Do Professional Traders Exhibit Loss Realization Aversion?

Peter R. Locke *
The George Washington University

Steven C. Mann **
Texas Christian University

November 2000

* Finance Department, School of Business and Public Management, The George Washington University, Washington DC, 20052. plocke@gwu.edu, (202) 994-3669.

** M.J. Neeley School of Business, Texas Christian University. Fort Worth, Texas 76129 S.mann@tcu.edu ; (817) 257-7569.

We wish to thank Peter Alonzi, Chris Barry, Rob Battalio, Gerald P. Dwyer, Avner Kalay, Paul Laux, Paula Tkac, Steve Manaster, Arthur Warga, and seminar participants at the 1998 FMA meetings, the 1999 Chicago Board of Trade Spring Research seminar, the 1999 Western Finance meetings, the 1999 Southern Finance meetings, the Commodity Futures Trading Commission, TCU, University of Texas at Dallas, and the First Annual Texas Finance Festival for discussions and comments helpful to the evolution of the paper. Pattarake Sarajoti provided valuable assistance. Mann acknowledges the support of the Charles Tandy American Enterprise Center. A good portion of this work was completed while Locke was on the staff of the U.S. Commodity Futures Trading Commission. However, the views expressed are the authors' only and do not purport to represent the views of the Commodity Futures Trading Commission or its staff.

Do Professional Traders Exhibit Loss Realization Aversion?

Abstract

Recent evidence (e.g. Odean, 1998a) describes investor behavior that is at odds with traditional economic theory. These alternative behaviors, such as those consistent with the disposition effect or overconfidence, form the basis for recent "behavioral" explanations for asset returns (e.g. Daniel, Hirshleifer and Subrahmanyam 1998a and 1998b, Odean 1998b, and Shumway, 1998). Notably, the evidence of alternative investor behavior is based largely on retail customer accounts - those of amateur traders.

In this paper we examine trades by populations of professional futures traders for evidence of activity best described by the "behavioral finance" literature. The data provide support for the existence of a disposition effect (derived from the prospect theory of Kahneman and Tversky 1979) among professional traders. We find that traders hold losing trades longer than winning trades and that average position sizes for losing trades are larger than for winners. Our evidence also indicates that relative aversion to loss realization is related to contemporaneous and future trader relative success.

Introduction

Recent evidence suggests that investors and experimental subjects exhibit behaviors that are somewhat at odds with the predictions of traditional economic and financial theory. For example, Odean (1998a and 1999) provides evidence that small investors trade "too much", and that while trading, they sell winners and hold losers. These results may be interpreted as supporting alternative behavioral theories, particularly prospect theory (Kahneman and Tversky 1979). These striking results have been received passively, perhaps because retail investors (noise traders) are not expected to have much of an impact on market prices.

Perhaps such empirical evidence of alternative trading behaviors by small investors should not surprise us, since texts offering investors trading advice typically warn against exactly the type of trading documented by Odean. In an attempt to mitigate the potential investment harm caused by such behavior, the trading literature proposes "disciplined" approaches, through which investors lay out contingency plans. While such advice appears to be required for small investors, the conventional wisdom among professional traders suggests that "disciplined" trading is pervasive.[1] Based on their need for continuing success, the natural presumption should be that market professionals are disciplined traders who are less prone than retail investors to exhibit alternative and costly behavioral tendencies. If so, then behavioral problems may be an annoying but essentially harmless anomaly confined to some retail investors and experimental subjects. On the other hand, evidence that professional traders also exhibit alternative behavioral

[1] For example, the memoirs of Chicago Board of Trade member Everett Klipp (1995) state, "…to be a successful trader, I must love to lose money and hate to make money….The first loss is the best loss; there is no better loss than the first loss….Trading is discipline." Similarly, Bear Stearns Chairman Alan "Ace Greenburg states, "If you have bad inventory, mark it down and sell it quickly." *Wall Street Journal, March 8, 1999.*

tendencies would provide increased support for research on the systemic effects of behavioral financial models, as, for example, in the model of Barberis, Schliefer and Vishny (1999).

In this paper we study the trading behavior of professional futures traders, using high frequency analysis where trades are closed out in a matter of minutes. These traders depend on the profitability of their trading for income. Our findings reveal that these traders do consistently hold losing trades longer than winning trades. Further analysis shows that this does not appear to be a finding directly attributable to market-making techniques, such as the relative quick arrival of profitable offsetting customer orders. Despite the clear difference in the time to completion of winning and losing trades, we fail to find further costs associated with this behavior. Another view of these findings is that trades that are held longer are clearly less likely to be profitable, but once they are offset there is no further regret. Perhaps most redeeming is the finding that the more successful traders exhibit the appearance of loss aversion to a lesser degree: Relatively successful traders are less prone to sit on losing trades.

The paper's structure is as follows. Section 2 reviews behavioral theories related to finance and some of the existing evidence. Section 3 describes the futures trading data and general methodology. In section 4 we present the results, and section 5 concludes.

2. Behavioral models: theory and existing evidence.

In this section we examine the extant evidence and theoretical research related to the relevant behavioral models. This section is not meant as a complete survey of the behavioral finance literature. Shiller (1997) provides an interesting overview of the literature up to 1997, focused on market efficiency.

Aberrant trading behavior must be measured against some acceptable benchmark. For instance, the second rule of trading could be termed "Cut your losses, ride your gains." (With the first rule being, of course, "Buy low, sell high.") However, recent evidence provided by Odean (1998a, 1999), Heisler (1996), and Barber and Odean (2000a, 2000b) shows that small investors often ignore this well-known rule, and tend to hold losses longer than gains. *What sort of behavioral model would result in investors holding losing trades for extended periods while cashing in winning trades early?* Shefrin and Statman (1985) introduce the disposition effect, based on the prospect theory of Kahneman and Tversky (1979), as an explanation for the perceived anecdotal evidence at that time of investor reluctance to realize losses. The disposition effect arises when investors focus on a reference point for their position from which gains and losses are calculated, rather than following a portfolio choice model. Agents are alleged to use a form of "frame reference" - evaluating opportunities to close existing positions as either gains or losses, measured against the reference point.

Prospect theory modifies expected utility theory in two areas, and leads to predictions that are consistent with investor loss realization aversion. First, investor utility is assumed to be a function of gains and losses relative to a benchmark, rather than a function of absolute wealth. For example, Shumway (1997) finds that an assumed investor *evaluation period* of at least a year is required for the asymmetric predictions of prospect theory to be consistent with observed stock price movements over 1963-1995. Second, while standard utility functions are concave on both sides of a wealth point, prospect theory assumes utility functions that are concave for gains and convex for losses (but steeper so that overall risk aversion is attained). The prediction of a disposition effect relies on these two wrinkles to expected utility theory.

Early evidence supporting prospect theory is largely experimental (Kahneman and Tversky 1979, Kahneman, Knetsch, and Thaler 1990). The early experimental literature has been criticized for a lack of realism due to the absence of a monetary payoff. Other research looks at volume patterns for stocks conditioned upon prior price changes, including Shefrin and Statman (1985) and Ferris, Haugen and Makhija (1988). More recently, Barberis, Shleifer and Vishny (1998), Daniel, Hershleifer and Subrahmanyam (1998a, 1998b), and Barberis, Huang and Santos (1999) have examined prospect theory in asset prices, in conjunction with the concept of the "house-money" effect. House-money is the issue of altering behavior upon realizing gains and losses, i.e., becoming less risk averse after realizing a gain. Fama (1998) points out that "observational" evidence is clearly subject to various, potentially conflicting, interpretations.

Odean (1998a, 1999), Heisler (1996), and Barber and Odean (2000a, 2000b), look at direct evidence in the trading of small retail investors, or, in the case of Heisler, small off-exchange retail speculators. These studies support the notion that these investors trade in a manner that is consistent with behavior predicted by prospect theory. That is, they hold their losing trades longer than their winning trades, and this leads to deteriorating profitability, according to the evidence in Odean (1998a).

