Risk-Taking Behavior and Profitability: A Trade-by-Trade Examination of Retail Traders in Futures Market

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Abstract

We analyze risk-taking behavior of retail investors in the futures market by tracking their trade-by-trade history to examine how they respond, and the variations in their responses, to some threshold levels of losses and gains. Although in aggregate they exhibit a tendency to reduce risk and offset their trades after reaching the thresholds, their risk-taking tendencies vary with trading activity in a systematic fashion, which in turn affect profitability accordingly. Among profitable traders, those who take more risk by continuing to accumulate more positions in the face of threshold losses and gains are more profitable. On the other hand, among unprofitable traders, those who tend to reduce risk by offsetting their positions when faced with the thresholds suffer smaller losses. We also examine in detail the variations among traders in their profitability and document the direct relationship between profitability and trading activity, shedding new light on overconfidence.

I. Introduction

Voluminous studies in finance, economics, and psychology have long tackled various aspects of risk and risk-taking. Yet, little is known about risk-taking during the trading process when traders are deciding on whether to continue adding more positions or start unloading the existing positions. Undoubtedly confronting traders constantly, these decisions cannot be dismissed as trivial given their obvious consequence on profitability, especially when the traders are faced with large losses that may determine their survival. The lack of research on this issue is therefore surprising and plausible reasons may be the unavailability of trading data of each trader individually and the daunting task involved in tracking their trades. Overcoming these obstacles, we conduct a trade-by-trade examination of this risk-taking behavior in the face of threshold levels of losses and gains of all retail traders on the Taiwan Futures Exchange (TAIFEX).

Evidence from such an examination contributes to the literature in three ways. First, it validates the necessity of trading risk management long advocated by successful traders. To be profitable, according to them, investors must not only pick the best stocks or correctly predict the direction of the futures price but also properly manage the risk of trading. Second, it sheds light on the debate in investment on the relative merits of two opposite trading strategies: averaging down versus averaging up. Following the former, investors will take more positions on a bet that is already showing a loss. In contrast, traders who average up bet more when they are profitable. To provide evidence on this issue, it is necessary to be able to dissect the trading process to compare the actions traders take in the face of losses versus gains and contrast the respective effects on profitability. Linking risk-taking to profitability, our trade-by-trade analysis of the histories of each trader individually allows us to achieve this. Finally, while numerous studies in behavior finance has examined how investors deal with gains and losses by examining their tendency to sell winners and hang onto losers, i.e., the disposition effect. That line of research only deals with how investors sell and liquidate positions, leaving the issue of how they buy and accumulate positions unaddressed. The possibility of taking either long or short positions, equivalently making the buying or selling decisions, in effect offers us an opportunity to fill this void and provide a full picture of how investors deal with risk in general.

Our results show that in aggregate they have a high tendency to reduce risk by offsetting their trades after reaching some threshold level of losses and gains. However, the risk-taking tendency varies with trading frequency and volume among the traders in a systematic fashion: the more frequent and the higher volume the traders trade, the more likely they take risk to continue accumulating positions. Depending on whether they are profitable or not, such variations in tendency in turn affect their profitability differently. Among traders who are profitable, those who tend to take risks after reaching thresholds are more profitable, while those who reduce risk are less profitable. On the other hand, among unprofitable traders, those who tend to reduce risk when faced with the thresholds suffer smaller losses and those who take more risk suffer more losses. These results provide a clear picture of the risk-taking behavior of investors and demonstrate a link between profitability and risk-taking behavior that should have practical implications for traders.

In addressing the risk-taking and profitability linkage, we also document the cross-sectional variations in trading profitability. We show that despite a net loss, after accounting for all transaction costs, in the aggregate, about 1/3 of traders who trade frequently and in high volume are profitable. This result of profitable trading by frequent traders sheds a new light on the behavioral finance literature on the issue of overconfidence that generally concludes, based on the analysis of the aggregate investor, that excessive trading due to overconfidence reduces profitability, or, worse, results in losses.

The rest of the paper is organized as follows: Section II reviews the related literature. Section III explains the data and methodology. Section IV presents and discusses the results. Finally, Section V concludes the paper.

II. Literature Review

2.1 Risk-Taking

Voluminous studies in psychology and experimental economics have examined the issue of risk-taking. However, most of them are devoted to the understanding of how people perceive risk in general. While research in experimental finance extends this line of research by examining investors' perception of, and attitude toward, risk in their financial and investment decision making,[1] little is known about risk taking in action and the associated consequences on profitability. In recent years, studies in behavioral finance[2] fill this gap by examining the disposition effect, the loss-aversion tendency of holding onto losing securities and selling winning securities too readily. As this tendency is manifested when investors are deciding on whether to hold onto or sell securities, it leaves unanswered[3] the issue of risk-taking tendency when investors are contemplating buying and accumulating more investment positions. This is surprising given that investors, and especially speculators, take on the risk of unexpected movements in asset price, such that the act of buying and accumulating investment is equally as important as, if not more than, selling investment. Therefore, much remains to be explored about risk-taking associated with buying and accumulating securities and its impact on profitability. A study on these issues is therefore warranted.

2.2 Profitability

[1] See Ricciardi [2008] for a review.

[2] To name just a few: in experimental setting, Kahneman and Tversky [1979]; in equity market, Odean [1998], Barber and Odean [2000], and Dhar and Zhu [2006] look at retail investors in a US discount brokerage house, Barber et al. [2007] analyze four types of investors (individuals, corporations, dealers—but not mutual funds, and foreign investors) in Taiwan, and Shefrin and Statman [1985] look at aggregate purchases and redemptions in mutual funds; in futures market, Heisler [1994] studies small off-exchange retail speculators, Locke and Mann [2005] investigate professional traders of the currency and agriculture futures in CME, and Frino et al. [2004] examine local traders of four main futures contracts traded on the Sydney Futures Exchange; in other markets, Genesove and Mayer [2001] examine real estate investors and Heath et al. [1999] look at employees exercising stock options. Recently, however, Annaert et al. [2008] examine the transactions by mutual funds and document a propensity of mutual fund managers cutting losses early, hence the absence of the disposition effect.

[3] The closest to examine risk-taking behaving is the studies on house money effect proposed by Thaler and Johnson [1990] that prior outcome affects risk taking behavior. Empirically, Liu et al. [2010] and Frino et al. [2008] find evidence supporting the existence of such tendency among option market makers in Taiwan and professional traders in futures exchange in Australia, respectively.

Profitability is not a new issue in the literature and has attracted the attention of academics and practitioners. However, most studies aggregate across investors and present the performance for the group as a whole or for distinctive subgroups (e.g., individuals and institutional investors) at the group level.[4] The general conclusion of these studies is that individual investors tend to lose money after accounting for all transaction costs.[5] Despite these bleak findings, there is some evidence of small group of investors with superior stock investment skills from studies that focus on examining investors at the individual level.[6] Among studies that look at the performance at the group level there is also evidence suggesting superior performance.[7]

The mixed results on performance at the group level and the evidence of superior performance of some investors suggest that to gain further insight on investors' profitability, it is necessary to go beyond the group level by examining investors at the individual level and exploring the heterogeneity among them in their characteristics and trading behaviors. For example, after documenting the existence of a small group of day traders in Taiwan who are consistently profitable, Barber et al. [2009] pursue further by examining the order records of the traders. They find that trading losses of individuals are linked to their aggressive orders and passive orders placed by individuals are profitable at short horizons but suffer modest losses at longer horizons.

2.3 Overconfidence

[4] For example, in analyzing the returns earned by a random sample of 2,500 individual investors at a full-service brokerage firm, Schlarbaum et al. [1978a] construct two monthly "aggregate" portfolios by combining the portfolios of all sample investors. Similarly, Barber et al. [2009] construct two portfolios, one buy and the other sell, for each of the five investor groups—individuals, corporations, dealers, foreigners, and mutual funds.

[5] Garvey et al. [2006] show 150 professional stock traders working for a national security dealer barely broke even before trading costs and lost after costs over a one-year period. Likewise, Barber et al. [2009] document that individual investors in Taiwan suffer losses that are equivalent to 2.2 percent of the country's GDP or 2.8 percent of total personal income.

[6] For example, Harris and Schultz [1998] examine individual day traders who use NASDAQ's Small Order Execution System (SOES). By establishing a position before most market makers have updated their quotes and laying off the position at favorable prices via Instinet or SelectNet, these traders are profitable despite being less informed than market markers. Analyzing the gross and net returns of round-trip trades made by the same sample of investors over the same period examined in Schlarbaum et al. [1978a], Schlarbaum et al. [1978b] conclude that the investors show some skill in security selection, especially on short-term trades.

[7] For example, Barber and Odean [2000] document that the top-performing quartile of the individuals outperform the market on average by 0.5 percent per month. Ivkovich and Weisbenner [2005] find that stocks of companies geographically close to individual investors generate higher returns than the stocks of distant companies. Finally, Ivkovich et al. [2007] find that individuals with relatively concentrated portfolios outperform those with more diversified portfolios.

One behavior tendency that has been a major subject in many studies in psychology and experimental economics is overconfidence. Drawing heavily on the findings in these fields, the overconfidence literature in finance argues it is an innate human tendency for investors to be overconfident about their abilities and the precision of their knowledge. Odean [1999] analyzes the trading of investors in a discount brokerage house and suggests that due to overconfidence, individual investors trade excessively in the sense that they trade even when the expected gains through trade are not sufficient to cover the trading costs. Examining the trading activity of households accounts in the same discount brokerage, Barber and Odean [2000] show that overconfidence leads to excessive trading and the more active the trading the lower the after-trading-cost returns. Using the same data, Barber and Odean [2001] further show that men trade more excessively than women and, as a result of excessive turnover, both suffer a reduction of returns with men suffering an additional 1.44 percentage points reduction in annual returns than women. Odean [1999] conjectures that the disposition effect he observes may have contributed to the documented pattern of security sales in his sample.

Given that excess trading due to overconfidence reduces returns, it seems logical to expect traders who trade excessively to lose money—as in Barber and Odean's [2000] words "excess trading is hazardous to your wealth"—and eventually exit the market. Several theoretical studies have examined this issue and come to two opposite conclusions. Sandroni [2005] demonstrates that agents with correct beliefs drive agents with incorrect beliefs out of the market. However, numerous studies (e.g., De Long et al. [1990], Kyle and Wang [1997], Wang [2001]) demonstrate that overconfident traders not only survive, they also thrive.

III. Data and Methodology

3.1. Data

We employ a tremendous amount of computing resources—hardware that requires the use of many work stations as well as programming that relies heavily on the help from professional programmers—in processing and tracking the trade-by-trade transaction histories of 132,021

individual traders on the Taiwan Futures Exchange (TAIFEX). Methodologically, trade-by-trade tracking eliminates the need to make assumptions required in many previous studies of futures traders such as zero open interests by the end of the day (e.g., Garvey and Murphy [2004] and Locke and Mann [2005]). It also frees us from choosing an arbitrary interval to measure return.

Our data consists of all of the trades of the front-month[8] Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX) Futures contracts (hereafter, TX, the tick symbol) from the TAIFEX that mature between January 2003 and December 2004. To obtain each trader's complete trading history for each contract, we trace her trades back to the first day when the contract started trading. This means, for example, for the March 2003 contract, we go back to April 1, 2002. Therefore, our data spans the period from April 1, 2002 to the third Wednesday of December 2004, the last trading day of the December 2004 contract. Introduced on July 21, 1998, TX is the first index product traded in Taiwan and the most active futures contract, accounting for close to 70% of the trading volume of the TAIFEX futures contracts. TX is based on the major stock index of the Taiwan Stock Exchange (TWSE), TAIEX, which includes all stocks traded on the TWSE. Each TX tick represents 200 times the TAIEX index value. By examining futures contracts, as opposed to stocks, we avoid the complications typically involved with stocks of different sizes, frequency of trading, and risk levels, as well as the composition and rebalancing of portfolios. Furthermore, the daily settlement that compels futures traders to constantly evaluate their performance makes futures traders' trading a better instinctive reflection of their profit motives and offers a clearer view of traders' behavior biases.

In addition to the typical information such as the time—to the second, date, price, volume—number of contracts, and buy-sell indicator of the transaction, each record also includes an account number distinctively identifying whether the trader is an individual, institution, or proprietary trader.

