent with Baker and Wurgler (2006).

The book-to-market results in Tables 7 and 8 do not reveal significant differences in the return spread between high and low sentiment periods. This spread perhaps best exemplifies the potentially confounding effects of risk and mispricing. On one hand, the usual risk-based interpretation of the value-growth spread (e.g., Fama and French, 1993) argues that stocks at one extreme of the book-to-market spectrum are those whose risk exposures differ the most from those at the other extreme. On the other hand, Baker and Wurgler (2006) provide evidence in support of their argument that the stocks at both extremes of the book-to-market spectrum are more likely to be mispriced due to sentiment than those in the middle. Thus, perhaps not surprisingly, the book-to-market spread does not exhibit significant effects in our results. Finally, the liquidity-beta spread also exhibits no significant sentiment effects.

5. Controlling for additional macro variables

One might be inclined to seek a risk-based explanation of our results, as an alternative to sentiment-driven overpricing. One risk-based explanation would involve an omitted risk factor to which each short leg is sensitive but each long leg is not. If the premium on that risk factor then varies over time in a manner correlated with our sentiment index, our results could obtain. Explaining why, across the 11 anomalies, there would be such differences in loadings between long and short legs presents a challenge. Even if such differences exist, however, the question remains of whether the omitted risk factor's premium exhibits the required correlation with sentiment. It seems reasonable to expect that variations in any risk premium would be correlated with some aspect of macroeconomic conditions.

Baker and Wurgler (2006) remove macro-related variation from their sentiment index by regressing raw sentiment measures on six macro variables: the growth in industrial production, the growth in durable, nondurable, and services consumption, the growth in employment, and a flag for National Bureau of Economic Research recessions. To assess the potential for a risk-based explanation of our results, we control for an additional set of macro-related variables that seem reasonable to entertain as being correlated with a risk premium:

the default premium, the term premium, the real interest rate, the inflation rate, and the consumption-wealth ratio (cay). The default premium is defined as the yield spread between BAA and AAA bonds, and the term premium is defined as the spread between 20-year and 1-year Treasuries. The real interest rate is defined as the most recent monthly difference between the 30-day T-bill return and the Consumer Price Index inflation rate. cay is the consumption-wealth variable defined in Lettau and Ludvigson (2001).[11]

Table 9 reports the results of regressing excess returns on the lagged sentiment index, the contemporaneous returns on the three Fama and French factors, and the five lagged macro-related variables. Thus, we investigate whether the ability of sentiment to predict benchmark-adjusted returns is robust to including macro-related fluctuations in addition to those already controlled for by Baker and Wurgler. The effects of investor sentiment remain largely unchanged by including the additional five variables. The coefficients and their t statistics are close to those in Table 5, in which the additional macro-related variables are not included.

[Insert Table 9 near here.]

In sum, if an unnamed risk factor drives our results, it seems the variation over time in its premium must not be strongly related to either the six macro variables used by Baker and Wurgler or the five additional variables included in our analysis. Even if such a factor does exist, the challenge remains of explaining why, across the 11 anomalies, the short legs are sensitive to this factor while the long legs are not.

6. Conclusions

With impediments to short selling, overpricing becomes more difficult to eliminate, so a firm's stock price can reflect the views of investors who are too optimistic. With market-wide variations in investor sentiment, such overpricing can occur for many stocks during periods of high sentiment.

Long-short strategies for a broad set of anomalies in cross-sectional returns exhibit empirical properties consistent with a combination of short-sale impediments and market-wide sentiment. Because overpricing is more likely than underpricing in our hypothesized setting, anomalies should be stronger following periods of high sentiment, to the extent that the anomalies reflect mispricing. We find greater profitability of the long-short strategies following high sentiment. If overpricing is the primary source of those greater profits, the short legs of the strategies should be more profitable following high sentiment, and we also find that implication to be supported strongly by the data. Sentiment does not exhibit a significant effect on profits from the long legs of the strategies. The latter result is also consistent with the prediction that underpricing should be less prevalent in our simple setting where short-sale impediments present the key obstacle to traders seeking to exploit mispricing.

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[11] The bond yields are obtained from the St. Louis Federal Reserve, the T-bill return and inflation are obtained from CRSP, and cay is obtained from Sydney Ludvigson's website, www.econ.nyu.edu/user/ludvigsons/.

This study does not aim to find complete explanations for each of the anomalies considered. Numerous studies examine the individual anomalies in more detail and provide more specifically focused contexts and interpretations. We paint the set of anomalies with an intentionally broad brush, given our objective to consider the implications when market-wide sentiment interacts with short-sale impediments. Our objective is to explore the possibility that sentiment plays a pervasive role over time in affecting the degree of mispricing that arises in a broad range of specific contexts. We do not attempt to add to explanations for why, in the cross section, greater mispricing is associated with more extreme values of a particular characteristic used to produce an anomaly. While this approach reveals novel evidence consistent with overpricing as at least a partial explanation for many anomalies, certainly more work lies ahead to develop a richer understanding of how sentiment plays a role in pricing financial assets.

