A Test of the Different Implications of Overconfidence and Disposition Hypotheses

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ABSTRACT

Under both the overconfidence and disposition biases, a positive relationship is predicted between prior returns and subsequent trading volume. However, theoretically the overconfidence and disposition effects have different implications on the relationships between the long- and short-position gains of traders and their subsequent buying and selling activities. Many of the prior studies have been unable to differentiate between these two effects. We examine a unique dataset obtained from the Taiwan Futures Exchange which records all account-level trades and orders. By adopting signed volume, along with an order aggressiveness measure, we are able to examine the different implications of the overconfidence and disposition hypotheses. We demonstrate that the trading behavior of investors is consistent with both the overconfidence and disposition hypotheses, indicating that the conclusions drawn in many of the studies in the literature may be doubtful, where the examination of either of these two hypotheses has been undertaken by testing the relationship between returns and volume. We further test these two hypotheses based upon different types of traders, and find that the tendency to demonstrate behavioral biases is much stronger for individual traders.

Keywords: Disposition effect; Order aggressiveness; Overconfidence; Signed volume.

JEL Classification: G10; G11.

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1. INTRODUCTION

Extensive evidence has been presented in the extant literature of a positive relationship between trading activity and prior returns. Both the overconfidence and disposition biases have been proposed to explain this positive relationship. Theoretical models are developed, for example, in both Daniel et al. (1998) and Odean (1998), based upon the overconfidence of investors, from which they conclude that following positive returns, there will be an increase in volume when such returns have the effect of boosting the confidence of investors.

The disposition effect, proposed by Shefrin and Statman (1985), also implies that volume follows returns, because investors are reluctant to sell after accruing poor returns, and also eager to lock in gains after an increase in stock prices. Hence, both the overconfidence and disposition effects could result in a positive relationship between trading activity and prior returns. One particular consequence of this is that it is quite difficult to empirically differentiate between the overconfidence and disposition effects based purely upon a positive return-volume relationship.

Nevertheless, the overconfidence and disposition effects have different implications for the relationship between long- and short-position gains and subsequent buying and selling activities. In this study, we adopt the signed volume along with an order aggressiveness measure to examine a unique account-level
dataset obtained from the Taiwan Futures Exchange (TAIFEX). As will be discussed below, our account-level data has the advantage of being able to differentiate between these two effects. We are able to observe the positions taken up by investors, and thereby, to examine their trading profitability. Signed volume can then be used to test the relationship between prior long- and short-position gains and the subsequent buying and selling activities of investors, while the order aggressiveness measure is able to better capture latent buying and selling intentions of traders following long- and short-position gains.

Behavioral models are proposed in several studies (Barberis et al., 1998; Daniel et al., 1998; Hong and Stein, 1999) based upon the notion that momentum profits arise as a result of inherent biases in the ways in which investors interpret the information they receive. Daniel et al. (1998) demonstrate that in the presence of investor overconfidence and self-attribution bias, changes in securities prices exhibit short-term momentum, largely due to excessive buying and selling. The self-attribution bias refers to the propensity for investors to credit themselves with their prior successes.

It is argued in numerous studies (Barberis et al., 1998; Daniel et al., 1998; Gervais and Odean, 2001; Statman et al., 2006; O’Connell and Teo, 2009; Glaser and Weber, 2009) that such self-attribution bias leads to a tendency among investors
to overweight their prior experience of success, since it confirms their original evaluation of a stock. As a result, experiences of prior success in their trading activities will give rise to overconfidence among investors in their original predictions of the price trends, and this will tend to make them engage in more aggressive buying or selling in accordance with their prior positions. According to the overconfidence hypothesis, if investors have previously held a long (short) position, then trading gains from that position would induce them to buy (sell) more in the subsequent period, and to do so more aggressively.

On the other hand, the disposition effect (Shefrin and Statman, 1985) also implies that volume follows returns, because investors are reluctant to trade after accruing poor returns, but they will be keen to lock in their gains. The positive relationship between individual securities turnover and lagged returns is interpreted by Statman et al. (2006) as evidence of the disposition effect, while the positive relationship between market share turnover and lagged returns is interpreted as evidence of the overconfidence effect; however, they point out that the distinctions between overconfident trading and the disposition effect are somewhat subjective, and rather difficult to differentiate.

According to the disposition effect, investors will tend to sell quickly after making gains while holding on to their positions after making losses. In the present
study, we argue that if investors have previously held a profitable long (short) position, then in order to quickly realize their gains, they will hastily sell off (cover) their long (short) position and engage in more aggressively selling (buying) in the subsequent period. This is a prediction which contrasts the overconfidence hypothesis. Thus, we see the overconfidence and disposition effects as having different implications on the relationship between long and short position gains and the subsequent directions of trading (buying and selling) activities of investors.