3. Data and Methodology

3.0 The trading pit environment

The futures trading pit which forms our data generation mechanism has been described in some detail. Kuserk and Locke (1993) in particular describe the high frequency trading of futures floor traders trading for their own account. Silber (1984) examines in detail several such traders. Manaster and Mann (1996, 1999) delve further into inventory management and sources

of profits for futures floor traders. Together, these papers find that a large group of floor traders trade frequently, making small but positive revenue per trade, on average, and rarely hold overnight positions. From this environment we seek evidence of behavioral problems among these floor traders.

3.1 The data

In this section we define the rich data set, and provide some general detail of the prices and volumes traded. We use transactions data from the Chicago Mercantile Exchange (CME) graciously supplied by the Commodity Futures Trading Commission. We use data from 1995 for the two most active currencies (Deutsche mark and Swiss franc) and the two most active non-financial commodities (Live cattle and Pork bellies). We use the first six months of data to document trader behavior, and the second six months to examine the relationship between measures of trader loss realization aversion for the first six months and subsequent trader success.

We select all traders that executed at least five trades for their personal account on at least ten different days during the 1995 calendar year, resulting in a sample of 334 traders. These traders were responsible for 99.54% of the personal account volume traded in these contracts during this period. The excluded traders are much more transient, or may even be entering and offsetting brokerage error trades.

Table 1 provides descriptive statistics for the traders and the volatility of the instruments traded, for each six-month sub-period. The typical daily dollar trading range (measured for the most active contract month each day) is highest for the Swiss franc futures and lowest for cattle, consistently across each sub period. When we compare trading ranges as a percentage of contract notional value, we see that Pork bellies exhibit the highest percentage volatility, while

the dmark exhibits the least, again across sub periods. Describing, for convenience, only the first six months, we see that the mean daily price range for the franc, at $1229, is almost 100 times the minimum price increment, or tick, of $12.50, but that the mean daily percentage range is 1.17%, much smaller than the typical percentage range for pork bellies, which averages 3.12%. While cattle futures have the smallest typical daily price ranges, the mean daily range, at $353, is still over 35 times the tick, and the percentage range (1.31%) is slightly higher than the franc.

In addition to volatility statistics, Table 1 also provides statistics on income and volume for personal account traders included in the sample. Traders were selected using the full year sample. The fifth row reveals the number of selected traders that were present in the first and second six-month periods. Note that these traders are under no obligation to trade, and most may trade any commodity any time. There appears to be slightly fewer traders active in the second six-month period, across the four commodities. The highest number of traders is in the dmark contract, the fewest in bellies.[2] Row 8 reveals that traders make a small income per contract on a round trip basis, around 1 tick or less across all four commodities. Row 9 shows the aggregate income for the sample of floor traders. In a sense this is measure of the gross value added of the exchange. Rows 10,11 and 12 show the quartiles for mean daily incomes across traders. Clearly there is heterogeneity in terms of income across these trader groups, which we explore in detail later.

3.2 Trade histories and accounting

In this section we describe the method for determining a trader's history, and our accounting methodology. We construct trade sequences for each trader (and also for each different contract delivery month in which the trader executes personal account trades) for each

trading day of the six-month sample period. The data provide trades sequenced to the minute. For each minute of the trading day (for each contract) we determine the quantity of contracts that traders buy and sell. In addition we calculate certain market statistics by minute. We assume that all trades are closed out at the end of each day, so traders carry no overnight position (Kuserk and Locke 1993, and Manaster and Mann 1996, present evidence that floor traders rarely hold overnight positions).

Sometimes multiple trades occur within a minute, which cannot be sequenced. If a trader buys contracts at two different prices during a minute, we consolidate the trades and use the quantity-weighted mean price as the trader's purchase price for the minute. We treat sales analogously so that for each minute, we track each trader's buy volume and mean purchase price as well as the trader's sell volume and mean sales price.

We develop a methodology for revenue and timing accounting. Trading language typically refers to how much was made or lost on 'a trade.' For a simple trade, in which something is purchased, then later sold (or vice versa), the trade is easy to define, as are any revenues associated with it. Floor trader histories typically exhibit much more complicated trade sequences. Therefore, average cost allows trades, and their associated revenues, to be defined without resorting to either specific identification accounting (attempts to match specific contract purchases with specific sales), or a LIFO/FIFO scheme. This method parallels Silber (1984). We employ analogous methods to calculate the length of time that positions are held. A complete description of this methodology, with a numerical example, is provided in Appendix 1.

The **cost** for each contract in a trader's position at the beginning and the end of each minute is defined as the quantity-weighted average price for the position. We use cost in a

[2] Generally, traders are free to migrate among these and other CME pits, although Kuserk and

generic sense: long position cost is the average purchase price and short position cost is the average sale price (at any particular time a trader's position is either long or short, or the trader has no position). When trades add to an existing position (long traders that buy or short traders that sell), average per contract cost is adjusted; when a trader reduces a position (long traders selling futures, or short traders buying futures) the per-contract average cost of the remaining position is unchanged.

We calculate the **holding time** for all trades in a manner analogous to the cost basis accounting. The holding time for a trade increases by one minute at the start of each minute. As a trader adds to a position, the holding time for each contract in the position is reduced to reflect the shorter holding time of the newest contracts. As positions are reduced but not eliminated, the holding time of the remaining position increases since additional time has passed.

A **round trip** describes the purchase and sale, in either order, of one contract. For a particular trade, the number of round trips is the quantity of contracts in a sale that offset prior purchases, or the number of purchased contracts that offset a prior sale. Thus round trips indicate the number of contracts involved in a 'completed trade'.

Existing positions typically have either unrealized gains or unrealized losses. We calculate the daily sequence of each trader's unrealized revenues by marking the trader's positions to market each minute, performing this calculation for all minutes that they trade as well as all minutes between trades. We mark positions to market by comparing the cost of the position to the average pit price each minute. The average pit price is the quantity weighted average transaction price for all trades within the minute. If the average pit price is higher than a long position's cost, then the position has an unrealized gain, and a positive mark-to-market. A

Locke (1993) find little evidence of frequent pit-hopping.

positive mark-to-market indicates that at that time, the position could probably be closed for a gain; a negative mark-to-market indicates that the position could probably be closed at a loss.

In addition to a running mark-to-market, we count the minutes that a trader had the opportunity to complete a trade with an outcome similar to the eventual outcome, but did not. For example, consider a trade that had been held for 20 minutes and was subsequently completed with a gain. If, over the 20 minutes that the position was held, the position was marked-to-market at a gain for 12 minutes and a loss for 8 minutes, then for that trade we count 12 **potential exit** minutes. Thus each losing trade's potential exit minute statistic represents the number of prior opportunities to take a loss; potential exit minutes for gains represent the number of prior opportunities to take a gain. For trades that are offset within a minute, we treat potential exit minutes as undefined.

We also calculate for each trade the position size and mark-to-market for each of these potential exit minutes. For trades resulting in losses, we evaluate position size (number of contracts held) and the mark-to-market for only those minutes for which the mark-to-market is negative, with corresponding calculations for trades resulting in gains. Finally, for each trade, we calculate the average position and mark-to-market across those potential exit minutes to complement the simple count of potential exit opportunity minutes.

In sum, for every trade, we record the revenue, cost, holding time, the current mark of the trader's position, the count of potential exit minutes, and the average position and mark over those potential exit minutes. The **revenue** from a trade is the sale price or cost of the short position, minus the purchase price or cost of the long position. The sequence, buy first, sell later, or vice versa, is irrelevant to futures market accounting.