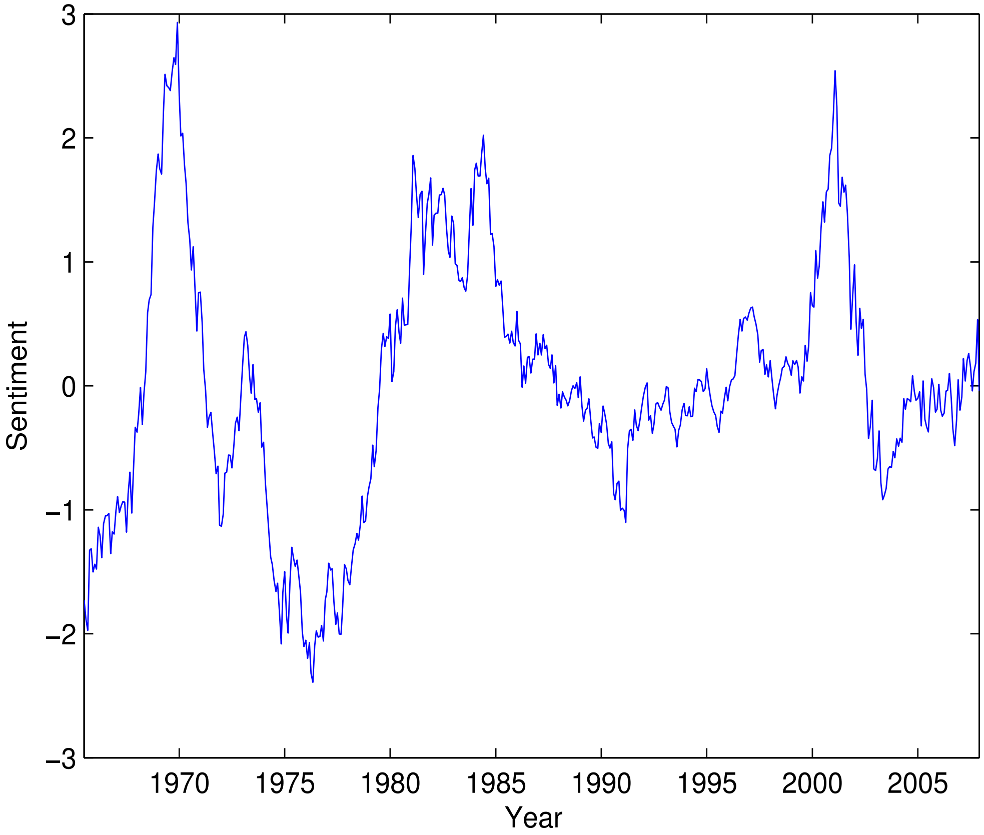

Fig. 1. The investor sentiment index from 1965:07 to 2007:12. The sentiment index is the first principal component of six measures: the closed-end fund discount, NYSE share turnover, the number of and the average of first-day returns on initial public offerings, the equity share in new issues, and the dividend premium. To control for macro conditions, the six raw sentiment measures are regressed on the growth of industrial production, the growth of durable consumption, the growth of nondurable consumption, the growth of service consumption, the growth of employment, and a dummy variable for National Bureau of Economic Research recessions.

