An Examination of the Relationship between the Disposition Effect and Gender, Age, and the Traded Security

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Keywords: Behavioral Finance; Disposition Effect; Innate Characteristics; External Factor

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Abstract

We analyze how gender and age, internal characteristics of futures traders—one that remains fixed while the other changes over the lifetime—and the security being traded, an external factor, are related to the disposition effect by separately tracking their trade-by-trade transaction histories over a period of 33 months on the Taiwan Futures Exchange (TAIFEX). We show that women and mature traders, compared with their male and younger counterparts, exhibit a stronger disposition effect. The effect is also stronger among traders who trade financial-sector futures contracts than those who trade electronic-sector futures contracts. Further test results provide convincing evidence that the disposition effect indeed is related to both internal and external factors.

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I. Introduction

According to Commodity Research Bureau\(^1\) (CRB), fewer than 25% of all futures traders are successful. Surveying the top traders who consistently make hundreds of thousands—even millions of dollars—each year, CRB compiles “50 Rules of Futures Trading.” Among these rules, six are related to how to deal with unrealized gains and losses and the most familiar ones are “cut your losses short” and “let profits run.”\(^2\) Similarly, veteran futures practitioners advise that to be successful traders need to control emotion and adhere to a trading plan. A major component of such a plan is to manage trading risk by establishing thresholds to limit losses and establishing objectives at which profits are to be taken. Simple risk management rules they attribute to a trader’s overall profits are the same: “cutting losses and letting profits run.”

Examining investors in aggregate in various markets, voluminous studies have documented that instead of following these well-known rules of successful trading, average investors behave just the opposite. They exhibit the disposition effect, i.e., the tendency to hold onto losses too long but realize gains too readily. Going beyond the aggregate investor approach followed by most studies and by tracking the trade-by-trade history of each individual trader on the Taiwan Futures Exchange (TAIFEX), this study extends this research by conducting an in-depth examination of the variations in the disposition effect among traders and how such variations are related to internal biological characteristics such as gender, an enduring trait that remains fixed over the lifetime, and age, which changes over time.

In addition to examining these internal factors, we further investigate whether and how external factors also play a role in the disposition effect. To motivate this investigation we again look to veteran futures traders. According to them, to be profitable, traders must have a trading plan and a major component of the plan is a risk management program which specifies how much money to risk on a trade and when to cut losses.\(^3\) Specifically, the exact amount of loss that a trader should tolerate before a position is closed depends on factors such as the amount of margin in the trader’s account and the volatility of the product being traded.

\(^2\) The other four include: “Isolate your trading from your desire for profit,” “Never add to a losing position,” “Avoid holding losing positions,” and “Learn to like losses.”
The greater the volatility the more risk is involved if one wants to carry the position through transitory price movements without being forced to exit the position prematurely. This advice suggests that volatility may be an external factor affecting how traders behave and potentially reflecting the behavioral bias such as the disposition effect. Unfortunately, we cannot explore the issue of margin due to lack of such information in our dataset. Adding trade-by-trade volatility on top of the already daunting task of trade-by-trade tracking also creates an insurmountable technical nightmare. As an alternative to tackle this volatility-related external factor, we choose to examine how the security being traded as an external factor is related to the disposition effect. To do so, we compare how traders vary in the trading of two different futures contracts that, as discussed in Section III, have two distinct underlying assets—the electronic sector index versus financial sector index—with different characteristics. It’s plausible that these two futures contracts attract different traders and through trading the varying degrees of the disposition effect among the traders are revealed.

This in-depth analysis of the behavioral aspect of trading extends the literature in four ways. First, until recently, most studies on the disposition effect focus on the aggregate trader, treating all traders as if they were identical. Recognizing that not all investors are the same, Dhar and Zhu (2006) and Feng and Seasholes (2005) show that indeed there are significant cross-sectional variations in the degree of the disposition effect. They attribute such variations to the differences among investors in knowledge, ability, and sophistication. Although these studies have made considerable contribution toward the understanding of the disposition effect by linking it to individual characteristics such as income, wealth, and education, two most basic characteristics, gender and age, have yet to be linked to the disposition effect. The lack of attention to these two internal factors of traders is in sharp contrast to the vast literature in sociology, psychology, and experimental economics that examine investor attitude toward risk. A survey of these studies on financial risk assessment (e.g., Hallahan et al. 2004) and risk tolerance reveals that gender and age are the two most investigated factors while factors such as income, wealth, and educations that have been examined in previous studies of the disposition effect are less so. Additionally, judging from the evidence that education, wealth, and other environmental factors have been found to be less important than generic factors, such as gender, in determining investor behavior (Barnea et al. 2009), an investigation of gender and age differences is therefore warranted.
Second, the examination of both gender and age offers further insight into the disposition effect considering that while both are internal fundamental biological factors, gender is an innate and enduring characteristic that is fixed over the lifetime of an individual. Age, on the other hand, changes with time and the aging process has been shown to be related to a decrease in risk tolerance attributable to biological changes in enzymes (e.g., Harlow and Brown 1990). By examining both factors, we are able to explore whether behavior traits indeed are determined by enduring innate characteristics, and, simultaneously, whether they are also subject to change over time. Third, our inclusion of two distinctive futures contracts in the analysis affords us a rare opportunity to explore whether any external factor—in this case, the security being traded—in addition to internal factors, is related to the disposition effect, further contributing to the understanding of the disposition effect. The contribution to the literature of this study involving internal and external factors is analogous to that of studies on nature versus nurture in various areas in psychology that concludes that that human behavior is rarely, if ever, determined solely by either nature—internal characteristics—or nurture—an external factor. Fourth, the evidence on whether and how the specific security being traded, a factor specific to the microstructure of trading, is linked to behavioral bias in our analysis also adds to the microstructure literature that trading-related factors indeed matter in financial decision making.

