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Mutual Fund Trades: Timing Sentiment and Managing Tracking Error Variance

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ABSTRACT

We use portfolio holdings to show that mutual funds preferentially trade stocks according to the stocks' sentiment betas. Stocks with high sentiment betas are more responsive to investor sentiment and increase (decrease) in value as sentiment increases (decreases). Sentiment-based trades may be motivated by the opportunity to increase fund returns through timing predictability in sentiment, or by management of portfolio risk. Sentiment is mean-reverting, but its level and recent change only partially explain these trades. In contrast, 30 percent of sentiment-based trades are explained by the initial sentiment beta of funds that trade to reduce their tracking error variance.

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Mutual Fund Trades: Sentiment Betas and Tracking Error Variance

A mutual fund's performance depends on how the constituent stocks contribute to the portfolio's return and risk. We expect that fund returns will respond to changing investor sentiment according to the weighted average of the sentiment betas of the fund's portfolio in a manner directly analogous to the stock-level relation identified by Baker and Wurgler (2007). However, unlike stock sentiment betas, fund sentiment betas may be altered by trading that changes the composition of the portfolio. Fund managers have the option to adopt a variety of trading strategies but are constrained by how their return and risk performance compares to those of their peers. We use a procedure based on mutual fund holdings that permits identification of different trading strategies. By discerning trades that adjust fund sentiment betas and also portfolio risk, as measured by tracking error variance, we contribute to the literature by establishing a relation between sentiment-based trading and tracking error variance.

Baker and Wurgler (2006) define investor sentiment as the degree of optimism (pessimism) about future stock returns, or, alternatively, the propensity of investors to speculate. Furthermore, Baker and Wurgler (2007) point out that a stock's sentiment beta reflects the co-movement of its price with an index of sentiment changes. Stocks with high sentiment betas are more responsive to investor sentiment and increase (decrease) in value as investors become more optimistic (pessimistic).

A key finding of their research, and one that mutual fund managers could potentially exploit, is predictability in stock returns. They show that, subsequent to investor sentiment highs, stocks with low sentiment betas outperform those with high sentiment betas. Conversely, when sentiment is low, high sentiment beta stocks subsequently outperform. This relation relies on two conditions. First, stock mispricing is a function of the stock's sentiment beta, and second, investor sentiment is mean-reverting. Baker and Wurgler (2007) create indexes of investor sentiment and investor sentiment change. We use their indexes to confirm that investor sentiment is to some extent predictable, and not only depends on the level of investor sentiment, but also on recent changes in sentiment.

In choosing stocks to trade, mutual fund managers may consider various stock attributes such as risk, recent performance, liquidity, capitalization, and/or turnover, and how they interact with expected market conditions. Stock sentiment betas correlate with these attributes. Moreover, Baker and Wurgler (2006, 2007) and Glushkov (2006) associate sentiment beta with similar attributes that affect the difficulty of valuing a stock, or arbitraging its mispricing. Accordingly, a stock's sentiment beta may be used as proxy for the attributes considered by fund managers. This proxy has the advantage of relating a stock's price sensitivity to investor sentiment. Investor sentiment affects market conditions, and in forming expectations of the future, fund managers implicitly consider the expected change in sentiment.

Since investor sentiment affects stock returns, and is somewhat predictable, we postulate that it will be reflected in the trades of mutual funds. A mutual fund can increase (decrease) the weighted average of the sentiment beta of their portfolio by buying (selling) high sentiment beta stocks and selling (buying) low sentiment beta stocks. We use actual mutual fund holdings to measure each fund's sentiment beta each quarter, and we denote this measure as their "fund-quarter sentiment beta" (FQSbeta). Trades relating to any attribute that correlates with stock sentiment betas will effectively alter fund FQSbetas. Moreover, since sentiment beta measures the sensitivity of stock returns to changes in investor sentiment, fund returns will vary in response to investor sentiment according to the fund's FQSbeta.

A notable insight is that trading to alter a fund's FQSbeta may resemble momentum or contrarian trading strategies depending on whether investor sentiment increased or decreased during the previous return period. If, in the previous period, investor sentiment had increased, stocks with high sentiment betas would have been (on average) the better performers and the decision to increase (decrease) a fund's sentiment beta in the following period would resemble momentum (contrarian) trading. This insight may explain the extensive use of momentum and contrarian trading strategies by fund managers documented by Menkhoff and Schmidt (2005). The use of momentum/contrarian strategies appears unwarranted because stock-level analyses suggest that the profitability of naïve trading strategies based solely on prior returns is, at best, modest. This is one of the issues addressed in the present study.

In contrast to stock-level momentum or contrarian strategies, trading strategies based on sentiment betas appear profitable if changes in investor sentiment can be forecast. However, to determine whether mutual funds use either strategy requires a method to identify such trading. Unfortunately, the extant literature does not provide a suitable method for identifying, statistically, mutual funds that engage in momentum or contrarian trading or in trading with respect to sentiment betas. To overcome this deficiency, we adapt a method reported in Cullen, Gasbarro, and Monroe (2010) that uses fund holdings to reveal trading preferences for stocks with particular attributes. That is, we use stocks' previous performance to identify mutual funds that appear to be using momentum and contrarian strategies. We use the same method to identify funds that conduct orchestrated trading to increase or decrease the fund's sentiment beta. By demonstrating a link between fund-level trading strategies based on prior stock return with trading strategies based on stock sentiment betas, we provide insights into momentum/contrarian trading by mutual funds.

We find that trading intended to alter mutual fund FQSbetas can be largely explained by the fund's attitude to portfolio risk. Cullen, Gasbarro, Monroe, and Zumwalt (2012) use a procedure to identify mutual funds that focus on reducing tracking error variance. In the present study, we use this procedure to show that trades designed to reduce tracking error variance tend to move the fund's FQSbeta towards the average of all funds. After controlling for the initial FQSbeta, these funds, on average, appear to trade on the assumption that investor sentiment will mean-revert, and they adjust their FQSbetas accordingly. Funds that allow their tracking error variance to increase, possibly while pursuing trades they believe will enhance their performance, do the opposite.

We also show that the effect of investor sentiment on fund returns is consistent with the effect on stock returns established by Baker and Wurgler (2007). That is, funds with high (low) sentiment beta portfolios experience better performance following periods of low (high) investor sentiment. More directly, as investor sentiment increases (decreases), funds with high (low) FQSbeta experience better returns over the same period. Finally, we show that trading to alter FQSbeta can enhance returns.

In Section I, we review the literature and develop our hypotheses. Section II describes the data and outlines our research procedure. Initially, in Section III, we examine how stock returns relate to their past returns, to sentiment betas, and returns' interaction with investor sentiment. Later in Section III, we investigate whether mutual fund trades are simultaneously consistent with insights gleaned from our examination of stock returns, and with management of fund tracking error variances. In Section IV, we consider whether this is reflected in fund performance. The summary and conclusions are presented in Section V.

I. Empirical Predictions and Related Literature

The performance of portfolios held by mutual funds reflects the individual stock returns and how each stock contributes to the fund's risk. Separately, empirical studies have linked stock returns to (1) investor sentiment, (2) stock prior performance, and (3) have related mutual fund risk to the management of tracking error variance. We review and integrate these three strands of research in formulating our empirical predictions.

A. Returns and Investor Sentiment

Baker and Wurgler (2006) argue that investor sentiment, defined as optimism (pessimism) about future stock returns, or alternatively, the propensity of investors to speculate, varies over time. Stocks with more subjective valuations are more prone to over- (under-) pricing by speculators when sentiment is high (low). The same characteristics that make stocks speculative also restrict the opportunity to arbitrage the mispricing. These characteristics may be conveniently proxied by the stock's sentiment beta. Sentiment betas measure stocks' price sensitivity to investor sentiment. High sentiment beta stocks tend to be smaller and more volatile, and, therefore, more difficult to value and arbitrage. In contrast, low sentiment beta stocks tend to be larger, less volatile, and easier to value and arbitrage.

Baker and Wurgler (2007) create portfolios based on stock volatility, regress the portfolio monthly returns on their index of sentiment changes, and interpret the gradient as the portfolio's sentiment beta.[1] Portfolios with higher volatility have higher sentiment betas. In addition, the authors demonstrate predictability in stock returns. Higher volatility (and therefore higher sentiment beta) stocks perform poorly (well) following high (low) investor sentiment. Conversely, stocks with low sentiment betas perform well (poorly) following high (low) investor sentiment. By definition, sentiment beta measures a stock's response to increasing or decreasing investor sentiment. Intuitively, low sentiment tends to herald an increase in sentiment, while high sentiment tends to precede a decrease, or, as Baker and Wurgler (2007) note, "…market crashes tend to occur in high sentiment periods."[2]

Cornell, Landsman, and Stubben (2011) employ a factor analysis of the 10 measures of subjectivity of valuation in Baker and Wurgler (2006) to obtain a subjectivity factor. They regressed stock returns on the interaction of the subjectivity factor with the Baker and Wurgler

[1] Glushkov (2006) also calculates sentiment betas but does so, on a stock-by-stock basis, by regressing stock returns on a Fama and French (1995) three-factor model augmented by a Pastor and Stambaugh (2003) liquidity factor and an index of investor sentiment change.

[2] Refer to Baker and Wurgler (2007), page 148.

(2007) (BW07) sentiment index in the previous period. If we interpret the subjectivity factor as a measurement of sentiment beta, the negative coefficient on the interaction term supports the Baker and Wurgler (2007) finding that the returns of stocks with high (low) sentiment betas decrease (increase) following a period of high sentiment.

A natural extension to these studies is to calculate stock sentiment betas from their historical response to changes in sentiment, and to examine how subsequent stock returns respond to the actual *changes* in investor sentiment, depending on their sentiment betas. Baker and Wurgler (2007) suggest calculating stock sentiment betas from their sentiment changes index. This provides a direct measure of stock price sensitivity to this index that is analogous to the traditional market beta. By using the BW07 sentiment changes index, it is possible to examine more frequent changes in investor sentiment that are obscured by examining only the levels index. Based on the findings using the level of investor sentiment, and by symmetry with the traditional security market line, we expect a strong positive relation between stock returns and the interaction of the contemporaneous index of change in sentiment with the stock sentiment beta.

Mutual funds' portfolio sentiment betas are equal to the weighted average of the sentiment betas of the stocks they hold. Accordingly, fund returns should respond to changing investor sentiment in a similar manner. Moreover, if mutual fund managers believe they can predict the direction of the change in investor sentiment, then the sentiment betas of stocks they trade will reflect their expectations.