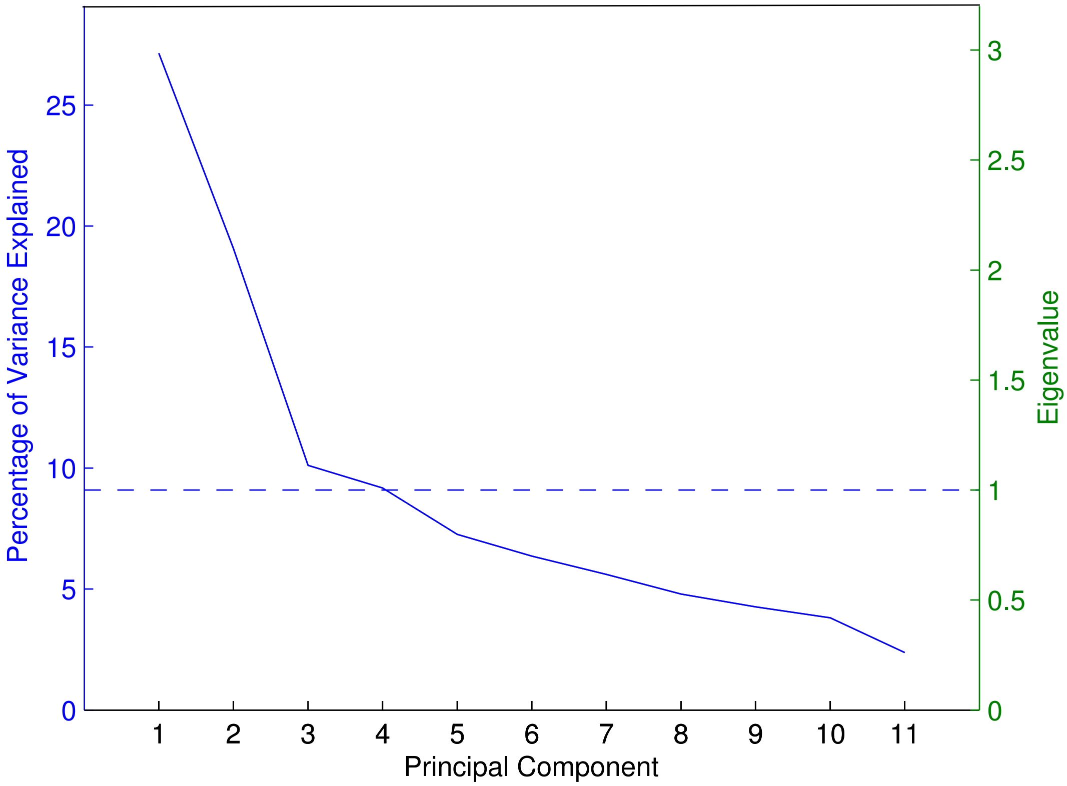

Fig. 2. Percentage of variance explained by principal components and eigenvalues. The figure plots the percentage of variance explained by the principal components of the 11 benchmark-adjusted long-short spreads. The fraction of variance explained by the nth principal component is the nth largest eigenvalue of the correlation matrix divided by 11. The dashed line (at 9.1%) would be the percentage of variance explained by each principal component if all 11 spreads were uncorrelated with each other.