Based on these motivations, we investigate and show that the disposition effect is related to traders’ gender and age and the specific type of futures traded. Specifically, women and mature traders, compared with their male and younger counterparts, exhibit a stronger disposition effect. The effect is also stronger among traders who trade the financial-sector futures contract than those who trade the electronic-sector futures.

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.

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4 With the exception of people who undergo a surgical sex change.
II. Literature Review

2.1 The Disposition Effect

Voluminous studies have documented the existence of the disposition effect among various market participants—individual investors as well as proprietary traders—and in different markets. To name just a few: in an experimental setting, Kahneman and Tversky (1979); in the equity market, Odean (1998) and Dhar and Zhu (2006) look at retail investors of a US discount brokerage house, Garvey and Murphy (2004) examine 15 proprietary stock traders, and Barber et al. (2007) analyze four types of investors (individuals, corporations, dealers, and foreign investors) in Taiwan; in the futures market, Heisler (1994) studies small off-exchange retail speculators, Locke and Mann (2005) investigate professional floor traders of currency and agriculture futures in CME, and Frino et al. (2004) examine local traders of three 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. These studies conclude that investors sell winning trades too quickly and hold onto their losing trades too long. Recently, however, Annaert et al. (2008) examine transactions by mutual funds and document a propensity of mutual fund managers to cut losses early, hence the absence of the disposition effect.

With the exception of Frino et al. (2004), Locke and Mann (2005), Feng and Seasholes (2005), and Dhar and Zhu (2006), most of the evidence on the disposition effect is based on the examination of the behavior at the group level, treating all traders as if they were one identical person. Recognizing this limitation and using a methodology that refines the one used by Odean (1998), Frino et al. (2004) demonstrate that local (on-floor) traders exhibit a stronger disposition effect than non-local (off-floor) traders. Feng and Seasholes (2005) show that sophistication and trading experience together eliminate investors’ reluctance to realize losses. Dhar and Zhu (2006) also examine how the disposition effect varies with cross-sectional differences in characteristics and show that investors with higher incomes who work in professional occupations—presumably more sophisticated, trade more frequently, and hence are considered to be more experienced—exhibit a weaker disposition effect.
2.2 Gender and Age as Factors in Investor’s Behavior

To our knowledge, no published studies have yet to link gender and age to the disposition effect. In contrast, extensive studies in sociology, psychology, and experimental economics have examined the impact of gender and age in decision making. In finance, studies have examined differences in investment performance between men and women. Barber and Odean (2001) show that men underperform women and attribute the difference to men being more overconfident. In a recent study, Korniotis and Kumar (2010) ask the question whether older investors make better investment decisions by examining older investors’ performances. They conjecture that with experience people who continue pursuing an activity should become more knowledgeable about that activity. On the other hand, it takes time to accumulate knowledge and no one is spared the brutal fact of aging, which besides the obvious physical decline has shown to be associated with the deterioration of cognitive abilities. Does the wisdom accumulated over the years help investors make better decisions or does the deterioration of the cognitive abilities hinder older people’s ability to effectively put the knowledge to work? Korniotis and Kumar show that older investors underperform benchmarks and conclude that the adverse effect of aging dominates the positive effect.

Among the behavioral issues examined in previous studies, most closely related to the disposition effect is risk aversion/tolerance. If gender and age differences in risk aversion affect investors’ decisions and behaviors, it is logical to suspect that such differences should also be reflected in behavior biases such as the disposition effect. This supposition is not without basis. The finding in Barber and Odean (2001) and Agnew et al. (2003) that men trade more actively than women suggests that gender differences are related to behavior biases. Therefore, though not the same as the loss aversion that underlies the disposition effect, the vast evidence, briefly summarized below, on gender and age differences in risk aversion from these studies suggests that an examination of the linkage between gender and age and the disposition effect is warranted.

In addition to cognitive ability, spatial ability, personality development, and social behaviors, a large amount of research in sociology and psychology has revealed gender differences in the perception of risk associated with risky behaviors, various hazards, and dangerous activities (e.g., Spigner et al. 1993; Flynn et al. 1994; Boverie et al. 1994; etc.).

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5 See Eagly (1995) for a review.
Many experimental economists also examine differences in risk preference between men and women. The most common conclusion drawn from these studies is that women are more risk averse than men. Not surprisingly, such gender differences in risk aversion are reflected in investment decisions and financial risk-taking behaviors. Using data on investment decisions and from household surveys as well as experiments, these studies investigate gender differences in stock market participation (versus in less risky securities) and allocation of retirement assets (among assets with varying levels of risk). Most of them reach the same conclusion that men take more risks than women.

The second most frequently examined factor linked to risk tolerance is age. Consistent with the generally held belief that risk tolerance decreases with age, McInish (1982) and Hallahan et al. (2004) demonstrate a strong negative, but nonlinear, relationship between age and the risk levels of investors’ portfolios, suggesting that risk tolerance is a dynamic characteristic that varies throughout the life of an investor. On the other hand, Xiao and Anderson (1997) and Donkers and Van Soest (1999) find a positive relationship between age and risk tolerance while many other studies (e.g., Cutler 1995; Sunden and Surette 1998; and Van de Venter and Michayluk 2009) find little or no relationship.

Interestingly, the prospect theory of Kahneman and Tversky (1979), the theoretical basis of the disposition effect, is used in the conceptual framework in Xiao and Anderson (1997) to explain their finding of a positive relationship between age and risk tolerance. Combined with the theory of hierarchical household financial needs and consumer demand theory, they hypothesize that consumers with limited resources can only afford low-risk liquid assets and as their resources increase (with age) they pursue riskier assets. Viewed from this life cycle aspect of needs, consumers are assumed to behave differently as the contexts (whether an asset is considered to relate to lower-level or higher-level needs) change. In this framework, we see that age is related to wealth, a factor that has been shown to be positively linked to risk tolerance (e.g., Chaulk et al. 2003; Fan and Xiao 2006; Grable 2000; and Grable et al. 2004). Similarly, Chaulk et al. (2003) rely on the prospect theory, along with family development theory, to argue that the changes in marital status and family development stages alter the reference points that determine how people view and evaluate financial gains.