In this study, we make use of the available information on the position of investors, along with the signed volume and order aggressiveness measures, to assess the different implications of the overconfidence and disposition hypotheses. To the best of our knowledge, no such approach has been adopted in the extant literature. Our study differs from the extant literature on these two hypotheses in the following ways. Firstly, in the majority of the prior studies, market-level data are used to test the relationship between returns and volume.¹ This is possibly due to the fact that it is difficult to directly observe the trading volume and returns of investors at the account level. However, in the model proposed by Gervais and Odean (2001), there are dynamic changes in the level of overconfidence which is exhibited by

¹ Examples include Lin (2005), Chuang and Lee (2006), Statman et al. (2006) and Griffin et al. (2007).
investors based upon their own prior successes and failures, as opposed to prior market returns.

In a recent study, Glaser and Weber (2009) note that investors will tend to buy high-risk stocks after experiencing high portfolio returns, whereas high prior market returns do not lead to similar propensity for higher risk taking. Thus, they show that the portfolio returns of investors are more related to their subsequent trading activity than they are to market returns. Since our dataset contains all trades at the account level, we can examine the relationship between the returns accrued from the prior positions held by investors and their subsequent trading activities, which is a test better suited to the theoretical predictions.

Secondly, trading volume is used in the prior literature (Lin, 2005; Chuang and Lee, 2006; Statman et al., 2006; Griffin et al., 2007) to explore the relationship between returns and volume. However, it is possible that the positive relationship reported in many of these studies being attributable to both the overconfidence and disposition biases. Given that our account-level data can be used to identify the direction of trades (buying and selling), we examine signed volume, which has the advantage of being able to distinguish between the overconfidence and disposition effects.
Thirdly, the prior studies mostly examine trading volume subsequent to trading gains. However, since volume contains only information on the total amount of trades, it therefore provides no information on order aggressiveness. It is argued in various studies (Gervais and Odean, 2001; Wang, 2001; Chuang and Lee, 2006) that if investors are overconfident, then they will tend to trade more aggressively. The overconfidence models predict that when the level of overconfidence is high, there will be a corresponding increase in the aggressiveness of traders. It is thus plausible that they will submit more aggressive orders in order to increase the chance of such orders being executed.

Similarly, the disposition effect implies that investors are likely to close their positions more aggressively after gains than after losses. Direct tests of the order aggressiveness are absent in the literature. We adopt a quantitative measure, which takes into account both the quantity and the price of orders submitted, in an attempt to capture a trader’s order aggressiveness level. By calculating the returns and subsequent order aggressiveness at the account level, we can perform tests which provide a better match with the theoretical predictions of both the overconfidence and disposition hypotheses.

Finally, we test the overconfidence and the disposition hypotheses by different types of traders. Individual investors are generally regarded as being more likely to be
influenced by behavioral biases than institutional investors. Statman et al. (2006) find that the positive relationship between market returns and volume is more pronounced in periods where individual investors hold a greater proportion of shares.

From their investigation of the dynamic relationship between market-wide trading activity and the stock returns of 46 countries, Griffin et al. (2007) find that in Japan, Taiwan and Thailand, the responses to prior trading volume are much stronger from individuals than from institutions. Using a sample of discount brokerage accounts, Odean (1999) and Barber and Odean (2000, 2001, 2002) also find apparent overconfidence among individual investors both with regard to the information which they possess and in their perceived ability to trade, such that they will trade too much.

Nevertheless, other studies (Shapira and Venezia, 2001; Garvey and Murphy, 2004; Barber et al., 2007) show that the disposition effect exists not only for individual traders, but also for institutional traders. It would clearly be of considerable interest if we were able to determine whether professional traders do in fact exhibit similar overconfidence and disposition biases to those commonly associated with individual traders. Given the availability of detailed account-level trade and order history in our study, we are able to provide such additional evidence,
and therefore, a clearer picture on the overconfidence and disposition effects by different types of traders.

We analyze account-level data on the TAIFEX between January 2001 and December 2006. We find a positive relationship between prior returns and subsequent total trading volume, which is largely in line with those reported in the prior literature (Chuang and Lee, 2006; Statman et al., 2006). However, this might well be consistent with either the overconfidence or disposition biases, or both.

We go on to explore the relationship between prior long- and short-position returns and the subsequent signed trading volume, as well as subsequent buy and sell order aggressiveness, since these tests can be used to distinguish between the overconfidence and disposition effects. Interestingly, we find that both the overconfidence and disposition effects are significant, indicating that investors simultaneously exhibit both types of behavioral biases. These results bring into question the conclusions drawn by the prior studies, such as Chuang and Lee (2006) and Statman et al. (2006), in which examinations of either of these two hypotheses are undertaken by testing the relationship between total volume and past returns and they were unable to distinguish between the two distinctive effects.

We further examine the overconfidence and disposition hypotheses for different types of traders and find that the effects are significant for both institutional and
individual traders, while individual traders tend to exhibit stronger behavioral biases. These results are again consistent with the findings in the literature, that individual investors are particularly prone to behavioral biases.

The remainder of the paper is organized as follows. A description of the trading mechanism of the TAIFEX is provided in Section 2, along with an explanation of the data sample. This is followed in Section 3 by the presentation of our empirical analyses and results. Finally, the conclusions drawn from this study are presented in Section 4.