4. Empirical results.

4.1 Intra-minute trades

In this section we describe the characteristics of the subset of trades that were offset within a minute. Our goal is to make inferences about trader decision processes regarding existing positions. However, a cursory examination of the data revealed that traders frequently execute offsetting transactions (buys and sells) during a minute while leaving their position unchanged; sometimes traders change their positions while executing some intra-minute offsetting trades as well. The data do not allow a sequencing of these intra-minute trades, which makes some behavioral inferences from these trades problematic.[3] Because of this uncertainty, for our cost and time accounting described above we isolate these trades, imposing no changes to the holding times or average costs of existing positions. We do, however, include the trades in our analysis, and the revenue and holding time are calculated accordingly. The revenue for an intra-minute trade is the quantity traded times the difference in sales price minus purchase price. The holding time for an intra-minute trade is zero. Because these trades are a significant fraction of all trades, we describe them in some detail relative to other trades. Table 2 provides summary statistics for these intra-minute trades compared to other trades in the January-to-June sample.

The results in table 2 shows that such intra-minute trades comprise roughly 20% of all trades for each of the four pits, ranging from a high of 25% for the Deutsche mark to a low of 18% for pork bellies. Comparing these offset trades to other trades that are held longer, three results bear particular notice. First, trades offset inside a minute are much more likely to be executed with realized revenues equal to zero ("scratch" trades) than are trades that are held at

[3] For example, suppose a trader has an open position of long one contract. In the next minute, suppose the trader buys one contract and sells one contract. We do not know the sequence, that is, whether within the minute the trader

least one minute (other trades). For example, 23.8% of Deutsche mark paired offsets are scratch trades, compared to only 6.11% for other trades. Second, considering only trades that exhibit a gain or a loss, we see that intra-minute trades are predominantly gains, to a much greater extent than trades with longer holding times. For example, the proportion of gains for paired offsets ranges from 66.7% (dmark) to 80.9% (bellies) compared to gains proportions ranging from 57.7% (dmark) to 60.4% (bellies) for other trades.[4] Third, as a somewhat mechanical result, trades that are held longer exhibit more revenue volatility than do the intraminute trades. The inter-quartile range of per contract gains and losses is three to five times wider for trades held for a minute or longer than for the intraminute trades.

4.2 Differences in holding times for losses compared to gains

In this section we examine whether professional traders, as a group, exhibit "loss realization aversion," by comparing trader holding times for winning trades to their holding times for losing trades, using only the first six months of the data for the analysis. As a first pass, we compare holding times for gains versus losses, with no control for the relative magnitude of absolute revenues. However, insofar as the distribution of *sizes* of gains and losses may differ, these aggregate results may be misleading for our purposes. With that in mind, we examine the holding times in more detail by comparing gain and loss holding times for sub-samples selected on the basis of the absolute revenue per contract for the trade. The categories are for illustrative purposes, and the following break points are somewhat arbitrary, although we did seek a sufficient sample size in each category. The six categories are: 1) trades with zero revenue (no

---

first went up to two, then down to one, or first went flat and then up to one. We do know at the end of the minute the trader is still up one.

gain or loss2) absolute revenue less than $10 per contract; 3) at least $10 but less than $25; 4) at least $25 but less than $50; 5) at least $50 but less than $100; and 6) any trades with absolute revenue of at least $100 per contract.

Table 3 provides descriptive statistics for revenues, aggregated (all gains and all losses) in Panel A, and broken down by absolute revenue category in Panel B. Both panels provide the raw number of trades with gains and losses (first two columns), the number of round trips (second two columns), the percentage of trades with gains versus losses, the mean trade size, and the mean revenue per contract for gains and losses. For example, Panel A shows that mean trade sizes were virtually identical for gains and losses, that roughly 60% of all trades with nonzero revenue were gains, and that losses are larger in magnitude than gains on average for all four commodity markets. These comparisons are significantly different. Panel B reports statistics for trades separated by absolute revenue per contract. Rather than reporting percentages of gains versus the percentage of losses *within* each absolute revenue category, Panel B reports the percentage distribution of gains and losses *across* the absolute revenue categories – providing a rough frequency distribution across gain and loss magnitudes.

Examination of the Panel B columns labeled "percent of trade totals" reveals the reason that the average loss is larger in magnitude than the average gain: the *percentage* of large magnitude losses is higher than the percentage of large magnitude gains. For example, consider trades with absolute revenues over $100 for the Deutsche mark. While the mean loss is slightly larger than the mean gain ($227 compared to $225), the percentage of large losses (14.5%)

[4] All differences are significant at the one percent level, using a two-sample binomial test for equal proportions (normal approximation).

exceeds the percentage of large gains (11.8%).[5] Table 4 reports the results of holding time comparisons. Panel A reports comparisons without regard to absolute revenue magnitude, while Panel B compares gain and loss holding times for trades with similar absolute revenues. The median hold times range from three to twenty-three minutes across the four commodities. These numbers might appear somewhat high given the suggestion by Silber (1984) that holding a trade longer than 2 minutes would result in an expected loss. The difference could be due to the different time periods and different exchanges. However, our sample is much more comprehensive; we analyze entire trading populations over a six-month period, rather than selected individuals. Comparing gains to losses, the results are striking: professional traders as a group hold losses significantly longer than gains. Panel A shows that overall, losses are held substantially longer than gains for all four commodities. Median and average holding times for losses range from 35% to 133% longer than counterpart holding times for gains. The differences in times are most noticeable in the two agricultural commodities, and in particular in pork bellies.

As noted above, we were concerned that gains and losses might be treated differently depending on the size of the absolute revenue. We tested for differences in holding times by revenue magnitude using the revenue categories developed for table 3. These results are reported in Panel B of table 4, which provides overwhelming evidence that gains are realized more quickly than losses regardless of the magnitude of the absolute gain. For example, the median time for $10 to $25 pork bellies losses is 9 minutes, compared to about 2 minutes for the corresponding gains between $10 and $25. Similar differences exist across most categories, with

[5] Using the two-sample binomial test for equal probabilities (normal approximation), the percentage of large losses is significantly greater (at the one percent level) than the percentage of large gains for all commodities but pork bellies.

some exceptions, such as the 1-minute median times for gains and losses for francs and dmarks in the $10-$25 range. However, across all revenue categories, losses are held significantly longer than gains. Clearly, the professional traders in our sample appear to exhibit the characteristics of loss realization aversion as a group - in that they hold losing trades longer than winning trades.

However, evidence that losses are held longer than gains, while consistent with loss realization aversion, is subject to alternative explanations consistent with entirely rational activity. Traders have no affirmative obligation to trade, and therefore are likely to enter positions only when they have an expectation that the price will move in their favor. Since futures floor traders have positive trading revenues, on average (Kuserk & Locke, 1993), their expectations are rational in that they are correct, on average. The expectation could be driven by a pure market-making technique, with revenue generated from the bid-ask bounce, or could derive from an informational advantage such as the advantage of being on the floor and observing the order flow, as described by Manaster and Mann (1999).

Either of these suggestions may mean that traders will be facing an opportunity to realize gains more rapidly, on average, than losses. Consider a market maker buying at the bid, which he expects to be less than the current *intrinsic value*, borrowing a term from traditional microstructure literature. A market maker bids in rational anticipation of receiving subsequent offers to buy, so that he can sell at the ask. This should happen relatively soon, and more frequently than other outcomes, if the trader is successful on average. Less often, the market maker will scratch the trade, earning zero income, or, worse, there could be an adverse information effect (or, the market maker erred), and the market maker may find it in his or her best interest to sell at a price lower than the buy price, losing money on the trade. This last type

of event may take longer to develop on average relative to the successful bid-ask bounce (scalping) trades. In other words, the results in Table 4 may indicate that losses are held longer only because the successful market making technique implies that a gain occurs more rapidly than the opportunity for a loss. For convenience we label this alternative explanation of differential holding times the "differential opportunity" explanation.

We examine the differential opportunity explanation by following the history of a trade – specifically identifying the opportunities to realize a loss or gain prior to the actual realization of a loss or gain for each trade. For each trade we calculate the potential exit minutes – the number of opportunities to realize a gain (loss) prior to actually realizing a gain (loss) (see section 3.2 for a more complete explanation). For this analysis, the potential minutes for trades that are offset within a minute are undefined. If traders hold losses longer than gains only because gain opportunities occur more rapidly than loss opportunities, then we would expect average potential exit minutes for gains and losses to be the same. On the other hand, if the evidence shows that traders pass up more opportunities to take a loss, on average, than they do for gains, then this would not support the differential opportunity explanation, leaving loss realization aversion as a plausible explanation.