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8 See Campbell (2006) for an extensive review of the literature on investor behavior.
and losses, resulting in changes in risk tolerance.

III. Data and Methodology

3.1 Data

We employ a tremendous amount of computing resources in processing and tracking the trade-by-trade transaction histories of 137,527 individual traders on the TAIFEX. Methodologically, trade-by-trade tracking eliminates the need to make assumptions required in many previous studies such as zero open interests by the end of the day (e.g., 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 Taiwan Stock Exchange Electronic Sector Futures (hereafter TE, the ticker symbol), which is based on the Taiwan Stock Exchange Electronic Sector Index, and the Finance Sector Futures (hereafter TF, the ticker symbol), which is based on the Taiwan Stock Exchange Financial Sector Index. The contracts examined include all those mature between January 2003 and December 2004. To obtain each trader’s complete trading history for each futures security, we trace 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.

Although both futures contracts are similar in contract specification, their underlying assets capture distinctively different sectors of Taiwan’s economy. Specifically, accounting for more than 50% of the stock market in terms of the number of listed firms and total market capitalization, the electronic sector represents the most dynamic side of the economy. The demands of the consumers are ever increasing and the companies are compelled to develop state-of-the-art technologies and services to stay in competition. The ever-changing nature of this sector holds great potential for investors who are eager to bet on new companies in the pursuit of potentially phenomenal returns. To these investors with greater tolerance toward risk, the staid and stodgy financial sector could never capture their imaginations. Instead, it is

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9 Contracts listed for trading include the front month, the next calendar month, and the next three quarterly months.
the more conservative investors who would prefer to invest in the financial sector to obtain steady and reliable returns.

Given the differences between these two sectors, it’s plausible to argue that each sector appeals to investors with different levels of risk appetite. These differences in risk preference are reflected differently in the specific trading activities. To lend support for this argument, we investigate how these two sectors are different by examining several trading statistics such as the number of shares per trade, trading volume and value per trade, and turnover over the entire trading history, from January 1995 to December 2004, of both electronic and financial sector indexes traded on TSEC. The results\(^{10}\) show a statistically significant difference between the two indexes in all these measures. Specifically, the trading volume of the electronic sector is more than three times the volume of the financial sector. Clearly, this large difference in trading volume between the two sector indexes should be reflected in turnover. This indeed is true since the turnover rate of the former is a little over three times that of the latter.

On a per trade basis, although the trading of the former involves a smaller number of shares per trade, the amount at stake, i.e., the dollar value per trade, is much higher, indicating that more risk is involved trading in the electronic-sector index. Similarly, the examination of the dollar returns as well as the profitability, measured as earnings of the firms in the sectors, shows that the electronic sector exhibits much greater variation than the financial sector. Together these characteristics lend strong support for the existence of great differences between the two sectors.

To some extent, the appeal to investors with different levels of risk preference based on these differences is analogous to the clientele effect underlying dividend policy that has attracts voluminous studies in corporate finance. As such, a study in investment like this that comparatively examines the trading and behavioral differences between distinctive groups of investors offers a great potential to expand our general understanding of how investors behave.

\(^{10}\) Detailed results, based on monthly as well as daily trading statistics, are available upon request.
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 more instinctive and a better reflection of their profit motives, thus offering a clearer view of traders’ behavior biases.

In addition to 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 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 underlying 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 dictates that their trades be the main subject of the investigation.11

3.2 Methodology

We identify the complete sequence of trades for each trader in all individual accounts of TAIFEX for each contract starting from the first trade of the contract. As shown in the appendix, we mark to market after each trade and calculate and update all relevant trading statistics such as the open interests (OIs), weighted average costs, and realized and unrealized gains/losses after transaction costs (commissions and taxes) until the contract expires. By continuously updating after each trade, we are able to investigate how traders control their trade-by-trade and examine their decisions to offset their accumulated positions. The offsetting trades result in either a realized gain or loss, ignoring the extremely rare cases of zero profit. The stronger the traders tend to be subject to the disposition effect, the more

11 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.
likely they are to offset their positions when doing so results in a realized gain, while the more reluctant they are to offset if it leads to a realized loss. Consequently, we expect a higher proportion of offsets that result in gains than losses. By calculating and comparing the proportion of offsets that result in a realized gain, called proportion of positive offset (PPO), and proportion of offsets that lead to a realized loss, called proportion of negative offset (PNO), as shown below, we can demonstrate the existence and extent of the disposition effect.

And by examining PPO and PNO at the individual level we can further investigate whether and how traders vary in the degree of risk tolerance.

\[
PPO_t = \frac{\# of \text{ contracts offset}}{\text{open interest}_{t-1}} \quad \text{when there is a realized gain at } t \quad (1)
\]

\[
PNO_t = \frac{\# of \text{ contracts offset}}{\text{open interest}_{t-1}} \quad \text{when there is a realized loss at } t \quad (2)
\]

A priori, if the disposition effect exists, then PPO will be higher than PNO. Notice that these measures are calculated after separating all offsets into two cases, those that result in a realized gain or those that lead to a loss, the sum of PPO and PNO is not one or expected to be any specific number. Additionally, since these two measures are calculated for each offset, we account for all opportunities available to traders to realize gains and losses. In comparison, the groundbreaking measures, the proportion of gains realized (PGR) and proportion of losses realized (PLR) in Odean (1998) are calculated cross traders—hence potentially ignoring many intraday selling opportunities—by aggregating all buys and sales of the same stock during the day into one. Building on the insight gained from Odean (1998) and applying our measures chronologically to the futures market after each offset for each trader individually, we also address a few technical issues associated with the measurement of profitability.12

Theoretically, there should also be a third measure calculated in a similar way, called the proportion of zero offset, PZO, for cases when the realized gains/losses are zero.