B. Momentum and Investor Sentiment

Similar themes relating to predictability in stock returns are found in the momentum literature. Momentum profits have been related to stock attributes that contribute to uncertainty in their valuation (Zhang (2006) and Arena, Haggard, and Yan (2008)), and to variation over time (Chordia and Shivakumar (2002), Cooper, Gutierrez and Hameed (2004), and Antoniou, Doukas and Subrahmanyam (2010). Antoniou, Doukas and Subrahmanyam (2010) focus on time variation related to investor sentiment and find greater mispricing of stocks during periods of optimism.

Traditional studies that ignore time variation in momentum or contrarian profits struggle to identify economically significant value in these strategies after consideration of trading costs.[3] In addition, the momentum literature does not simultaneously consider stock attributes such as sentiment beta and time variation in investor sentiment. Considering sentiment beta and the variation in investor sentiment together may reveal contemporaneous stock returns that have previously been identified as momentum/contrarian trading. That is, sentiment beta may provide an alternative avenue to explain stock returns that are presently attributed to momentum or contrarian trading strategies.

Baker and Wurgler's (2007) analysis suggests that stocks with high sentiment betas are more responsive to investor sentiment, and should increase (decrease) in value as sentiment

[3] The impact of transaction costs on the profitability of momentum trading strategies is considered by Grundy and Martin (2001) and Lesmond, Shill, and Zhou (2004), while Avramov, Chordia, and Goyal (2006) and De Groot, Huij, and Zhou (2012) consider their impact on the profitability of contrarian strategies.

increases (decreases). Moreover, they show that some “bond-like” stocks have negative sentiment betas, implying small decreases (increases) in value as sentiment increases (decreases). Accordingly, in the “portfolio formation” period where mutual funds are examining the returns of stocks they are considering for momentum or contrarian based trading, if investor sentiment increases, the returns on stocks with high (low) sentiment betas would, on average, be higher (lower). Conversely, if investor sentiment decreases, the returns on high (low) sentiment beta stocks would be lower (higher).

In the “trading” period following an increase in investor sentiment, funds that increase their portfolio’s sentiment beta would appear to be executing a momentum strategy of buying recent better performers (high sentiment beta stocks) and selling recent poor performers (low sentiment beta stocks). After a decrease in investor sentiment, funds that decreased their portfolio’s sentiment beta would also appear to be conducting momentum trades; selling recent poor performing (high sentiment beta) stocks and buying recent better performing (low sentiment beta) stocks. Conversely, following an increase in sentiment, funds that trade to decrease their portfolio’s sentiment beta would sell high sentiment beta stocks and buy low sentiment beta stocks. Following a sentiment decrease, funds that increase their sentiment beta would buy high sentiment beta and sell low sentiment beta stocks. Both cases resemble a contrarian trading strategy.

[Insert Figure 1]

We summarize these insights in Figure 1. In addition, we define mutual funds that are momentum (contrarian) traders as having a positive (negative) “MomentumTradeBeta”, and funds that trade to increase (decrease) their sentiment beta as having a positive (negative) "SentimentTradeBeta". This leads to the empirically testable prediction that MomentumTradeBetas are positively related to the multiplicative interaction of the SentimentTradeBeta and the lagged sentiment changes index.

B.1. Mutual Fund Trading Strategies

Several studies investigate momentum trading by institutions. However, before testing their measures of momentum trading for statistical significance, the studies either aggregate across funds (Gompers and Metrick (2001)), average over time (Grinblatt, Titman, and Wermers (1995)), or average over time and across funds (Badrinath and Wahal (2002)). Furthermore, Sias (2007) demonstrates that, before aggregation or averaging occurs, the Grinblatt, Titman, and Wermers (1995) measure of momentum (contrarian) trading is dominated by trading in the largest capitalization stocks. In general, the extant literature does not provide a measure that will statistically identify whether, in a particular calendar quarter, a particular mutual fund has engaged in momentum or contrarian trading. We address this deficiency by adapting a procedure in Cullen, Gasbarro, and Monroe (2010) and Cullen, Gasbarro, Monroe, and Zumwalt (2012) that permits statistical testing of whether mutual fund trades exhibit preferences related to certain stock attributes in any fund-quarter. Using this procedure, we identify mutual funds that trade to alter their sentiment beta, or pursue momentum/contrarian trading. That is, we identify funds with statistically significant SentimentTradeBetas or MomentumTradeBetas, respectively.

The question of why funds choose to increase or decrease sentiment beta may relate to their expectations of the direction of sentiment. Implicitly, Baker and Wurgler (2007) and Cornell, Landsman, and Stubben (2011) assume mean reversion of investor sentiment, after periods of high or low sentiment, is responsible for the stock returns in the following period. The assumption that sentiment can be forecast may be examined from the BW07 sentiment index and BW07 sentiment changes index.

C. Risk, Tracking Error Variance, and Sentiment Beta

Funds may adjust their sentiment beta because of their attitude towards risk. According to Brown, Harlow, and Starks (1996), risk adjustment is a feature of mutual funds engaged in tournament behavior. Chevalier and Ellison (1997) note that funds participating in tournaments are concerned with adjusting tracking error variance[4] while Jorion (2003) notes that tracking error variance constraints are commonly imposed on fund managers. When fund managers are assessed relative to others, Chen and Pennacchi (2009) show that they are more concerned with tracking error volatility than with return volatility. Cullen, Gasbarro, Monroe, and Zumwalt (2012) demonstrate that reducing tracking error variance is a major focus of mutual fund trading. They identify, statistically, tracking error variance trading behavior in 22% of fund-quarters.

Ammann, Kessler, and Tobler (2006) decompose tracking error variance and show that it is related to the squared deviation of the portfolio's benchmark beta from unity. Stock sentiment

[4] Chevalier and Ellison (1997) define tracking error variance as the variance of the difference between fund return and market return.

betas are highly correlated with market betas[5], such that trading to minimize tracking error variance will have the tendency to move the fund's sentiment beta towards the mean. As a general attitude to risk, we expect that funds that focus on reducing tracking error variance will also attempt to keep their portfolio's sentiment beta from deviating from the market's average sentiment beta. Accordingly, funds with initially high (low) sentiment betas will trade to reduce (increase) their sentiment beta. Funds that trade stocks with the aim of enhancing their performance will allow tracking error variance to increase, and will simultaneously permit their sentiment beta to deviate from the market norm. It follows that, for these funds, those with initially high (low) sentiment betas will trade to increase (decrease) their sentiment beta.

D. Mutual Fund Trades and Return Performance

By combining literature relating to investor sentiment, momentum, and tracking error variance, we are able to discern an inter-relationship that has not been fully explored. From the investor sentiment literature, we note potential for incorporating the sentiment changes index to calculate individual stock sentiment betas. Mutual funds may alter their sentiment beta according to their expectations of investor sentiment, and in doing so appear to conduct momentum-/contrarian-motivated trades. By appealing to research into the management of mutual fund tracking error variances, we identify an additional possible motivation for trading to alter a fund's sentiment beta.

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[5] Table I and separate analysis demonstrates this correlation.

However, irrespective of the specific motivation for a mutual fund to alter its sentiment beta, the effect of such trading should be apparent in the fund's performance. We argue that if the relative performance of stocks with high (low) sentiment betas is better when sentiment increases (decreases), then mutual funds that increase their holding of these stocks should improve their performance. That is, funds will improve their performance if they adjust their FQSB in the direction of the change in investor sentiment.

II. Data Description and Method

A. Data Description

To calculate stock sentiment betas, we use the monthly sentiment changes index developed by Baker and Wurgler (2007) and made available on Jeffrey Wurgler's website,[6] and stock return data from the *Center for Research in Security Prices (CRSP).* We obtained the periodic stock holdings of all US equity mutual funds from *Thomson Financial Services Ltd* for the period January 1991 to December 2005. Since most holdings are reported on a quarterly basis, we infer transactions from the quarterly changes to the holdings, while allowing for stock capitalization changes. Stock price and return data from *CRSP* are used to calculate quarterly excess returns for the individual stocks before we combine these with the holdings data. The *CRSP* database is also

[6] Two sets of investor sentiment indexes are available at http://www.stern.nyu.edu/~jwurgler. The indexes have a correlation of 0.84 over the period of our study, and we use the sentiment indexes based on the first principal components of six non-orthogonalized sentiment proxies. Until recently, these index series finished in 2005, and we conclude our study accordingly.

the source of mutual fund returns, and these returns are matched with the *Thomson's* holdings data using *Mutual Fund Links*.

To ensure that our data covers most of the changes to a mutual fund's portfolio, we restrict our sample to funds with average equity holdings exceeding 80% of fund investments and average cash holdings of less than 10%. In a further restriction to limit data errors and omissions, we must be able to replicate[7] the value of the fund's net tangible assets (NTA) by using the stock holdings data and assuming start-of-quarter prices for the stock to remain in our sample.

B. Method

We calculate the sentiment beta for each stock by regressing the monthly stock returns on the BW07 index of monthly investor sentiment changes, in a procedure analogous to that for calculating the traditional market beta. The stock sentiment betas are used in two ways. First, we use the stock sentiment betas to examine the differential effect of investor sentiment and sentiment changes on stock-level returns. Relating these returns to lagged stock returns provides an insight into the profitability of momentum and contrarian trading strategies. Second, we weight the stock sentiment betas in proportion to the value of the stocks in mutual fund portfolios to compute the sentiment beta for each fund each quarter. We refer to these as fund-quarter sentiment betas (FQSbeta). Using the FQSbetas and BW07's measures of investor sentiment and investor sentiment change, we explore their relation with mutual fund trading behavior in a

[7] We allow a discrepancy of up to 10%, but exclude funds outside that range.

quarter. We extend this analysis to assess whether fund returns are affected by mutual funds trading to alter the sentiment beta of their portfolios.

Our assessment of mutual fund trading behavior is based on “real world” mutual fund portfolios. Specifically, we identify mutual funds that engage in momentum/contrarian trading, trading to increase or decrease FQSB, or trading to increase or reduce tracking error variance in a calendar quarter. This is achieved by employing a procedure that identifies, with statistical confidence, individual funds that exhibit preferential trading with respect to a particular stock attribute in the quarter. In turn, we use the stock attributes: prior return, stock sentiment beta, and tracking error variance contribution.