Table 5 provides results of tests for differences between prior opportunities to exit trades at gains versus losses by reporting mean and median potential exit minutes for gains compared with losses. The results clearly show that traders, on average, pass up more opportunities to exit losing trades at a loss than they do winning trades at a gain. The first two columns of Table 5 report mean and median potential exit minutes for gains and losses. For all four pits, trades that eventually result in a loss are preceded by significantly more prior opportunities to realize that loss than similar gainful opportunities for their counterpart winning trades. For example,

considering dmark trades, those trades resulting in a loss averaged 22.2 prior minutes when the trade could have been offset at a loss, compared to a significantly lower average of 17.3 minutes when trades that eventually resulted in gains could have been offset with a gain. Similarly, median potential exit minutes for dmark trades were 6 for losses and 4 for gains, with the Wilcoxon statistic indicating that the distributions are significantly different. For pork bellies, there are a generally higher number of prior opportunities to offset both gains and losses, corresponding to the longer average holding times for belly trades observed in table 4. Opportunities for offsetting losses preceding trades that realized losses are again significantly higher than the comparable measure for gains.

The simple counting measure for opportunities reported above may be misleading if there are differences in the rate at which losses or gains accrue. We calculate, for same sign exit possibility minutes over the history of the trade, the average and median position, and the average and median mark-to-market value of the position. These are reported in columns 4 through 7 of table 5. For example, losses being held by dmark traders have an average position size of 13.5 contracts, compared to 11.4 contracts while holding gains. Similarly, for the franc, the average value of the position preceding a loss is negative $1800, while the average value of a position preceding a gain is positive $1187, and the absolute values are significantly different. In fact, in each case (position size and value of potential gain or loss) across the four commodities, trades that resulted in a loss exhibit greater exposure. Traders hold on to losses with significantly greater position sizes and significantly greater absolute mark-to-market than for the gains that they hold. In summary, these results show that traders pass up more opportunities to realize losses than gains, hold larger positions while holding losses, and are exposed to bigger losses than potential gains.

We have established that these traders take significantly longer to realize their losses than their gains. Predictions based on market making behavior, which could be consistent with this result, are not validated with additional statistics based on trade histories. Nonetheless, we have not established that loss realization aversion for these traders has negative consequences. Odean (1998a) documents negative consequences for equity investors associated with the timing element of the choice to sell – in that the winning stocks that are sold subsequently outperform losing stocks that are retained. He also alludes to benefits from momentum-based trading which may be diluted by the disposition effect. In the remainder of the paper we seek measures identifying similar costs associated with loss realization aversion for these futures traders.

Comparing "trade quality" for position-closing trades with gains versus losses.

In this section we examine the quality of the decision to close out a trade. The extra holding time associated with losing trades established above does not imply inferior trade quality for those trades, especially on an intra-day trade. In other words, our finding of a longer holding time for trades that result in losses may simply be the discovery of a benign characteristic of trader behavior. Similar to Odean (1998a) we identify certain post-trade measures of the quality of the decision to terminate a trade. We examine trade quality by defining several measures of post-trade potential revenues and one measure of pre-trade potential and comparing these quality measures for trades that resulted in gains versus those that resulted in losses.

The forward-looking measures compare prices obtained for position-reducing trades to three alternative subsequent potential exit prices. We term these "*what if*" profits **foregone income**. For positions reduced by selling, foregone income is defined as the benchmark potential exit price less the actual sale price. For position reductions via purchase (i.e. covering a

short position) foregone income is defined as the purchase price less the benchmark price. Thus, for both purchases and sales, foregone income measures the dollars that were "lost" by trading at that time rather than at some particular later price. Positive foregone income indicates that the position-reducing trade was - in effect - poorly timed (looking forward to the alternate benchmark). On the other hand, negative or zero foregone income indicates that the trade was, *ex post*, well timed

The three forward-looking potential exit price benchmarks implicitly embed various assumptions about the ability of the traders to time their trades. The first measure looks forward 10-minutes to examine the quality of the trade *vis-à-vis* an estimate of contract value shortly after the close of the trade. For this we use the average pit price in the 10^{th} minute after the completion of a trade, which may be viewed as an unbiased predictor of the intrinsic value of the contract at the time that the trader offsets their position. The second measure uses the more standard closing price for the day. These two measures define the same benchmark price for purchases and sales. Thus, if a trader closes a position by selling at 'the ask' or buying at 'the bid' then we would expect negative foregone revenues versus the 10-minute ahead price or the closing price, which serve as proxies for the contemporaneous intrinsic value. We employ multiple benchmarks to allow for the possibility that trader compensation for liquidity provision accrues from longer-term liquidity swings, in addition to the higher frequency bid-ask bounce. For an elaboration on this distinction, see Manaster and Mann (1999). Finally, we use a *perfect foresight* benchmark; looking forward from the time the trade is offset to the end of the day, and searching for the best subsequent price (highest price for offsets by sales, lowest for offsets by purchases.)

To complement the forward-looking trade quality measures, we use a retrospective measure of trade quality for position reductions, which we label the "percentage realized". For trades with gains, the percentage gain realized is defined as the revenue divided by the maximum potential (market-to-market) revenue available on the trade. For losses, the percentage gain realized is defined as the absolute revenue per contract divided by the maximum absolute potential loss per contract over the time the trade was held open. If a trader receives the best price possible looking back over the life of the trade, then the percent of gain realized should be 100. If the trader receives the greatest loss possible looking back over the life of a trade, then the percent loss realized is 100.

Table 6 presents statistics comparing the three foregone measures and percent realized statistics for gains and losses (aggregated across all trades for each commodity). The first column gives the number of trades used in calculating the statistics, with two rows for each commodity, positive revenue trades and negative revenue trades. The remaining columns represent the trade quality measure: foregone using the closing price, foregone using the 10-minutes ahead price, perfect foresight, and percentage of possible revenue realized. For each measure we present the mean and the median for winning and losing trades for each commodity. Below the row of means and medians for each commodity we present two statistics to test the hypothesis that the position-reducing winning trades have the same quality as losing trades. The statistics are a simple t-test for equal means, and a nonparametric Wilcoxon test for equal distributions.

The results may be considered somewhat confounding, in that many of the statistics are significant, although the signs change. Simply comparing the means and medians reveals that the numbers are relatively close for most measures. This is especially true for the perfect

foresight measure, where foregone losses and gains are nearly identical. For example, for the Dmark, there is an average of $390 per trade left on the table when a gain is offset, and $388 left on the table when a loss is offset. Nonetheless, the number of observations is high, and leads to many instances of statistical significance for even small differences.

In contrast to the striking difference between holding times for gains and losses, the foregone measures exhibit no systematically significant variation between gains and losses. There is slightly stronger evidence that traders realize a higher percentage of their possible gains than they do their losses, but the overall message of the comparisons of trade quality is ambiguous. The evidence does not suggest that the current mark-to-market of a trade (whether it is a gain or a loss) influences the quality of the decision to close the trade. However, recall that, on average, losing trades are held longer.

4.3 Trader success and loss realization aversion

In this section, we develop an alternative method to assess the importance of loss realization aversion, by examining the relationship between measures of loss realization and trader relative success. The previous section provides substantial evidence that these professional traders as a group exhibit loss realization aversion. Combined with prior research findings that retail investors are reluctant to realize losses (Odean 1998a, Heisler 1996), the results suggest that the disposition effect is a widespread phenomenon. However, in contrast to the findings of Odean (1998a), the prior section's results provide no evidence that loss realization aversion is associated with negative financial consequences. Traders hold losing trades longer than winning trades, but the relative amount won or lost on the trade appears to be driven by the trade initiation, rather than the timing of the trade offset. Odean (1998a) attributes

negative consequences of the disposition effect to the consequences of price momentum that are presumably more noticeable in individual equities than for commodity futures prices. If negative consequences are due only to momentum effects, then trader loss realization may be harmless on average in the absence of momentum.