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12 It is very possible that, on any day, trading on a particular stock may yield gains for some traders while result in losses for other traders. For the former, the stock is included in the portfolio of stocks that investors sold for a gain while for the latter it is in the portfolio that investors sold for a loss. It’s not clear how this affects the calculation of PGR and PLR in Odean (1998), but it may potentially bias the evaluation of the profitability of the two portfolios and the conclusion regarding the consequence of the disposition effect on profitability. Additionally, the calculation of PGR and PLR treats stocks with different price levels as well as portfolios of investors holding a different number of shares of the same stock equally, and hence cannot measure the variation in the disposition effect among traders. Finally, the elimination of sales at a price lying between the daily high and low also poses a problem in accurately measuring the profitability of traders.
However, we decide to exclude PZO for three reasons: first, the incidences of zero realized gains/losses are rare, accounting for less than one percent of all trades; second, other than contract expiration, the literature offers no clear guidance on what’s behind a PZO; and third, based on Odean (1998) and Frino et al. (2004), who exclude similar ambiguous cases like these, we believe any potential loss in accuracy will be so trivial that it won’t render our results any less convincing.

Once all PPOs and PNOs for each trader are calculated whenever an offsetting trade takes place after the accumulation phase of trades, we calculate the average PPO and PNO and use them along with trading activity variables, i.e., the trading frequency and volume, in the analysis. In addition to allowing us to treat each trader distinctively, hence avoiding the limitation of the aggregate trader approach used in previous studies, this methodology makes it possible to include all traders, whether they accumulate positions or not. This is an important methodological consideration given that many individual traders in Taiwan trade futures in a quick in-and-out fashion, i.e., they take a long (short) position in one trade and offset the position immediately in the following trade. On the other hand, there are many traders who tend to accumulate positions in a sequence of trades before they start the offsetting trades to unload the positions. Therefore, this method preserves the heterogeneity of the traders and affords us to explore their diversity.

IV. Results

4.1 Trading Statistics

Among all TAIFEX traders in the sample period, there are 65,631 traders trading TE and 71,896 trading TF. We eliminate those who execute only one trade—possibly for hedging purposes—and hence don’t even have one roundtrip before the maturity of the contract, as well as those who lack either a PPO or PNO value. To obtain a final sample of traders who have sufficient trading to reveal their behavioral tendency, we also require that they trade more than ten days over the sample period and have more than ten pairs of PPO and PNO. Similarly, we also exclude traders who may not have enough trading history due to being too

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13 In a separate paper, we examine exclusively these traders who trade in sequences of accumulation trades followed by offsetting trades.
young to trade futures. Given that TAIFEX doesn’t have a specific age requirement, we believe it is reasonable to consider 20 a minimum age that anyone contemplate and/or start trading futures. Adding five—the number of years since TAIFEX has existed by the beginning of our sample period—to 20, we have 25 years as our minimum age requirement for the final sample. In total, 18,172 TE traders and 22,950 TF traders meet all sampling criteria. Based on the information provided in our dataset, we examine their internal characteristics along with their trading activities and report the basic statistics in Table 1.

Separating TE from TF traders, as shown in Part 1, we see that the TE traders have an average age of 43.13 years and a median age of 42 years. Their trading tenure, defined as the number of days they have been trading the specific contract, has an average of 21.56 days and a median of 16 days. For TF traders, the numbers are very similar, although TF traders, with an average age of 43.42 and median of 43 years, are slightly older than TE traders, supporting our argument that TF may attract more mature traders. On gender, we see that 62.5% of the TE traders are men and 37.5% are women. For TF contracts, 61.9% are male and 38.9% are female. Therefore, women appear to represent a slightly higher percentage of the TF traders, suggesting more women, probably more risk averse, trade TF contracts that have more conservative underlying assets.

To see how these traders trade, we examine the total number of contracts traded, the number of contracts traded per day, and the number of trading days. To explore whether and how differences in gender and the security traded manifest in trading activities, we separate men from women and TE traders from TF traders and report the results in Part 2. At first glance, we see women trade a higher average number of contracts than men. However, this appears not be the case given that the average statistics tend to be influenced by extreme values and women have a higher maximum value than men, 43,974 versus 38,084 contracts. Indeed, it is men who report a higher median number of contracts, 74 versus 68 contracts. Finally, there exist wide variations among traders: ranging from 20 to 38,084 contracts for men and 20 to 43,974 contracts for women, one to 287.02 contracts per day for men and one to 258.12 contracts per day for women, and 10 to 493 trading days for men and 10 to 489 trading days for women.

14 In fact, the number of traders fail to meet this requirement is only 304 and 433 for TE and TF, respectively.
Examining traders’ tendencies to offset positions, we notice from Panel A of Part 2 that men have an average PPO and PNO of 88.40% and 86.61%, respectively, while the corresponding numbers for women are 88.63% and 85.63%, respectively. The relatively high average PPO and PNO values for both men and women clearly reflect three characteristics of futures trading: the daily marking to market, the expiration of futures contracts, and the higher leverage involved in futures trading. What’s more relevant in this study is the difference between PPO and PNO since it gauges the extent of the disposition effect. The result that PPO is higher than PNO, in both means and medians, is consistent with the existence of the disposition effect. For men, the average difference is 1.79%. In comparison it is a bit higher, 2.98%, for women. The fact that female traders have a higher value in the difference suggests that women exhibit a stronger disposition effect.