2. MARKET DESCRIPTION AND DATA SAMPLE

2.1 The Trading Mechanism of the Taiwan Futures Exchange

The TAIFEX is an order-driven electronic futures market in which there are no designated market makers and futures prices are determined by the limit and market orders which are submitted by traders and executed under a price and time priority system. Prior to July 29, 2002, the TAIFEX was operated under an automated (ten-second) batch-call system, but was transformed to a continuous auction system thereafter. Trading on the TAIFEX is conducted from 8:45 a.m. to 1:45 p.m. on Mondays to Fridays (excluding public holidays), with the price limits on the TAIFEX being ±7% of the previous day’s close.
2.2 Data Sample

Our sample comprises of all Taiwan Capitalization Weighted Stock Index (TAIEX) futures contracts traded on the TAIFEX between January 2001 and December 2006. The TAIEX is a value-weighted index of all common stocks listed on the Taiwan Stock Exchange (TSE), where the trading units of the TAIEX futures are the index value of the TAIEX × 200 New Taiwan Dollars (NT$). The nearby contracts are used in our analysis because they are the most liquid contracts.²

Our dataset contains detailed information on the order flow, order book, and transaction data. For each order, the dataset reports the date and time of the arrival of the order, its direction (buy or sell), the quantity, the price, order types (limit or market order), and most importantly, the account identification, which includes the type of trader. The transaction data include the date and time of the transaction, its direction (buy or sell), the quantity, transaction price, and the identity of the traders. Since the dataset provides account identification, we are able to trace specific trading activities to a particular account. Thus, we can explore both the buying and selling activities of traders, as well as their level of order aggressiveness subsequent to trading gains at the account level.

² During the maturity month, the nearby futures prices are rolled over to the first deferred contract when the trading volume of the first deferred contract is greater than the trading volume of the nearby contract. The rollovers often occur in the middle or later parts of the maturity month.
We define investors as holding a net long (short) position, if their cumulative buy volume during a sample holding period is larger (smaller) than their cumulative sell volume. The direction of orders and trades (either buy or sell) is important, since it enables us to explore the relationship between the net long- and net short-position returns, and both the subsequent buy and sell volume and the level of order aggressiveness. Traders are further classified into four types: individual traders, domestic institutions, futures proprietary firms, and foreign institutions to evaluate the overconfidence and disposition hypotheses by the different types of traders.

3. EMPIRICAL ANALYSES AND RESULTS

3.1 Summary Statistics

As in the literature, we begin by examining trading volume following trading gains, where volume is the daily total buy and sell volume of each trader. In order to more precisely capture the level of aggressiveness of our traders, we further adopt a quantitative measure of order aggressiveness. Following Chou and Wang (2009), buy order aggressiveness is defined as:

$$\text{Agg}^{b} = \frac{\sum_{i}(P_{i}^{*} - P_{i}^{b}) \times Q_{i}^{b}}{Q_{i}^{bt}}$$, \hspace{1cm} (1)

and sell order aggressiveness is defined as:
\[
Agg^s = \frac{\sum_i (P^s_i - P^s_i^*) \times Q^s_i}{Q^{sr}},
\]

where \( P^s_i \) is the immediate transaction price of the \( i^{th} \) order; \( P^b_i (P^s_i) \) is the \( i^{th} \) buy (sell) order price; \( Q^b_i (Q^s_i) \) is the \( i^{th} \) buy (sell) order size; and \( Q^{br} (Q^{sr}) \) is the total buy (sell) order size. From Equations (1) and (2), the smaller the indices \( Agg^b \) and \( Agg^s \), the greater the level of order aggressiveness.

In order to calculate an investor’s prior trading gains, we follow the method proposed in Puckett and Yan (2008). For each account on a sample day, we look back through its trading history for the previous five days. We define traders as holding a net long (short) position if their cumulative buy (sell) volume is greater than the cumulative sell (buy) volume, and measure the returns for each buy (sell) transaction in the position as the log (negative log) difference between the price at the end of the five-day holding period and the transaction price. The net long or net short position returns are then calculated by averaging all of the transaction returns during the five-day holding period.

The summary statistics of the holding-period returns for net long and net short positions, average daily trade volume, and order aggressiveness are presented in

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3 Odean (1998) and Gervais and Odean (2001) do not specify any exact timeframe for the lead-lag relationship between returns and trading activity, as their models simply predict that high (low) returns will lead to high (low) subsequent trading volume. We go on to examine the returns defined by the previous five-, ten- and twenty-five-day holding periods, and find that the results are qualitatively similar.
Table 1. Panel A reports the statistics for all traders, and Panels B, C, D and E report the statistics for foreign institutions, domestic institutions, futures proprietary firms and individual traders, respectively. The number of observations refers to the sample account-days, with the *Returns* variable being defined in terms of the five-day holding period for both net long and net short positions. As we can see from Panel A, the mean buy (sell) order aggressiveness is 6.37 (4.99), which indicates that traders tend to engage in more aggressive selling than buying.