However, regardless of the role of momentum, the results presented in section 4.2 aggregate all traders, and the floor trading population is not a homogenous group. Traders vary by experience, capitalization, and trading strategies. If conventional wisdom about trading has validity, then successful traders presumably have more discipline than their less successful peers, where discipline is taken to mean minimization of alternative and potentially costly behavioral tendencies such as loss realization aversion. In the rest of the paper we examine the relationship between success and loss realization aversion.

Defining success

To determine whether success is related to discipline, we first tackle the problem of formulating a working definition of success. Intuitively, trading revenue ought to be directly related to trading success. However, the amount of risk undertaken in order to achieve short-term revenue is certainly vital to long-run survival. To accommodate this sampling problem, we utilize two related measures of success. The first measure is total income for the six-month sample period. The second measure, which we label "risk-adjusted performance", or RAP, measures a trader's daily "return" on a measure related to the economic capital required by traders to cover potential losses undertaken in order to trade the position. The RAP measure gives low rankings to traders who may have been successful in terms of income, but exposed themselves to relatively higher risk in the process of generating the income.

We estimate a measure related to a trader's economically required capital by considering the trader's marked-to-market position for each minute of each day that the trader trades. We define the maximum exposure for each trader each day as the absolute value of the trader's maximum loss exposure (negative mark-to-market) each day. In some cases this may be the largest loss taken by a trader, but more generally will represent the largest potential loss. We define an *ex post* value at risk (VaR) measure as the 95th percentile daily maximum exposure for the trader. If a trader trades for one hundred days, we take the trader's fifth largest potential loss over the hundred days as the *ex post* VaR.

Given our VaR estimates related to trading capital requirements, we define the RAP as the average daily income divided by the VaR. Table 7 reports distributional statistics for RAP rankings. From this table, it is clear that traders with similar average trading incomes vary widely in the amount of risk they take in order to earn the income. The first two columns report median incomes and median 95th percentile potential losses for the traders within each quartile. The median trader in the highest RAP-ranked quartile for the Deutsche mark earned a daily average of $1,101, and the 95th percentile potential loss for traders in the highest ranked Deutsche mark group was $3,398. The last column of Table 7 provides the RAP for the median trader within each group. The median trader in the highest-ranked Deutsche mark group has an RAP of 0.359.

A natural interpretation of the RAP ratio is the relationship of income to potential loss. In this sense, traders with a RAP of 0.20 risk at least 5 times their average daily trading income around once every 20 days. From this table it appears that lower-ranked traders expose themselves to much more risk for a given level of income. For example, the median traders in the second- and third-ranked Deutsche mark groups have RAPs of 0.142 and 0.058, respectively,

which indicates that these traders risk about seven times and seventeen times respectively, their mean daily income every twenty days.

Success and the disposition effect

Having described our trader sample's heterogeneity with respect to risk and income, in this subsection we assess the impact of trader behavior on success. We examine the relationship between success and the disposition effect using contemporaneous measures, and then investigate whether proxies for relative loss realization aversion have predictive power for subsequent success. Conventional wisdom (e.g. "cut your losses") suggests that more successful traders exhibit more "discipline", where discipline indicates the ability to exit losing positions relatively quickly. In fact, discipline is the term employed by successful traders, or their managers, as we reported in footnote 1. In other words, we are using the term "discipline," to indicate a relative avoidance of the disposition effect. We investigate success and discipline by comparing the profitability of trades for various holding times across trader success groupings.

We examine trade profitability across these various holding times because loss realization aversion, or the disposition effect, implies declining profitability as holding time increases. The disposition effect predicts that, all else being equal, gains are realized sooner than losses, so that as trade holding time increases, the proportion of losses should increase as well. If a subset of traders are more prone to the disposition effect, then the profitability of their trades should decline relative to other traders who are less prone to such behavior as holding times increase.

Table 8 reports mean revenue per contract for trades classified by holding times, across trader success quartiles. The first five columns report average income per contract results for traders ranked by risk adjusted performance (RAP), and the second five columns represent the

same statistics using trader ranks determined by total income. Figures 1 and 2 present these results graphically. As Table 8 and the figures show, profitability remains relatively constant across holding times for higher ranked traders, in marked contrast to the lowest ranked traders. For example, the lowest RAP quartile for Dmark traders earns $8.63 per contract on average for trades held less than 1-minute, but lose $11.52 on average for trades held longer than 10 minutes. In contrast, Deutsche mark traders in the highest RAP quartile have comparable revenue per contract of $8.44 and a positive $14.87 respectively.

These results are perhaps clearest in figures 1 and 2. The lowest ranked traders earn revenues comparable to their more successful peers for holding times up to 10 minutes. But trades held longer than 10 minute are especially unprofitable for less successful traders. If relative discipline is defined as the relative absence of loss realization aversion, or a relative propensity to quickly take losses, then the evidence in this section is consistent with the notion that relative discipline is related to success. The least successful traders seem particularly prone to the disposition effect.

The relationship between holding time profitability and simultaneous success is subject to a bias, since profitability is a component of both measures. In other words, all else being equal, low-income traders are more likely to earn less on their trades. In particular, the simultaneous relationship between success and holding time profitability is most evident for trades held a long time, which may simply indicate that trades must be held a long time in order to lose a lot. If so, then it is not surprising that when we look at loss distributions across trader relative success, we find large losses on long-held trades by lower ranked traders.

To address the simultaneity problem, we develop proxies for relative loss realization aversion and examine the relationship between the proxies for relative loss realization aversion

and subsequent trading success. We use several proxies for evidence of relative loss realization aversion, and two measures of relative success. The data set is expanded to include the second six-month period for our success measurements, after establishing relative loss realization aversion in the first six-month period.

Measures of relative loss realization aversion

Traders with higher aversion to realizing losses should exhibit longer holding times for both losses and gains, all else equal, since some proportion of realized gains represent losses held until they became gains. Therefore, as one set of proxies for relative loss realization aversion, we use trader mean and median holding times for trades in the first six months of 1995. For each trader, we calculate holding times for each trade the trader completed from January through June 1995, then calculate mean and median holding times for that trader.

For the other set of proxies, we use each trader's mean and median potential loss exposure for trades held more than ten minutes during the first six months of the sample. For each trader, we collect all completed trades held more than ten minutes, along with the minute-by-minute mark-to-market history for each trade. We define the loss exposure for each trade as the absolute value of the most negative mark-to-market gain (the largest potential loss) per contract during the trade history.

Given proxy measures for relative loss realization aversion, we examine the relationship between relative loss realization aversion, or discipline, and subsequent success via correlation and tabulation. Table 9 provides correlations between the first-period discipline measures and subsequent success. The table provides ordinary (Pearson) and rank (Spearman) correlations between first period holding times and the two measures of subsequent success defined above.

The significance of the correlations versus a null hypothesis of no correlation is measured by the *p-values* that are presented in italics below each correlation.

Table 9 shows that first period trade holding times are negatively correlated with subsequent success. Using the two correlation measures, two loss aversion measures, and four commodities provides 16 correlations, all of which are negative and significant in the case of RAP. Correlations between first period holding times and subsequent gross income are of mixed sign, with 7 negative and 9 positive, and with low significance levels. The results indicate that higher relative loss realization aversion in the first period is associated with lower subsequent success, particularly as measured by return on economically required capital, or RAP.

Table 9 also provides correlations between our measure of potential loss exposures and subsequent success, in the final two columns. Traders that exposed themselves to larger potential losses per contract on average in the first period appear to have lower subsequent success. All 16 correlations between first period exposure and subsequent RAP are negative, and 12 of these have significance levels less than 10%. Consistent with the hold time measure, correlations between exposure and subsequent income are less conclusive. While 11 of the correlations are negative, 4 are significant at the 10% level, and two are positive and significant.