Separating traders who are younger than or equal to and older than the median age, 42 for TE and 43 for TF, into two age groups, young and mature, we calculate the same statistics and report them in Panel B of Part 2. Young traders trade a smaller median number of contracts but higher median number of contracts per day and lower median trading days. Their average PPO is 89.38%, PNO is 87.92%, and a difference of 1.70%. The corresponding numbers for their mature counterparts are an average PPO of 87.59%, PNO of 84.54%, and a difference of 3.04%, suggesting mature traders exhibit a stronger disposition effect.

Between TE and TF traders, Panel C shows that TE traders have an average PPO of 87.97% and PNO of 86.26% and a difference of 1.7%. The corresponding numbers for TF traders are an average PPO of 88.89%, PNO of 86.22%, and a difference of 2.67%. The higher difference for TF traders suggests that they exhibit a stronger disposition effect.

To further examine the differences between gender and age groups, we first focus on age while controlling for gender by separating young traders from mature traders among men and women, separately. The results are reported in Panel AB. Among the male traders, we see that young traders have a difference of 0.97% between average PPO and average PNO, whereas mature traders have a much higher difference of 2.68%. Among the female traders, young traders have a difference of 2.31%, while mature traders have an even higher difference of 3.57%. Together, these difference values further suggest that mature traders exhibit a stronger
Similarly, to control for the gender factor while focusing on the security traded, we separate TE traders from TF traders among men and women separately and report the results in Panel AC. We see that among the male traders, those who trade TE have a difference between average PPO and average PNO of 1.16% while the TF traders have a difference of 2.30%, suggesting that among male traders, those who trade TF exhibit a stronger disposition effect. Similarly, among the female traders, those who trade TE have a difference of 2.61% whereas TF traders have a difference of 3.26%, suggesting, again, that TF traders exhibit a stronger disposition effect.

Finally, controlling for the age factor, we separate TE traders from TF traders among young traders and mature traders separately and report the results in Panel BC. Among young traders, TE traders have a difference between average PPO and average PNO of 0.97% while TF traders have a difference of 1.84%. Among mature traders, the difference is 3.49% for TF traders, again, higher than the difference of 2.46% for the TE traders.

The results reported in all panels in Part 2 indicate very clearly that the difference between average PPO and average PNO, the measure of the disposition effect, varies with gender, age, and the security traded. It is higher for women and mature traders, indicating traders of these characteristics exhibit a stronger disposition effect. It is also stronger among TF traders. The even higher difference values for traders with combinations of gender, age, and the security traded, e.g., mature women traders, mature TF traders, and female TF traders, lend further support for this conclusion.

4.2 In-depth Analysis of Trading and Behavioral Characteristics

The great variations among traders in trading activity reported in Section 4.1 suggest that more insight may be gained by examining the trading statistics in more details. To achieve this, we separate the total sample into 10 decile groups based on trading volume and report the trading statistics in Table 2. As shown in Panel A, there are 8,239 TE traders in the first volume decile, accounting for over 46% of the traders but only a 10% of total trading volume. In contrast, 1,074 traders, the total number of traders in the last five deciles, amounting to only 6.00% of all traders, are responsible for 50% of the total volume. Similarly,
11,302 TF traders, about 50.33% of the traders, are in the first volume decile, and hence account for only 10% of the trading volume, while 1,073 traders, only about 4.75% of all traders, are responsible for 50% of the trading volume. These numbers further illustrate the great variations in trading behavior among traders. Will these variations be reflected in the extent of the disposition effect?

The answer to this question can be seen easily from the clear pattern in the PPO and PNO numbers. Going from lower to higher decile groups, we see steadily decreasing values for both PPO and PNO, indicating the more they trade the lower the traders’ tendency to offset positions. More strikingly, for TE, traders in the first five deciles have an average and median PPO higher than PNO, indicating that they exhibit the disposition effect. This is reversed to a higher PNO than PPO for the last five deciles, indicating traders in these deciles behave opposite to the disposition effect. Clearly, traders in the first five deciles, being the majority, are responsible for the higher average PPO than PNO reported in Part 1 for all traders in aggregate. Results for TF traders, reported in Panel B, are similar with the exception of traders in decile 5 who have a higher average PPO than PNO but smaller median PPO than PNO.

Insert Table 2 about here

4.3 Test of Difference between PPO and PNO

In addition to the great variations among traders in trading characteristics, the results reported so far suggest that traders exhibit a great deal of difference in the extent of the disposition effect. We formerly test this by accounting for differences in gender, age, and the security being traded and report the results in Table 3. We first examine gender. As shown in Panel A, men have an average PPO of 88.4% and PNO of 86.6%. The difference of negative 1.8% is statistically significant at the better than one percent level based on both t-test and sign-rank test. For women, the average PPO is 88.63% and PNO 85.63%. The average difference of 2.98% is statistically significant.

Comparing male with female traders, we cannot but notice that the differences between PPO and PNO are higher for the latter than the former, confirming the results reported in Table 1 that women appear to exhibit a stronger disposition effect.

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Among the TE (TF) traders A, some also trade TF (TE). If securities being traded influence trader’s behavior, it is possible that there may be differences in the extent of the disposition effect between traders who trade each contract solely and those who trade both contracts. We therefore separate traders based on whether they trade both securities or solely one security. As reported, among all men who trade both contracts, the difference between PPO and PNO is 1.39% and statistically significant. In contrast, traders who trade TE or TF solely have an average difference of 2.43%, again statistically significant. For women, traders who trade both securities have a statistically significant difference of 2.54% and those who trade one security solely have a statistically significant difference of 3.62%. Comparing each set of the three differences in PPO and PNO—all traders, traders who trade both, and traders who trade one security only—for both men and women, we notice that traders who trade both TE and TF have the smallest difference, 1.39% for men (and 2.54% for women), while traders who trade TE or TF solely have the highest difference, 2.43% for men (and 3.62% for women), with all traders having values in between, 1.79% for men (and 2.98% for women). This pattern suggests that securities being traded indeed is a factor related to the disposition effect and when traders trade both securities some of the differences related to this microstructure factor cancel out. However for traders who trade each contract solely, the influence of the distinct underlying market, be it the electronic or financial sector, is fully revealed in trading.