We exclude trades by institutional and proprietary traders and focus only on trades that are executed by individual traders for three reasons. First, unlike institutional traders, individual traders trade for themselves, therefore their trades are not complicated by agency relationships or

[8] Contracts listed for trading include the front month, the next calendar month, and the next three quarterly months.

hedging motives. Instead, driven purely by the motive to accumulate wealth in order to survive, they are the ideal subjects for the analysis of the profitability and behavior biases. Second, many institutions employ more than one trader who trade in rotating shifts, rendering trades by institutions a reflection of the behaviors of more than a single individual, therefore distorting the analysis of individual behavior biases. Finally, the dominance of individual traders in Taiwan[9] dictates that their trades be the main subject of the investigation.

3.2. Methodology

We track and calculate the gains and losses of trading by each trader and analyze how profitability is affected by risk-taking behavior in the face of gains and losses. To achieve this, we construct a sequence of trades for each trader for each contract by tracing trades executed by the trader back to his first trade of the contract. This requires us to search for trades that are executed as far as one year before January 2003. Therefore, our examination actually extends beyond the two-year sample period. Once the first trade is located we then track each subsequent trade. We mark to market after each trade and calculate all the necessary statistics such as the open interests (OIs), weighted average costs, and realized and unrealized gains/losses. For detail, please see the discussion in Appendix.

A. Maximum Possible Losses and Gains

To analyze the risk-taking behavior in the face of gains and losses we examine how gains/losses of earlier trades influence the trader's decision on subsequent trades. To perform this analysis we look at traders whose trade repeatedly in what we call "rounds". Within each round, there are two phases: the accumulation phase and offsetting phase, labeled as "A" and "O", respectively, in Column 3 in Table A in the Appendix. In the accumulation phase, the trader is building up his position with a continually rising OI in one position direction, either long or short. After this phase, the trade sequence enters the offsetting phase when the trader reverses the position direction and starts to unload his contracts. The offsetting phase ends when he starts the

[9] Individual traders account for 80.17% and 75.60% of the total trading volume, in number of contracts, of TAIFEX in 2003 and 2004 respectively.

next round by starting a new accumulation phase. It is important to note that at the end of the offsetting phase of each round the OI is not necessarily reduced to zero. Additionally, not all trades by all traders follow this regular sequence of rounds with alternating phases. In analyzing the risk taking behavior, we exclude the erratic trades that don't follow this trade sequence and only look at trades with regular round sequences. Utilizing the two phases in the trade sequence, we examine how the unrealized gains/losses during the accumulation phase affect the subsequent trades in the offsetting phase that result in the realization of gains/losses. By focusing on these trades, we are able to analyze the risk taking behavior of traders by examining their trades to see whether they continue building up or start unloading their positions when they are faced with losses and gains.

Obviously, for experienced traders such accumulation or offsetting decisions are not as important when they are faced with tiny, insignificant gains or losses as when the losses and gains are large enough to reach some threshold. The threshold may be a predetermined target price at which the trader will liquidate to take profit or reevaluate the situation. It can also be a level that will trigger the margin call. The issue now, therefore, is what constitutes threshold-level losses or gains. The risk management literature has been working on this issue for a while and the standard today is Value at Risk (VaR). It has been broadly applied in banking and securities firms and companies that are involved in trading energy and other commodities to measure the market risk of their portfolios. Although widely accepted by institutions, VaR is not without limitations from individual traders' point of view. First, its successful application hinges on the use of a vast amount of data on numerous classes of assets with a sufficiently long history. Whether individual traders have access to such data and are sophisticated enough to apply the VaR technique is seriously questionable. Second, for the retail traders in the futures market who are rarely involved in managing a portfolio of different classes of assets, using a sophisticated measure such as VaR seems to be overkill. Finally, application of VaR to risk management has mostly emphasized on the loss aspect, although theoretically no edict exists to forbid its application to gains. Due to these practical concerns, we choose not to use VaR, though Locke and Mann [2005] apply it ex post in their analysis of professional futures traders at CME. Instead, following the spirit of VaR: the maximum loss concept, we propose to use the maximum unrealized loss and gain during the accumulation phase of a round as the threshold level of loss

and gain and call them the maximum possible loss (MPL) and maximum possible gain (MPG). For traders, the MPL signifies a threshold level of loss beyond which some may feel intolerable and the MPG represents a threshold level of gain that some traders may be content with. Although we identify these measures ex post by poring over traders' trading histories, given that it's impossible to actually observe traders in action, we believe this method is simple and straightforward and more likely to reflect how individual traders behave. Such a belief can be justified on the grounds that some traders do limit their losses either voluntarily by placing stop-loss orders or involuntarily as losses accumulate to reach the levels that trigger margin calls. On the profit side, the evidence in the literature on the disposition effect that traders tend to take profit too eagerly indicate that there are some thresholds level of profit at which traders are content to close their position. The short-term nature of futures trading and the immediate cash-flow impact of the daily marking to market suggest that our proposed MPL and MPG should capture the dynamics of traders in action. Though speculative on our part, we don't think it is far-fetched to assume that traders are fully aware of, keep a running tally of, and react to the unrealized gains/losses throughout the accumulation phase of trades. By examining the trades after the MPLs and MPGs are reached, we hope to explore how traders behave when facing trading losses and gains.

Continuing with the same example in the Appendix, the MPL and MPG in Round 1 are the maximum unrealized loss of -206 and unrealized gain of 29, respectively, as highlighted in bold face in the table. Notice that there are some rounds that experience only unrealized losses and no unrealized gains, and, vice versa, there are some rounds that only show unrealized gains and no unrealized losses. For the former, there are no MPGs, and for the latter, there are no MPLs.

B. Reversals of Loss (ROL) and Reversals of Gain (ROG)

Throughout the accumulation phases, the trader is constantly keeping track of the MPLs and MPGs. Taking into account these threshold-level losses and gains, he may decide to load up more contracts or unload the existing ones. Continuing with the example in Table A, we see that the accumulation phase of Round 2 includes Trades 19 through 41 and the MPL and MPG are, respectively, -193 and 3,066. Notice that while facing an MPL of -193 after Trade 28 is executed,

instead of quitting, Trader A takes a chance by continuing to load up more contracts. In doing so, he is apparently hoping for the tide to turn. The tide indeed turns in his favor and reduces the unrealized loss to -28 in Trade 29, turns the unrealized loss to an unrealized gain in Trade 30, and continues to boost the unrealized gain in subsequent trades. By the end of the accumulation phase in Trade 41, Trader A experiences a total reversal of loss (ROL) of 3,259, which is the difference between the unrealized gain of 3,066, at the end of the accumulation phase, and the MPL of -193. By construction, ROL is either zero or a positive value, given that MPL, the maximum value among all unrealized gains/losses in the accumulation phase, is subtracted from the last unrealized gains/losses, which is either less than or equal to the maximum value, the MPL, in the accumulation phase.

For unrealized gains, a similar process takes place. Faced with MPG, a threshold-level of gain, the trader may be content with the gain and starts offsetting. Or, he may continue taking on more bets, only to realize in hindsight that doing so is a mistake because rather than gaining more, some of the gain achieved earlier is taken away. In our example, the MPG of 3,066 for Round 2 appears after Trade 41 is executed. Since this trade is the last one in the accumulation phase, it indicates Trader A decides to start the offsetting trades, presumably being content with the gain. Therefore, in Round 2, the reversal of gain (ROG) is zero, because the ending unrealized gain is also the MPG in this round.

Finally, there are some rounds when traders experience only gains or only losses, possibly when the overall market is steadily moving in one direction. For these rounds there are no MPLs or MPGs, hence no associated ROLs and ROGs. An example of these cases can be seen in Round 3, when Trader A faces only a string of unrealized losses, rendering no MPG and ROG in this round. We indicate cases like this with a NA.

C. Proportions of Zero and Positive Reversal of Loss (PZROL and PPROL) and Zero and Negative Reversal of Gain (PZROG and PNROG)

A zero ROL occurs when the unrealized loss at the end of the accumulation phase equals the MPL, indicating that the trader, in the face of a threshold-level loss, reverses the course and

starts the offsetting phase to reduce risk, apparently feeling uncomfortable with the MPL. Similarly, a zero ROG happens when, facing the maximum possible gain, the trader ends the accumulation phase and starts to offset his/her bets to stop taking more risk, presumably satisfied with the threshold-level gain and preferring not to risk it. On the other hand, a positive ROL suggests that instead of starting the offsetting trades, presumably hoping to recover some of the loss, the trader takes more risk by accumulating more bets which results in recovering some loss before he eventually starts the offsetting trades. Similarly, in the case of a negative ROG, instead of offsetting his bets, which would result in a zero ROG, the trader takes more risk but ends up losing some gain before he finally starts the offsetting trades. By examining the relative frequency of the zero ROLs and positive ROLs and, similarly, the relative frequency of zero ROGs and negative ROGs, we are able to analyze the risk taking behavior of traders and its consequences on profitability of traders in the face of gains/losses.

After all the ROLs and ROGs are calculated for each trader, we calculate the proportion of zero ROLs (PZROL) and proportion of positive ROLs (PPROL). The former is the total number of zero ROLs divided by the total number of ROLs—which is the sum of the number of zero ROLs and the number of positive ROLs, and the latter is the total number of positive ROLs divided by the total number of ROLs:

$$PZROL = \frac{\#\ zero\ ROLs}{\#\ zero\ ROLs + \#\ positive\ ROLs} \quad (1)$$

$$PPROL = \frac{\#\ positive\ ROLs}{\#\ zero\ ROLs + \#\ positive\ ROLs} \quad (2)$$

For ROGs, we similarly calculate the proportion of zero ROGs (PZROGs) and proportion of negative ROGs (PNROGs) for each trader by dividing the total number of zero ROGs by the total number of ROGs for the former and total number of negative ROGs by the total number of ROGs for the latter:

$$PZROG = \frac{\#\ zero\ ROGs}{\#\ zero\ ROGs + \#\ positive\ ROGs} \quad (3)$$

$$PNROL = \frac{\#\ positive\ ROGs}{\#\ zero\ ROGs + \#\ positive\ ROGs} \quad (4)$$

Given that a zero ROL indicates that as the trader reaches a threshold-level of loss he takes an immediate action to reduce his risk, while a positive ROL suggests that rather than reducing his exposure he takes on more risk, a comparison between PZROL and PPROL therefore offers us a way to evaluate the risk-taking behavior of the trader. If PPROL is greater than PZROL we know that the trader tends to take more risk by continuing to load up his bets than to reduce risk by offsetting his bets as the loss threshold is reached. Similarly, since a zero ROG indicates that the trader takes an immediate action to reduce his exposure as the threshold gain is achieved, while a negative ROG suggests more risk is taken, a higher PPROG than PZROG therefore tells us that the trader is likely to take more risk than to reduce risk as the threshold-level gain is reached.