As shown in Panels B, C, D and E of Table 1, individual traders comprise of 98.13% of the sample account-days, the highest among all types of traders. Futures proprietary firms rank second (0.83%). Domestic institutions, which include government-owned firms and domestic corporations, rank third (0.79%), and foreign institutions account for only 0.25% of all samples. It should be noted that futures proprietary firms differ from futures brokers as they trade futures on their own accounts; in other words, they trade to make profits, as opposed to earning commission.

For average daily trading volume, futures proprietary firms trade the largest amount of contracts (buy = 148, sell = 145), while individuals trade the smallest amount (buy = 3, sell = 3). Comparing order aggressiveness by trader types, we find
that the order aggressiveness measures for foreign institutions are the smallest (buy = 5.51, sell = 2.11), indicating that foreign institutions tend to trade more aggressively than other types of traders.

3.2 Signed Volume and Order Aggressiveness following Gains and Losses

As discussed earlier, the overconfidence hypothesis of Gervais and Odean (2001) predicts that if investors are overconfident, they will tend to trade more aggressively after a period of gains, since their prior successful trading experience create overconfidence in their original price trend predictions. If investors hold a net long (short) position, such trading gains would then induce them to buy (sell) more in the subsequent period, and to do so more aggressively.

Conversely, the disposition hypothesis of Shefrin and Statman (1985) implies that volume follows returns, because investors are reluctant to trade after poor returns, but they will be keen to lock in their gains. Thus, if investors hold a net long (short) position, trading gains in that position would then make them sell off (buy back) more aggressively in the subsequent period, a prediction which directly contrasts the overconfidence hypothesis.

We adopt both the signed volume measure and the order aggressiveness measure in this study to test the different implications of these two hypotheses. Table
2 presents the results for subsequent total trading volume, signed volume and order aggressiveness for all traders, classified by their prior position gains and losses.

<Table 2 is inserted about here>

Panel A of Table 2 presents the results for total volume and Panels B and C present signed volume and order aggressiveness for the overconfidence and disposition hypotheses. Prior position gains and losses are defined on the basis of whether the position returns are positive or negative. Panel A reveals that investors who have experienced either prior net long- or net short-position gains will tend to trade more than those who have experienced prior losses; however, these results could be due to either the overconfidence effect or the disposition effect, or both.

In order to distinguish between the two effects, we next examine the signed volume and order aggressiveness following prior net long- and net short-position gains. We begin by testing the overconfidence hypothesis, and find from Panel B(1) of Table 2 that those investors who accrued profits in their previous net long positions are more likely to buy, and to buy more aggressively, than those experiencing prior net long-position losses.

For example, for those investors experiencing prior net long-position gains, the mean buy volume is 4.81, while that for those experiencing prior net long-position losses is 3.63. The mean buy order aggressiveness is 3.76 for those experiencing
prior long-position gains, while that for those experiencing prior net long-position losses is 6.78. These results thereby indicate that traders have a tendency to buy and to buy more aggressively following long position gains. Panel B(2) similarly reveals that those investors who accrued profits in their prior net short positions were more likely to sell, and to do so more aggressively.

The non-parametric Kruskal-Wallis statistics in Panel B show that the differences in both signed trading volume and order aggressiveness are all significant at the 1% level. We find that prior successes in net long (short) positions induce investors to buy (sell) more in the subsequent period, and to do so more aggressively. These results are consistent with the overconfidence hypothesis, which posits that investors tend to overweight their prior experience of trading in which their original valuation has been successfully confirmed.

Turning to the disposition effect, we can see from Panel C(1) of Table 2 that investors who have experienced gains in their prior net long positions are more likely to sell, and to do so more aggressively than those investors who have experiences losses in their prior net long positions. The differences between gain and loss positions with regard to sell volume and sell order aggressiveness are all significant at the 1% level.
Panel C(2) similarly shows that investors who have experienced gains from their prior net short positions are more likely to buy back, and to do so more aggressively than those who have experienced losses in their prior short positions. These results provide support for the disposition hypothesis, as they confirm that while investors are keen to lock in their gains, they are, nevertheless, reluctant to realize their losses.

By exploring the relationship between the returns from the prior long and short positions of traders and their subsequent signed volume and order aggressiveness, we are able to separately test the overconfidence and disposition effects based upon their distinct theoretical perspectives. We find that despite the fact that they are two theoretically distinct behavioral biases, both the overconfidence and disposition effects contribute to the positive relationship between prior returns and subsequent volume. The implications of our findings are that conclusions drawn in many of the prior studies (e.g., Chuang and Lee, 2006; Statman et al., 2006) are likely to be ambiguous, because examinations of either of these two hypotheses are undertaken by testing the relationship between total volume and prior returns. We argue that when testing either the overconfidence or the disposition hypothesis, an examination of volume may be inappropriate.
We now go on to examine the two hypotheses by different types of traders and the results are presented in Panels A to D of Table 3. Overall, we find that the results based upon trader types are consistent with those for the whole sample. For the overconfidence tests, all four types of traders reveal a significantly stronger tendency to buy (sell), and to do so more aggressively, following success in their prior long (short) positions. The difference in signed volume (order aggressiveness) between those investors experiencing gains and losses, is found to be significantly positive (negative), which indicates that all four types of traders tend to become more overconfident after successful prior trading.