To supplement the correlations, we also examine the success/disposition relationship in tabular format. We rank traders into quartiles on the basis of first-period relative loss realization aversion, and then examine measures of subsequent success across the relative aversion quartiles. Table 10 provides mean and median second-period success statistics for traders within each first-period aversion quartile, where we measure relative discipline by median potential loss exposure. Consistent with table 9, there is only weak evidence of a negative relationship between first-period exposure and subsequent income. However, there is strong evidence of a positive

relationship between first-period exposure and subsequent VaR, defined *ex post* as above. The VaR here is the potential loss in the subsequent period (second six months), measured again by focusing on negative mark-to-markets. The strong positive relationship between first-period exposure and subsequent VaR, combined with the weak negative relationship between first-period exposure and subsequent income, leads to a negative relationship between first-period loss exposure and subsequent RAP.

Table 11 provides mean and median second-period success statistics for traders within each first-period aversion quartile, where relative discipline is measured using median trade holding time. Traders most averse to realizing losses (those with the longest median holding times) generally have lower subsequent incomes, higher subsequent risk exposure (VaR) and lower subsequent RAP than do traders with more discipline, or lower relative loss realization aversion.

5. Summary and Conclusion

In this paper we provide evidence that professional futures floor traders appear to be subject to the disposition effect. These traders as a group hold losing trades longer on average than gains. As previous research documenting loss realization aversion focuses on small retail customers and experimental subjects, these findings – that professional traders, whose livelihood depends on their success, also exhibit the disposition effect - provide evidence that behavioral attributes are pervasive in the population. On one hand, this could be reassuring, in the sense that professional traders are really no different than the rest of us. On the other hand, the finding

may be somewhat troubling, in the sense that these behaviors may affect asset pricing through market microstructure.

Examination of differences in trading activity and subsequent trader success shows that the least successful traders appear to exhibit most strongly the characteristics described as less disciplined. Specifically, while traders at every success level on average hold losses longer than gains, the least successful traders hold losses the longest while the most successful traders hold losses for the shortest time. Thus there is evidence that trading success is negatively related to the degree of loss realization aversion.

Appendix 1. Accounting Methodology

In order to provide an example of the accounting methodology, we provide Chart 1, an example of a trade history for an imaginary trader, Trader Z.

Chart 1: Hypothetical Trade history for Trader Z

Time	Trade	Price	Position Average cost		Mean hold time (minutes)		Realized Revenue	Round trips	end of minute marking to market:		
			Start	End	Start	End			pit price	Total Mark	Mark/ contract.
9:10	Buy 1	$100	-	$100.00	-	0	-	-	$100	0	0
9:11	Buy 1	99	$100.00	99.50	1.0	0.5	-	-	99	-$1.00	-$0.50
9:12	Buy 1	98	99.50	99.00	1.5	1.0	-	-	98	-3.00	-1.00
9:13	Buy 1 Sell 1	96 97	99.00	99.00	2.0	2.0	1.00	1	97	-6.00	-2.00
9:14	Sell 1	96	99.00	99.00	3.0	3.0	-3.00	1	96	-6.00	-3.00
9:15	-	-	99.00	99.00	4.0	4.0	-	-	93	-12.00	-6.00
9:16	-	-	99.00	99.00	5.0	5.0	-	-	98	-2.00	-1.00
9:17	Sell 1	100	99.00	99.00	6.0	6.0	1.00	1	100	1.00	1.00
9:18	Sell 2	102	99.00	102.00	7.0	0.0	3.00	1	102	0	0
9:19	Buy 1 Sell 2	102 103	102.00	102.50	1.0	0.5	1.00	1	103	-1.00	-1.00
9:20	Buy 2	101	102.50	-	1.5	-	3.00	2	101	-	-

Focusing on the first 5 columns of chart 1, Trader Z opens a position at 9:00 by buying a contract at $100; the end-of-minute **average cost** of the position is $100. In each of the next two minutes Z adds to the position, buying one contract each minute at declining prices. The average per contract cost declines with each trade building the position: after 9:12 (the third minute), the average cost is $99.00, which is the average price of the three purchased contracts (the price of

each trade weighted by trade quantity). Continuing with the example, as Trader Z liquidates the position by selling, the average cost of the remaining position is unchanged until 9:18, when the trader "switches" positions, moving from long (positive) to short (negative). At that point, the end-of-minute average cost is adjusted to the average sale price of the new short position, $102.

Chart 1 illustrates **intraminute** trades in minutes 9:13 and 9:19. At 9:13, Z buys 1 at $96 and sells 1 at $97. Z starts the minute long three contracts and ends the minute long three contracts. For these accounting purposes, we consider the intraminute trades as distinct trades from the existing position and therefore the offsetting trades do not change the position average cost. Intraminute trades may sometimes be concurrent with a position change, as at 9:19. In situations such as this, we define the minimum of intra-minute buy and sell quantities as the intraminute offset trades, and adjust the average cost only for the net change in position. In the example, Z's trades at 9:19 result in an (absolute) increase in her short position. The mean sales price is 103, so the cost basis is adjusted to reflect one contract (the pre-existing position) sold at 102 and one new contract (the net change in position) sold at 103, for and end-of-minute position cost basis of 102.5.

We calculate **realized revenues** as the sale price less the purchase price times the number of **round trips.** The term 'round trips' means the number of contracts in a 'completed trade'. In the example, the 9:13 intraminute offsets result in realized revenue of 1 (97 less 96) for one round trip. For position reductions (absolute), we calculate realized revenues as the difference between the trade price when the offset occurs and the average cost of that trade, multiplied by the number of round trips. Trader Z generates a loss of $3 and single round trip at 9:14 and a gain of $3 ($1.5 per contract) on 2 round trips at 9:20, with both of these trades being position reductions, one via sale at 9:14 and one via purchase at 9:20.

Chart 1 also illustrates our treatment of time. An example of the **holding time** calculation can be seen by focusing on columns 6 and 7. At the end of minute 9:11, trader Z has a long position of two contracts, one that was purchased at 9:11, one purchased at 9:10. The first contract has been held one minute and the second has just been purchased, so that the mean contract holding time is 0.5 minutes. As Trader Z sells to reduce the (absolute) position (beginning at 9:14), the hold time continues to increase, since position reductions do not affect the time that the remaining position has been held.

Chart 1 also illustrates the **marking-to-market** technique. At 9:15, trader Z has a long position of two contracts with a cost basis of $99.00. The 9:15 average pit price is $93.00, so Z's unrealized loss is $6.00 per contract, and the end-of-minute position mark-to-market for the two contracts is a $12.00 unrealized loss. Position marks are indicative of unrealized revenues at a point in time; rapid price changes can lead to observed unrealized losses becoming realized gains, and unrealized gains can become realized losses. The chart 1 example shows that trader Z enters the minute 9:17 with an unrealized loss on the long position, but rapid increase in the pit price allows Z to liquidate some of the position at a gain.

References

Barber, Brad and Terrance Odean, 2000a. Trading is Hazardous to your wealth: The common stock investment performance of individual investors. *Journal of Finance* 55, 773-806

Barber, Brad and Terrance Odean, 2000b. Boys will be boys: Gender, overconfidence, and common stock investment. *Quarterly Journal of Economics*, forthcoming.

Barberis, Nicholas, Ming Huang, and Tano Santos, 1999. Prospect theory and asset prices, *National Bureau of Economic Research Working Paper 7220.*

Barberis, Nicholas, Andrei Shleifer, and Robert Vishny, 1998. A model of investor sentiment. *Journal of Financial Economics* 49, 307-343.

Benartzi, S. and R. Thaler, 1995. Myopic loss aversion and the equity premium puzzle. *Quarterly Journal of Economics* 110, 73-92.

Benos, Alexandros, 1998. Aggressiveness and survival of overconfident traders. *Journal of Financial Markets*.3-4, 353-383.

Bernstein, Peter, 1998. *Against the Gods: The Remarkable Story of Risk*. John Wiley & Sons, New York.

Daniel, Kent, David Hirschleifer, and Avanidhar Subrahmanyam, 1998a. Investor psychology and security market under-and overreaction. *Journal of Finance* 53, 1839-1885.