III. Fund Trading Strategies and Returns

A. Descriptive Statistics

In Panel A of Table I, we partition stocks into quintiles of sentiment beta and report the averages of sentiment beta and the following stock attributes: market beta, return standard deviation, capitalization, and turnover (both by value and by proportion). Our sample size is 1,219,090 stock-months. The average sentiment beta of stocks in quintile 1 is negative, consistent with Baker and Wurgler’s (2007) bond-like stocks. Notably, all other quintiles have positive average sentiment betas, while the beta of the highest quintile is considerably greater than the absolute value of the first quintile. The traditional market beta increases monotonically across quintiles 1 to 5. In separate analyses, we find the correlation between sentiment beta and market beta to be 0.357.[8] Baker and Wurgler (2006) and Glushkov (2006) infer a positive relation between volatility (return standard deviation) and sentiment beta. We find that return standard deviation follows a largely similar pattern, except that the minimum occurs in sentiment beta quintile 2. The higher return standard deviation in quintile 1 is possibly consistent with flight-to-quality (during times of uncertainty) causing greater volatility in the negative sentiment beta, bond-like stocks.

In addition, in Panel A we standardize the market capitalization of stocks to recognize growth over time by dividing by the average market capitalization of all stocks in each corresponding month. Consistent with the expectation that low (high) sentiment beta stocks are easier (harder) to value and arbitrage, and also consistent with Baker and Wurgler (2006) and Glushkov (2006), stock market capitalization decreases monotonically. Market turnover (by value, standardized for market growth over time) and proportionate turnover (turnover divided by the number of shares outstanding) are greater for stocks with the highest sentiment betas, consistent with Glushkov (2006). Possibly, these results reflect herding in these stocks. Stocks in the lowest sentiment beta quintile also have elevated turnover, consistent with increased demand for bond-like stocks, but due to the larger capitalization of these stocks, this is most pronounced when turnover is measured by value.

As shown in Panel B, our sample contains 2,450 distinct mutual funds, and 31,409 fund-quarters that meet our selection and data quality criteria. We calculate the weighted average

[8] This result is consistent with BW07, who find a 0.32 correlation between the value-weighted market return and sentiment changes index.

sentiment beta for each portfolio of the 16,783 fund-quarters that remain after we match stock sentiment betas and fund returns. We also report the distribution of the change in a fund's weighted average sentiment beta over a trading quarter. Notably, changes to the portfolio sentiment betas, caused by a fund's trading during a quarter, are close to zero on average, with a standard deviation of 0.0049.

[Insert Table I]

Panel C shows the distributions of the three-month value-weighted market returns and the three-month moving averages of the BW07 monthly sentiment changes index. The three-month averages are moved forward one month at a time so that they overlap to be consistent with our analyses that use overlapping quarters of fund trades and returns.[9]

B. Stock Level Returns

We calculate sentiment betas for each stock ($Sbeta_i$) using the BW07 monthly "sentiment changes index" in a procedure analogous to that for calculating the traditional market beta. That is, we use the stock returns over the previous 60 months,[10] but use the sentiment changes index, over the same interval, in place of market returns, as follows:

$$RR_{it} = a_0 + Sbeta_i \times SChI_t + \varepsilon_{it} \tag{1}$$

[9] The mean of the sentiment changes index in our sample is similar to the BW07 index that was standardized to have a mean of zero over their 40-year examination period. However, as a consequence of using a 3-month moving average, our standard deviation is lower than their unit variance.

[10] We eliminate stocks without a minimum of 12 months of returns.

where RR_{it} is the monthly raw return of stock i over period t, and $SChI_t$ is the BW07 monthly non-orthogonalized sentiment changes index at time t. This procedure is repeated monthly over the fifteen-year period of the present study. We convert the monthly stock return and index series into overlapping two-, and three-month series, commensurate with the return intervals we wish to examine. For the sentiment changes index, this involves the moving average of two or three successive values, respectively.

To investigate how stock returns relate to their sentiment beta and past returns, we estimate the regression:

$$\begin{aligned} R_{it} = {} & a_0 + b_1 R_{it-1} + b_2 R_{it-1} \times Sbeta_i + b_3 SI_{t-1} + b_4 SI_{t-1} \times Sbeta_i + b_5 SChI_t + b_6 R_{it-1} \times SChI_i \\ & + b_7 SChI_t \times Sbeta_i + b_8 R_{it-1} \times SChI_t \times Sbeta_i + b_9 Sbeta_i + b_{10} R_{it-1} \times Variance_i + \varepsilon_{it} \end{aligned} \qquad (2)$$

where R_{it} is the return of stock i over period t in excess of the risk-free rate, R_{it-1} is the lagged excess return, SI_{t-1} is the moving average of the BW07 monthly non-orthogonalized sentiment index at the start of period t, and $Variance_i$ is the variance of returns for stock i.

We use return intervals of one, two, and three months in Panels A, B, and C, respectively, of Table II, such that the return intervals in Panels B and C are overlapping. By using overlapping data, we introduce autocorrelation in the error term that biases the t-statistic. Hansen and Tuypens (2004) and Hjalmarsson (2011) suggest corrections to the ordinary least squares t-statistic that permit statistical inference at the conventional levels. We adopt the more conservative Hjalmarsson (2011) correction and rescale our t-statistics by dividing by 1.414 and 1.732 when we use two- and three-month returns, respectively. In Panels D and E, we continue to use overlapping three-month returns, but replace the returns in excess of the risk-free rate in

Panel C with cumulated CAPM residual returns in Panel D and cumulated Fama-French residual returns in Panel E. The residuals are created from regressions using:

$$R_{it} = a_0 + b_1(R_{mt} - R_{ft}) + \varepsilon_{it} \tag{3}$$

and

$$R_{it} = a_0 + b_1(R_{mt} - R_{ft}) + b_2 SMB_t + b_2 HML_t + \varepsilon_{it} \tag{4}$$

where R_{mt} is the monthly value-weighted market return, R_{ft} is the monthly risk-free rate at month t, SMB_t is the return for small minus large stock portfolios, HML_t is the return for high minus low book-to-market portfolios, for panels D and E, respectively, and three successive residuals are summed to create the cumulated residuals over the relevant quarters.

[Insert Table II]

In model 1, the coefficient on R_{it-1} (variously denoted as R1M, R2M, or R3M) ranges from significantly positive in Panels A, B, and C, to significantly negative in Panels D and E. However, the explanatory power of the model, indicated by the r-squares, is low. Inclusion of terms for the interaction of prior return with stock sentiment beta ($R_{it-1}xSbeta_i$) and with variance ($R_{it-1}xVariance_i$) in models 2 and 5, respectively, do not materially contribute to the r-squares. Accordingly, we conclude that although stock returns are significantly related to their prior return, it is practically insufficient to motivate the adoption of a momentum or contrarian trading strategy.

The coefficient on $SI_{t-1}xSbeta_i$ is significantly negative in model 3 of all panels in Table II, consistent with Baker and Wurgler (2007) and Cornell, Landsman, and Stubben (2011). Stocks with high sentiment betas produce, on average, positive returns following low investor sentiment, and negative returns following high investor sentiment. Stocks with low (negative) sentiment betas produce the opposite. The inclusion of sentiment change ($SChI_t$) and its interactions with lagged stock return and sentiment beta in model (4) of Panels A, B, and C leads to a substantial increase, over model (3), in the r-square (to 0.069, 0.079, and 0.081, respectively). Moreover, the model continues to have explanatory power in Panels D and E when CAPM and Fama-French residuals are considered in place of returns exceeding the risk free rate. Notably, the coefficient on $SChI_t xSbeta_i$ is significantly positive on all models. Accordingly, we conclude that, as expected, on average, the contemporaneous returns of stocks with high (low) sentiment betas increase (decrease) as investor sentiment increases. The reverse occurs when investor sentiment declines.

Although much of the impact of the interaction between stock sentiment beta and changes in investor sentiment on stock returns is subsumed by CAPM and the Fama-French models, we argue that investors trading on short-term expectations of stock price changes are more interested in raw returns. Hence, if investors could predict the direction of sentiment change, they might profitably exploit the relation between return and $SChI_t xSbeta_i$ by trading stocks according to their sentiment beta. That is, purchasing stocks with high (low) sentiment betas when they predict an increase (decrease) in investor sentiment. While the relation is significantly positive over one-, two- and three-month return horizons, our focus is on three-month returns because mutual funds mostly report their holdings quarterly. From the changes to their holdings, we can infer the actual trades made by funds over this horizon.

B.1 Predictability of Investor Sentiment

The time-series of the BW07 investor sentiment index appears to mean revert, and is possibly predictable. To test this, we regress the BW07 investor sentiment changes index on the BW07 investor sentiment index and lagged values of the BW07 investor sentiment changes index.

$$SChI_t = a_0 + b_1 SI_{t-1} + b_2 SChI_{t-1} + \varepsilon_{jt} \tag{5}$$

We consider sentiment change monthly, and when successive values of the sentiment index are averaged over two and three months, and report these results in Table III. When two- and three-month changes are used, overlapping causes autocorrelation in the residuals, and we employ the Hjalmarsson (2011) correction to the t-statistics. In Table III, the coefficients on SI_{t-1} are significantly negative in models (1) and (2) and $SChI_{t-1}$ is significantly negative in model (3), providing evidence that investor sentiment is mean reverting. Moreover, the r-squares of 0.021, 0.056, and 0.086 indicate that changes to investor sentiment are, to some extent, predictable.

[Insert Table III]

C. Fund Level Trading Strategies

The evidence in the preceding section supports our contention that practical momentum and contrarian trading strategies are unlikely to be profitable. In contrast, a profitable strategy of trading stocks according to their sentiment beta may be possible if investor sentiment can be predicted with accuracy. However, anecdotal evidence and survey data suggest that mutual funds adopt both momentum and contrarian trading strategies, while strategies to explicitly alter a portfolio's sentiment beta according to expected changes in sentiment receive scant mention. Accordingly, the present study examines mutual fund trades to identify funds that employ momentum or contrarian trading strategies, and to identify funds that trade to alter the sentiment beta of their stock portfolio. Noting that Cullen, Gasbarro, Monroe, and Zumwalt (2012) find evidence that mutual funds also trade to reduce tracking error variance, we consider how this constraint may affect trades that change fund sentiment betas.