<Table 3 is inserted about here>

For the disposition tests, all four types of traders show a tendency to quickly lock in their gains while being reluctant to realize their losses. We find that investors are more likely to sell off (buy back), and to do so more aggressively after accruing profits from their long (short) positions. However, disposition bias is found to be somewhat weaker for foreign institutions. As we can see from Panel A(3) of Table 3, foreign institutions do not tend to realize their long position gains as quickly, while their sell order aggressiveness after accruing profits from their long positions are only marginally significant. Overall, we find that, to a certain degree, all four types
of traders tend to exhibit both overconfidence and disposition biases, although foreign institutions reveal a somewhat weaker disposition bias.

3.3 Regression Analyses

Within the extant literature, market conditions are seen as an important determinant of the order aggressiveness of traders (Biais et al., 1995; Griffiths et al., 2000; Ranaldo, 2004; Hall and Hautsch, 2006). We therefore carry out regression analyses to control for other factors which may potentially affect the order aggressiveness of traders following their profitable positions. Briefly, the order submission strategies of traders become more aggressive when the bid-ask spread is small, depth on the same (opposite) side is large (small), and volatility is low. Lower spreads and volatility mean lower trading costs, and competing orders as reflected in the depth on the same side of the order book encouraging traders to become more aggressive. Conversely, more depth on the opposite side of the limit-order book reduces the need for traders to place such aggressive orders.

Bid-ask spread ($SPREAD$) is defined as the difference between the ask price and the bid price scaled by the mid-point of the ask and bid prices. The depth behind the respective bid and ask quotes ($DEPTH_{bid}$ and $DEPTH_{ask}$) is measured by the total size of the best five bid and ask quotes. Volatility ($VOLATILITY$) is measured by realized volatility, calculated as $\sqrt{\sum_{t=1}^{n}(r_t)^2}$, where $r_t$ is the five-minute intraday

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return and $n$ is the number of five-minute intraday returns. As in Biais et al. (1995) and Griffiths et al. (2000), lagged order aggressiveness is added into the regression to control for potentially positive autocorrelation.

The regression results for subsequent order aggressiveness, after controlling for market conditions, are presented in Table 4, with Model (1) showing the results for all traders and Models (2) to (5) showing the respective results for foreign institutions, domestic institutions, futures proprietary firms and individual traders. In order to test the overconfidence hypothesis, buy order aggressiveness is regressed in Panel A(1) and sell order aggressiveness is regressed in Panel A(2). The regression is carried out against a position gain dummy variable, $D_{gain}$, which is equal to 1 if the previous five-day holding period return is positive; and 0 otherwise. The $t$-values are computed using heteroskedasticity-consistent standard errors (White, 1980).

With regard to the results for all traders in Panel A, the coefficients of $D_{gain}$ in Model (1) are all negative and significant at the 1% level. After controlling for other market factors, we find that those investors who experienced gains from their net long (short) positions tended to buy (sell) more aggressively than those investors who experienced losses. These results are once again consistent with the overconfidence hypothesis.
The control variables of significance in Model (1) of Panel A are *SPREAD*, $DEPTH_{bid}$, $LAGAGG_{buy}$ and *VOLATILITY*, of which we find that lower spreads, larger depth on the same side and lower volatility all lead to investors trading more aggressively. These results are consistent with several of the prior studies (Biais et al., 1995; Griffiths et al., 2000; Ranaldo, 2004; Hall and Hautsch, 2006). Our finding of positive autocorrelation in order aggressiveness is consistent with that of Biais et al. (1995) and Griffiths et al. (2000), which is possibly attributable to the order-splitting behavior of traders.

In order to test the disposition effect, we examine the trading behavior of all traders in Model (1) of Table 4. Panel B(1) show the selling behavior of all traders on their net long-position gains, and Panel B(2) show their buying behavior on their net short-position gains. We can see that the coefficients of $D_{gain}$ are statistically negative at the 1% level, which indicates that after controlling for other market factors, investors experiencing gains from their previous net long (short) positions are likely to sell off (buy back) more aggressively, which is consistent with the disposition hypothesis.

In order to determine whether the overconfidence of investors differs among different types of investors, the regression analyses are repeated separately for foreign institutions, domestic institutions, futures proprietary firms and individual
traders. In the tests of the overconfidence effect (Panel A of Table 4), we find that foreign institutions, domestic institutions and individual traders tend to buy (sell) more aggressively following long (short) position gains, which indicates that these three types of traders are more likely to be overconfident following prior trading gains.

It is interesting to note that after controlling for other market conditions, futures proprietary firms experiencing gains do not tend to trade more aggressively; this may be due to the fact that professional futures traders are better disciplined (Locke and Mann, 2005; Frino et al., 2004). Thus, Panels A(1) and A(2) of Table 4 reveal a propensity for overconfidence among foreign institutions, domestic institutions and individual traders, but not futures propriety firms.