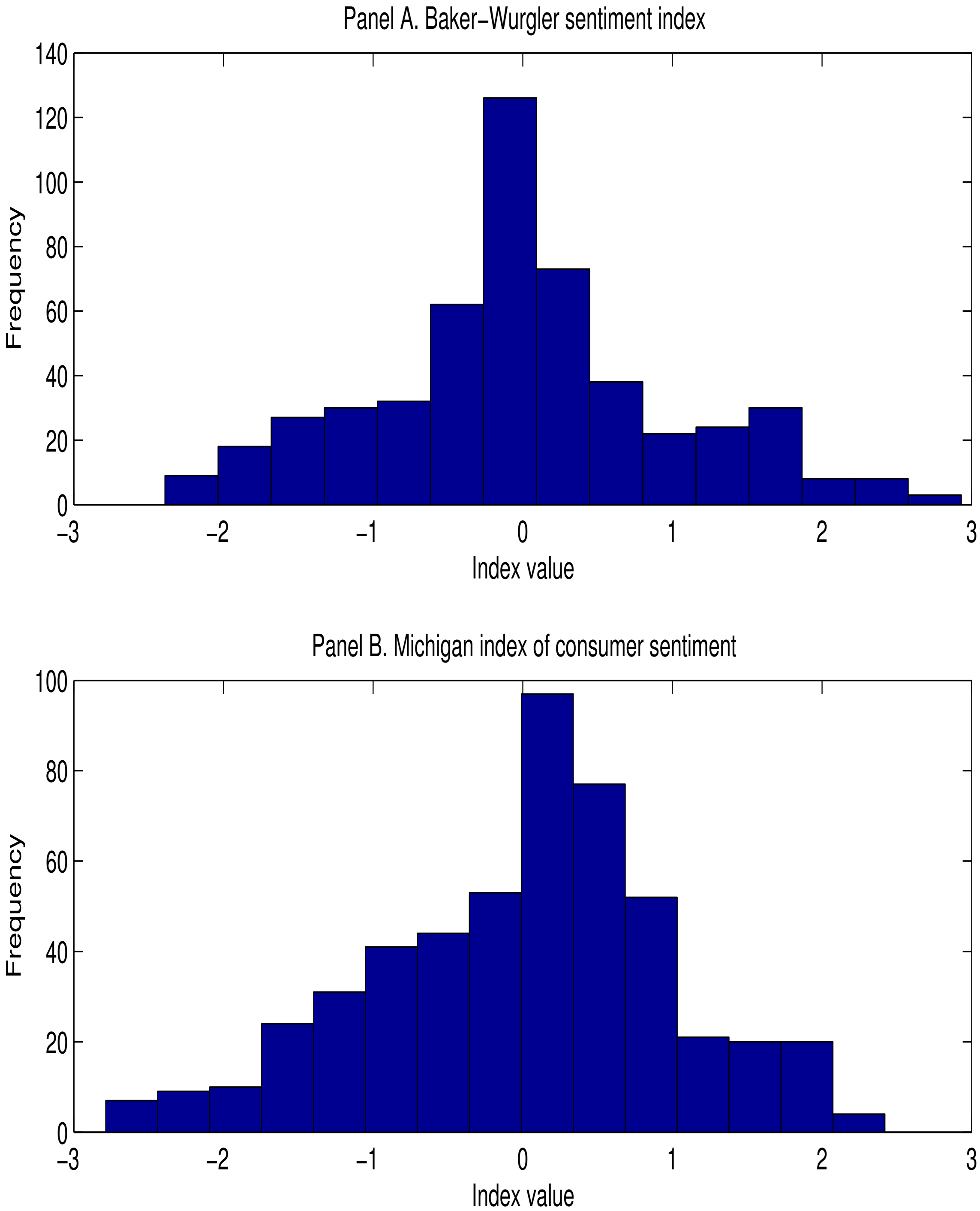

Fig 3. Histograms of sentiment indexes. Panel A displays the histogram of the monthly values of the Baker-Wurgler sentiment index in Figure 1. Panel B displays the histogram of an index formed as the residuals in a regression of the University of Michigan consumer sentiment index on the six macro-related variables used by Baker and Wurgler.

Table 1
Anomaly returns across all months

The table reports properties of returns across all months for the 11 anomalies and an equal combination of them. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. The correlations in Panel A are for benchmark-adjusted average returns, computed as the fitted values of $\epsilon_{i,t}$ in the regression

$$R_{i,t} = a_i + bMKT_t + cSMB_t + dHML_t + \epsilon_{i,t},$$

where $R_{i,t}$ is a strategy's excess return in month t. The correlation are computed using the unequal-length series, applying the method in Stambaugh (1997). The benchmark-adjusted average returns in Panel C are estimates of a_i in the above regression. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Correlations: Long minus short													
(1)	Failure probability	1.00											
(2)	Ohlson's O (distress)	0.47	1.00										
(3)	Net stock issues	0.27	0.20	1.00									
(4)	Composite equity issues	0.20	0.11	0.43	1.00								
(5)	Total accruals	0.15	0.08	0.15	0.11	1.00							
(6)	Net operating assets	0.09	0.16	0.22	0.10	0.26	1.00						
(7)	Momentum	0.62	0.18	0.22	0.25	0.15	0.14	1.00					
(8)	Gross profitability	0.36	0.34	0.21	0.01	-0.12	0.13	0.19	1.00				
(9)	Asset growth	0.09	0.03	0.36	0.22	0.22	0.36	0.17	-0.01	1.00			
(10)	Return on assets	0.58	0.41	0.16	0.01	0.03	0.02	0.31	0.38	-0.03	1.00		
(11)	Investment-to-assets	-0.02	-0.01	0.19	0.12	0.34	0.32	0.08	-0.08	0.51	-0.08	1.00	
(12)	Combination	0.77	0.52	0.52	0.39	0.42	0.42	0.68	0.43	0.44	0.56	0.35	1.00
Panel B. Excess Returns													
Long leg (mean)		0.94	0.51	0.70	0.62	0.72	0.71	1.11	0.69	1.00	0.64	0.91	0.76
Short leg (mean)		-0.01	-0.19	0.07	0.20	0.13	0.06	-0.45	0.29	0.04	-0.34	0.15	-0.01
Long minus short (mean)		0.95	0.70	0.63	0.42	0.58	0.65	1.56	0.40	0.96	0.98	0.75	0.77
Long leg (t-statistic)		3.97	2.18	3.66	3.47	2.54	2.98	3.81	3.20	3.82	2.56	3.65	3.57
Short leg (t-statistic)		-0.01	-0.51	0.27	0.79	0.40	0.22	-1.23	1.33	0.14	-0.88	0.57	-0.05
Long minus short (t-statistic)		2.55	2.83	5.11	2.59	3.11	4.41	5.45	2.45	5.34	3.53	5.22	6.91
Panel C. Benchmark-Adjusted Returns													
Long leg (mean)		0.39	0.21	0.20	0.02	0.26	0.25	0.63	0.43	0.22	0.38	0.17	0.28
Short leg (mean)		-1.16	-0.93	-0.46	-0.41	-0.34	-0.51	-1.14	-0.23	-0.44	-0.90	-0.37	-0.60
Long minus short (mean)		1.55	1.13	0.66	0.43	0.61	0.76	1.77	0.66	0.66	1.28	0.54	0.87
Long leg (t-statistic)		3.39	3.37	3.87	0.29	1.85	2.27	4.95	4.42	1.76	4.40	1.59	7.66
Short leg (t-statistic)		-4.53	-6.17	-4.62	-3.85	-2.24	-4.75	-5.11	-2.19	-3.93	-4.29	-3.30	-7.07
Long minus short (t-statistic)		5.00	7.13	5.96	3.18	3.09	4.98	5.82	4.30	3.94	5.48	3.78	9.38