C.1. Identifying Mutual Fund Trading Strategies

Funds that preferentially purchase (sell) stocks that were recently better (poorer) performers follow a momentum trading strategy. A contrarian strategy involves the purchase (sale) of stocks that were recently poorer (better) performers. To identify whether a mutual fund is following either strategy in any quarter, we adapt the method in Cullen, Gasbarro, and Monroe (2010) by ranking each stock held by a fund at the start of a quarter by its return in the preceding quarter. We use this ranking to assign each fund's stocks to "prior performance buckets" before applying regression analysis to determine whether the stocks it trades during the quarter are related to the stocks' prior performance.[11]

[11] We acknowledge the observation by Elton et al. (2010) that approximately 20% of the within-quarter transactions are not observed with quarterly mutual fund holdings data. However, we balance sample size with frequency of observation to obtain 2,450 funds and 31,409 fund-quarters in the period 1991–2005 of our study. This compares with 215 funds and 6,432 fund-months in the Elton et al. (2010) study over a similar period.

For each mutual fund, in each quarter, we create twenty ranked "prior performance buckets". Each bucket is a stock portfolio of approximately equal value, to which we assign a measure of the bucket's prior performance (BucketPP). This measure is calculated by weighting the prior performance of each stock in the bucket by the stock's proportionate value. We perform 31,409 regressions, one for each fund-quarter between 1991 and 2005, using BucketPP as the independent variable. Like Cullen, Gasbarro, and Monroe (2010), we use TradeValue as the dependent variable in these regressions, as follows:

$$\text{TradeValue}_k = \alpha + \beta\,\text{BucketPP}_k + \varepsilon_k \tag{6}$$

where

$$\text{TradeValue}_k \equiv \sum_{i=1}^{n} \text{Value of stock}_i \text{ from PriorPerformanceBucket}_k \text{ that is traded during a quarter;}$$

$$\text{BucketPP}_k \equiv \sum_{i=1}^{n} \left(\text{StockPriorPerformance}_i \times \frac{\text{Value stock}_i \text{ held}}{\text{Value of all stock held in PriorPerformanceBucket}_k}\right);$$

$$\text{PriorPerformanceBucket}_k = \text{prior performance bucket k created from allocating stocks ranked on prior performance;}$$

$$\text{StockPriorPerformance}_i = \text{quarterly excess return of stock i; and}$$

$$n = \text{number of stocks in PriorPerformanceBucket}_k.$$

These regressions identify fund quarters in which there is an association between the value of stock traded and stock prior performance. A significantly positive (negative) coefficient, which we refer to as the "momentum trade beta", indicates that the fund is making momentum (contrarian) trades, while an insignificant regression coefficient indicates that the trades are neither momentum- nor contrarian-motivated. The cumulative binomial distribution is used to determine whether the count of significant momentum betas could have occurred by chance.[12]

We repeat the above procedure twice by forming buckets from the stocks held in fund portfolios, first when the stocks are ranked by sentiment beta, and second when stocks are ranked by their tracking error variance contribution (TEVC). By symmetry, equation (6) is modified by replacing "stock prior performance" with "stock sentiment beta" in the first instance and "TEVC" in the second. Correspondingly, $BucketPP_k$ is replaced with the weighted average sentiment beta of the stocks in bucket k, in the first instance, and the weighted average of TEVC in the second. When we form buckets by ranking by stock sentiment beta, we refer to the regression coefficients as "sentiment trade betas". Significantly positive (negative) values indicate that a fund's trades are designed to increase (decrease) the sentiment beta (FQSbeta) of the fund's portfolio. We refer to the regression coefficient from buckets formed by ranking stocks by TEVC as "tracking error variance contribution trade betas". Significantly positive (negative) values indicate that a fund's trades are designed to increase[13] (decrease) the fund's tracking error variance.[14]

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[12] The number of regressions is used as the number of trials; the level of significance at which we find the coefficients to be positive (momentum) or negative (contrarian) is used as the probability of a success; and the critical number of successes corresponds to a cumulative binomial probability of 1%.

[13] We refer to funds that we identify statistically as increasing tracking error variance as "anti-trackers" and funds that decrease tracking error variance as "trackers". Unlike funds that trade with the objective of reducing tracking error variance, funds that allow their tracking error variance to increase focus on return as the objective. Our

Table IV shows the results of these analyses. We find that 4,777 fund-quarters have statistically negative momentum trade betas, while 4,702 fund-quarters have statistically positive momentum trade betas. Therefore, of the 31,409 fund-quarters in our dataset, 15.2% follow the contrarian trading strategy of re-balancing their portfolios away from recently better performing stocks towards recent poor performers. Momentum traders that follow the opposite strategy comprise 15.0% of fund quarters. These frequencies statistically exceed the expected frequency of 5%, where funds, trading randomly with respect to stock prior return, may be misidentified as either contrarian or momentum traders.

Also statistically exceeding random proportions, in Table IV, is the number of funds that trade to increase (positive) or decrease (negative) their sentiment beta. This result is consistent with our expectation gained from stock-level returns (Table II); funds have the incentive to alter their sentiment beta if they can predict the direction of changes in investor sentiment. Table IV shows that approximately one fifth (22.1%) of mutual funds trade to reduce their tracking error

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terminology recognizes that our method only identifies the subset of funds that increase tracking error variance by satisfying linearity in the relation between TEVC and value traded, and also recognizes that it specifically excludes funds that trade without significant alteration to their sentiment beta.

[14] The tracking error variance of a mutual fund's portfolio is equal to the value-weighted average of the TEVCs of stocks in the fund's portfolio. TEVC, which accounts for the covariances of the returns of stocks in the portfolio in determining an individual stock's contribution to the tracking error variance of the portfolio, is discussed in detail in Cullen, Gasbarro, Monroe, and Zumwalt (2012). The significant tracking error variance contribution trade betas in the current study are a subset of those identified in Cullen, Gasbarro, Monroe, and Zumwalt (2012), where mutual funds report their holdings quarterly.

variance (trackers), while we identify a subset (anti-trackers) of funds (4.6%) that increase tracking error variance through their trades.

[Insert Table IV]

C.2. The Relation Between Trading Strategies

Momentum and contrarian trades are defined according to whether a stock is bought or sold preconditioned on its performance in the previous period. However, our stock-level results in Table II show a strong contemporaneous relation between stock returns and $SChI_t xSbeta_i$, raising the possibility that our identification of funds as momentum and contrarian traders may be linked to our identification of funds trading to increase or decrease their sentiment beta. This follows because, on average, stocks with high sentiment betas would be the better performers in the previous period if sentiment had increased. Therefore, the decision to increase (decrease) a fund's sentiment beta in the following period by buying (selling) stocks with high (low) sentiment betas would appear to be motivated by momentum (contrarian) trading. Similar arguments apply when investor sentiment has decreased in the previous period.

To test whether the funds we independently identify as momentum/contrarian traders or sentiment traders in Table IV are related in this manner, we logistically regress 'momentum trade beta' on the multiplicative interaction of 'sentiment trade beta' and the three-month average of sentiment change in the previous period as follows:

$$MomentumTradeBeta_{jt} = a_0 + b_1 SentimentTradeBeta_{jt} + b_2 SentimentTradeBeta_{jt} \times ChSI_{t-1} + \varepsilon_{jt} \quad (7)$$

where $\text{MomentumTradeBeta}_{jt}$ are the signed statistically significant 'β' coefficients estimated using equation (6) for each fund j in period t when stocks are ranked on prior performance, and $\text{SentimentTradeBeta}_{jt}$ are the signed statistically significant 'β' coefficients when stocks are ranked on stock sentiment beta.

The result shown as model (2) in Table V is consistent with the above argument. The positive coefficient on the interaction term shows that funds that trade to increase (decrease) their sentiment beta following an increase in investor sentiment are identified as momentum (contrarian) traders. Moreover, the model's high Nagelkerke r-square (0.420) indicates good explanatory power, and correctly predicts 76% of the actual momentum and contrarian trades. In contrast, model (1), which does not include the interaction with prior change in investor sentiment, has little explanatory power.

[Insert Table V]

Mutual fund managers may not identify themselves as sentiment traders; however, it is apparent from Table IV that many alter their sentiment beta through orchestrated trading. This may be explained because fund managers are instead focusing on one or more of the correlated stock attributes shown in Panel A of Table I, or perhaps stock liquidity or prior performance. In this context, we regard sentiment beta as a convenient proxy. Trading to alter a fund's sentiment beta may reflect incentives observed at the stock level, such as the relation identified by Baker and Wurgler (2007) and confirmed by Table II, where high (low) sentiment beta stocks earn higher average returns when investor sentiment is low (high). Because high (low) sentiment beta stocks perform better when sentiment increases (decreases), trading may reflect fund manager expectations of future sentiment changes. The predictability of changes in investor sentiment shown in Table III, and discussed in Section III B.1, may be used by fund managers.

In addition to trades designed to exploit stock-level returns, fund managers consider trades in a portfolio context. Specifically, funds may trade to reduce or increase the tracking error variance of their portfolio, as shown by Chevalier and Ellison (1997) and further supported by Chen and Pennacchi (2009). We apply the method developed by Cullen, Gasbarro, Monroe, and Zumwalt (2012) to statistically identify mutual funds that trade to decrease (trackers) or increase (anti-trackers) tracking error variance, as reported in Table IV. This allows us to separate trackers and anti-trackers who possess different attitudes to risk that may dictate their behavior with respect to a fund's sentiment beta. Accordingly, tracker funds with initially high (low) sentiment betas may reduce (increase) their sentiment beta to maintain comparable sentiment betas with other funds. Anti-tracker funds that are prepared to allow risk to increase may do the opposite.

To examine the relation between trades intended to alter a fund's sentiment beta, the fund's initial sentiment beta, the level and prior change in investor sentiment, and concurrent change in investor sentiment, we logistically regress:

$$SentimentTradeBeta_{jt} = a_0 + b_1 FQSBeta_{jt-1} + b_3 SI_{t-1} + b_4 ChSI_{t-1} + b_5 ChSI_t + \varepsilon_{jt} \quad (8)$$

where $FQSBeta_{jt-1}$ is the value-weighted average of the sentiment betas of the stocks held by fund j at the start of quarter t.

Model (1) of Panel A in Table VI shows a negative relation between sentiment trade beta and the initial weighted average sentiment beta of the fund's portfolio. This suggests that funds actively trade to adjust their sentiment beta towards the mean of all funds. However, the explanatory (pseudo r-squares of 0.034 and 0.046) and predictive power of the model is low. Incorporating market sentiment (model (3)) only modestly improves the explanatory power, increasing the pseudo r-squares to 0.038 and 0.051.

However, the apparent preference of funds to adjust their sentiment beta towards the mean may be driven by the predominance (22.1%) of tracker funds that trade to reduce the tracking error variance of their portfolios. Funds that avoid tracking error risk may also avoid the risk from having an extreme sentiment beta. That is, funds that are focused on reducing risk would simultaneously trade to reduce tracking error variance and rebalance the sentiment beta of their portfolio towards the average. Moreover, indirect support for this expectation comes from Ammann, Kessler, and Tobler (2006), who demonstrate a relation between tracking error variance and the market beta, which can be extended to sentiment beta by virtue of the correlation shown in Table I.