We now turn to an examination of disposition biases among the different types of traders, in light of recent evidence in a number of studies indicating that both individual and institutional investors tend to display such bias (Shapira and Venezia, 2001; Garvey and Murphy, 2004; Barber et al., 2007). Models (2) to (5) of Table 4 show the regression results of order aggressiveness against the position gain dummy, $D_{gain}$, by different types of traders, with sell order aggressiveness being regressed against the long position gains in Panel B(1), and buy order aggressiveness being regressed against the short position gains in Panel B(2).
We find that the coefficients of $D_{gain}$ in Panel B(1) are negative and significant for foreign institutions, domestic institutions and individual traders, while those in Panel B(2) are negative and significant for foreign institutions and individual traders. After controlling for other market factors, we find that following long (short) position gains, both individuals and foreign institutions sell off (buy back) more aggressively, results which indicate support for the recent findings of the disposition effect not only among individual traders, but also among institutional investors.

Interestingly, the coefficients of the trading gains dummy, $D_{gain}$, do not achieve statistical significance for futures proprietary firms, which indicates that these firms exhibit no disposition bias. Consistent with the overconfidence hypothesis tests, we find that futures proprietary traders on the TAIFEX show insignificant behavioral biases, which may be explained by the fact that, as professional investors trading on their own account, they are likely to be better trained and disciplined, and are thus less prone to behavioral biases (Locke and Mann, 2005; Frino et al., 2004).

### 3.4 Which Traders Exhibit the Strongest Behavioral Biases?

In order to further test which types of traders have a propensity for stronger behavioral biases, we run the order aggressiveness regressions on the interactions between the position gains and trader type dummies. Our comparisons of the overconfidence effects among trader types are reported in Panels A and B of Table 5.
As we can see from the table, the coefficients of the interaction terms between the trading gain dummies ($D_{gain}$) and the trader type dummies ($D_{foreign}$, $D_{domestic}$ and $D_{proprietary}$) are all significantly positive, which shows that following trading gains, the order aggressiveness measures for individual traders are relatively smaller than those for the other three types of traders. That is, individual traders tend to trade more aggressively. These results indicate that individual traders seem to have more overconfidence than the other three types of institutional traders, thereby providing support for the argument that individuals are more likely to be influenced by behavioral biases (Statman et al., 2006; Griffin et al., 2007). The weaker overconfidence of institutional investors indicates that professional training and experience may well be capable of reducing behavioral biases, although they do not appear to be completely eliminated (Statman et al., 2006).

Finally, we examine whether individual traders exhibit stronger disposition biases as compared to institutional investors, with Panels B(1) and B(2) of Table 5 presenting the results. We find that the coefficients on the interaction terms are all significantly positive, indicating that, relative to all other types of traders, individual traders tend to sell off (buy back) more aggressively following gains from their prior long (short) positions.
Individual traders seem keen to lock in their gains, while being reluctant to realize their losses; they also tend to exhibit stronger disposition biases. Overall, our results provide direct evidence to show that although to a certain extent, both institutional investors and individual traders exhibit some behavioral biases, the strongest overconfidence and disposition biases tend to be exhibited by individual traders.

4. CONCLUSIONS

Using a unique dataset obtained from the TAIFEX, we set out in this study to examine the overconfidence and disposition hypotheses by directly testing the signed trading volume and order aggressiveness of traders following trading gains from their prior positions. We find that the overconfidence and disposition effects both give rise to positive relationships between trading activity and prior returns, and therefore argue that this brings into question the conclusions drawn in the prior studies in which examinations of either of these two hypotheses are undertaken by testing the relationship between total volume and prior returns.

We propose new tests to examine the signed volume, and then go on to adopt an order aggressiveness measure. As a result, we are able to test the implications of the overconfidence hypothesis and the disposition hypothesis separately. Our results reveal that, at the account level, investors are more likely to buy (sell), and to do so more aggressively, when they have experienced gains from their prior long (short)
positions. These results are consistent with the overconfidence hypothesis as prior successful trading experiences will tend to lead to overconfidence among investors with regard to their predictions of the price trends, which makes them to buy or sell more aggressively in accordance with their prior positions (Daniel et al., 1998; Gervais and Odean, 2001).

We further find that investors are more likely to sell off (buy back), and to do so more aggressively, when they have experienced gains from their prior long (short) positions. These results are consistent with the disposition hypothesis as traders are keen to lock in their gains, but are reluctant to realize their losses. Finally, we test both the overconfidence and disposition effects among different types of traders. Our results provide support for the argument that individual traders are more likely to be influenced by behavioral biases (Statman et al., 2006; Griffin et al., 2007). It is, however, also worth noting that institutional investors also tend to exhibit both overconfidence and disposition biases to some extent, although the weaker behavioral biases exhibited by the institutional investors would seem to indicate that their professional training and experience may well help to reduce the extent of such behavioral biases, although they do not seem to be completely eliminated.
REFERENCES


Table 1  Sample characteristics

This table presents the summary statistics of returns, volume and order aggressiveness, with Panel A showing the statistics for all traders, and Panels B, C, D and E presenting the respective statistics for foreign institutions, domestic institutions, futures proprietary firms and individual traders. ‘Returns’ refer to the five-day holding period returns for both the net long and net short positions. A net long (net short) position is defined when an investor’s cumulative buy volume during the five-day holding period is larger (smaller) than his cumulative sell volume. Volume is the average daily trading volume for all accounts.