IV. Results

4.1 Profitability and Trading Statistics

Table 1 describes the data used in this study. There are a total of 132,021 accounts. Together, they account for a total of 24,496,774 contracts. Accounting for all transaction costs—commissions plus taxes—and aggregating across the net profits of all traders, we show that they have a total net loss of 68,553,921 ticks and an average net loss of 519 ticks. Since each tick is worth NT$200, this translates to a total loss of NT$13,710,784,200 and average loss of NT$103,800, or about $415,478,309 and $3,145 respectively, based on the exchange rate of NT$33/$ on 12/31/2003. This result is consistent with the evidence in prior studies that average investors lose money. However, beyond these aggregate numbers, tremendous variations apparently exist among traders considering that while the median loss is a mere 159 ticks ($964), the contrast between the loss suffered by the extremely unsuccessful trader and the profit earned by the most profitable trader is striking, as indicated by the minimum net profit of -3,566,781 ticks ($20,981,064) and maximum of 4,777,947 ($28,105,570).[10]

[10] With a loss of over $20 million, one may wonder why such a loss is possible and conjectures that these traders must have ceased trading. Since former investigation into such issue is beyond the scope of this study, we have done

These variations suggest clearly that not all investors are equal in their performances and call for further detailed look at the profitability statistics beyond the aggregate level. We do so by presenting the traders' profitability among subgroups according to their trading activity for the simple practical reason that information on trading activity, measured as number of trading days and trading volume, over the sample period is readily available in our data. A more important motivation for using trading activity to separate traders stems from the evidence in the overconfidence literature that excess trading leads to reduced profitability or even a loss (Barber and Odean [2000]). Whether that evidence, which is based on the aggregate investor in the stock market, applies to retail futures traders individually has yet to be examined and warrants a second look. To conserve space, we only present the results based on trading day and will make those based on trading volume available upon request. Because traders who trade fewer than 90 days account for over 90% of the sample, we group them in increments of 10 days and those who trade over 90 days in increments of 30 days. The number of trading days is added one when a trader trades in this day and not counted when a trader does not trade between two trading days. For example, trader A trades on Monday and then trades on Friday in the same week. Trading days are counted to 2, not 5. The results show that traders who trade less than or equal to 10 days account for over 41% of the accounts and have a net loss of 10,277,271, representing 14.99% of the total net loss of all traders. The corresponding numbers for traders who trade between 11 and 20 days are 17.08% of the accounts and a net loss of 9,540,413, or 13.92% of total net loss, a bit lower than the amount of loss of the first group. Continue moving down to longer trading-day groups, one cannot but see a general trend of declining total loss until the 241-270 group. Beyond that, all remaining groups report an aggregate profit but don't appear to exhibit a strong trend. This lack of trend in profits turns out to be due to the ever dwindling number among these more frequent traders. By looking at average and median values, the trends of losses and profits are undeniably clear: the average and median losses (profits) for groups trading under (over) 270 days clearly rise as traders trade more frequently. Another notable trend appears among the minimum net profit value, i.e., the largest losses. For traders who trade up to 150 days, we notice the largest losses generally rise as trading days get longer and, as mentioned above, the trader

some preliminary analysis and found that traders with similar losses not only trade frequently, they continue to trade over the sample period. From conversations with traders, we were told that these traders earn enough from trading other securities to make up for the losses incurred in the trading of TAIEFX.

who lost the most, with a net loss of 3,566,718 ticks is among the 121-150-day group, which is also the group that has the trader with the largest net profit of 4,777,947 ticks. There is no apparent trend beyond this group regarding the minimum values, nor is there a trend among the maximum net profit values.

The above results on the average and median net profits among traders in different trading-day groups suggest a relationship between profitability and trading days. The shape of the relationship, however, is not monotonic. As shown in Figures 1, it can best be described as a ladle, with the downward sloping segment of the curve resembling the tilted-v-shaped cup of a ladle and reflecting the worsening losses as trading days increase and the upward sloping segment of the curve showing the handle of the ladle and reflecting the rising profits as trading days increase, with the juncture of the two parts at 270 days, in terms of mean, and 330 days, in terms of median.

Insert Figure 1 about here

To demonstrate how aggregation conceals the disparity among traders, we, arbitrarily and partly to conserve space, group traders who trade less than 90 days in increments of 30 days and report the results at the bottom of Panel A. Notice that traders who trade less than 30 days represent 69.06% of all accounts, between 31 and 60 days, 16.04%, and between 61 and 89 days, 6.80%. Together, these three groups account for 91.91% of all accounts. The rest of the traders who trade 90 days and over, accounting for the remaining 8.09%, are combined into one group, given their small numbers. Although small in number, traders of this fourth group are responsible for 59.8% of the trading volume and 38.12% of the trading days. Looking at the average net profits across these four groups, we notice that among the first three groups, as trading days increase, losses steadily rise, but that the loss of group four is smaller than the loss of group three. However, the median values show that losses rise steadily from the low trading-day group to high trading-day groups.

Insert Table 1 about here

The above demonstration of how aggregation conceals disparity among traders illustrates the necessity to examine investors separately. To further demonstrate this, we notice that the minimum net profit numbers across all trading subgroups are not systematically greater or smaller in magnitude than the maximum net profit numbers, indicating the distribution of the net profit is not skewed either to the right or left. The implication of this observation is that there exists no survival bias in this sample of traders. If there were a survival bias, we would have a skewed distribution of the net profit since unprofitable traders would have disappeared, leaving out-of- proportionally more profitable trader in the higher-trading-day groups. To investigate whether this indeed is the case, it's necessary that we examine unprofitable traders and profitable traders separately. We report the results of this examination in Panel B of Table 1. Among all 132,021 traders, 91,546 (69.34%) are unprofitable, while 40,475 (30.66%) are profitable. Although the profitable group has an average profit of 1,590, higher than the average loss, in magnitude, of 1,452 for the unprofitable group, the latter has a higher median loss, in dollar amount, than the median gain for the former. Since the unprofitable group is more than double the profitable group in number of traders, we see why the overall traders have a net loss reported in Panel A. Going down the list from the groups with shorter trading days to those with longer trading days we see the mean and median losses or gains increase almost monotonically, indicating that longer trading days can be either detrimental or beneficial for traders' profitability.

Looking closely, we also notice that the number of accounts between the profitable and unprofitable traders tend to be linked to the number of trading days. As highlighted by the line under the group of 151-180 trading days in the table, for accounts that trade less than 180 days, the unprofitable traders have median account numbers more than double the profitable groups. After that, among traders who trade between 181 and 330 days the unprofitable traders still have a higher median account numbers, but for traders who trade more than 330 days, the profitable traders outnumber the unprofitable traders. Another notable difference between the two groups is the median profits or losses. As indicated by the bold-faced numbers in the table, the unprofitable traders have a higher dollar amount in loss than their profitable counterparts have in profit for traders who trade less than 300 days and traders who trade between 451 and 480 days, while the profitable traders have a higher dollar amount in profit than the unprofitable traders have in loss for traders who trade over 300 days except for traders between 451 and 480 days.

These detailed differences in dollar amount of profit versus loss clearly are hidden when we aggregate the traders into smaller number of groups such as the four groups in increments of 30 days and over 90 days shown at the bottom of the table. With such a coarser grouping, we can only see unprofitable traders with a larger dollar amount in loss than the profitable traders have with profit. Furthermore, when traders are separated into only four groups, the difference in the number of accounts noted above are hidden again such that we only see that the number of accounts of the unprofitable traders is more than twice than that of the profitable traders.

Finally, for the 10,426 traders with regular rounds of accumulation and offset phases of trades, 3,288 (31.54%) are profitable, with an average net gain of 10,279 and median gain of 1,604 while the remaining 7,138 traders are unprofitable with a smaller average net loss of 6,039 but larger median loss of 2,134.

These profitability and trading day results shed new light on the evidence on overconfidence in the literature. Typically, previously studies treat frequent trading as equivalent to excessive trading and conclude excessive trading due to overconfidence leads to reduced profits or even losses. The trend of increasing loss as trading days increase reported here is consistent with such a conclusion. However, our results also show that traders who are profitable have higher profits as they trade more frequently, in sharp contrast with the conclusions in the literature. Without disaggregating traders into profitable and unprofitable and examining them separately, this new evidence would have remained hidden. If one accepts the premise that profitable traders represent skillful investors with superior ability, one can interpret this evidence of a positive relation between trading frequency and profit to be that these traders trade actively not because of overconfidence. Rather, they are aware of their ability and the more they are confident about their skill, the more often they trade and consequently their profits are higher. In view of these two contrasting results, we see that trading frequency is a noisy proxy for overconfidence, hence it's necessary to consider an alternative proxy such as trading volume. As reported later in Table 5, the correlation between these two measures is statistically significant. Not surprisingly, the results based on volume are similar to those based on trading days. The most important one is that the mean and median net profits exhibit a ladle-shaped pattern as shown in Figure 2. As a whole, traders lose money which increase with trading volume, but as

trading volume exceeds 7,000 contracts, traders turn profitable and the profit steadily increases with trading volume. To conserve space, other detailed results based on volume are not reported but available upon request.

Insert Figure 2 about here

We conduct further examination comparing the profitable and unprofitable traders and report the results in Part 1 of Table 2. In Panel A, as highlighted by the bold-faced numbers, among all traders, the unprofitable traders have higher median trading days, volume, and absolute dollar amounts of both net profit and gross profit. However, for traders with over 90 days of trading, Panel B shows that based on either mean or median, the profitable traders are more frequent traders—132 days versus 123 days in median and 154 days versus 140 days in mean—and have higher volume—508 contracts versus 382 contracts in median and 2,442 versus 875 in mean. This is also true for the 10,426 traders with regular trading rounds and over 90 trading days as reported in Panel C. Together, Panels B and C show that among traders with over 90 days of trading and regular trading rounds, those who are profitable, although accounting for less than 1/3 in number, trade more frequently and have higher volume than their unprofitable counterparts.

Insert Table 2 about here

Clearly, Panels B and C show that in addition to the trading days, profitability varies with trading volume and there are variations among traders regarding trading volume. So far, these two measures of trading activity are examined separately; whether and how they interact and affect the profitability among traders therefore requires further analysis. We do this by double sorting the 10,426 traders with regular trading rounds,[11] such that all traders are sorted by trading days into 10 decile groups and into 10 decile groups based on trading volume, resulting in 100 trading day and volume groups. We then examine the profitability among these 100 groups and report the results in Part 2 in Table 2. To avoid clutter, only the means and medians are presented. To highlight the profit, we boldface those median numbers that are positive. Looking at the table,

[11] Results for all traders are similar.

one immediately notices that groups in the upper diagonal are mostly unprofitable. Specifically, groups in the lowest and second lowest trading volume decile have losses in both means and medians across all trading day deciles. Among the groups with the third lowest trading volume deciles, only the 8th trading day decile group has a profit, based on either the median or mean values. As we move from lower to higher trading volume deciles and lower to higher trading day deciles, i.e., groups in the lower diagonal, we see most of them are profitable.

In sorting the traders, we separate them into 10 trading day decile groups in increments of roughly 40 days between groups: from the first group, that trades between 90 and 129 days, to the last group that trades between 451 and 491 days. The former has a total of 5,512 traders accounting for 52.87% of the sample traders, while the latter only boasts a total of 31 traders. Similarly, traders are sorted into ten trading volume decile groups. The first decile group has 5,318 traders (51.01%) trading between 102 and 428 contracts and a total trading volume of 1,414,568 contracts. In contrast, the tenth group, with 9 traders (less than 0.09 %), trades a median of 123,702 contracts with a total trading volume of 1,461,357 contracts. We also group the 3,288 profitable traders into five quintile groups in terms of their share of the total profit. The majority, 88.38% (=2906 ÷ 3288) are in the first quintile with a median net profit of 1,294, while the remaining four quintile groups, with a total of 382 traders, represent only 11.62% of the profitable traders but earn large profits, ranging from 13,518 (NT$2,703,600 or $81,927) to 4,777,947 (NT$955,589,400 or $28,957,254). Similarly, we group the unprofitable traders into five quintile groups based on their share of the total losses. The least unprofitable quintile group, with a total of 5,235 traders representing 73.34% of total unprofitable traders, has an average loss of 1,625 (NT$325,000 or $9,848). On the other hand, the remaining four quintiles account for 26.66% of the unprofitable traders and have losses ranging from 3,975 (NT$795,000 or $24,091) to 3,566,781 (NT$713,356,200, or $21,616,855). To conserve space, detailed statistics of trading days among these subgroups are not reported but available upon request.

Due to the clustering of traders in the lower deciles/quintiles, the above decile/quintile sorting method results in the number of traders varying significantly among groups. To check for robustness of our results, we also employ an alternative sorting method that yields about the same number of traders in each group. It entails ranking the traders from the lowest to highest

value in trading days, trading volume, profit, and loss, then dividing the traders into 10—for trading days and volume groups, or 5—for profitable and unprofitable groups with about equal numbers of traders. However, this method, called the equal-number method, also has its undesirable consequences. Since most traders cluster around the first and/or second groups the equal-number method results in many groups in the lower order essentially coming from the lowest decile/quintile group reported above, while the last group in fact is a mixture of the higher decile/quintile traders who vary a great deal in trading characteristics, making the comparison between groups less meaningful. Surprisingly though, results based on these equal-number groups are qualitatively similar to the results based on the decile/quintile method reported. To conserve space, these additional equal-number results are not reported but are available upon request.

As a final step of our examination of profitability, we conduct ANOVA tests on the effect of trading days and trading volume on profitability. We first conduct univariate tests for trading frequency and trading volume separately. We then test whether profitability is affected by trading days, trading volume, and the interaction of trading days and volume. The results, not reported, of all these tests are statistically significant, indicating profitability is affected by trading days and trading volume.