Table 2
Anomalies during periods of high and low investor sentiment: excess returns on long-short strategies

The table reports average returns in excess of the one-month T-bill in months following high and low levels of investor sentiment, as classified based on the median level of the index of Baker and Wurgler (2006). Also reported are returns on a strategy that equally combines the strategies available within a given month. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long Leg			Short Leg			Long − Short		
	High sentiment	Low sentiment	High −low	High sentiment	Low sentiment	High −low	High sentiment	Low sentiment	High −low
Failure probability	0.77	1.14	-0.38	-1.10	1.25	-2.34	1.86	-0.10	1.96
	(2.16)	(3.74)	(-0.81)	(-1.54)	(2.26)	(-2.60)	(3.25)	(-0.24)	(2.72)
Ohlson's O (distress)	0.42	0.61	-0.19	-0.98	0.61	-1.59	1.40	-0.00	1.40
	(1.14)	(2.06)	(-0.41)	(-1.69)	(1.33)	(-2.15)	(3.81)	(-0.01)	(2.85)
Net stock issues	0.64	0.75	-0.11	-0.50	0.63	-1.13	1.14	0.12	1.02
	(2.22)	(3.04)	(-0.28)	(-1.26)	(2.10)	(-2.28)	(5.71)	(0.88)	(4.20)
Composite equity issues	0.53	0.72	-0.19	-0.28	0.69	-0.97	0.81	0.02	0.79
	(1.93)	(3.08)	(-0.52)	(-0.72)	(2.13)	(-1.91)	(3.19)	(0.13)	(2.46)
Total accruals	0.37	1.07	-0.71	-0.57	0.84	-1.41	0.94	0.23	0.70
	(0.82)	(3.10)	(-1.25)	(-1.06)	(2.22)	(-2.14)	(3.11)	(1.04)	(1.88)
Net operating assets	0.50	0.92	-0.43	-0.57	0.69	-1.26	1.07	0.24	0.83
	(1.36)	(3.01)	(-0.90)	(-1.37)	(2.20)	(-2.41)	(4.66)	(1.29)	(2.84)
Momentum	0.78	1.43	-0.64	-1.24	0.34	-1.58	2.03	1.09	0.93
	(1.69)	(4.12)	(-1.11)	(-2.14)	(0.76)	(-2.16)	(4.49)	(3.12)	(1.64)
Gross profitability	0.59	0.79	-0.20	-0.06	0.64	-0.70	0.65	0.15	0.50
	(1.84)	(2.73)	(-0.47)	(-0.18)	(2.48)	(-1.62)	(2.93)	(0.64)	(1.53)
Asset growth	0.79	1.22	-0.43	-0.60	0.68	-1.27	1.39	0.54	0.85
	(2.14)	(3.26)	(-0.81)	(-1.30)	(1.92)	(-2.20)	(5.04)	(2.34)	(2.37)
Return on assets	0.61	0.66	-0.05	-1.10	0.44	-1.55	1.72	0.22	1.50
	(1.60)	(2.10)	(-0.10)	(-1.78)	(1.00)	(-2.02)	(4.01)	(0.65)	(2.74)
Investment-to-assets	0.44	1.38	-0.94	-0.47	0.78	-1.25	0.91	0.60	0.30
	(1.19)	(4.13)	(-1.90)	(-1.14)	(2.25)	(-2.32)	(4.48)	(2.93)	(1.06)
Combination	0.56	0.95	-0.39	-0.68	0.65	-1.32	1.23	0.31	0.93
	(1.72)	(3.51)	(-0.93)	(-1.54)	(1.96)	(-2.41)	(6.64)	(2.64)	(4.25)

Table 3

Anomalies during periods of high and low investor sentiment: benchmark-adjusted returns on long-short strategies