To examine this issue, we consider only funds that we identify as having traded to reduce their tracking error variance, and repeat the earlier analyses, which we report in Panel B. The negative coefficient on FQSbeta shows that funds with high (low) sentiment betas overwhelmingly trade stocks to reduce (increase) their sentiment beta. Notably, the explanatory (pseudo r-squares of 0.585 and 0.781) and predictive power (percentage correct of 89.5) of model (1) is substantially improved from Panel A. Therefore, trading by tracker funds to alter their sentiment beta is almost fully explained by the fund's existing sentiment beta. In the subset of 2,374 fund-quarters (Panel B) that are identified as trackers out of the 7,097 fund-quarters

(Panel A) where we identify sentiment-based trades, the model correctly classifies 2,124 fund-quarters, or 30% of all sentiment-based trades. Similar to Panel A, the inclusion of market sentiment variables in model (3) only marginally improves the explanatory power, indicating that the apparent predictability of investor sentiment has a relatively minor impact on trading to alter sentiment beta. However, the negative coefficients on the start of period sentiment index (SI_{t-1}) and prior period sentiment changes index ($SChI_{t-1}$) in models (2), (3) and (4) could suggest that funds focused on reducing tracking error variance also reduce (increase) their sentiment beta when sentiment is high (low) or has recently increased (decreased). Intuitively, these conservative (tracker) mutual funds expect investor sentiment to revert towards its mean.

The 77.9% of fund-quarters that we do not statistically identify as trackers may be: trackers that have not met our strict criteria, funds that are indifferent to tracking error variance, or funds that are motivated to improve their returns but are willing to allow their tracking error variance to increase. Tracking error variance is reduced by adjusting the weighting of stocks in a fund's portfolio towards unique target proportions. However, tracking error variance is increased not as a goal, but as a consequence of seeking higher returns; therefore, there is no unique target composition. We are unable to distinguish funds motivated by higher returns (that allow their tracking error variance to increase) from other funds that are not statistically identified as trackers except for a sub-group of 4.6% of fund-quarters. These are funds that conduct trades diametrically opposite to the trades that would reduce tracking error variance, and hence our terminology 'anti-tracker'.

In Panel C we report results from equation (8) for funds we identify as anti-trackers. Consistent with this group of funds being risk-takers, the coefficient on FQSbeta is positive. That is, funds with high (low) sentiment betas predominantly trade stocks to increase (reduce) their sentiment beta. The explanatory (pseudo r-squares of 0.604 and 0.837) and predictive power (percentage correct of 93.9) of model (1) parallels those of the trackers in Panel B. As with Panels A and B, there is only marginal improvement in explanatory power from the inclusion of market sentiment variables in model (3). However, the positive coefficients on the start-of-period sentiment index (SI_{t-1}) in models (2), (3), and (4) could suggest that anti-tracker funds increase (reduce) their sentiment beta when sentiment is high (low), perhaps anticipating continuation of sentiment.

In all panels of Table VI, model (4) shows that trades designed to change fund sentiment betas are unrelated to actual changes in investor sentiment over the same period. This follows because the coefficient on ($SChI_t$) is insignificant, and the model has no additional explanatory power over model (3). Accordingly, we conclude that the behavior of a mutual fund in deciding which stocks to trade is largely explained by whether the fund is traded to increase or decrease tracking error variance, the existing sentiment beta, and to a lesser extent, past level and changes to investor sentiment.

[Insert Table VI]

IV. Fund Sentiment Betas, Investor Sentiment, and Fund Returns

In the previous section, we identified funds that traded to intentionally increase or decrease the fund's sentiment beta. However, funds may alter their sentiment beta by trading that was either not with the intention of doing so, or did not meet our strict requirements for statistical significance. In the following section, we examine the association between fund returns, fund sentiment betas, and changes to fund sentiment betas, irrespective of whether the change was intentional. Accordingly, we relax our strict requirements to consider the change in fund beta over a period ($\Delta FQSbeta_t$) caused by trading for whatever reason.

A. Fund Sentiment Betas

We use the stock sentiment betas to calculate each fund's start-of-quarter sentiment beta ($FQSBeta_{t-1}$) by weighting the sentiment betas of the stocks held in the fund's portfolio by their proportionate values. Each fund's end-of-quarter weighted average sentiment beta ($FQSBeta_t$) is calculated using the same stock sentiment betas and stock prices used to calculate the start-of-quarter sentiment beta, but with end-of-quarter stock holdings. By subtracting the start-of-quarter $FQSBeta_{t-1}$ from the end-of-quarter $FQSBeta_t$, we obtain the change in the fund's sentiment beta ($\Delta FQSbeta_t$) that we attribute to the trades conducted by the fund during the quarter. This procedure is analogous to that used by Chevalier and Ellison (1997) to calculate the change to fund return variances over each trading period. Table VII demonstrates that trades intended to increase sentiment beta most commonly (2488) result in the largest increases, and trades intended to reduce sentiment beta most commonly (1737) result in the largest decreases.

[Insert Table VII]

B. Fund Returns

Stock level returns depend on the interaction of the level or change in investor sentiment with the stock's sentiment beta. To investigate whether fund returns also depend on the interaction of the level or change in investor sentiment with fund sentiment beta, and changes to fund sentiment beta in particular, we estimate the following:

$$
\begin{aligned}
R_{jt} = {} & a_0 + b_1 SI_{t-1} + b_2 FQSBeta_{jt-1} + b_3 FQSBeta_{jt-1} \times SI_{t-1} + b_4 SChI_t + b_5 FQSBeta_{jt-1} \times SChI_t \\
& + b_6 \Delta FQSBeta_{jt} + b_7 \Delta FQSBeta_{jt} \times FQSBeta_{jt-1} + b_8 \Delta FQSBeta_{jt} \times SI_{t-1} \\
& + b_9 \Delta FQSBeta_{jt} \times SChI_t + \varepsilon_{jt}
\end{aligned} \quad (9)
$$

where R_{jt} is the return in excess of the value-weighted market return for fund j in quarter t, $FQSBeta_{jt-1}$ is the weighted average of the stock sentiment betas in the portfolio of fund j at the start of quarter t, SI_{t-1} is the BW07 non-orthogonalized monthly investor sentiment index at the start of quarter t, $SChI_t$ is the three-month average of the BW07 non-orthogonalized monthly investor sentiment changes index over quarter t, and $\Delta FQSBeta_{jt}$ is the change to the fund's sentiment beta caused by trading during quarter t. Because the return intervals are overlapping, we adjust the t-statistics for autocorrelation in the residuals using the Hjalmarsson (2011) correction.

[Insert Table VIII]

In model (1) of Table VIII, the coefficient on the sentiment beta and sentiment index interaction term ($FQSbeta_{jt-1}$ x SI_{t-1}) is statistically negative, significant at 1%. This indicates that when investor sentiment is low (high), funds with high (low) sentiment betas, on average, have higher returns in the following quarter. Therefore, we find that the relation between future stock returns and sentiment beta that Baker and Wurgler (2007) established in their seesaw diagram and confirmed in our Table II (e.g., model (3) in Panel C) also applies at the level of fund returns and fund sentiment betas.

In model (2) of Table VIII, the coefficient on the sentiment beta and sentiment change index interaction term ($FQSbeta_{jt-1}$ x $SChI_t$) is statistically positive, significant at 1%. That is, the sensitivity of returns to fund sentiment beta $\left(\frac{\partial R_t}{\partial FQSbeta_{t-1}}\right)$ is positively related to $SChI_t$, which has values ranging from positive to negative. Accordingly, the performance of funds with high (low) sentiment betas improves when investor sentiment increases (decreases). This is consistent with our observations of stock level returns in Table II (e.g., model (4) in Panel C).

However, unlike in model (1), where returns are a function of information that is available ex-ante, in model (2), $ChSI_t$ is only known ex-post. Therefore, the relation cannot be used to predict returns. Instead, it bolsters the implicit assumption that the source of the relation between investor sentiment level, stock sentiment betas, and subsequent stock returns is the subsequent change in investor sentiment. Intuitively, investor sentiment increases (decreases) tend to follow periods of low (high) investor sentiment.

In model (3) of Table VIII, the coefficient on $\Delta FQSbeta_{jt}$ x SI_{t-1} is significantly positive, suggesting that when investor sentiment is high (low) at the start of a period, funds reduce their performance by decreasing (increasing) their sentiment beta. This is seemingly at odds with the result in models (1) to (3) of Table VIII, which shows initially low (high) sentiment betas are advantageous when start of period sentiment is high (low), unless the changes to sentiment beta occur too late to capture a pecuniary benefit. In addition, investor sentiment is only partially predictable, and only some periods of high (low) investor sentiment are followed by a decrease (increase).

Model (4) of Table VIII shows that the effect of changing the fund's sentiment beta on fund returns is a complex relation that depends on the existing sentiment beta, the level of investor sentiment, and the contemporaneous change in investor sentiment. The positive sign on $\Delta FQSbeta_{jt}$ x SI_{t-1} noted in model (3) persists, but notably, the coefficient on $\Delta FQSbeta_{jt}$ x $SChI_t$ is significantly positive. This indicates that when investor sentiment does increase (decrease) over the period, a fund that increases (decreases) its sentiment beta contributes positively to its performance. The positive sign on $\Delta FQSbeta_{jt}$ x $SChI_t$ is consistent with the positive coefficient for $FQSbeta_{jt}$ x $SChI_t$ in both models (2) and (4), which indicates that having a high (low) sentiment beta is advantageous when sentiment increases (decreases).

We show that fund performance responds, in the expected direction, to both the level and change in investor sentiment according to the fund's initial sentiment beta. That is, funds with initially high (low) sentiment betas have better performance when the level of investor sentiment is low (high) or when the change in sentiment is positive (negative). If funds are unable to predict the change in sentiment, but trade to increase or decrease their sentiment beta on the basis of the initial level of sentiment, perhaps by window dressing, they would not receive a performance benefit. We find that, on average, this is the case, but also show that funds improve their performance if they succeed in adjusting their sentiment beta in the direction of the *actual* change in investor sentiment. However, model (4) of Table VI, suggests that the trades conducted by fund managers that adjust a fund's sentiment beta are, on average, independent of the *actual* changes in investor sentiment, casting doubt on the ability of fund managers to forecast investor sentiment.