4.2 Risk Taking Behavior in the Face of Losses

The profitability results show that frequent and high-volume trading can be either beneficial for or detrimental to profitability, suggesting that it is imperative that we examine the profitable traders separately from the unprofitable traders and seek determinants of profitability other than trading frequency and volume. As discussed in earlier sections, risk-taking behavior is one of the determinants we propose to examine in this study. To perform such an examination using the method discussed in Section III, it is necessary that traders have sufficient trading history and follow regular rounds of accumulation and offsetting trades. For this reason, for the rest of the paper we exclude traders who trade less than 90 days and focus on the remaining

traders who follow regular rounds of accumulation and offsetting trades.[12] Among all 132,021 accounts, 10,426 are in the final sample. As shown in Panel A of Table 1, representing only 7.9% of all accounts, these traders account for 59.52% of all trading volume and 37.34% of total trading days. Despite their large share of trading volume and frequent trading, their share of the total net loss is a mere 13.58%. The results of the examination of their risk-taking behavior of these traders are reported in Table 3.

Part 1 shows that based on 10,309 traders who have non-zero MPLs, the average PZROL is 88.94%, indicating that faced with threshold-level losses, close to 89% of the traders choose to reduce risk by offsetting their positions, while the average PPROL is 11.06%, indicating only 11% of them continue to accumulate contracts. This evidence suggests that instead of taking more risk, traders as a group tend to cut their losses and start unwinding their holdings to reduce risk.

Insert Table 3 about here

To see how the variations among the sample traders in trading characteristics transpire in their risk-taking tendency, we examine and report the statistics of PPROLs among trading-day and trading-volume subgroups in Part 2 of Table 3. Among the trading-days groups, it is very clear in Panel A that the median PPROLs steadily rise as traders trade more frequently, from 4.17% for Group 1, the group that trades least frequently, to 31.06% for Group 10, the group that trades most frequently. The trend is equally apparent in mean values. In Panel B, the rising trend also exists among the trading-volume groups: both medians and means mostly increase from lower-volume to higher-volume groups. In Panel C, the increasing tendency to take risk shows up among the profitable quintile groups too: the greater the profitability, the higher the PPROLs. For the most profitable group, the median and mean PPROLs are higher than 50%, 53.75% and 52.59% respectively, suggesting this group is more likely to take risk to accumulate more positions. Examining in more detail, we see that the values for the three traders in this group are 84.62%, 53.76%, and 19.39%, respectively. Therefore, two of the three most profitable traders

[12] Traders in the remaining 261 (=10,687-10,426) accounts that exhibit no such regularity in trade sequences typically accumulate a position and offset the position in the subsequent trade.

are more likely to take more risk by increasing their positions than to reduce risk by offsetting their positions. On the other hand, the third trader tends to offset his positions.

As mentioned before, equal-number grouping obscures the variation among groups as the majority of traders are in the first quintile or decile group. This is indeed true as we look at PPROLs across the equal-number groups on the right hand side of Panel C. Though still steadily rising, the medians and means show smaller variations. Among these, we notice that the median for Groups 1 is zero, indicating over half, 215, of the 430 traders in Group 1 tend to stop taking more risk to accumulate positions whenever they reach the threshold-level losses. In Group 2, the mean and median are less than 10%, similarly suggesting that the majority of traders offset their trades in the face of threshold-level losses. By doing so, the profits of these traders are the lowest among profitable traders. This evidence of low profitability among traders who reduce risk by starting to offset in the face of threshold losses and gains and the contrasting higher net profits among traders who choose to take more risk by continuing accumulating positions clearly suggests risk-taking can lead to higher profitability.

The rising trend in PPROLs is equally apparent among the unprofitable traders. As shown in Panel D, from the least-unprofitable quintile group to the most-unprofitable quintile groups, the median steadily rises from 0 to 51.97%, and mean values, from 6.52% to 52.07% respectively. Similar to the profitable traders, the results among the equal-number groups reported on the right-hand side of the panel show the steadily rising trend, but with lesser variations. However, before proceeding further, let's not overlook the opposite consequences of the similar trend of rising PPROLs reported in Panels C and D between profitable and unprofitable traders on the profitability of risk taking. Instead of taking more risk by accumulating more positions, the action by Group 1 to reduce risk by offsetting their positions, as suggested by the low average PPROL of 6.52% and median of zero indicates that unprofitable traders in this group save themselves from incurring larger losses. In contrast, the same behavior of Group 1 among the profitable traders keeps them from earning more profit. Vice versa, by increasing their positions, hence taking more risk, as suggested by the higher average PPROLs of 52.07%, unprofitable traders in Group 5 incur the greatest losses, whereas their profitable Group 5 counterparts earn tremendous profits.

Not surprisingly, the apparent variations in PPROLs among subgroups show up in formal statistical tests. The results, not reported, from ANOVA tests, t-tests, and Mann-Whitney tests clearly show that there is a statistically significant difference in PPROLs among the subgroups in terms of number of trading days, volume, or profitability, confirming the results that traders indeed vary in their reactions to losses.

4.3 Risk Taking Behavior in the Face of Gains

We next investigate how traders behave when they are faced with gains by examining the reversal of gains and report the results in Table 4. Part 1 shows that as a group, traders have a significantly high average PZROG, 82.17%, and low average PNROG, 17.83%, indicating a strong tendency to stop taking risk by accumulating more trades after reaching the maximum possible gains. Looking at subgroup results reported in Part 2, the steadily rising trend reported for PPROLs reported in Table 3 is also present here. In Panels A through D, going from lower to higher decile or quintile groups, there is clearly a steadily increasing PNROG. Overall, traders who are in groups with more frequent trading have higher PNROGs, so are groups with higher trading volume, groups that are more profitable among the profitable traders, and groups that have more losses among the unprofitable traders. Examining Panels C and D more carefully, one notices that both the most profitable and most unprofitable groups have a median over 50%.[13] Clearly, both the most profitable and unprofitable traders have a higher tendency to take risk to continue accumulating positions in the face of gains.

Insert Table 4 about here

Further test results, not reported, from ANOVA, t-tests and Mann-Whitney tests the difference of PNROGs between groups clearly indicate that there are statistically significant

[13] Specifically, two of the three most profitable traders, with a PNROG of 56% and 54.36%, respectively, are more likely to take risk than to reduce risk, while the third trader, with a PNROG of 39.31% is more likely to reduce risk. In the case of the unprofitable groups, we find that the nine traders have a mean and median PNROG higher than 61%.

differences in PNROGs among traders in different subgroups based on the number of trading days, volume, profits, and losses.

Overall, the results reported in this section show that traders who trade more frequently and in higher volume have higher PNROGs. Additionally, traders who are more profitable and traders who lose more also have higher PNROGs. Together, Tables 3 through 4 depict a very clear picture that when faced with threshold-level gains, traders exhibit a steadily increasing tendency to accumulate more positions, from the lowest decile or quintile group to the highest decile or quintile group.

We further examine whether traders react to gains differently from the way they react to losses by comparing the difference between PNROG and PPROL. The results, not reported, show in aggregate traders have higher PNROG than PPROL indicating they take more risk loading up their position in the face of gains than when they are faced with losses. However, looking in detail, we see that this is true only among unprofitable traders. For traders with higher trading volume (deciles 9 and 10) and more profitable (quintiles 2 and above), the opposite seems to be true, suggesting, again, great variations in risk-taking behavior between profitable and unprofitable traders.

4.5 Regression Tests of the Relationship between Profitability and Risk Taking

The results reported in Sections 4.2 – 4.4 indicate that risk-taking tendency varies with traders' trading activities and profitability. Given these variations, the immediate question is how the risk-taking tendency and traders' trading characteristics affect trading profitability. To answer this question, we run formal tests using regressions in various univariate and multivariate forms of the following model:

$$Profitability = \beta_0 PPROL + \beta_1 D_{PPROL} + \beta_2 PNROG + \beta_3 D_{PNROG} + \beta_4 Volume + \beta_5 D_{Volume} + \beta_6 Day + \beta_1 D_{Day} \quad (5)$$

Where

Profitability = Net profit or loss of the trader,

PPROL = Proportion of positive reversal of loss,

D_{PPROL} = PPROL for unprofitable traders and zero for profitable traders,

PNROG = Proportion of negative reversal of gain,

D_{PNROG} = PNROG for unprofitable traders and zero for profitable traders,

Volume = Trading volume of the trader,

D_{Volume} = Volume for unprofitable traders and zero for profitable traders,

Day = Number of trading days of the trader,

D_{Day} = Day for unprofitable traders and zero for profitable traders,

The rationale behind the inclusion of dummy variables in the above model stems from the evidence reported in previous sections that risk-taking and trading activity of profitable traders appear to be related to profitability in opposite way to those of unprofitable traders to profitability. Ignoring this evidence by not allowing for different coefficients in the model is in effect imposing a restriction forcing a common coefficient for all traders that is likely to lead to incorrect inference. To avoid this problem, we use the dummy variables in the above model to allow the coefficients of the regressors to be different between profitable and unprofitable traders. Specifically, using the univariate regression of profitability on PPROL as an example, by using D_{PPROL} that takes on the value of PPROL only for the unprofitable traders, we have

$Profitability = \beta_0 PPROL + \beta_1 \times 0 = \beta_0 PPROL$ for profitable traders, whereas

$Profitability = \beta_0 PPROL + \beta_1 \times PPROL = (\beta_0 + \beta_1) PPROL$ for unprofitable traders.

The evidence thus far suggests that we should expect β_0 to be positive, β_1 negative, and, furthermore, the sum of β_0 and β_1, $\beta_0 + \beta_1$, negative. The same arguments apply to the other regressors, PNROG, volume, and day.

Before presenting the regression results, we report the correlations among the variables in Table 5. It is clear that all correlations between all pairs of variables are statistically significant. Looking at all traders, we see that the correlations are positive between profitability and PPROL,

trading day, and trading volume, but negative between profitability and PNROG. While the positive correlations are consistent with the picture presented so far that risk-taking and trading activity are good for the profits of the profitable traders, they clearly contradict the evidence that the same are associated with greater losses for the unprofitable traders. Similarly, the opposite is true regarding the negative correlation between profitability and PNROG. These contradictions demonstrate again the problem of aggregation and the need to separate traders into profitable traders and profitable traders. Indeed, when we do this, as shown in the table, we see that the signs of the correlations are now consistent with the evidence presented earlier.

Insert Table 5 about here

Given that the correlations are all significant, it behooves us to verify whether poses a multicollinearity problem in the regressions. Not reported to save space, based on the VIF values we believe multicollinearity is not an issue since among all VIFs, the largest value is 1.91, far smaller than 5, the critical value customarily considered to indicate the presence of a multicollinearity problem.

Insert Table 6 about here

Table 6 reports the main results from various univariate and multivariate regressions. In the univariate regression of profitability on PPROL in Model 1, we see that the coefficient for PPROL is a statistically significantly 0.019, indicating the more risk-taking the higher the profitability. Though consistent with the picture presented in previous sections for profitable traders, this positive relationship is at odds with earlier results for unprofitable, and the culprit is treating unprofitable traders the same as profitable traders. As explained, employing the dummy variable D_{PPROL} should solve this problem and the result for Model 2 confirms it. As expected, the coefficient for PPROL is a significant 0.199, while that for D_{PPROL} a significant -0.324, and the sum of the two -0.152, consistent with the picture depicted earlier that risk-taking in the face of losses benefits profitable traders but harms unprofitable traders.

Results for PNROG are similar. We see in Model 3 that by ignoring the divergent effect of risk taking on profitability in the face of gains between profitable and unprofitable traders we only see the negative effect of risk-taking that is true only for unprofitable traders. Employing the dummy variable D_{PNROG} to separate the unprofitable from the profitable, we see that the coefficient for PNROG is a statistically significant 0.193, indicating the positive relationship between profitability and PNROG for profitable traders. Adding this positive coefficient with the statistically significant coefficient of -0.326 for the dummy variable, D_{PNROG}, we have a sum of -0.133, indicating the negative relationship between profitability and PNROG for unprofitable traders. Comparing the adjusted-R^2 between Model 1_D and Model 1, and, similarly, between Model 2 and Model 2_D, we see the inclusion of the dummy variable, D_{PPROL} and D_{PNROG}, increases the explaining power of the risk-taking variables by a large margin, providing further justification for treating profitable and unprofitable traders differently.