The table reports average benchmark-adjusted returns following high and low levels of investor sentiment, as classified based on the median level of the index of Baker and Wurgler (2006). The average returns in high- and low-sentiment periods are estimates of a_H and a_L in the regression

$$R_{i,t} = a_H d_{H,t} + a_L d_{L,t} + bMKT_t + cSMB_t + dHML_t + \epsilon_{i,t},$$

where $d_{H,t}$ and $d_{L,t}$ are dummy variables indicating high- and low-sentiment periods, and $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference. Also reported are returns on a strategy that equally combines the strategies available within a given month. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long Leg			Short Leg			Long − Short		
	High sentiment	Low sentiment	High −low	High sentiment	Low sentiment	High −low	High sentiment	Low sentiment	High −low
Failure probability	0.43	0.33	0.10	-1.65	-0.58	-1.07	2.08	0.91	1.17
	(2.52)	(2.33)	(0.44)	(-4.33)	(-1.81)	(-2.19)	(4.45)	(2.39)	(1.95)
Ohlson's O (distress)	0.25	0.16	0.09	-1.24	-0.60	-0.64	1.49	0.76	0.73
	(2.70)	(2.09)	(0.72)	(-5.29)	(-3.23)	(-2.16)	(6.13)	(3.77)	(2.32)
Net stock issues	0.28	0.11	0.17	-0.80	-0.12	-0.68	1.08	0.23	0.85
	(3.68)	(1.68)	(1.69)	(-4.86)	(-1.09)	(-3.42)	(6.19)	(1.79)	(3.90)
Composite equity issues	0.08	-0.03	0.11	-0.64	-0.17	-0.47	0.72	0.14	0.58
	(0.69)	(-0.31)	(0.72)	(-3.62)	(-1.57)	(-2.26)	(3.40)	(0.89)	(2.23)
Total accruals	0.19	0.34	-0.14	-0.70	0.02	-0.73	0.89	0.31	0.58
	(0.85)	(2.13)	(-0.53)	(-2.88)	(0.15)	(-2.53)	(3.02)	(1.33)	(1.60)
Net operating assets	0.22	0.27	-0.05	-0.87	-0.15	-0.72	1.09	0.42	0.67
	(1.36)	(2.04)	(-0.24)	(-4.94)	(-1.25)	(-3.40)	(4.78)	(2.20)	(2.30)
Momentum	0.66	0.60	0.06	-1.51	-0.76	-0.75	2.17	1.36	0.81
	(3.64)	(3.46)	(0.23)	(-4.03)	(-3.22)	(-1.69)	(4.46)	(3.87)	(1.35)
Gross profitability	0.46	0.41	0.05	-0.40	-0.06	-0.33	0.85	0.47	0.38
	(3.17)	(3.25)	(0.26)	(-2.43)	(-0.47)	(-1.59)	(3.77)	(2.23)	(1.24)
Asset growth	0.37	0.07	0.30	-0.82	-0.06	-0.76	1.18	0.13	1.05
	(2.23)	(0.38)	(1.29)	(-4.48)	(-0.48)	(-3.43)	(4.81)	(0.60)	(3.35)
Return on assets	0.49	0.27	0.23	-1.26	-0.51	-0.75	1.75	0.78	0.97
	(4.01)	(2.26)	(1.35)	(-3.98)	(-2.01)	(-1.88)	(5.00)	(2.66)	(2.16)
Investment-to-assets	0.01	0.32	-0.31	-0.73	-0.01	-0.72	0.74	0.33	0.41
	(0.09)	(2.53)	(-1.57)	(-4.31)	(-0.07)	(-3.34)	(3.75)	(1.76)	(1.54)
Combination	0.30	0.26	0.04	-0.92	-0.26	-0.66	1.22	0.52	0.70
	(5.62)	(5.40)	(0.62)	(-6.46)	(-2.95)	(-3.89)	(7.92)	(5.01)	(3.74)

Table 4
Investor sentiment and anomalies: predictive regressions for excess returns on long-short strategies

The table reports estimates of b in the regression

$$R_{i,t} \quad = \quad a + bS_{t-1} + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and S_t is the level of the investor-sentiment index of Baker and Wurgler (2006). Also reported are returns on a strategy that equally combines the strategies available within a given month. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long leg		Short leg		Long − short	
	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic
Failure probability	-0.43	-1.74	-1.80	-2.99	1.37	2.59
Ohlson's O (distress)	-0.24	-0.80	-1.09	-2.31	0.85	2.95
Net stock issues	-0.28	-1.38	-0.84	-2.92	0.55	3.93
Composite equity issues	-0.21	-1.12	-0.68	-2.38	0.47	2.68
Total accruals	-0.59	-1.82	-0.96	-2.49	0.37	1.77
Net operating assets	-0.34	-1.29	-0.83	-2.76	0.49	3.50
Momentum	-0.69	-2.38	-1.02	-2.41	0.33	1.07
Gross profitability	-0.22	-0.94	-0.54	-2.21	0.32	1.81
Asset growth	-0.48	-1.68	-0.91	-2.66	0.44	2.16
Return on assets	-0.20	-0.66	-1.14	-2.35	0.94	2.79
Investment-to-assets	-0.70	-2.46	-0.77	-2.51	0.07	0.49
Combination	-0.43	-1.85	-0.93	-2.90	0.50	3.79