V. Conclusions

Mutual funds report using momentum and contrarian trading strategies even though the returns from naïve stock-level strategies appear to be an inadequate incentive. However, Baker and Wurgler (2007) show that stock returns depend on the interaction of investor sentiment and the stocks' sentiment betas. In turn, the sentiment beta of a mutual fund depends on the composition of its stock portfolio, and fund returns may be enhanced by trading to increase (decrease) their sentiment beta ahead of increasing (decreasing) investor sentiment. We show that, depending on the previous change in investor sentiment, trading to change a fund's sentiment beta has the appearance of a trading strategy based on past stock returns.

Managers of a mutual fund may not knowingly trade stocks to change a fund's sentiment beta, but rather, believe they are considering one or more of the correlated attributes of these stocks, in view of anticipated market conditions. Such attributes may include: prior performance, size, turnover, stock liquidity, market beta, or return standard deviation. In this context, we regard sentiment beta as a convenient proxy that, by definition, also relates a stock's returns to investor sentiment. We develop a method that determines, with statistical confidence, whether a mutual fund is pursuing a particular trading strategy over a specific period of time. Specifically, we identify funds that, during a calendar quarter, intentionally adjust their stock portfolios to reflect past stock returns or the sentiment betas of these stocks. We find that 13.0% of funds trade to increase the sentiment beta, while 9.9% trade to reduce the sentiment beta of their stock portfolio over our fifteen-year sample period.

To adjust their sentiment beta ahead of changes to investor sentiment, mutual funds must form an opinion about the future direction of the change. Their opinion cannot be observed, but the trades they make can be observed using our method. On average, these trades align with those that would be conducted based on the mean reversion of investor sentiment. However, mutual funds also consider risk, and are cognizant of the sentiment beta of the extant portfolio and the portfolio's tracking error variance. We find that funds that trade to reduce tracking error variance also trade to restore the sentiment beta of their portfolio towards the mean of all funds. Conversely, funds that allow tracking error risk to increase trade towards extreme values of sentiment beta. Together, the prior level and change in investor sentiment, and the fund's management of portfolio risk, largely explain the sentiment beta trades we observe, although the marginal contribution of prior investor sentiment is small.

We show that when investor sentiment is high, (low) returns are greater for funds holding low (high) sentiment beta portfolios. This relation is consistent with Baker and Wurgler's (2007) finding relating stock returns, stock sentiment betas, and the level of sentiment, but revealed in a "real world" mutual fund context. Moreover, in the same period that investor sentiment increases (decreases), funds with high (low) sentiment betas experience better returns. Funds that increase (decrease) their sentiment beta in the same period that sentiment increases (decreases) also enhance their returns, however, their ability to forecast sentiment is an area for further research.

REFERENCES

Ammann, Manuel, Stephan Kessler, and Jurg Tobler, 2006, Analyzing active investment strategies using tracking error variance decomposition, *The Journal of Portfolio Management* 33, 56-67.

Antoniou, Constantinos, John A. Doukas, and Avanidhar Subrahmanyam, 2010, Sentiment and Momentum, Working Paper, http://ssrn.com/abstract=1479197.

Arena, Matteo P., K. Stephen Haggard, and Xuemin (Sterling) Yan, 2008, Price momentum and idiosyncratic volatility, *Financial Review* 43, 159-190.

Avramov, Doron, Tarun Chordia, and Amit Goyal, 2006, Liquidity and autocorrelations in individual stock returns, *Journal of Finance* 61, 2365-2394.

Badrinath, Swaminathan G., and Sunil Wahal, 2002, Momentum trading by institutions, *Journal of Finance* 57, 2449-2477.

Baker, Malcolm, and Jeffrey Wurgler, 2006, Investor sentiment and the cross-section of stock returns, *Journal of Finance* 61, 1645-1679.

Baker, Malcolm, and Jeffrey Wurgler, 2007, Investor sentiment in the stock market, *Journal of Economic Perspectives* 21, 129-151.

Brown, Keith C., W.V. Harlow, and Laura T. Starks, 1996, Of tournaments and temptations: An analysis of managerial incentives in the mutual fund industry, *Journal of Finance* 51, 85-110.

Chen, Hsiu-lang, and George G. Pennacchi, 2009, Does prior performance affect a mutual fund's choice of risk? Theory and further empirical evidence, *Journal of Financial and Quantitative Analysis* 44, 745-775.

Chevalier, Judith, and Glenn Ellison, 1997, Risk taking by mutual funds as a response to incentives, *Journal of Political Economy* 105, 1167-1200.

Chordia, Tarun, and Lakshmanan Shivakumar, 2002, Momentum, business cycle, and time-varying expected returns, *Journal of Finance* 57, 985-1019.

Conrad, Jennifer, and Gautam Kaul, 1998, An anatomy of trading strategies, *Review of Financial Studies* 11, 489-519.

Cooper, Michael J., Roberto C. Gutierrez Jr., and Allaudeen Hameed, 2004, Market states and momentum, *Journal of Finance* 59, 1345-1365.

Cullen, Grant, Dominic Gasbarro, and Gary S. Monroe, 2010, Mutual fund trades and the value of contradictory private information, *Journal of Banking and Finance* 34, 378-387.

Cullen, Grant, Dominic Gasbarro, Gary S. Monroe, and J. Kenton Zumwalt, 2012, Changes to mutual fund risk: Intentional or mean reverting?, *Journal of Banking and Finance* 36, 112-120.

Cornell, Brad, Wayne R. Landsman, and Stephen R. Stubben, 2011, Do institutional investors and security analysts mitigate the effects of investor sentiment?, Working Paper, http://ssrn.com/abstract=1848207.

De Groot, Wilma, Joop Huij, and Weili Zhou, 2012, Another look at trading costs and short-term reversal profits, *Journal of Banking and Finance* 36, 371-382.

Elton, Edwin J., Martin J. Gruber, Christopher R. Blake, Yoel Krasny, and Sadi O. Ozelge, 2010, The effect of holdings data frequency on conclusions about mutual fund behavior, *Journal of Banking and Finance* 34, 912-922.

Fama, Eugene F., and Kenneth R. French, 1995, Size and book-to-market factors in earnings and returns, *Journal of Finance* 50, 131-155.

Glushkov, Denys, 2006, Sentiment beta, Working Paper, http://ssrn.com/abstract =862444.

Gompers, Paul A., and Andrew Metrick, 2001, Institutional investors and equity prices, *Quarterly Journal of Economics* 116, 229-259.

Grinblatt, Mark, Sheridan Titman, and Russ Wermers, 1995, Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior, *American Economic Review* 85, 1088-1105.

Grundy, Bruce D., and J. Spencer Martin, 2001, Understanding the nature of the risks and the sources of the rewards to momentum investing, *Review of Financial Studies* 14, 29-78.

Hansen, Charlotte S., and Bjorn E. Tuypens, 2004, Long-run regressions: Theory and application to US asset markets, Working Paper, http://ssrn.com/abstract=609888.

Hjalmarsson, Erik, 2011, New methods for inference in long-horizon regressions, *Journal of Financial and Quantitative Analysis* 46, *815-839.*

Jorion, Philippe, 2003, Portfolio optimization with tracking error constraints, *Financial Analysts Journal* 59, 70-82.

Lesmond, David A., Michael J. Schill, and Chunsheng Zhou, 2004, The illusory nature of momentum profits, *Journal of Financial Economics* 71, 349-380.

Menkhoff, Lukas, and Ulrich Schmidt, 2005, The use of trading strategies by fund managers: Some first survey evidence, *Applied Economics* 37, 1719-1730.

Pastor, Lubos, and Robert F. Stambaugh, 2003, Liquidity risk and expected stock returns, *Journal of Political Economy* 111, 642-685.

Sias, Richard W., 2007, Reconcilable differences: Momentum trading by institutions, *Financial Review* 42, 1-22.

Zhang, X. Frank, 2006, Information uncertainty and stock returns, *Journal of Finance* 61, 105-136.

Formation period (t-1)			Trading period (t)				
SChI	Sbeta	Stock performance (relative)	Sbeta trade	Stock trade	Apparent strategy	Sentiment Trade Beta	Momentum Trade Beta
Increase (+)	High	Good	Increase	Buy	Momentum	+	+
			Decrease	Sell	Contrarian	-	-
	Low	Bad	Increase	Sell	Momentum	+	+
			Decrease	Buy	Contrarian	-	-
Decrease (-)	High	Bad	Increase	Buy	Contrarian	+	-
			Decrease	Sell	Momentum	-	+
	Low	Good	Increase	Sell	Contrarian	+	-
			Decrease	Buy	Momentum	-	+

Figure 1. Summary of how trades that change sentiment beta resemble momentum/contrarian trades.

The figure shows how the change in investor sentiment (SChI) during the portfolio formation period of a momentum or contrarian trading strategy differentially affects the performance of stocks according to their sentiment beta (Sbeta). In the subsequent period, trades to alter sentiment beta lead to the same outcome as momentum/contrarian strategies. For example, the first row shows that during the formation period, with increasing investor sentiment, stocks with high sentiment betas are expected to perform well and in the subsequent period, a fund’s decision to increase its sentiment beta by buying high sentiment beta stocks (positive SentimentTradeBeta) would resemble a momentum trade (positive MomentumTradeBeta).

Table I
Descriptive Statistics

Table I presents descriptive statistics for the period January, 1991, to December, 2005. Panel A reports the averages of the various stock attributes for each stock sentiment beta quintile from the full sample of 1,219,090 stock-months. Stock capitalization is standardized for growth in market capitalization over time before averaging; turnover (value) is the standardized market turnover of the stock multiplied by its price; and turnover (proportion) is the stock's market turnover divided by the number of shares outstanding. Panel B presents descriptive statistics for mutual funds and their associated trading periods. Panel C shows the distribution of three-month market returns and the three-month average of the BW07 sentiment changes index.