Moving on to multivariate regression results, we see in Model 3_D that both PPROL and PNROG remain significantly positive, the dummies, D_{PPROL} and D_{PNROG}, significantly negative, and the sums, (PPROL plus D_{PPROL}) and (PNROG plus D_{PNROG}), negative, consistent with the univariate results from Models 1_D and 2_D. Comparing the adjusted-R^2 between Models 3_D and either 1_D or 2_D, we see a marginal increase in the explaining power when either PNROG or PPROL is added to the univariate Model 1_D or Model 2_D, respectively, indicating both variables are needed in explaining profitability.

Continuing with multivariate results with trading activity variables, we see in Model 4_D that the statistically significant coefficient 0.345 for trading volume indicates higher trading volume is positively related to profitable traders' profitability. On the other hand, the significant -0.701 for trading volume dummy, D_{Volume}, and sum of Volume and D_{Volume}, -0.356, demonstrate the relationship between profitability and trading volume is negative for unprofitable traders. Similarly, the results for trading day reported in Model 5_D also show that trading more frequently is beneficial for profitable traders but harmful for unprofitable traders.

Overall, the results from regressions are consistent with those reported in Sections 4.2 – 4.4, offering further supports that risk-taking, along with trading activity, is related to profitability and the relationship is opposite between profitable traders and unprofitable traders.

4.6 Additional Tests

Considering the diverse trading characteristics exhibited among our traders, there is a distinct possibility that they also vary in the amount of capital they expose themselves to during trading. Traders whose exposure is higher plausibly will have greater gains or losses. To measure profitability sufficiently, it is therefore important to account for not only all transaction costs, as we have done all along, but also such exposure. To do so, we estimate the exposure of each trader based on the MPLs of the trader and come up with an ex post measure defined as the 95th percentile of the risk exposure. For simplicity, we call this measure VaR. Interpreted as the trader's fifth largest potential loss over 100 rounds of trades that have potential losses, this VaR measure provides us with an estimate of risk facing the trader. We then define the risk-adjusted profitability as the profitability divided by the VaR, $\frac{Profitability}{VaR}$.

Using this risk-adjusted profitability, we then run the following regression tests:

$$\frac{Profitability}{VaR} = \beta_0 PPROL + \beta_1 D_{PPROL} + \beta_2 PNROG + \beta_3 D_{PNROG} + \beta_4 \frac{Volume}{VaR} + \beta_5 D_{\frac{Volume}{VaR}} + \beta_6 \frac{Day}{VaR} + \beta_7 \frac{D_{Day}}{VaR} \quad (6)$$

We also run the same regressions with both volume and day without being divided by VaR. As shown in Table 7, the results based on risk-adjusted profitability are the same as those without adjustment and reported in Table 6, although the number of observations in Table 7 is smaller due to the loss of some traders in the sample for lacking sufficient data points required to calculate VaR. We see that the adjusted-R^2s in Table 7 are notably higher than their counterparts in Table 6, suggesting risk-adjusted profitability provides a better fit. Comparing the adjusted-R^2 between Models 9_D and 11_D , where volume instead of $\frac{Volume}{VaR}$ is used, and between 10_D and 12_D,

where day instead of $\frac{Day}{VaR}$ is used, it's clear that the explaining power of the models improved with VaR-adjusted volume and day as the regressors.

In addition to VaR, we also use the standard deviation of the unrealized losses of each trader as an alternative measure of risk exposure. We also consider the effect that trading activity has on profitability—more trading may result in higher profitability—and account for it by dividing the profitability by either trading days or trading volume. Results, available upon request, based on all these alternative measures of profitability are all similar to, and demonstrate the robustness of, those reported in Tables 6 and 7.

Insert Table 7 about here

V. Discussion and Conclusion

By tracking the trade-by-trade transaction histories of retail traders separately on the Taiwan Futures Exchange (TAIFEX) and using our proposed measures of risk-taking during trading, we demonstrate that while overall they tend to reduce risk by offsetting their positions after reaching threshold levels of gains and losses, they have a greater tendency to reduce risk in the face of losses than when they are faced with gains. To some extent, this is analogous to aversion to loss of traders when they liquidate positions. Linking this tendency to profitability, we show that risk-taking by these traders in the face of losses and gains has opposite effects on profitability between profitable traders and unprofitable traders. For profitable traders, taking on more risk by continuing to accumulate positions leads to greater profits. For unprofitable traders, the opposite is true: reducing risk by offsetting their positions results in smaller losses. From the standpoint of traders, the practical implications for traders are that for profitable traders, resisting the temptation to unload their positions can lead to greater profits, whereas for unprofitable traders, reducing risk results in smaller losses.

While addressing the link between risk-taking and profitability, we also examine in detail traders' profitability. Although as a group they are unprofitable, after accounting for all transaction costs, roughly one third of them are actually profitable—especially among those who

trade frequently and in high volume. This evidence of the existence of profitable, frequent, and high-volume traders offers a close-up picture beyond the general conclusion in the literature that after transaction costs, average investors lose money. It also sheds new light on the widely-cited evidence documented in Odean [1998] and similar studies regarding overconfidence. Examining investors in aggregate, not separately, these studies suggest that excessive trading due to overconfidence results in reduced profitability and even losses. Examining profitable and unprofitable traders separately, we show that trading activity, measured by either trading days or trading volume, is systematically associated with profits for profitable traders and losses for unprofitable traders. For the former, the more active they trade, the more profitable they are, while for the latter, the more active they trade, the more losses they suffer. While the result for the unprofitable traders is consistent with the literature that excessive trading due to overconfidence reduces the profitability of investors, the positive relationship between active trading and profits among the profitable traders is at odds with the literature. One possible explanation for this new finding is that the profits of profitable traders reflect their ability and trading skills. Employing these skills they trade actively to maximize their returns, hence the positive relationship between profits and trading activity. Whether this conjecture is true is clearly beyond the scope of this paper and a topic for future studies.

In conclusion, using our method to analyze each trader individually, we are able to explore and present a fresh picture of risk-taking during trading and its impact on profitability, along with additional results related to trading activity. These results suggest that studies that go beyond the aggregate trader open the door for new evidence on investor behavior and offer the most potential for extending the literature on behavior finance.

Appendix
Calculation of Relevant Variables

To demonstrate the calculation of variables used in the analysis, please refer to Table A. It is a snapshot capturing a tiny portion of one trader's trading history and listing the sequence of trades along with other information and calculated values. Please note that the prices reported are the execution prices of the trades actually executed by the trader, as indicated in the title of the column. Since between any two trades many price changes, up and/or down, resulting from trades conducted by other traders might have occurred but are not reported, the sequence of prices should not be interpreted as a time series of the market price. Therefore one should avoid assuming the existence of a market trend when one sees an apparent trend in the execution prices in the table. Although a nonissue, we did examine the market trends during the sample period to see if there are some periods of continuing up- or down-trends. The results, available upon request, suggest there is no discernible trend.

As an example, Trader A shorts five TX contracts that expire in March 2003 (TXC3). Our analysis of his trading history for TXC3 starts with this trade and shows a short position of five contracts. Subsequent trades are tracked individually until the maturity of TXC3 in March 2003. With each trade, we calculate and update the OIs, weighted average costs of the contracts, and unrealized as well as realized gains/losses using the weighted average costs and current price. By constantly updating after each trade, we have a running tally of the OIs and unrealized and realized gains/losses. These calculations are detailed below using Table A for illustration.

A. Weighted Average Costs and Open Interests

As shown in Table A, the first trade executed by Trader A for TXC3 is identified to be a short position of five contracts at a price of 5,951 (ticks). His record thus shows an open interest of -5 and an average cost of 5,951. After shorting one more contract in his second trade at a price of 5,950, his record is updated to show an average cost of 5,950.833 (= (5,951×5 + 5,950) ÷ (5+1)) and an OI of -6.

Insert Table A about here

B. Unrealized Gains/Losses

With the market price now being 5,950, an average cost of 5,950.833, and open interest of -6, the trader now has an unrealized gain of 5 (= (5,950 – 5,950.833) × -6). Same calculations like these are repeated for the following five trades, Trades 3 to Trade 7. Together, these first seven trades constitute the accumulation phase of his trades when he loads up contracts and are labeled as "A" in Column 3 in Table A to indicate that the trades are in the accumulation phase.

C. Realized Gains/Losses

Following the accumulation phase of trades, Trader A starts to offset his positions which results in realized gains/losses. Continuing with the same example, Trader A starts the offsetting phase of his trades in Trade 8 by longing two contracts, resulting in a realized gain of 14.267 (= (5,952.133 – 5,945)× 2). To calculate the net profit, we subtract the commission and transaction tax, which is 1/100th of one percent of the transaction value. The commission varies among the brokerage houses and based on our interviews with many of them, the average is about 150 New Taiwan Dollar (NT$), the currency of Taiwan, for each contract longed and each contract shorted. Given that a tick for TX is worth NT$200, this average commission of NT$150 has a value equivalent to 0.75 tick, we therefore subtract 0.75 as the commission from each contract longed and shorted in our analysis. Although in practice traders must pay the commission and transaction tax after each trade but considering the extremely short-term nature of futures trading as well as the fact that realized gains/losses occur only with the offsetting trades, we choose to add all commissions and transaction taxes incurred for all trades in the accumulation phase to those for the first trade in the offsetting phase. Therefore, after executing the Trade 8, Trader A should have paid a total commission of 24, which is calculated as 0.75 times 32 contracts–30 contracts shorted in the first seven trades plus two contracts longed in the 8th trade. The total transaction tax[14] incurred is 19.045, calculated as 0.01% of the sum of the total transaction values

[14] There is no capital gain tax in Taiwan; instead, investors are required to pay a transaction tax equal to 1/100th of one percent of the value of each trade.

of 190,450 [= (5,951×5 + 5,950 ×1+…+ 5,959×5) + (5,945×2).] Subtracting these transaction costs from the realized gain, we have a net realized gain of -28.779 (= 14.267 – 24.000 – 19.045). For positions that are held until maturity and closed by the exchange, we calculate the net realized gains/losses based on the final price of the contract. Notice that, unlike Locke and Mann [2005] who impose an assumption that open interest is zero at the end of each trading day, our calculation of realized gains/losses does not have to make such an assumption, hence providing us with an accurate measure of realized gains/losses.

Table A. An Example of the Calculation of the Variables of Gains/Losses in Three Rounds of Trades

Trade sequence	Round	Trade phase	Buy/sell	Price	Number of contracts	Average cost	Open interest	Unrealized gain/loss	Realized gain/loss	Commission	Tax	Net realized gain/loss	Cumulative realized gain/loss	Net profit/loss	Maximum possible loss	Maximum possible gain	Reversal of loss	Reversal of gain
1	1	A	S	5951	5	5951.000	-5	0.000										
2	1	A	S	5950	1	5950.833	-6	5.000										
3	1	A	S	5951	4	5950.900	-10	-1.000										
4	1	A	S	5948	5	5949.933	-15	**29.000**										
5	1	A	S	5949	5	5949.700	-20	14.000										
6	1	A	S	5955	5	5950.760	-25	-106.000										
7	1	A	S	5959	5	5952.133	-30	**-206.000**							-206.000	29.000	0.000	-235.000
8	1	O	B	5945	2	5952.133	-28	199.733	14.267	24.000	19.045	-28.779	-28.779					
9	1	O	B	5945	1	5952.133	-27	192.600	7.133	0.750	0.595	5.789	-22.990					
10	1	O	B	5945	2	5952.133	-25	178.333	14.267	1.500	1.189	11.578	-11.412					
11	1	O	B	5946	5	5952.133	-20	122.667	30.667	3.750	2.973	23.944	12.531					
12	1	O	B	5948	3	5952.133	-17	70.267	12.400	2.250	1.784	8.366	20.897					
13	1	O	B	5948	2	5952.133	-15	62.000	8.267	1.500	1.190	5.577	26.474					
14	1	O	B	5948	1	5952.133	-14	57.867	4.133	0.750	0.595	2.789	29.263					
15	1	O	B	5948	4	5952.133	-10	41.333	16.533	3.000	2.379	11.154	40.417					
16	1	O	B	5949	1	5952.133	-9	28.200	3.133	0.750	0.595	1.788	42.205					
17	1	O	B	5949	4	5952.133	-5	15.667	12.533	3.000	2.380	7.154	49.359					
18	1	O	B	5951	5	0.000	0	0.000	5.667	3.750	2.976	-1.059	48.300	48.300				
19	2	A	S	5961	10	5961.000	-10	0.000										
20	2	A	S	5960	5	5960.667	-15	10.000										
21	2	A	S	5957	5	5959.750	-20	55.000										
22	2	A	S	5959	2	5959.682	-22	15.000										
23	2	A	S	5955	3	5959.120	-25	103.000										
24	2	A	S	5959	11	5959.083	-36	3.000										
25	2	A	S	5955	4	5958.675	-40	147.000										
26	2	A	S	5953	5	5958.044	-45	227.000										
27	2	A	S	5959	5	5958.140	-50	-43.000										
28	2	A	S	5962	5	5958.491	-55	**-193.000**										
29	2	A	S	5959	5	5958.533	-60	-28.000										
30	2	A	S	5956	15	5958.027	-75	152.000										
31	2	A	S	5955	5	5957.838	-80	227.000										
32	2	A	S	5954	10	5957.411	-90	307.000										
33	2	A	S	5946	5	5956.811	-95	1027.000										

* A round includes two phases of trades: the accumulation phase of trades when the number of contracts is rising in one trading direction, buy or sell, followed by the offsetting phase when the numbers of contracts are falling as traders offset the contracts accumulated in the earlier phase.