Daniel, Kent, David Hirschleifer and Avanidhar Subrahmanyam, 1998b. Investor overconfidence, covariance risk, and predictors of securities returns. Working paper, University of Michigan.

Fama, Eugene, 1998. Market efficiency, long-term returns, and behavioral finance. *Journal of Financial Economics* 49, 283-306.

Ferris, Stephen, Robert Haugen, and Anil Makhija, 1988. Predicting contemporary volume with historic volume at differential price levels: evidence supporting the disposition effect. *Journal of Finance* 43, 677-697.

Heisler, Jeffrey, 1996. Loss aversion among small speculators in a futures market. Working paper, Boston University.

Ito, Takatoshi, Richard K. Lyons, and Michael Melvin, 1998. Is there private information in the FX market? The Tokyo experiment. *Journal of Finance* 53, 1111-1130.

Kahneman, D. and A. Tversky, 1979. Prospect theory: an analysis of decision under risk. *Econometrica* 47, 263-291.

Kuserk, Gregory. and Peter R.. Locke, 1993. Scalper behavior in futures markets: an empirical examination. *Journal of Futures Markets* 13, 409-431.

Manaster, Steven and Steven C. Mann, 1996. Life in the Pits: competitive market making and inventory control. Review of Financial Studies 9, 953-975.

Manaster, Steven and Steven C. Mann, 1999. Sources of market making profit: man does not live by spread alone. Working paper, Texas Christian University and University of Colorado.

Odean, Terrance, 1998a. Are investors reluctant to realize their losses? *Journal of Finance* 53, 1775-1798.

Odean, Terrance, 1998b. Volume, volatility, price, and profit when all traders are above average. *Journal of Finance* 53, 1887-1934.

Odean, Terrance, 1999. Do investors trade too much? *American Economic Review* 89, 1279-98.

Shefrin, Hersh and Meir Statman, 1985. The disposition to sell winners too early and ride losers too long: theory and evidence. *Journal of Finance* 40, 777-790.

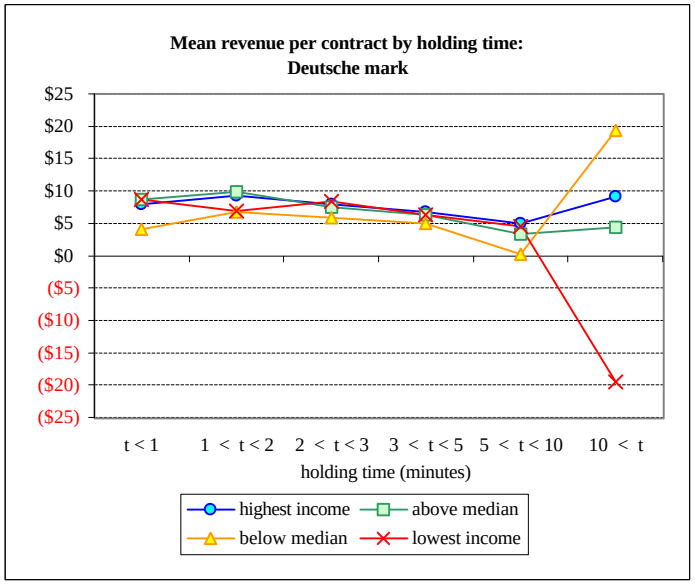
Shiller, Robert J. 1997. Human behavior and the efficiency of the financial system, working paper, Yale University, prepared for *Handbook of Macroeconomics,* John B. Taylor and Michael Woodford, editors.

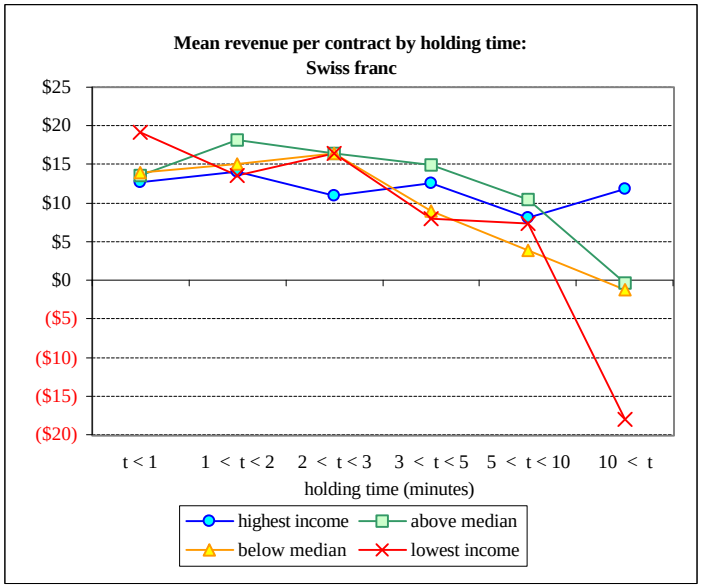
Shumway, Tyler, 1997. Explaining returns with loss aversion. Working paper, University of Michigan.

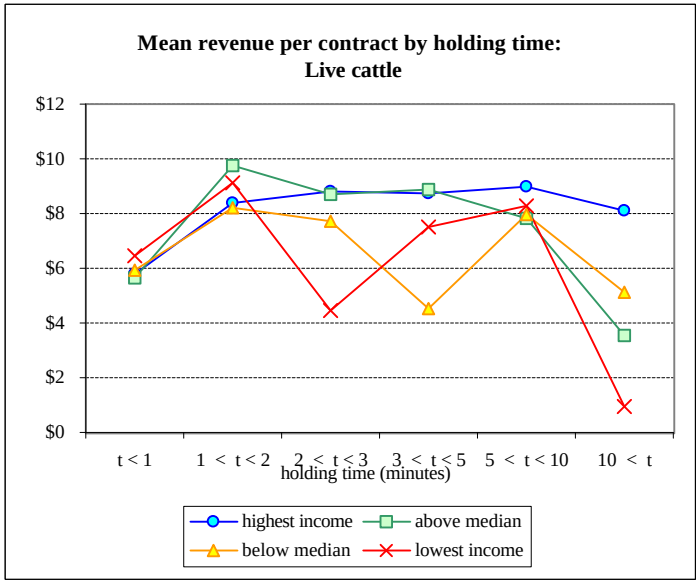
Silber, William L., 1984. Marketmaker behavior in an auction market: an analysis of scalpers in futures markets. *Journal of Finance* 39, 937-953.

Thaler, Richard and Eric Johnson, 1990. Gambling with the house money and trying to break even: the effects of prior outcomes on risky choice. *Management Science* 36, 643-660.

Figure 1. Mean revenue per contract by holding times for trade: Traders ranked into quartiles based on total income







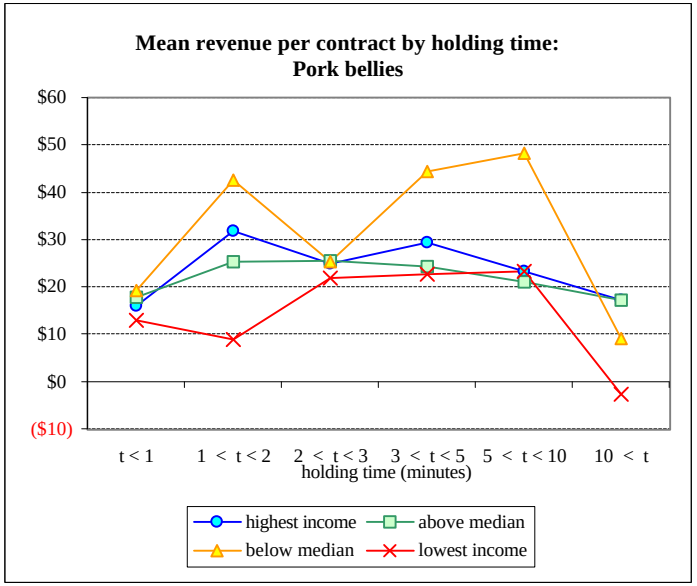


Figure 2. Mean revenue per contract by holding times for trade: Traders ranked into quartiles based on Risk-adjusted preformance (RAP).