Table 5
Investor sentiment and anomalies: predictive regressions for benchmark-adjusted returns on long-short strategies

The table reports estimates of b in the regression

$$R_{i,t} \quad = \quad a + bS_{t-1} + cMKT_t + dSMB_t + eHML_t + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and S_t is the level of the investor-sentiment index of Baker and Wurgler (2006). Also reported are returns on a strategy that equally combines the strategies available within a given month. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long leg		Short leg		Long − short	
	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic
Failure probability	-0.01	-0.09	-0.92	-2.79	0.91	2.15
Ohlson's O (distress)	0.07	0.95	-0.52	-2.64	0.59	3.03
Net stock issues	0.01	0.13	-0.38	-3.58	0.39	3.38
Composite equity issues	0.02	0.29	-0.21	-1.89	0.23	1.77
Total accruals	-0.02	-0.12	-0.26	-1.54	0.24	1.21
Net operating assets	0.07	0.72	-0.32	-2.81	0.39	2.86
Momentum	-0.04	-0.30	-0.30	-1.11	0.26	0.76
Gross profitability	0.14	1.40	-0.20	-1.62	0.34	1.94
Asset growth	0.06	0.62	-0.35	-2.88	0.41	2.74
Return on assets	0.14	1.44	-0.58	-2.49	0.71	2.67
Investment-to-assets	-0.21	-2.07	-0.24	-2.22	0.03	0.22
Combination	0.00	0.15	-0.32	-3.01	0.32	2.98

Table 6
Michigan sentiment index and anomalies: predictive regressions for benchmark-adjusted returns on long-short strategies

The table reports estimates of b in the regression

$$R_{i,t} \quad = \quad a + bS_{t-1} + cMKT_t + dSMB_t + eHML_t + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and S_t is the level of the Michigan sentiment index. Also reported are returns on a strategy that equally combines the strategies available within a given month. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long leg		Short leg		Long $-$ short	
	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic
Failure probability	0.23	1.65	-0.45	-1.66	0.68	2.10
Ohlson's O (distress)	0.03	0.52	0.01	0.05	0.03	0.16
Net stock issues	0.07	1.12	-0.36	-2.93	0.43	3.60
Composite equity issues	-0.06	-0.68	-0.21	-1.69	0.16	1.03
Total accruals	0.02	0.14	-0.39	-2.24	0.41	2.03
Net operating assets	0.06	0.53	-0.41	-3.23	0.47	2.82
Momentum	0.11	0.71	-0.32	-1.15	0.42	1.13
Gross profitability	0.35	2.98	-0.08	-0.66	0.44	2.39
Asset growth	-0.23	-1.82	-0.38	-2.75	0.15	0.78
Return on assets	0.13	1.50	0.07	0.28	0.07	0.25
Investment-to-assets	-0.20	-1.72	-0.23	-1.84	0.03	0.23
Combination	0.06	1.40	-0.27	-2.68	0.33	3.00

Table 7

Spreads on beta, size, book-to-market, and liquidity beta during periods of high and low investor sentiment

Panel A reports average returns in excess of the one-month T-bill in months following high and low levels of investor sentiment, as classified based on the median level of the index of Baker and Wurgler (2006). Panel B reports estimates of a_H and a_L in the regression

$$R_{i,t} = a_H d_{H,t} + a_L d_{L,t} + bMKT_t + cSMB_t + dHML_t + \epsilon_{i,t},$$

where $d_{H,t}$ and $d_{L,t}$ are dummy variables indicating high- and low-sentiment periods, and $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference. The sample period is from 1965:8 to 2008:1, except that the liqidity-beta spread begins in 1968:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long Leg			Short Leg			Long − Short		
	High sentiment	Low sentiment	High −low	High sentiment	Low sentiment	High −low	High sentiment	Low sentiment	High −low
Panel A. Excess returns									
Beta	-0.45	1.37	-1.81	0.00	0.46	-0.46	-0.45	0.90	-1.35
	(-0.69)	(2.78)	(-2.22)	(0.01)	(2.05)	(-1.31)	(-0.79)	(2.23)	(-1.95)
Size	0.06	1.43	-1.37	0.33	0.44	-0.11	-0.26	0.99	-1.26
	(0.15)	(3.84)	(-2.40)	(1.11)	(1.86)	(-0.29)	(-0.78)	(3.33)	(-2.80)
Book-to-market	0.53	1.23	-0.71	0.15	0.50	-0.35	0.38	0.73	-0.35
	(1.64)	(3.52)	(-1.49)	(0.41)	(1.74)	(-0.76)	(1.35)	(2.52)	(-0.88)
Liquidity beta	0.55	1.05	-0.50	0.03	0.64	-0.61	0.52	0.41	0.11
	(1.39)	(3.15)	(-0.96)	(0.08)	(1.82)	(-1.11)	(2.45)	(1.93)	(0.36)
Panel B. Benchmark-adjusted returns									
Beta	-0.55	0.29	-0.84	-0.35	-0.18	-0.17	-0.20	0.47	-0.67
	(-2.29)	(1.36)	(-2.69)	(-1.90)	(-1.23)	(-0.77)	(-0.62)	(1.59)	(-1.62)
Size	-0.20	0.07	-0.27	0.08	0.03	0.05	-0.28	0.04	-0.32
	(-1.49)	(0.83)	(-1.71)	(2.31)	(0.99)	(1.06)	(-2.08)	(0.51)	(-2.05)
Book-to-market	-0.15	-0.06	-0.08	0.12	0.22	-0.10	-0.27	-0.28	0.02
	(-1.15)	(-0.56)	(-0.48)	(1.40)	(2.72)	(-0.85)	(-1.86)	(-2.27)	(0.09)
Liquidity beta	0.27	0.30	-0.02	-0.18	-0.04	-0.14	0.45	0.34	0.11
	(1.92)	(2.34)	(-0.13)	(-1.20)	(-0.29)	(-0.64)	(2.18)	(1.61)	(0.38)