Table A (continued).

Trade sequence	round	Trade phase	Buy/sell	Execution Price**	Number of contracts	Average cost	Open interest	Unrealized gain/loss	Realized gain/loss	Commission	Tax	Net realized gain/loss	Cumulative realized gain/loss	Net gain/loss	Maximum possible loss	Maximum possible gain	Reversal of loss	Reversal of gain
34	2	A	S	5943	5	5956.120	-100	1312.000										
35	2	A	S	5944	4	5955.654	-104	1212.000										
36	2	A	S	5944	1	5955.543	-105	1212.000										
37	2	A	S	5943	5	5954.973	-110	1317.000										
38	2	A	S	5938	5	5954.235	-115	1867.000										
39	2	A	S	5939	2	5953.974	-117	1752.000										
40	2	A	S	5937	3	5953.550	-120	1986.000										
41	2	A	S	5928	10	5951.585	-130	**3066.000**							-193.000	3066.000	3259.000	0.000
42	2	O	B	5957	1	5951.585	-129	-698.585	-5.415	98.250	77.966	-181.632	-181.632					
43	2	O	B	5957	4	5951.585	-125	-676.923	-21.662	3.000	2.383	-27.044	-208.676					
44	2	O	B	5957	1	5951.585	-124	-671.508	-5.415	0.750	0.596	-6.761	-215.437					
45	2	O	B	5957	1	5951.585	-123	-666.092	-5.415	0.750	0.596	-6.761	-222.198					
46	2	O	B	5957	1	5951.585	-122	-660.677	-5.415	0.750	0.596	-6.761	-228.959					
47	2	O	B	5957	2	5951.585	-120	-649.846	-10.831	1.500	1.191	-13.522	-242.481					
48	2	O	B	5961	5	5951.585	-115	-1082.769	-47.077	3.750	2.981	-53.807	-296.289					
49	2	O	B	5959	1	5951.585	-114	-845.354	-7.415	0.750	0.596	-8.761	-305.050					
50	2	O	B	5959	1	5951.585	-113	-837.938	-7.415	0.750	0.596	-8.761	-313.811					
51	2	O	B	5958	3	5951.585	-110	-705.692	-19.246	2.250	1.787	-23.284	-337.095	-1042.787				
52	3	A	S	6000	4	5953.690	-115	-5325.692										
53	3	A	S	5998	5	5955.536	-120	-5095.692										
54	3	A	S	6000	9	5958.638	-129	**-5335.692**										
55	3	A	S	5999	1	5958.949	-130	-5206.692							-5335.692	NA	129.000	NA
56	3	O	B	6023	10	5958.949	-120	-7685.254	-640.438	22.500	18.022	-680.960	-680.960					

* A round includes two phases of trades: the accumulation phase of trades when the number of contracts is rising in one trading direction, buy or sell, followed by the offsetting phase when the numbers of contracts are falling as traders offset the contracts accumulated in the earlier phase.
** The declining trend in the execution prices between trades #19 – #41 may not represent a declining market; anything can happen between any two trades

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Table 1 Profitability and Trading Statistics

Panel A: Trading and Profitability of All Traders

Trading Days	Number of Accounts	%	Number of Contracts	%	Number of Trading days	%	Net Profit (in ticks) Sum	%	Average	Median	Min	Max
All	132021	100	24496774	100	4045886	100	-68553921	100	-519	-159	-3566781	4777947
1-10	54902	41.59	691830	2.82	248340	6.14	-10277271	14.99	-187	-59	-170952	101100
11-20	22553	17.08	1094790	4.47	339193	8.38	-9540413	13.92	-423	-212	-227964	164617
21-30	13720	10.39	1233554	5.04	344851	8.52	-7554635	11.02	-551	-318	-182786	96417
31-40	9475	7.18	1364704	5.57	333773	8.25	-6987300	10.19	-737	-422	-227597	334964
41-50	6757	5.12	1215038	4.96	305982	7.56	-5714189	8.34	-846	-486	-240043	285214
51-60	4946	3.75	1175308	4.80	273457	6.76	-5639274	8.23	-1140	-594	-502218	241929
61-70	3880	2.94	1128020	4.60	253441	6.26	-5602539	8.17	-1444	-660	-968521	95223
71-80	2967	2.25	1023502	4.18	223461	5.52	-4189340	6.11	-1412	-767	-459516	145222
81-89	2134	1.62	921250	3.76	181016	4.47	-3643302	5.31	-1707	-811	-275649	73768
90-120	4814	3.65	3013890	12.30	497144	12.29	-8725642	12.73	-1813	-940	-1140125	700186
121-150	2456	1.86	2128548	8.69	329238	8.14	-1697411	2.48	-691	-1016	-3566781	4777947
151-180	1352	1.02	1874122	7.65	222009	5.49	-1690615	2.47	-1250	-1423	-180662	140759
181-210	822	0.62	1593456	6.50	159683	3.95	-1434796	2.09	-1745	-1434	-288797	229966
211-240	501	0.38	975354	3.98	112250	2.77	-872399	1.27	-1741	-1574	-195298	394631
241-270	281	0.21	916052	3.74	71553	1.77	-114596	0.17	-408	-1418	-695350	491667
271-300	199	0.15	998644	4.08	56562	1.40	931849	-1.36	4683	245	-109832	477353
301-330	110	0.08	846986	3.46	34556	0.85	1016175	-1.48	9238	-165	-86713	442415
331-360	65	0.05	665212	2.72	22441	0.55	922222	-1.35	14188	1373	-52723	146225
361-390	23	0.02	342044	1.40	8659	0.21	286878	-0.42	12473	1590	-286682	269221
391-420	21	0.02	189706	0.77	8451	0.21	493916	-0.72	23520	4297	-21160	226473
421-450	12	0.01	103552	0.42	5214	0.13	234743	-0.34	19562	6179	-19371	143819
451-480	19	0.01	724760	2.96	8726	0.22	641829	-0.94	33780	6683	-930570	1110426
481-537	12	0.01	276452	1.13	5886	0.15	602188	-0.88	50182	31115	308	146498
1-30	91175	69.06	3020174	12.33	932384	23.05	-27372320	39.93	-300	-102	-227964	164617
31-60	21178	16.04	3755050	15.33	913212	22.57	-18340763	26.75	-866	-474	-502218	334964
61-89	8981	6.80	3072772	12.54	657918	16.26	-13435180	19.60	-1496	-729	-968521	145222
≥ 90	10687	8.09	14648778	59.80	1542372	38.12	-9405658	13.72	-880	-1024	-3566781	4777947
Regular Rounds*	10426	7.9	14581086	59.52	1510825	37.34	-9311066	13.58	-893	-1061	-3566781	4777947

* A round includes two phases of trades: the accumulation phase of trades when the number of contracts is rising in one trading direction, long or short, followed by the offsetting phase when the numbers of contracts are falling as traders offset the contracts accumulated in the earlier phase.

Table 1 Continued

Panel B: Profitability of Unprofitable Traders versus Profitable Traders

	Unprofitable Traders								Profitable Traders							
Trading Days	# of Accounts	%	Net Profit	%	Mean	Median	Min	Max	# of Accounts	%	Net Profit	%	Mean	Median	Min	Max
All	91546	100	-132901105	100.00	-1452	-399	-3566781	0	40475	100	64347184	100.00	1590	170	0	4777947
1-10	36305	39.66	-15118004	11.38	-416	**-159**	-170952	0	18597	45.95	4840733	7.52	260	61	0	101100
11~20	16209	17.71	-14415004	10.85	-889	**-384**	-227964	0	6344	15.67	4874591	7.58	768	190	0	164617
21-30	9893	10.81	-11887969	8.94	-1202	**-557**	-182786	0	3827	9.46	4333333	6.73	1132	303	0	96417
31-40	6912	7.55	-11484895	8.64	-1662	**-719**	-227597	0	2563	6.33	4497594	6.99	1755	392	0	334964
41-50	4873	5.32	-9244416	6.96	-1897	**-836**	-240043	0	1884	4.65	3530227	5.49	1874	482	0	285214
51-60	3605	3.94	-7987991	6.01	-2216	**-989**	-502218	-2	1341	3.31	2348717	3.65	1751	518	0	241929
61-70	2763	3.02	-8093238	6.09	-2929	**-1161**	-968521	0	1117	2.76	2490699	3.87	2230	628	1	95223
71-80	2156	2.36	-6102766	4.59	-2831	**-1314**	-459516	-2	811	2.00	1913426	2.97	2359	692	2	145222
81-89	1523	1.66	-5311533	4.00	-3488	**-1410**	-275649	-2	611	1.51	1668232	2.59	2730	937	1	73768
90-120	3469	3.79	-15755497	11.86	-4542	**-1603**	-1140125	-1	1345	3.32	7029855	10.92	5227	1059	1	700186
121-150	1663	1.82	-10557370	7.94	-6348	**-2061**	-3566781	0	793	1.96	8859959	13.77	11173	1365	2	4777947
151-180	937	1.02	-4822613	3.63	-5147	**-2585**	-180662	-3	415	1.03	3131998	4.87	7547	1756	15	140759
181-210	537	0.59	-4064494	3.06	-7569	**-3141**	-288797	-19	285	0.70	2629699	4.09	9227	2105	17	229966
211-240	320	0.35	-2726260	2.05	-8520	**-3504**	-195298	-22	181	0.45	1853861	2.88	10242	3284	27	394631
241-270	176	0.19	-1887931	1.42	-10727	**-3469**	-695350	-39	105	0.26	1773335	2.76	16889	2837	77	491667
271-300	95	0.10	-877730	0.66	-9239	**-4862**	-109832	-144	104	0.26	1809579	2.81	17400	3549	7	477353
301-330	56	0.06	-547019	0.41	-9768	-4306	-86713	-135	54	0.13	1563194	2.43	28948	**5255**	113	442415
331-360	29	0.03	-293361	0.22	-10116	-6790	-52723	-114	36	0.09	1215583	1.89	33766	**20244**	16	146225
361-390	9	0.01	-390655	0.29	-43406	-7548	-286682	-1488	14	0.03	677533	1.05	48395	**8470**	694	269221
391-420	7	0.01	-50488	0.04	-7213	-4279	-21160	-2206	14	0.03	544404	0.85	38886	**11596**	1288	226473
421-450	3	0.00	-29507	0.02	-9836	-5536	-19371	-4601	9	0.02	264251	0.41	29361	**10415**	1353	143819
451-480	6	0.01	-1252365	0.94	-208728	**-52295**	-930570	-5087	13	0.03	1894194	2.94	145707	23730	713	1110426
481-537	0	0.00	0	0.00	0	0	0	0	12	0.03	602188	0.94	50182	**31115**	308	146498
1~30	62407	68.17	-41420977	31.17	-664	**-249**	-227964	0	28768	71.08	14048657	21.83	488	100	0	164617
31-60	15390	16.81	-28717301	21.61	-1866	**-813**	-502218	0	5788	14.30	10376538	16.13	1793	449	0	334964
61-89	6442	7.04	-19507537	14.68	-3028	**-1273**	-968521	0	2539	6.27	6072357	9.44	2392	701	1	145222
≥90	7307	7.98	-43255290	32.55	-5920	**-2077**	-3566781	0	3380	8.35	33849632	52.60	10015	1555	1	4777947
Regular Rounds	7138	7.80	-43107719	32.43	-6039	-2134	-3566781	0	3288	8.12	33796653	52.52%	10279	1604	1	4777947