We then examine how age difference transpires in the disposition effect and report the results in Panel B. Among the younger traders, who are younger than or equal to the median age of 42 for all traders, we see that the difference between PPO and PNO is 1.44% and statistically significant. In contrast, mature traders, those who are older than the median age, the differences between PPO and PNO is 3.04% and statistically significant, The higher difference for mature traders suggest they exhibit a stronger disposition effect. Similar to gender tests, we also separately examine traders who trade both contracts and those who trade each contract solely. The results, similar to those reported in Panel A, show that comparing to traders who trade TE or TF solely, those who trade both contracts have a smaller difference, again suggesting that the securities being traded indeed affect the disposition effect.
The formal tests of the existence of a difference due to the security being traded reported in both Panels A and B is conducted and reported in Panel C. The same pattern of differences among the three groups—all traders, those who trade both securities, and traders who trade one security solely—shows up again. Additionally, comparing TE with TF, it is obvious that TF traders report higher differences across all groups. These results, therefore, provide convincing evidence that the external factor, the security being traded, is indeed related to the disposition effect.

4.4 Regression Tests of the Relationship between Trader’s Characteristics and the Disposition Effect

Overall, the test results reported in Tables 2 and 3 confirm that the extent of the disposition effect varies with both internal factors, the gender and age, and an external factor, the security being traded. We provide further support for this conclusion by formally running various combinations of the following regression to examine the relationship between these factors and the disposition effect:

\[
\text{Disposition effect} = \beta_0 + \sum \beta_i \text{Trading activities} + \sum \delta_j \text{Internal characteristics} + \eta \text{External factor} + \sum \tau_k \text{Interaction} \tag{3}
\]

In all regressions, the dependent variable is the disposition effect, measured as the difference between PPO and PNO. The regressors include traders’ trading activities, traders’ internal factors, age and gender, and the external trading factor of the security being traded. The trading activity variables include trading volume per day and trading tenure—calculated as the number of days over the sample period each trader trades the security. Age is measured as the age of the traders and the gender variable takes on a value of zero for men and one for women. The security being traded variables include two dummy variables, \( D_{TE\_TF} \), which takes on a value of zero for TE traders and one for TF traders, and \( D_{both} \), which has a value of one for traders who trade both TE and TF, and zero otherwise. We also examine whether internal and external factors interact to influence the disposition effect by incorporating three interaction variables, which include the product of internal characteristics, age×gender, and two products of internal and external factors, age×\( D_{TE\_TF} \) and gender×\( D_{TE\_TF} \).
As the univariate regression results for Models 1 through 7 reported in Table 3 show, the coefficients for all regressors are statistically significant, indicating each is individually related to the disposition effect. Among them, volume per day, tenure, and \( D_{\text{both}} \) are all negative, indicating that the more traders trade, the longer they have traded the contracts, and in the case that they trade both contracts, the weaker they exhibit the disposition effect. On the other hand, the positive coefficients for age, gender, and \( D_{\text{TE_TF}} \) indicate the older they are, if they are female, and if they trade TF, the stronger they exhibit the disposition effect. Comparing the magnitude of the coefficients for age and gender, we see age has a higher value, 0.065 versus 0.042. Considering that while gender can only take on a value of one for female traders, the values of age range from 25 to 75, and we see that with multiplying by the higher coefficient the weight of the age factor is more than 38 times \( (38.69=0.065\times25/0.042) \) that of gender in relation to the disposition effect. It therefore seems fair to infer that while both gender and age are internal factors related to the disposition effect, the fixed and innate characteristic of gender appear to be less dominant than the time varying characteristic of age.

We then run numerous multivariate regressions that include various combinations of the regressors. Focusing on the internal and external factors, we start with both volume per day and tenure in the equation and add, one by one, age, gender, \( D_{\text{TE_TF}} \), and \( D_{\text{Both}} \) to see how both the internal trader characteristics and the external factor add incremental power in explaining the disposition effect. In all regressions reported in Models 8 to 15, the coefficients for volume per day and tenure remain negative and statistically significant. Given that all the variables are correlated, to test whether the correlations among the regressors pose a multicollinearity problem we specifically examine whether multicollinearity between variables is responsible for the significance of the coefficient estimates. Based on the magnitude of the variance inflation factors (VIFs), the maximum VIF has a value of 1.18, which is far smaller than 5, the critical value customarily considered to indicate the presence of a multicollinearity problem. To streamline the tables, these VIF statistics are not included in the reported results.

Before examining the multivariate results, notice that as more regressors are added the magnitude of the coefficient estimates of the trading activity variables stay about the same and they remain negative and statistically significant, indicating the robustness of the results. Now with age added to the model, as in Model 8, we see its coefficient is a significant 0.066,
almost indistinguishable from the multivariate estimate of 0.065 in Model 3. This remains true for the rest of the models when other variables are added, further confirming the inference so far that the older traders are the stronger they exhibit the disposition effect.

For the gender factor, its coefficient, a significant 0.037 in Model 9, is not much different from the univariate estimate in Model 4. Similar to the results for age, it remains pretty much unchanged as other variables are added in subsequent regressions. This new result therefore allows us to conclude with confidence that women traders exhibit a greater extent of the disposition effect.

The results for the external factor, the security traded, similarly provide further evidence supporting the results reported so far. As shown in Models 11 and 12, the coefficients for D_{TE,TF} and D_{both} are statistically significant. The facts that they all have a magnitude not much different from the univariate estimates and their signs remain unchanged add force to the conclusion that TF traders exhibit the disposition effect to a greater extent and this effect is mitigated when the traders also trade TE. The extent of reduction in the disposition effect for traders who trade both securities can be inferred from the comparison of the coefficients of the two dummy variables. Given that the coefficient for D_{both} is -0.023 while that of D_{TE,TF} is 0.033, the sum of the two is 0.01, which is 1/3 of 0.033, suggesting a reduction of 2/3 of the effect. Together, these new results allow us to comfortably conclude that external factors, at least in this case the security being traded, can indeed be related to the disposition effect.