Daily buy order aggressiveness is defined as:

\[
\frac{\sum (P_i^B - P_i^S) \times Q_i^B}{Q^{BT}},
\]

and the daily sell order aggressiveness is defined as:

\[
\frac{\sum (P_i^B - P_i^S) \times Q_i^S}{Q^{ST}},
\]

where \(P_i^S\) is the immediate transaction price of the \(i\)th order; \(P_i^B (P_i^S)\) is the \(i\) buy (sell) order price; \(Q_i^B (Q_i^S)\) is the \(i\)th buy (sell) order size, and \(Q^{BT} (Q^{ST})\) is the total buy (sell) order size.

<table>
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<tr>
<td><strong>Returns (10^{-3})</strong></td>
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<tr>
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<td>0.33</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Net Short Position</td>
<td>0.32</td>
<td>&lt;0.0001</td>
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<tr>
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<tr>
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<td>&lt;0.0001</td>
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<td>&lt;0.0001</td>
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<tr>
<td>Net Short Position</td>
<td>0.32</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Volume</td>
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<td></td>
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<tr>
<td>Buy</td>
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<tr>
<td>Aggressiveness</td>
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<tr>
<td>Buy</td>
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<tr>
<td>Sell</td>
<td>4.96</td>
<td>&lt;0.0001</td>
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Table 2  Subsequent total volume, signed volume and order aggressiveness for all traders, by prior gain and loss positions

This table presents the subsequent total trading volume, signed volume and order aggressiveness after prior net long and short position gains and losses for all traders. A net long (net short) position is defined when an investor’s cumulative buy volume during the five-day holding period is larger (smaller) than his cumulative sell volume. Gain (loss) positions are defined as the five-day holding period returns being positive (negative). We test the mean differences in total volume, signed volume and order aggressiveness measures, with Panel A following the literature to test the total volume, Panel B testing the overconfidence hypothesis, and Panel C testing the disposition hypothesis. *** indicates significance of the non-parametric Kruskal-Wallis test at the 1% level.

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<th>Aggressiveness</th>
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<td></td>
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<td>Difference</td>
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<tr>
<td>Panel A: Total Volume</td>
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<tr>
<td>(1) Net Long Position and Total Volume</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>1,071,276</td>
<td>10.87</td>
<td>3.82***</td>
</tr>
<tr>
<td>Loss</td>
<td>839,120</td>
<td>7.05</td>
<td>–</td>
</tr>
<tr>
<td>(2) Net Short Position and Total Volume</td>
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<td></td>
<td></td>
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<tr>
<td>Gain</td>
<td>1,073,371</td>
<td>11.06</td>
<td>4.04***</td>
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<tr>
<td>Loss</td>
<td>837,761</td>
<td>7.02</td>
<td>–</td>
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<td>(1) Net Long Position, Buy Volume and Buy Aggressiveness</td>
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<td>1.18***</td>
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<td>3.63</td>
<td>6.78</td>
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<td>Gain</td>
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<td>1.32***</td>
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<tr>
<td>Loss</td>
<td>837,761</td>
<td>3.60</td>
<td>5.21</td>
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<td>Panel C: Disposition Hypothesis</td>
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<td>(1) Net Long Position, Sell Volume and Sell Aggressiveness</td>
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<tr>
<td>Gain</td>
<td>1,071,276</td>
<td>6.06</td>
<td>2.64***</td>
</tr>
<tr>
<td>Loss</td>
<td>839,120</td>
<td>3.42</td>
<td>5.18</td>
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<td>3.42</td>
<td>6.70</td>
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Table 3  Subsequent signed volume and order aggressiveness, by trader types and prior gain and loss positions

This table presents the subsequent signed volume and order aggressiveness on prior net long and short position gains and losses by the four trader types (foreign institutions, domestic institutions, futures proprietary firms and individual traders); a net long (net short) position is defined when an investor’s cumulative buy volume during the five-day holding period is larger (smaller) than his cumulative sell volume. Gain (loss) positions are as the five-day holding period returns being positive (negative). We test the mean differences in signed volume and order aggressiveness measures. *** indicates significance of at the 1% level, ** indicates significance of at the 5% level, and * indicates significance of at the 10% level for the non-parametric Kruskal-Wallis test.