Table 2 More Trading Statistics

Part 1: Profitable versus Unprofitable Traders

Panel A: All Accounts

	All Number of Accounts: 132021				Profitable Number of Accounts: 40475				Unprofitable Number of Accounts: 91546			
	Trading Day	Volume	Net Profit	Gross Profit	Trading Day	Volume	Net Profit	Gross Profit	Trading Day	Volume	Net Profit	Gross Profit
Mean	31	186	-519	-275	30	281	1590	1960	31	143	-1452	-1263
Median	15	30	-159	-113	13	26	170	229	**16**	**32**	**-399**	**-322**
Minimum	1	2	-3566781	-3477935	1	2	0	0	1	2	-3566781	-3477935
Maximum	537	336980	4777947	4892206	537	336980	4777947	4892206	478	154620	0	17823
Sum	4045886	24496774	-68553921	-36308753	1226708	11385756	64347184	79319167	2819178	13111018	-132901105	-115627920

Panel B: Accounts with 90 Trading Days and Over

	All Number of Accounts: 10687				Profitable Number of Accounts: 3380				Unprofitable Number of Accounts: 7307			
	Trading Day	Volume	Net Profit	Gross Profit	Trading Day	Volume	Net Profit	Gross Profit	Trading Day	Volume	Net Profit	Gross Profit
Mean	144	1371	-880	928	154	2442	10015	13232	140	875	-5920	-4763
Median	126	410	-1024	-474	**132**	**508**	1555	**2382**	123	382	**-2077**	-1442
Minimum	90	100	-3566781	-3477935	90	110	1	184	90	100	-3566781	-3477935
Maximum	537	336980	4777947	4892206	537	336980	4777947	4892206	478	154620	0	16097
Sum	1542372	14648778	-9405658	9919733	521954	8253682	33849632	44725811	1020418	6395096	-43255290	-34806078

Panel C: Accounts with Regular Trading Rounds

	All Number of Accounts: 10426				Profitable Number of Accounts: 3288				Unprofitable Number of Accounts: 7138			
	Trading Day	Volume	Net Profit	Gross Profit	Trading Day	Volume	Net Profit	Gross Profit	Trading Day	Volume	Net Profit	Gross Profit
Mean	145	1399	-893	952	155	2502	10279	13576	140	890	-6039	-4863
Median	126	420	-1061	-501	**132**	**528**	1604	**2519**	124	390	**-2134**	-1495
Minimum	90	102	-3566781	-3477935	90	110	1	184	90	102	-3566781	-3477935
Maximum	537	336980	4777947	4892206	537	336980	4777947	4892206	478	154620	0	16097
Sum	1510825	14581086	-9311066	9925618	509882	8227558	33796653	44638593	1000943	6353528	-43107719	-34712975

Table 2 Continued

Part 2: : Net Gains/Losses (of 10426 Traders with regular rounds of trades) in Groups Double Sorted by Trading Days (1st decile: Smallest Number of Days & 10th decile: Largest Number of Days) and Trading Volume (1st decile: Smallest Number of Contracts & 10th decile: Largest Number of Contracts)

Trading Volume Decile Group		Trading Day Decile Group 1	2	3	4	5	6	7	8	9	10	Total
1	Observations	3871	1126	276	42	3	0	0	0	0	0	5318
	Mean	-1159	-1241	-1362	-1598	-2180						
	Median	-924	-1092	-1370	-1766	-1218						
2	Observations	933	735	462	231	89	13	2	0	0	0	2465
	Mean	-1542	-1298	-1884	-1867	-1784	-2443	-478				
	Median	-1319	-1181	-1711	-1630	-1540	-1998	-478				
3	Observations	403	316	245	170	83	60	14	6	1	0	1298
	Mean	-2235	-2727	-1920	-1441	-2224	-692	-3388	**787**	-5732		
	Median	-1680	-2182	-1890	-1357	-1949	-1134	-2461	**288**	-5732		
4	Observations	179	150	121	99	63	30	19	9	3	2	675
	Mean	-912	**489**	-1337	-1232	-1776	**928**	-4774	-2881	-2300	**2001**	
	Median	-712	**519**	-2166	-309	-1524	**797**	-3067	-2526	-4601	**2001**	
5	Observations	69	79	48	45	40	32	15	5	2	6	341
	Mean	-6060	-4380	-3467	-5127	3796	-5125	**21181**	**2209**	-8522	**4774**	
	Median	-407	-2709	-2174	-238	-2336	**159**	**9423**	**4297**	-8522	**3495**	
6	Observations	27	32	24	20	19	13	14	3	6	6	164
	Mean	-8600	**6931**	-6155	-7864	**7580**	-5549	**6793**	**33014**	**47116**	-9771	
	Median	-22526	**13140**	-9243	-5787	**6437**	**4052**	**18**	**37361**	**12316**	**3671**	
7	Observations	15	12	7	9	16	9	6	4	4	5	87
	Mean	-31417	**18128**	-28000	**30347**	**39189**	**45282**	**23168**	**18233**	**58176**	**22279**	
	Median	**4431**	**15017**	**31408**	**5647**	**17068**	**48308**	**14749**	**10930**	**39881**	**23730**	
8	Observations	9	1	5	2	6	8	4	2	1	10	48
	Mean	-85531	**87025**	**75027**	-86419	**112809**	**89969**	**55535**	-132952	**171423**	**97875**	
	Median	-160492	**87025**	**28560**	-86419	**34307**	**39778**	**56099**	-132952	**171423**	**69980**	
9	Observations	5	2	5	1	2	3	1	2	0	0	21
	Mean	**107687**	**102306**	**2559**	**75688**	**-315843**	**89532**	**96886**	**149584**			
	Median	**129479**	**102306**	**55048**	**75688**	**-315843**	**92557**	**96886**	**149584**			
10	Observations	1	1	1	0	1	1	1	1	0	2	9
	Mean	-619271	**102783**	**227528**		**135642**	**236577**	**146225**	**187391**		**89928**	
	Median	-619271	**102783**	**227528**		**135642**	**236577**	**146225**	**187391**		**89928**	
	Total	5512	2454	1194	619	322	169	76	32	17	31	10426

Table 3 Proportions of Positive Reversals of Losses (PPROL) and Proportions of Zero Reversals of Losses (PZROL)

Part 1: Total Sample (10,309 Observations)

	Average	Std. Dev.	T-Statistic	Significant Level
PPROL	0.1106	0.1380		
PZROL	0.8894	0.1380		
Difference	(0.7787)		286.44	0.0000

Part 2: PPROLs among Subgroups

Panel A: Trading Day Decile Groups (1st: Smallest Number of Days & 10th: Largest Number of Days)

Group	1	2	3	4	5	6	7	8	9	10
Observations	5428	2428	1188	618	322	169	76	32	17	31
Mean	0.0949	0.1108	0.1218	0.1438	0.1680	0.1950	0.2106	0.2029	0.2256	0.3063
Median	0.0417	0.0667	0.0857	0.1053	0.1300	0.1604	0.1651	0.1323	0.1562	0.3106
Std. dev.	0.1324	0.1358	0.1311	0.1455	0.1525	0.1533	0.1682	0.1915	0.1809	0.1673
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0000
Maximum	1.0000	0.7805	1.0000	0.8793	0.7470	0.6512	0.6667	0.6154	0.6097	0.6286

Panel B: Trading Volume Decile Groups (in Number of Contracts; 1st: Lowest & 10th: Highest)

Group	1	2	3	4	5	6	7	8	9	10
Observations	5213	2453	1298	675	341	164	87	48	21	9
Mean	0.0596	0.1135	0.1568	0.2173	0.2669	0.3043	0.3590	0.3745	0.3652	0.3747
Median	0.0000	0.0769	0.1250	0.1837	0.2500	0.2721	0.3492	0.3840	0.2914	0.3551
Std. dev.	0.0987	0.1226	0.1381	0.1607	0.1603	0.1591	0.1623	0.1596	0.2107	0.1290
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.0339	0.0629	0.0515	0.0816	0.2264
Maximum	1.0000	1.0000	0.8947	0.8400	0.7692	0.6857	0.8793	0.7692	0.8462	0.5955

Table 3 (continued).

Part 2: PPROLs among Subgroups

Panel C: Profitable Groups

	Quintile Groups (1^{st}: Lowest & 5^{th}: Highest)					**Equal-number Groups**				
Group	1	2	3	4	5	1	2	3	4	5
Observations	2796	261	88	30	3	430	429	426	441	441
Mean	0.1336	0.3590	0.4331	0.4345	0.5259	0.0681	0.0777	0.1153	0.1543	0.2992
Median	0.1000	0.3359	0.4135	0.4454	0.5375	0.0000	0.0286	0.0833	0.1282	0.2787
Std. dev.	0.1446	0.1755	0.1573	0.1477	0.3263	0.1010	0.1112	0.1341	0.1324	0.1694
Minimum	0.0000	0.0000	0.0816	0.1250	0.1939	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	1.0000	1.0000	0.7692	0.6857	0.8462	0.5217	0.7500	1.0000	0.7241	1.0000

Panel D: Unprofitable Groups

	Quintile Groups (1^{st}: Lowest & 5^{th}: Highest)					**Equal-number Groups**				
Group	1	2	3	4	5	1	2	3	4	5
Observations	5113	1365	437	90	9	594	610	614	615	612
Mean	0.0652	0.1163	0.1960	0.2967	0.5207	0.0539	0.0654	0.0675	0.0816	0.1599
Median	0.0000	0.0909	0.1667	0.2524	0.5197	0.0000	0.0000	0.0286	0.0556	0.1226
Std. dev.	0.0974	0.1105	0.1380	0.1711	0.1658	0.0840	0.0969	0.1006	0.0979	0.1372
Minimum	0.0000	0.0000	0.0000	0.0433	0.1778	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	0.7000	0.6923	0.7143	0.8793	0.7317	0.4118	0.5714	0.7000	0.6667	0.6857

Table 4 Proportions of Negative Reversals of Gains (PNROG) and Proportions of Zero Reversals of Gain (PZROG)

Part 1: Total Sample (9671 Observations)

	Average	Std. Dev.	T-Statistic	Significant Level
PNROG	0.1783	0.2039		
PZROG	0.8217	0.2039		
Difference	(0.6435)		155.165	0.0000

Part 2: PNROGs among Subgroups

Panel A: Trading Days Subgroups (1st Decile: Smallest Number of Days & 10th Decile: Largest Number of Days)

Group	1	2	3	4	5	6	7	8	9	10
Observations	4942	2313	1165	610	319	166	76	32	17	31
Mean	0.1637	0.1809	0.1865	0.2206	0.2112	0.2310	0.2405	0.1593	0.2858	0.3391
Median	0.0805	0.1282	0.1429	0.1797	0.1605	0.1956	0.2065	0.1086	0.2759	0.3419
Std. dev.	0.2122	0.1996	0.1883	0.1950	0.1841	0.1644	0.1656	0.1386	0.1515	0.1328
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	1.0000	1.0000	1.0000	1.0000	0.8000	0.7917	0.7083	0.5204	0.5394	0.5747

Panel B: Trading Volume Decile Groups (1st: Smallest Number of Contracts & 10th: Largest Number of Contracts)

Group	1	2	3	4	5	6	7	8	9	10
Observations	4632	2404	1291	674	341	164	87	48	21	9
Mean	0.1263	0.1858	0.2223	0.2628	0.3143	0.3706	0.3851	0.3969	0.2646	0.2412
Median	0.0000	0.1429	0.1875	0.2286	0.2857	0.3766	0.3983	0.4048	0.1261	0.1759
Std. dev.	0.2010	0.1868	0.1884	0.1836	0.1947	0.1828	0.1702	0.1869	0.2707	0.1349
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0464	0.0568	0.0426	0.0820
Maximum	1.0000	1.0000	1.0000	0.8571	0.9412	1.0000	0.7385	0.7447	0.9259	0.4434

Table 4 (continued).