Finally, the possibility of interaction among the internal and external factors is examined and the results reported in Models 13-15. We notice that both age and gender remain statistically significant with the sign remaining unchanged and that the interaction term, the product of the two, has a negative and statistically significant coefficient. This negative interaction term appears appropriate given that the coefficient for both age and gender in this model is higher than in Model 12 while the coefficients for all other variables remain identical. Furthermore, given that the $R^2$, 0.01, remains unchanged with this additional interaction term, we can safely say that Model 12 is sufficient to capture all relevant variables related to the disposition effect. Therefore, for the sake of parsimony, nothing is lost if we drop the interaction term. For Models 14 and 15, where an additional interaction term based on the products of internal and external factor is added, the
results—negative and significant interaction terms but unchanged $R^2$—can be similarly viewed and the same conclusion of parsimony reached.

Insert Table 4 about here

In sum, all regression results confirm the results in Tables 1 and 2 that traders exhibit variations in the disposition effect, which are related to trading activity, the internal factors of traders’ characteristics, and the external factor of security traded.

V. Conclusion and Discussion

Motivated by the rules of trading advocated by successful futures traders, this paper examines whether individual traders on the TAIFEX follow the rules to cut the losses and let the profits run. We show that as a group, they do not. They appear to behave the opposite to the rules and exhibit the disposition effect, i.e., they are more likely to offset their trading positions in the face of a gain than when they are faced with a loss. Exploring further, we show that these variations clearly are related to traders’ trading volume and tenure. Building on these results, our main objective is to examine whether and how innate characteristics of traders, such as gender and age, as well as an external market factor, the security traded, offer additional explanatory power to the variations in the disposition effect. The results show that indeed both gender and age as well as the security being traded add statistically significant explaining power to the disposition effect.

The contribution of these new results to the behavioral finance literature is analogous to the contribution of studies that add to the nature versus nurture debate in development psychology. Just as many of those studies demonstrate that both nature as well as nurture matter in the development of a person, we show that both internal as well as external factors are related to the disposition effect of individual investors.

Reflecting on the individual result for each of these factors, we first see that the finding of women exhibiting a stronger disposition effect suggests women are more loss averse. This is consistent with the literature in sociology, psychology, and experimental economics that women are more risk averse than men. It also adds to the common finding in investment decision and trading that men take more risk and trade more actively. Second, the finding that
more mature traders show stronger disposition effect, and hence more loss averse, sheds new light on the association between age and risk aversion, a related topic drawn on in the literature review. This evidence is in line with many studies that find people become more risk averse as they grow older, but at odds with others (e.g., Xiao and Anderson 1997) that reach the opposite conclusion. In explaining their conclusion, the latter studies assume that wealth rises with age and as a result of this link between wealth and age, older people have a higher tolerance for risk. This assumption may still be valid if we accept that risk aversion and loss aversion, though related, are not the same thing, therefore it’s not surprising to have opposite findings. It is also possible that the link between wealth and age is far from perfect, therefore one can still have a result of higher wealth along with a weaker disposition effect, as shown in Dhar and Zhu (2006), alongside our finding that more mature traders exhibit a stronger disposition effect. The recent evidence in Korniotis and Kumar (2010) that older investors underperform benchmarks due to the deterioration of their cognitive abilities may also offer a clue. Though the focus of their study is investment decision making, not behavior biases, it is plausible that despite the positive effect of experience as one ages, the adverse effect due to the deterioration of cognitive abilities may actually exacerbate behavior biases such as the disposition effect. Given that this study is the first one, as far as we know, to explore the link between the disposition effect and age, further studies are warranted before more robust statements between risk aversion and loss aversion, wealth and age, and the interaction of the two aversions with age can be made.

Finally, the fact that the security being traded, a trading microstructure factor, is shown to be related to the disposition effect adds to the evidence that microstructure matters. In this case, the security being traded is an element of the trading microstructure and it is shown to matter in the behavior of individuals. It’s plausible that what is behind this linkage is that traders of different risk tolerance levels are attracted to different products. Through the trading of these different products, their varying extents of the disposition effect are then reflected. By this logic, traders of the electronic sector, realizing the ever-changing nature of the market, are less likely to hold onto losses while their counterparts in the financial sector hold onto losses, hoping they may be reversed.
References


Croson, Rachel and Uri Gneezy, 2009, Gender Differences in Preferences, Journal of Economic Literature 47, 448-474.


Watson, John, and Mark McNaughton. 2007, Gender Differences in Risk Aversion and Expected Retirement Benefits, Financial Analysts Journal 63, 52-62

Appendix. Calculations of Costs, Unrealized and Realized Gains/Losses

A. Weighted Average Costs and Open Interests

As shown in Table A1, the first trade executed by Trader A for TXA3 is identified to be a short position of five contracts at a price of 5,951. The trader’s record thus shows an open interest of -5 and an average cost of 5,951. After shorting one more contract in the second trade at a price of 5,950, the trader’s record is updated to show an average cost of 5,950.833 (= (5,951×5 + 5,950) ÷ (5+1)) and an OI of -6.