Table 8
Predictive regressions for long-short spreads on beta, size, book-to-market, and liquidity beta

Panel A reports estimates of b in the regression

$$R_{i,t} \quad = \quad a + bS_{t-1} + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and S_t is the level of the investor-sentiment index of Baker and Wurgler (2006). Panel B reports estimates of b in the regression

$$R_{i,t} \quad = \quad a + bS_{t-1} + cMKT_t + dSMB_t + eHML_t + u_t.$$

The sample period is from 1965:8 to 2008:1, except that the liqidity-beta spread begins in 1968:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long leg		Short leg		Long − short	
	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic
Panel A. Excess Returns						
Beta	-1.40	-3.07	-0.20	-1.10	-1.20	-3.08
Size	-0.92	-3.02	-0.26	-1.23	-0.66	-2.82
Book to Market	-0.43	-1.63	-0.42	-1.60	-0.01	-0.05
Liquidity Beta	-0.47	-1.65	-0.69	-2.17	0.22	1.36
Panel B. Benchmark-Adjusted Returns						
Beta	-0.47	-2.76	0.01	0.11	-0.48	-2.23
Size	-0.17	-2.06	0.01	0.49	-0.18	-2.25
Book to Market	-0.06	-0.69	0.00	0.03	-0.06	-0.67
Liquidity Beta	0.03	0.33	-0.16	-1.34	0.19	1.23

Table 9
Sentiment and anomalies, controlling for additional macro variables: predictive regressions for benchmark-adjusted returns on long-short strategies

The table reports estimates of b in the regression

$$R_{i,t} \quad = \quad a + bS_{t-1} + cMKT_t + dSMB_t + eHML_t + \sum_{j=1}^{5} m_j X_{j,t} + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, S_t is the level of the Baker-Wurgler sentiment index, and $X_{1,t}, \ldots, X_{5,t}$ are five additional macro variables not used by Baker and Wurgler (2006) when removing macro-related fluctuations in sentiment: the default premium, the term premium, the real interest rate, inflation, and CAY. (Baker and Wurgler use the growth in industrial production, the growth in durable, nondurable, and services consumption, the growth in employment, and a flag for NBER recessions.) Also reported are returns on a strategy that equally combines the strategies available within a given month. The sample period is from 1965:8 to 2008:1 for all but anomaly (1), whose data begin 1974:12, and anomalies (2) and (10), whose data begin 1972:1. All t-statistics are based on the heteroskedasticity-consistent standard errors of White (1980).

	Long leg		Short leg		Long − short	
	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic	$\hat{b}$	t-statistic
Failure probability	0.05	0.28	-1.17	-2.97	1.22	2.39
Ohlson's O (distress)	0.07	0.79	-0.52	-2.04	0.58	2.33
Net stock issues	0.02	0.26	-0.44	-3.61	0.46	3.46
Composite equity issues	0.04	0.43	-0.20	-1.82	0.23	1.73
Total accruals	0.06	0.33	-0.30	-1.49	0.35	1.52
Net operating assets	0.05	0.44	-0.34	-2.61	0.39	2.47
Momentum	0.01	0.05	-0.22	-0.72	0.22	0.58
Gross profitability	0.09	0.83	-0.27	-1.93	0.36	1.86
Asset growth	-0.05	-0.46	-0.35	-2.50	0.30	1.81
Return on assets	0.06	0.59	-0.89	-3.24	0.95	3.01
Investment-to-assets	-0.28	-2.65	-0.27	-2.23	-0.02	-0.15
Combination	-0.01	-0.22	-0.35	-2.86	0.34	2.68

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