Part 2: PNROGs among Subgroups

Panel C: Profitable Quintile Groups (in ticks; 1st: Lowest & 5th: Highest)

	Quintile Groups (1st: Lowest & 5th: Highest)					Equal-number Groups				
Group	1	2	3	4	5	1	2	3	4	5
Observations	2795	261	88	30	3	600	621	643	656	657
Mean	0.1483	0.3198	0.3975	0.4235	0.4989	0.1056	0.1112	0.1343	0.1878	0.3124
Median	0.1000	0.3036	0.4356	0.4535	0.5435	0.0000	0.0000	0.0833	0.1429	0.2857
Std. dev.	0.1746	0.1797	0.1857	0.2063	0.0920	0.1532	0.1564	0.1715	0.1796	0.1895
Minimum	0.0000	0.0000	0.0000	0.0739	0.3931	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	1.0000	0.8000	0.7385	0.9091	0.5600	1.0000	1.0000	1.0000	1.0000	0.9091

Panel D: Unprofitable Quintile Groups (in ticks; 1st: Lowest & 5th: Highest)

	Quintile Groups (1st: Lowest & 5th: Highest)					Equal-number Groups				
Group	1	2	3	4	5	1	2	3	4	5
Observations	4630	1328	437	90	9	1241	1230	1273	1339	1411
Mean	0.1355	0.2632	0.3523	0.4474	0.6190	0.1060	0.1177	0.1461	0.2011	0.3158
Median	0.0417	0.2308	0.3333	0.4613	0.6182	0.0000	0.0000	0.0667	0.1667	0.2973
Std. dev.	0.1876	0.2188	0.2155	0.2062	0.1622	0.1731	0.1763	0.1910	0.2132	0.2194
Minimum	0.0000	0.0000	0.0000	0.0000	0.3992	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	1.0000	1.0000	1.0000	1.0000	0.9259	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5 Correlations between Variables

All Traders (Obs.: 10,426)

	PPROL	PNROG	Days	Volume
PNROG	0.313***			
Days	0.182***	0.098***		
Volume	0.233***	0.108***	0.264***	
Profit	0.045***	-0.020**	0.033***	0.130***

Profitable Traders (Obs.: 3,288)

	PPROL	PNROG	Days	Volume
PNROG	0.409***			
Days	0.193***	0.118***		
Volume	0.193***	0.113***	0.308***	
Profit	0.185***	0.126***	0.085***	0.381***

Unprofitable Traders (Obs.: 7,138)

	PPROL	PNROG	Days	Volume
PNROG	0.293***			
Days	0.125***	0.095***		
Volume	0.311***	0.166***	0.215***	
Profit	-0.193***	-0.130***	-0.053***	-0.616***

† Due to missing values the numbers of observations in each cell are different
*: 10% significant level; **: 5% level; *** 1% level

Table 6 Regressions of Profitability on PPROL, PNROG, Trading Volume, and Trading Days

	Model								
	1	1_D	2	2_D	3_D	4	4_D	5	5_D
Dependent Variable: Profit									
Regressors									
PPROL	0.019*	0.199***			0.147***	0.130***	0.064***	0.141***	0.134***
	(1.9)	(17.4)			(10.2)	(8.9)	(5.7)	(9.7)	(8.6)
D_{PPROL}		-0.324***			-0.253***	-0.247***	-0.037***	-0.250***	-0.242***
		(-28.4)			(-16.9)	(-16.5)	(-3.1)	(-16.7)	(-14.9)
PNROG			-0.043***	0.193***	0.063***	0.062***	0.057***	0.062***	0.055***
			(-4.3)	(13.7)	(3.7)	(3.6)	(4.3)	(3.6)	(3.0)
D_{PNROG}				-0.326***	-0.132***	-0.133***	-0.069***	-0.132***	-0.121***
				(-23.0)	(-7.1)	(-7.1)	(-4.8)	(-7.1)	(-5.9)
Volume						0.074***	0.345***		
						(7.5)	(41.5)		
D_{vol}							-0.701***		
							(-81.7)		
Day								0.038***	0.045***
								(3.8)	(3.9)
D_{day}									-0.019
									(-1.3)
Obs.	10,245	10,242	9,993	9,990	9,807	9,807	9,807	9,807	9,807
Adj. R^2	0.000	0.073	0.002	0.052	0.079	0.084	0.455	0.080	0.080

*: 10% significant level; **: 5% level; *** 1% level
Profit = net gain/loss after all transaction costs.
PPROL= Proportion of positive reversal of loss
PNROG: Proportion of negative reversal of gain
Volume = trading volume over the sample period.
Day = trading days over the sample period.
D_{PPROL}= PPROL for unprofitable traders; zero for profitable traders.
D_{PNROG}= PNROG for unprofitable traders; zero for profitable traders.
D_{Vol}= volume for unprofitable traders; zero for profitable traders.
D_{Day} = day for unprofitable traders; zero for profitable traders.

Table 7 Regressions of Risk-Adjusted Profitability on PPROL, PNROG, Trading Volume, and Trading Days

	Model								
	6	6_D	7	7_D	8_D	9_D	10_D	11_D	12_D
Dependent Variable: Risk-Adjusted Profitability (Profit/VaR)									
Regressors									
PPROL	0.058***	0.249***			0.188***	0.098***	0.168***	0.119***	0.151***
	(5.9)	(21.9)			(13.2)	(9.8)	(11.9)	(9.3)	(9.9)
D_{PPROL}		-0.345***			-0.268***	-0.104***	-0.249***	-0.108***	-0.230***
		(-30.4)			(-18.0)	(-15.3)	(-16.9)	(-8.1)	(-14.3)
PNROG			-0.022**	0.239***	0.085***	0.072***	0.066***	0.080***	0.053***
			(-2.2)	(16.9)	(4.9)	(5.2)	(3.9)	(5.3)	(2.9)
D_{PNROG}				-0.361***	-0.147***	-0.104***	-0.129***	-0.102***	-0.102***
				(-25.6)	(-7.9)	(-8.6)	(-7.1)	(-6.3)	(-5.1)
Vol/VaR						0.397***			
						(47.4)			
$D_{vol/VaR}$						-0.529***			
						(-61.4)			
Day/VaR							0.093***		
							(8.2)		
$D_{Day/VaR}$							-0.186***		
							(-16.4)		
Vol								0.287***	
								(30.4)	
D_{vol}								-0.507***	
								(-51.9)	
Day									0.071***
									(6.3)
D_{Day}									-0.081***
									(-5.6)
Obs.	10,242	10,239	9,887	9,884	9,804	9,804	9,804	9,804	9,804
Adj. R^2	0.003	0.086	0.000	0.062	0.093	0.386	0.117	0.294	0.097

*: 10% significant level; **: 5% level; *** 1% level

Profit = net gain/loss after all transaction costs.

VaR: 95th percentile of the possible losses of the trader reversal of loss (gain)

PPROL (PNROG): Proportion of positive (negative)

D_{PPROL}= PPROL for unprofitable traders; zero for profitable traders.

D_{PNROG}= PNROG for unprofitable traders; zero for profitable traders.

Volume = trading volume over the sample period.

$D_{VOL/VaR}$= volume/VaR for unprofitable traders; zero for profitable traders.

Day = trading days over the sample period.

$D_{Day/VaR}$ = day/VaR for unprofitable traders; zero for profitable traders.

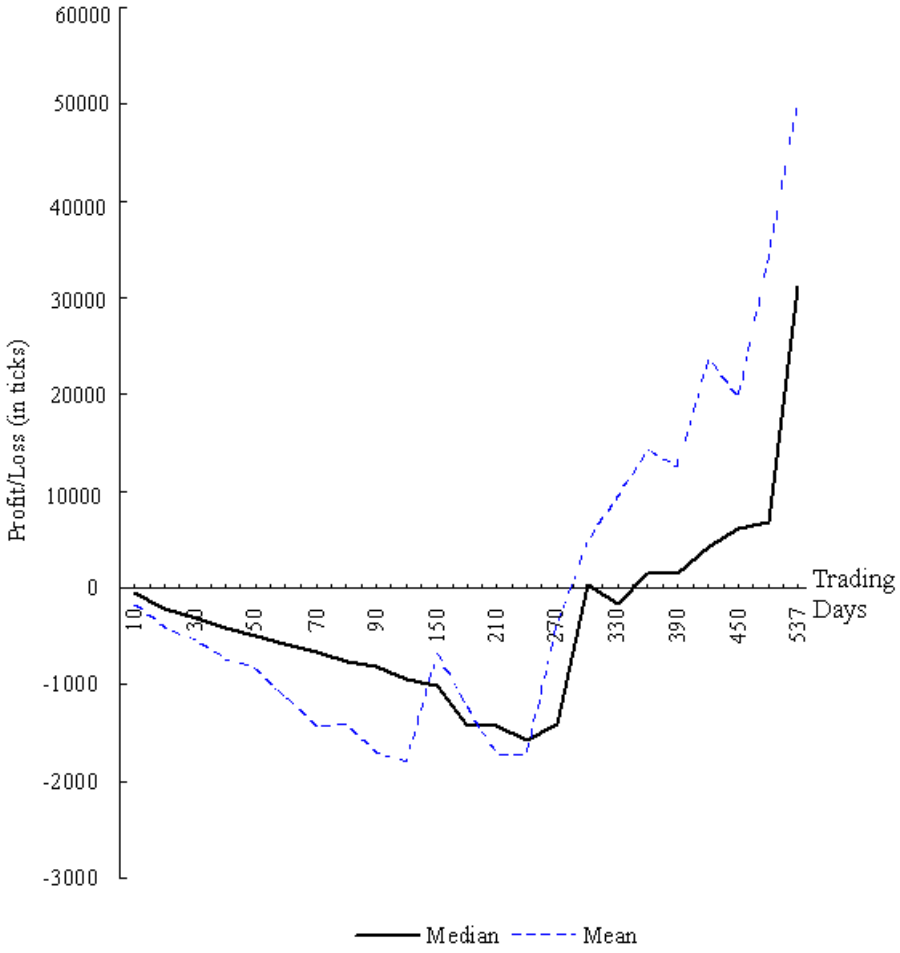

Figure 1 Profitability and Trading Days

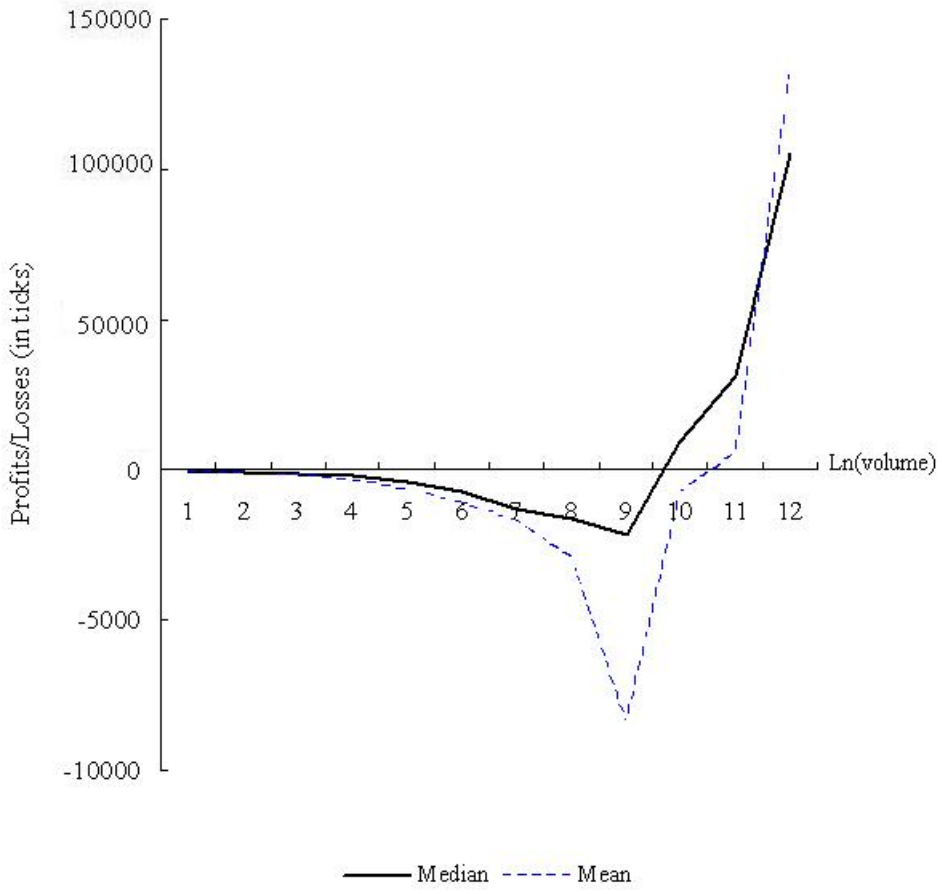

Figure 2 Profitability and Trading Volume