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). The same calculations are repeated for the following five trades, Trade 3 to Trade 7. Together, these first seven trades constitute the accumulation phase of the trades when the trader loads up contracts and are labeled as “A” in Column 3 in Table 1 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, and 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, 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 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 incurred is 19.045, calculated as 0.01% of the sum of the total transaction values of 190,450 (= (5,951×5 + 5,950×1+:+: 5,959×1) + (5,954×2)). Subtracting these transaction costs from the realized gain, we have a net realized gain of -28.799 (= 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 A1. Calculation of the PPOs and PNOs

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Note: Net realized gains/losses are gross profits/gains after transaction costs—commission and transaction tax, which is 1/100th of one percent of the transaction value. For simplicity’s sake, this calculation is not done during the accumulation phase and all accumulated transaction costs are subtracted on the first trade of the offset phase.
Table 1 Sample and Trading Statistics

Part 1: Trader Characteristics

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Note: Exclude observations with missing value

Part 2: Trading Statistics by Gender, Age, and Security Traded

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Panel C: Security Traded

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<td>29.00</td>
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**Note:** Excluding traders who lack either PPO or PNO value
### Table 2 Trading Statistics by Trading Volume Decile Groups

#### Panel A: TE

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<th>Decile Groups (1st: Smallest &amp; 10th: Largest; in Number of Contracts)</th>
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<td>153</td>
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<td>232</td>
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<td>622</td>
<td>1,107</td>
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<td>186</td>
<td>296</td>
<td>484</td>
<td>814</td>
<td>1,606</td>
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<td>116</td>
<td>186</td>
<td>294</td>
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<td>810</td>
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<td>8.6</td>
<td>14.8</td>
<td>28.4</td>
<td>53.4</td>
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</table>

| **PPO**                                                             |    |    |    |    |    |    |    |    |    |    |
| Mean                                                                | 93.12% | 88.33% | 85.34% | 82.11% | 78.55% | 73.66% | 66.85% | 61.40% | 58.46% | 53.91% |
| Median                                                              | 100.00% | 92.53% | 89.56% | 86.72% | 83.53% | 77.99% | 71.70% | 62.03% | 61.93% | 55.07% |

| **PNO**                                                             |    |    |    |    |    |    |    |    |    |    |
| Mean                                                                | 91.33% | 86.31% | 83.54% | 80.20% | 76.78% | 73.69% | 67.13% | 63.03% | 61.99% | 58.98% |
| Median                                                              | 100.00% | 91.67% | 88.10% | 85.37% | 81.40% | 78.75% | 73.44% | 69.44% | 68.76% | 71.97% |

| **Disposition Effect (PPO-PNO)**                                    |    |    |    |    |    |    |    |    |    |    |
| Mean                                                                | 1.78% | 2.01% | 1.84% | 1.91% | 1.78% | -0.03% | -0.27% | -1.63% | -3.53% | -5.07% |
| Median                                                              | 0.00% | 0.00% | 0.13% | 0.66% | 0.18% | -0.29% | -0.01% | -1.25% | -2.93% | -4.28% |
Table 2 Continued.

Panel B: TF

| Decile Groups (1st: Smallest & 10th: Largest; in Number of Contracts) |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Trading Volume | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| Observations   | 11,302 | 4,864 | 2,699 | 1,615 | 964 | 558 | 304 | 140 | 54  | 17  |
| Mean           | 42   | 97   | 176  | 295  | 490 | 848 | 1,575 | 3,327 | 9,211 | 26,775 |
| Median         | 40   | 94   | 172  | 288  | 476 | 817 | 1,522 | 3,073 | 7,819 | 24,986 |
| Minimum        | 20   | 70   | 136  | 232  | 380 | 652 | 1,152 | 2,270 | 5,580 | 18,394 |
| Maximum        | 70   | 136  | 232  | 380  | 652 | 1,150 | 2,266 | 5,516 | 16,814 | 43,974 |
| Contract Per Day |
| Mean           | 2.0  | 2.9  | 3.9  | 5.4  | 7.9  | 11.6 | 18.3 | 31.9 | 68.1 | 109.5 |
| Median         | 1.8  | 2.5  | 3.1  | 4.0  | 5.7  | 8.8  | 12.4 | 21.1 | 39.1 | 81.1 |
| PPO            |
| Mean           | 94.03% | 88.33% | 85.06% | 81.71% | 78.23% | 72.05% | 65.84% | 58.30% | 53.87% | 56.64% |
| Median         | 100.00% | 92.68% | 89.51% | 85.80% | 82.04% | 74.92% | 67.45% | 61.45% | 54.49% | 65.40% |
| PNO            |
| Mean           | 90.84% | 85.44% | 82.76% | 79.65% | 76.77% | 71.80% | 67.16% | 62.07% | 58.77% | 63.56% |
| Median         | 100.00% | 90.28% | 88.10% | 84.17% | 82.15% | 76.59% | 70.20% | 62.70% | 62.22% | 76.80% |
| Disposition Effect (=PPO-PNO) |
| Mean           | 3.20% | 2.89% | 2.33% | 2.10% | 1.46% | 0.24% | -1.32% | -3.77% | -4.90% | -6.92% |
| Median         | 0.00% | 0.44% | 0.92% | 0.72% | 0.44% | -0.21% | -0.92% | -2.82% | -3.74% | -10.01% |
Table 3 Tests of the Disposition Effect (PPO – PNO)

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<th>Female</th>
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<td>PNO</td>
<td>PPO</td>
<td>PNO</td>
</tr>
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<td>Panel A: By Trader Gender</td>
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<td>88.63%</td>
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<td>Panel C: By Trading Security Type</td>
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Table 4 Relationship between the Disposition Effect and Trading Variables and Internal and External Factors

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Note:

T-statistics in parenthesis and significant level indicated by *** for 1%, ** for 5%, and * for 10%.
Disposition Effect = PPO – PNO.
Volume Per Day = Total trading volume over trading days
Tenure = Number of trading days
Age = trader’s age in years from birth date to the last trading date in years
Gender = 0 for male; 1 for female.
D_{TE-TF} = 1 for traders who trade TF; 0 otherwise
D_{Both} = 1 for traders who trade both TE and TF; 0 otherwise