<table>
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<th>Variables</th>
<th>No. of Observations</th>
<th>Volume</th>
<th>Aggressiveness</th>
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<tr>
<td></td>
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<td>Difference</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(1) Net Long Position, Buy Volume and Buy Order Aggressiveness</td>
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<td></td>
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<tr>
<td>Gain</td>
<td>2,664</td>
<td>146.43</td>
<td>26.58***</td>
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<td></td>
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<tr>
<td>Gain</td>
<td>2,234</td>
<td>155.15</td>
<td>43.59***</td>
</tr>
<tr>
<td>Loss</td>
<td>2,256</td>
<td>111.56</td>
<td>2.63</td>
</tr>
<tr>
<td>Disposition Hypothesis</td>
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<td></td>
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<td>(3) Net Long Position, Sell Volume and Sell Order Aggressiveness</td>
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</tr>
<tr>
<td>Gain</td>
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<td>113.32</td>
<td>-8.76</td>
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<td>Loss</td>
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<td>122.08</td>
<td>3.14</td>
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<td>(4) Net Short Position, Buy Volume and Buy Order Aggressiveness</td>
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<tr>
<td>Gain</td>
<td>2,234</td>
<td>133.18</td>
<td>8.88***</td>
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<tr>
<td>Loss</td>
<td>2,256</td>
<td>124.30</td>
<td>6.64</td>
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<tr>
<td>Panel B:</td>
<td>Domestic Institutions</td>
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<tr>
<td>(1) Net Long Position, Buy Volume and Buy Order Aggressiveness</td>
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<tr>
<td>Gain</td>
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<tr>
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<td>13.18</td>
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<tr>
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<td>10.95</td>
<td>12.70</td>
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<table>
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<th>Aggressiveness</th>
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Table 3 (Contd.)

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<td>Difference</td>
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<td>Individual Traders (Contd.)</td>
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<td>1.97***</td>
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<td>2.06***</td>
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Table 4  Regression analysis of order aggressiveness

This table shows the regression analysis of order aggressiveness on the gains made from prior positions, with Panels A(1) and (2) presenting the results for the overconfidence hypothesis, and Panels B(1) and (2) presenting those for the disposition hypothesis. \( D_{\text{gain}} \) is a dummy variable which is equal to 1 if the previous five-day holding period return is positive; and 0 otherwise. The following market condition control variables are included in the regression: Bid-ask spread (\( \text{SPREAD} \)) is calculated as \( (P_{\text{ask}} - P_{\text{bid}}) / (P_{\text{ask}} + P_{\text{bid}})/2 \), where \( P_{\text{ask}} \) is the ask price and \( P_{\text{bid}} \) is the bid price; \( \text{DEPTH}_{\text{bid}} \) (\( \text{DEPTH}_{\text{ask}} \)) is the sum of the best five bid (ask) sizes; and \( \text{LAGAGG}_{\text{buy}} \) (\( \text{LAGAGG}_{\text{sell}} \)) refers to lagged buy (sell) order aggressiveness. *** indicates significance at the 1% level.

Realized volatility (\( \text{VOLATILITY} \)) is calculated by \( \sqrt{\frac{1}{n} \sum_{t=1}^{n} r_t^2} \), where \( r_t \) is the five-minute intraday return and \( n \) is the number of five-minute intraday returns.

<table>
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<th>Model (2) Foreign Institutions</th>
<th>Model (3) Domestic Institutions</th>
<th>Model (4) Futures Proprietary Firms</th>
<th>Model (5) Individual Traders</th>
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<td>Coeff.</td>
<td>t-statistic</td>
<td>Coeff.</td>
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<td>434.22</td>
<td>5.51</td>
<td>15.8</td>
<td>6.10</td>
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<td>Model (3) Domestic Institutions</td>
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<td>Model (5) Individual Traders</td>
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Panel B: Disposition Hypothesis

(1) Sell Order Aggressiveness on Net Long Position Gains

(2) Buy Order Aggressiveness on Net Short Position Gains
Table 5 Regression analysis of differences in order aggressiveness, by trader types

This table shows the regression analysis of order aggressiveness on the interactions between prior position gains and the dummy variables for trader types, with Panels A(1) and (2) presenting the results for the overconfidence hypothesis, and Panels B(1) and (2) presenting those for the disposition hypothesis. $D_{\text{gain}}$ is a dummy variable which is equal to 1 if the previous five-day holding period return is positive, and 0 otherwise. $D_{\text{foreign}}, D_{\text{domestic}}$ and $D_{\text{proprietary}}$ are dummy variables which are equal to 1 if the trader belongs to a foreign institution, a domestic institution or a futures proprietary firm, respectively, and 0 otherwise. The following market condition control variables are included in the regression: Bid-ask spread ($\text{SPREAD}$) is calculated as $(P_{\text{ask}} - P_{\text{bid}}) / [(P_{\text{ask}} + P_{\text{bid}}) / 2]$, where $P_{\text{ask}}$ is the ask price and $P_{\text{bid}}$ is the bid price; $\text{DEPTH}_{\text{bid}}$ ($\text{DEPTH}_{\text{ask}}$) is the sum of the best five bid (ask) sizes; and $\text{LAGAGG}_{\text{buy}}$ ($\text{LAGAGG}_{\text{sell}}$) refers to lagged buy (sell) order aggressiveness. Realized volatility ($\text{VOLATILITY}$) is calculated by:

$$\sqrt{\frac{\sum (r_t)^2}{n}},$$

where $r_t$ is the five-minute intraday return and $n$ is the number of five-minute intraday returns.

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Table 5 (Contd.)

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