Panel A. Stock Attributes by Quintile of Sentiment Beta (Full Sample)

	Quintile of sentiment beta				
Quintile average of:	1	2	3	4	5
Sentiment beta	-0.0167	0.0048	0.0186	0.0397	0.0946
Market beta	0.5021	0.6043	0.8510	1.2017	1.9566
Return (monthly)	0.0106	0.0111	0.0102	0.0082	0.0063
Return standard deviation	0.1237	0.1001	0.1222	0.1625	0.2427
Stock capitalization	1.5875	1.4906	1.1808	0.9773	0.5522
Turnover (Value)	1.0657	1.0553	1.0489	1.3088	1.2918
Turnover (Proportion)	0.0728	0.0623	0.0774	0.1051	0.1514

Panel B. Fund Descriptive Statistics

	Mean	Median	SD
Number of fund-quarters	31,409		
Number of fund-quarters with matching returns	16,783		
Number of funds	2,450		
Number of stocks in portfolio	149	92	43
Portfolio weighted average sentiment beta	0.0192	0.0170	0.0149
Δ Portfolio weighted average sentiment beta	-0.0015	-0.0006	0.0049

Panel C. Market Descriptive Statistics

Value weighted market return (3-month)	0.0283	0.0333	0.0748
Sentiment changes index (3-month average)	-0.0016	0.0089	0.5532

Table II

Stock Return as a Function of Sentiment Changes Index and Sentiment Beta

Table II presents the regression:

$$R_{it} = a_0 + b_1R_{it-1} + b_2R_{it-1} \times Sbeta_i + b_3SI_{t-1} + b_4SI_{t-1} \times Sbeta_i + b_5SChI_t + b_6R_{it-1} \times SChI_t$$
$$+ b_7SChI_t \times Sbeta_i + b_8R_{it-1} \times SChI_t \times Sbeta_i + b_9Sbeta_i + b_{10}R_{it-1} \times Variance_i + \varepsilon_{jt},$$

where R_{it} is the return of stock i over period t in excess of the risk-free rate, R_{it-1} is the lagged excess return, $Sbeta_i$ is the sentiment beta of stock I, SI_{t-1} is the moving average of the BW07 monthly non-orthogonalized sentiment index at the start of period t, $SChI_t$ is the moving average of BW07's monthly non-orthogonalized sentiment changes index at time t, and $Variance_i$ is the variance of returns for stock i. Respectively, in Panels A, B and C we use intervals of one- two- and three-months to calculate returns, (designated R1M, R2M, and R3M, respectively) with corresponding numbers of months in the moving averages of the sentiment indexes. Panels D and E also use three-month moving averages, but use the three-month cumulated residuals from the CAPM (equation (3)) and three-factor Fama-French model (equation (4)), respectively, in place of excess return. The t-statistics are adjusted for autocorrelation using the Hjalmarsson (2011) correction and are in parentheses.

	Model				
	(1)	(2)	(3)	(4)	(5)
Panel A: Raw one-month excess returns					
Intercept	0.006	0.008	0.009	0.008	0.008
	(43.53)	(45.00)	(50.74)	(46.08)	(46.04)
$R1M_{it-1}$	0.002	-0.003		0.003	0.004
	(2.47)	(-2.56)		(2.48)	(2.97)
$R1M_{it-1}$ x $Sbeta_i$		0.117		0.151	0.180
		(6.84)		(9.17)	(10.17)
SI_{t-1}			-0.005		
			(-18.23)		
SI_{t-1} x $Sbeta_i$			-0.392		
			(-62.91)		
$S1ChI_t$				0.001	0.001
				(6.90)	(6.90)
$R1M_{it-1}$ x $S1ChI_t$				0.015	0.015
				(15.54)	(15.57)
$S1ChI_t$ x $Sbeta_i$				0.913	0.913
				(240.43)	(240.47)
$R1M_{it-1}$ x $Sbeta_i$ x $S1ChI_t$				-0.248	-0.250
				(-16.08)	(-16.15)
$Sbeta_i$		-0.054	-0.015	-0.053	-0.053
		(-15.37)	(-4.16)	(-15.75)	(-15.76)
$R1M_{it-1}$ x $Variance_i$					-0.028
					(-4.51)
N	1,132,192	1,132,192	1,132,192	1,132,192	1,132,192
Adjusted R^2	0.000	0.000	0.007	0.069	0.069

Panel B: Raw two-month excess returns					
Intercept	0.001	0.004	0.005	0.004	0.004
	(7.21)	(22.03)	(27.19)	(22.60)	(22.66)
$R2M_{it-1}$	0.031	0.025		0.034	0.033
	(22.90)	(14.02)		(20.27)	(19.52)
$R2M_{it-1}$ x $Sbeta_i$		0.107		0.295	0.248
		(4.32)		(12.35)	(9.70)
SI_{t-1}			-0.006		
			(-19.65)		
SI_{t-1} x $Sbeta_i$			-0.346		
			(-56.53)		
$S2ChI_t$				0.003	0.003
				(21.91)	(21.91)
$R2M_{it-1}$ x $S2ChI_t$				0.007	0.007
				(6.82)	(6.62)
$S2ChI_t$ x $Sbeta_i$				0.471	0.471
				(170.71)	(170.63)
$R2M_{it-1}$ x $Sbeta_i$ x $S2ChI_t$				-0.131	-0.124
				(-7.69)	(-7.28)
$Sbeta_i$		-0.103	-0.074	-0.105	-0.104
		(-28.93)	(-20.80)	(-30.61)	(-30.57)
$R2M_{it-1}$ x $Variance_i$					0.047
					(4.98)
N	1,105,310	1,105,310	1,132,192	1,105,310	1,105,310
Adjusted R^2	0.001	0.003	0.013	0.079	0.079

Panel C: Raw three-month excess returns					
Intercept	0.002	0.004	0.004	0.003	0.003
	(21.79)	(31.20)	(33.27)	(31.07)	(31.19)
$R3M_{it-1}$	0.022	0.023		0.038	0.035
	(13.06)	(10.54)		(17.86)	(16.78)
$R3M_{it-1}$ x $Sbeta_i$		-0.057		0.308	0.207
		(-1.88)		(10.58)	(6.60)
SI_{t-1}			-0.003		
			(-16.36)		
SI_{t-1} x $Sbeta_i$			-0.172		
			(-44.25)		
$S3ChI_t$				0.001	0.001
				(16.57)	(16.47)
$R3M_{it-1}$ x $S3ChI_t$				-0.003	-0.003
				(-2.61)	(-2.96)
$S3ChI_t$ x $Sbeta_i$				0.211	0.211
				(141.25)	(141.19)
$R3M_{it-1}$ x $Sbeta_i$ x $S3ChI_t$				-0.138	-0.125
				(-7.82)	(-7.08)
$Sbeta_i$		-0.054	-0.038	-0.056	-0.056
		(-23.73)	(-16.70)	(-25.61)	(-25.46)
$R3M_{it-1}$ x $Variance_i$					0.097
					(8.60)
N	1,092,023	1,092,023	1,132,192	1,092,023	1,092,023
Adjusted R^2	0.001	0.002	0.013	0.081	0.081

Panel D: Cumulative three-month CAPM residuals					
Intercept	0.002	0.003	0.001	0.003	0.003
	(3.93)	(6.14)	(1.30)	(6.52)	(6.52)
$CAPMR3M_{it-1}$	-0.025	-0.015		-0.012	-0.012
	(-15.14)	(-7.14)		(-5.70)	(-5.71)
$CAPMR3M_{it-1}$ x $Sbeta_i$		-0.239		-0.029	-0.034
		(-7.71)		(-0.96)	(-1.05)
SI_{t-1}			0.008		
			(9.63)		
SI_{t-1} x $Sbeta_i$			-0.274		
			(-16.32)		
$S3ChI_t$				-0.010	-0.010
				(-36.18)	(-36.18)
$CAPMR3M_{it-1}$ x $S3ChI_t$				0.006	0.006
				(5.36)	(5.33)
$S3ChI_t$ x $Sbeta_i$				0.661	0.661
				(99.86)	(99.86)
$CAPMR3M_{it-1}$ x $Sbeta_i$ x $S3ChI_t$				-0.066	-0.066
				(-3.63)	(-3.57)
$Sbeta_i$		-0.052	-0.012	-0.061	-0.061
		(-5.30)	(-1.25)	(-6.25)	(-6.26)
$CAPMR3M_{it-1}$ x $Variance_i$					0.005
					(0.43)
N	1,091,461	1,091,461	1,130,254	1,091,461	1,091,461
Adjusted R^2	0.001	0.001	0.001	0.029	0.029

Panel E: Cumulative three-month Fama-French residuals					
Intercept	-0.000	-0.000	0.000	0.000	0.000
	(-0.37)	(-0.06)	(0.25)	(0.05)	(0.05)
$FFR3M_{it-1}$	-0.037	-0.032		-0.031	-0.031
	(-21.99)	(-15.09)		(-14.74)	(-14.74)
$FFR3M_{it-1}$ x $Sbeta_i$		-0.115		-0.103	-0.100
		(-3.71)		(-3.33)	(-3.03)
SI_{t-1}			0.000		
			(0.59)		
SI_{t-1} x $Sbeta_i$			-0.142		
			(-8.95)		
$S3ChI_t$				-0.008	-0.008
				(-27.63)	(-27.63)
$FFR3M_{it-1}$ x $S3ChI_t$				-0.008	-0.008
				(-7.18)	(-7.16)
$S3ChI_t$ x $Sbeta_i$				0.373	0.373
				(59.43)	(59.42)
$FFR3M_{it-1}$ x $Sbeta_i$ x $S3ChI_t$				-0.117	-0.118
				(-5.93)	(-5.93)
$Sbeta_j$		-0.004	0.010	-0.013	-0.013
		(-0.47)	(1.05)	(-1.40)	(-1.39)
$FFR3M_{it-1}$ x $Variance_i$					-0.003
					(-0.25)
N	1,091,461	1,091,461	1,130,254	1,091,461	1,091,461
Adjusted R^2	0.001	0.001	0.000	0.011	0.011

Table III

Investor Sentiment Change

Table III presents the BW07 sentiment changes index averaged over one, two, and three months in turn, regressed on the sentiment index at the start of each of the one, two, and three month periods, and values of the average of the sentiment changes index lagged by one, two and three months, respectively, for the period January, 1991, to December, 2005, as follows:

$$SChI_t = a_0 + b_1 SI_{t-1} + b_2 SChI_{t-1} + \varepsilon_{jt},$$

where $SChI_t$ is the one-, two- and three-month averages of the BW07 non-orthogonalized monthly investor sentiment changes index, SI_{t-1} is the BW07 non-orthogonalized monthly investor sentiment index at the start of period t, which is one-, two- and three-months in models (1), (2), and (3), respectively. The t-statistics are adjusted for autocorrelation using the Hjalmarsson (2011) correction and are in parentheses.

	Model		
	(1)	(2)	(3)
Intercept	0.042	-0.037	-0.031
	(0.58)	(0.53)	(0.46)
SI_{t-1}	-0.276	-0.233	-0.191
	(-2.28)	(-2.02)	(-1.75)
$SChI_{t-1}$	-0.092	-0.192	-0.260
	(-1.28)	(-1.91)	(-2.142)
N	192	191	190
Adjusted R^2	0.021	0.056	0.086

Table IV
Significant Sentiment, Momentum, and Tracking Error Variance Contribution Trade Betas

Table IV shows the number of statistically significant (10%, 2-tailed) momentum, sentiment, and tracking error variance contribution (TEVC) trade betas generated for each fund-quarter over the period January 1991 to December 2005. These trade betas are obtained from the regression:

$$TradeValue_j = \alpha + \beta\, BucketPP_j + \varepsilon_j ,$$

where $TradeValue_j$ is the value of stocks in prior return 'bucket' j that are traded during a quarter, and $BucketPP_j$ is the value-weighting of, in turn, stock prior return (momentum), stock sentiment beta, and stock TEVC of the stocks in 'bucket' j. Cumulative binomial distribution critical values reflect a 1% probability that a greater count occurs by chance. *** indicates significance at the 1 percent level (two tailed). ^{L} denotes lower than critical value.

			Fund-quarter Trade Beta			
		Binomial	Negative		Positive	
	N	Critical Values	Count	Percent	Count	Percent
Momentum	31,409	1,660	4,777	15.2***	4,702	15.0***
Sentiment	30,992	1639	3,054	9.9***	4,043	13.0***
TEVC	27,344	1283/1451	6,055	22.1***	1,252	4.6***^{L}

Table V
Momentum Trade Beta

Table V presents the logistic regression:

$$MomentumTradeBeta_{jt} = a_0 + b_1 SentimentTradeBeta_{jt} + b_2 SentimentTradeBeta_{jt} \times SChI_{t-1} + \varepsilon_{jt},$$

where $MomentumTradeBeta_{jt}$ are the signed statistically significant 'β' coefficients estimated using equation (6) for each fund, j, in period t when stocks are ranked on prior performance, $SentimentTradeBeta_{jt}$ are the signed statistically significant 'β' coefficients when stocks are ranked on stock sentiment beta, and $SChI_{t-1}$ are the three-month averages of BW07 non-orthogonalized monthly investor sentiment changes index. The p-values are in parentheses.

	Model			
	(1)		(2)	
Intercept	-0.009		0.014	
	(0.809)		(0.767)	
Sentiment Trade Beta $_{jt}$	0.070		0.077	
	(0.069)		(0.103)	
Sentiment Trade Beta $_{jt}$ x $SChI_{t-1}$			2.500	
			(0.000)	
Predicted	Contrarian	Momentum	Contrarian	Momentum
Observed Contrarian	613	747	1042	318
Observed Momentum	566	794	324	1036
Percent correct	51.7		76.4	
Cox & Snell R^2	0.001		0.315	
Nagelkerke R^2	0.002		0.420	

Table VI
Sentiment Trade Beta

The table presents the logistic regression:

$$\text{SentimentTradeBeta}_{jt} = a_0 + b_1 \text{FQSBeta}_{jt\text{-}1} + b_3 \text{SI}_{t\text{-}1} + b_4 \text{ChSI}_{t\text{-}1} + b_4 \text{ChSI}_{t} + \varepsilon_{jt}$$

where $\text{SentimentTradeBeta}_{jt}$ are the signed statistically significant 'β' coefficients estimated using equation (6) for each fund j in period t when stocks are ranked on stock sentiment beta, $\text{FQSBeta}_{jt\text{-}1}$ is the value-weighted average of the sentiment betas of the stocks held by fund j at the start of quarter t, and $\text{SChI}_{t\text{-}1}$ and SChI_t are the three-month averages of BW07 non-orthogonalized monthly investor sentiment changes index over quarters t-1 and t, respectively. Panel A consists of all 7,097 fund-quarters with statistically significant SentimentTradeBetas covering the period January 1991 to December 2005; and Panels B and C consist of the subsets of funds with statistically positive or negative tracking error variance contribution (TEVC) trade betas, respectively. The p-values are in parentheses.

	Model							
	(1)		(2)		(3)		(4)	
Panel A All Fund-periods								
Intercept	0.773		0.293		0.785		0.786	
	(0.000)		(0.000)		(0.000)		(0.000)	
$\text{FQSbeta}_{jt\text{-}1}$	-23.244				-22.900		-22.870	
	(0.000)				(0.000)		(0.000)	
$\text{SI}_{t\text{-}1}$			-0.050		-0.075		-0.065	
			(0.141)		(0.032)		(0.072)	
$\text{SChI}_{t\text{-}1}$			-0.255		-0.223		-0.220	
			(0.000)		(0.000)		(0.000)	
SChI_t							0.045	
							(0.313)	
Predicted	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos
Observed Negative	846	2208	153	2901	896	2158	901	2153
Observed Positive	630	3413	113	3930	640	3403	638	3405
Percent correct	60.0		57.5		60.6		60.7	
Cox & Snell R^2	0.034		0.006		0.038		0.038	
Nagelkerke R^2	0.046		0.008		0.051		0.052	

Panel B Tracker fund-periods								
Intercept	4.505		-0.049		5.115		5.132	
	(0.000)		(0.279)		(0.000)		(0.000)	
$FQSbeta_{jt-1}$	-267.307				-287.504		-288.584	
	(0.000)				(0.000)		(0.000)	
SI_{t-1}			-0.246		-0.898		-0.921	
			(0.000)		(0.000)		(0.000)	
$SChI_{t-1}$			-0.416		-0.705		-0.710	
			(0.000)		(0.000)		(0.000)	
$SChI_t$							-0.203	
							(0.136)	
Predicted	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos
Observed Negative	1128	131	872	387	1130	129	1132	127
Observed Positive	119	996	592	523	109	1006	109	1006
Percent correct	89.5		58.8		90.0		90.1	
Cox & Snell R^2	0.585		0.019		0.600		0.600	
Nagelkerke R^2	0.781		0.025		0.801		0.802	
Panel C Anti-tracker fund-periods								
Intercept	-4.219		0.059		-4.951		-4.944	
	(0.000)		(0.000)		(0.000)		(0.000)	
$FQSbeta_{jt-1}$	339.046				365.151		364.028	
	(0.000)				(0.000)		(0.000)	
SI_{t-1}			0.373		1.303		1.344	
			(0.002)		(0.000)		(0.000)	
$SChI_{t-1}$			-0.004		-0.254		-0.222	
			(0.977)		(0.381)		(0.454)	
$SChI_t$							0.223	
							(0.485)	
Predicted	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos
Observed Negative	202	19	0	221	205	16	205	16
Observed Positive	21	412	0	433	16	417	16	417
Percent correct	93.9		66.2		95.1		95.1	
Cox & Snell R^2	0.604		0.016		0.621		0.621	
Nagelkerke R^2	0.837		0.022		0.860		0.860	

Table VII
Crosstabulation of Change in Fund-quarter Sentiment Beta and Sentiment Trade Beta

For the period January 1991 to December 2005, Table VII crosstabulates the number of funds in each quintile of ΔFQSbeta by Sentiment Trade Beta, where $SentimentTradeBeta_{jt}$ are the signed statistically significant 'β' coefficients estimated using Equation (6) for each fund j in period t when stocks are ranked on stock sentiment beta; $\Delta FQSBeta_{jt-1}$ is the change in the value-weighted average of the sentiment betas of the stocks held by fund j over quarter t.

Quintile of ΔFQSbeta		Quintile Average	Sentiment Trade Beta		
			Negative	Not Significant	Positive
Low	1	-0.0086	1737	3925	171
	2	-0.0022	794	4982	211
	3	-0.0006	344	5402	321
	4	0.0004	61	5253	733
High	5	0.0034	7	3470	2488

Table VIII
Fund Excess Return as a Function of Change in Sentiment Beta

Table VIII presents the fund's excess market return as a function of the interaction of fund sentiment beta and changes to fund sentiment betas over a quarter, each with the sentiment index and the sentiment changes index for the period January 1991 to December 2005, in turn, based on the following regression:

$$R_{jt} = a_0 + b_1 SI_{t-1} + b_2 FQSBeta_{jt-1} + b_3 FQSBeta_{jt-1} \times SI_{t-1} + b_4 SChI_t + b_5 FQSBeta_{jt-1} \times SChI_t + b_6 \Delta FQSBeta_{jt} + b_7 \Delta FQSBeta_{jt} \times FQSBeta_{jt-1} + b_8 \Delta FQSBeta_{jt} \times SI_{t-1} + b_9 \Delta FQSBeta_{jt} \times SChI_t + \varepsilon_{jt},$$

where R_{jt} is the return in excess of the value-weighted market return for fund j in quarter t, $FQSBeta_{jt-1}$ is the weighted average of the stock sentiment betas in the portfolio of fund j at the start of quarter t, SI_{t-1} is the BW07 non-orthogonalized monthly investor sentiment index at the start of quarter t; $SChI_t$ is the three-month average of BW07 non-orthogonalized monthly investor sentiment changes index over quarter t, and $\Delta FQSBeta_{jt}$ is the change to the fund's sentiment beta caused by trading during quarter t. The t-statistics are adjusted for autocorrelation using the Hjalmarsson (2011) correction and are in parentheses.

	Model			
	(1)	(2)	(3)	(4)
Intercept	0.000	-0.005	-0.004	-0.007
	(0.12)	(-1.18)	(-0.88)	(-1.82)
SI_{t-1}	0.056	0.005	0.050	-0.004
	(10.59)	(0.91)	(9.18)	(-0.70)
$FQSbeta_{jt-1}$	-0.245	0.115	0.158	0.332
	(-1.51)	(0.76)	(0.84)	(1.92)
$FQSbeta_{jt-1}$ x SI_{t-1}	-2.636	-0.124	-1.921	0.601
	(-11.34)	(-0.54)	(-6.96)	(2.28)
$SChI_t$		-0.224		-0.235
		(-31.18)		(-31.15)
$FQSbeta_{jt-1}$ x $SChI_t$		9.597		10.119
		(31.82)		(29.01)
$\Delta FQSbeta_{jt}$			-3.268	1.352
			(-2.69)	(1.18)
$\Delta FQSbeta_{jt}$ x $FQSbeta_{jt-1}$			116.244	3.100
			(4.40)	(0.13)
$\Delta FQSbeta_{jt}$ x SI_{t-1}			3.338	4.679
			(3.90)	(5.57)
$\Delta FQSbeta_{jt}$ x $SChI_t$				4.241
				(3.79)
N	17,064	17,064	16,591	16,591
Adjusted R^2	0.028	0.187	0.036	0.196