Table 1. Sample descriptive statistics

	Deutsche mark		Swiss franc		Live cattle		Pork bellies	
	Jan. - June	July-Dec.	Jan. - June	July-Dec.	Jan. - June	July-Dec.	Jan. - June	July-Dec.
mean daily price range ($)	906	660	1,229	905	353	283	512	563
median daily price range ($)	788	544	1,119	775	330	240	480	540
mean notional contract value ($)	87,324	87,792	105,063	107,829	26,880	26,326	16,397	21,789
mean range as % of mean value	1.04%	0.75%	1.17%	0.84%	1.31%	1.07%	3.12%	2.59%
number of traders	109	100	86	84	98	95	36	35
trader mean total contracts traded	12,344	9,549	10,187	7,722	7,770	6,842	3,806	3,279
daily mean contracts traded per trader	121	97	104	85	79	70	37	37
mean revenue per contract - all traders ($)	$6.49	$6.32	$8.93	$6.20	$5.64	$4.88	$15.53	$20.50
total trader gross trading income ($)	8,744,641	6,030,949	7,819,764	4,025,140	4,293,790	3,175,152	2,128,527	2,352,982
trader mean daily trading incomes:								
lower quartile trader ($)	-32	42	51	2	31	11	182	181
median trader ($)	510	381	440	431	218	154	494	552
upper quartile trader ($)	1,070	728	1,395	1,012	629	397	964	1,023

Note: Data are for floor traders on the Chicago Mercantile Exchange, for the first and second six months of 1995. The sample includes all traders that executed at least five personal account trades on at least ten different trading days in 1995. The price range statistics are calculated for each commodity using the contract month with the highest volume for any given day, while other statistics combine all contract months. Income figures are based on daily trader incomes calculated by marking any end-of-day positions to market with contract settlement prices.

Table 2. Descriptive statistics for intra-minute trades compared to trades held at least one minute (others).

	Deutsche mark		Swiss franc		Live cattle		Pork bellies	
	intra-minute	others	intra-minute	others	intra-minute	others	intra-minute	others
number of round-trip trades	70,184	213,960	52,361	168,456	28,396	104,840	7,966	36,081
mean trade size (contracts)	4.2	4.4	3.4	3.8	4.1	4.3	2.1	2.1
mean revenue per contract ($)	6.34	6.71	10.88	8.87	4.40	7.16	13.60	17.92
quantity-weighted mean revenue per contract ($)	7.69	7.15	13.14	7.49	5.45	8.19	16.13	19.38
median revenue per contract ($)	5.83	6.57	12.50	12.50	1.67	9.46	10.00	20.00
gain/loss interquartile range ($)	15.00	62.50	25.00	100.53	10.00	56.15	28.33	120.00
percentage of round-trip trades with zero revenue	23.8%	6.1%	17.7%	3.6%	38.5%	4.3%	34.8%	3.7%
percentage of nonzero trades with positive revenue	66.7%	57.7%	71.5%	58.1%	73.6%	59.8%	80.9%	60.4%

Note: Intra-minute trades are those round trips where the puchase and sale occur in the same minute, with unknown sequence; the quantity of intra-minute round trips is the minimum of the quantity bought and the quantity sold during a minute. If there are only purchases or sales but not both within a minute, then there are no intra-minute trades for that minute. Trades in the 'others' category are round trip transactions (contracts bought and sold) where the position is held at least one minute.

Table 3. Detailed trade statistics

Panel A: Trades with non-zero revenues

	number of trades		number of round trips		percent of trades:		mean trade size		mean revenue/contract ($)	
Pit:	gains	losses	gains	losses	gain%	loss%	gains	losses	gains	losses
Deutsche mark	151,609	102,793	681,317	460,460	60%	40%	4.5	4.5	53.14	-60.08
Swiss franc	125,067	80,411	466,903	303,533	61%	39%	3.7	3.8	71.66	-85.78
Live cattle	72,805	44,953	320,366	196,944	62%	38%	4.4	4.4	36.49	-39.61
Pork bellies	25,170	14,754	53,728	31,672	63%	37%	2.1	2.1	75.95	-78.40

Panel B: Revenue categorized by the size of revenue per contract

	absolute revenue per	number of trades		number of round trips		percent of trade totals		mean trade size		mean revenue/contract ($)	
Pit	contract ($)	gains	losses	gains	losses	gains	losses	gains	losses	gains	losses
Deutsche mark											
	$y > 100$	17,913	14,868	90,207	74,633	11.8%	14.5%	5.0	5.0	224.56	-227.30
	$50 < y \leq 100$	23,156	17,837	101,883	79,323	15.3%	17.4%	4.4	4.4	72.15	-72.37
	$25 < y \leq 50$	31,559	21,645	137,760	93,875	20.8%	21.1%	4.4	4.3	38.55	-38.56
	$10 < y \leq 25$	61,356	34,676	249,409	135,482	40.5%	33.7%	4.1	3.9	17.08	-17.29
	$0 < y \leq 10$	17,625	13,767	102,058	77,147	11.6%	13.4%	5.8	5.6	5.60	-5.20
	$y = 0$	29,742		101,309				3.4			
Swiss franc											
	$y > 100$	22,803	19,386	97,066	86,040	18.2%	24.1%	4.3	4.4	234.54	-240.29
	$50 < y \leq 100$	23,932	16,373	89,065	61,232	19.1%	20.4%	3.7	3.7	72.86	-73.47
	$25 < y \leq 50$	27,694	15,944	100,849	56,386	22.1%	19.8%	3.6	3.5	39.07	-39.09
	$10 < y \leq 25$	40,545	21,083	134,485	67,485	32.4%	26.2%	3.3	3.2	18.04	-17.65
	$0 < y \leq 10$	10,093	7,625	45,438	32,390	8.1%	9.5%	4.5	4.2	5.60	-5.40
	$y = 0$	15,339		39,691				2.6			
Live cattle											
	$y > 100$	4,945	3,784	26,605	19,705	6.8%	8.4%	5.4	5.2	157.17	-158.67
	$50 < y \leq 100$	10,645	7,513	52,100	35,036	14.6%	16.7%	4.9	4.7	70.57	-70.65
	$25 < y \leq 50$	17,240	10,366	74,620	45,389	23.7%	23.1%	4.3	4.4	36.48	-36.52
	$10 < y \leq 25$	19,318	10,634	84,396	45,117	26.5%	23.7%	4.4	4.2	18.12	-17.82
	$0 < y \leq 10$	20,657	12,656	82,645	51,697	28.4%	28.2%	4.0	4.1	7.24	-6.43
	$y = 0$	15,478		47,270				3.1			
Pork bellies											
	$y > 100$	6,010	3,743	14,915	9,107	23.9%	25.4%	2.5	2.4	187.48	-190.48
	$50 < y \leq 100$	6,126	3,638	12,722	7,737	24.3%	24.7%	2.1	2.1	73.61	-73.56
	$25 < y \leq 50$	5,942	3,115	11,857	6,235	23.6%	21.1%	2.0	2.0	38.10	-37.73
	$10 < y \leq 25$	4,743	2,541	9,261	5,070	18.8%	17.2%	2.0	2.0	19.02	-18.47
	$0 < y \leq 10$	2,349	1,717	4,973	3,523	9.3%	11.6%	2.1	2.1	7.43	-6.79
	$y = 0$	4,123		7,404				1.8			

Note: The table reports statistics for traders in these four contracts of the Chicago Mercantile Exchange for the first six months of 1995. A trade is the completion of a buy-sell combination, in any order. The number of round trips in the trade are the number of contracts offset at the time of the completion of the trade. Revenue per contract is the income generated by the trade divided by the number of round trips for the trade.

Table 4. Holding times

Panel A: Holding times for trades with nonzero revenues: gains versus losses

Pit:	median trade holding time gain	median trade holding time loss	average trade holding time gain	average trade holding time loss	t-stat	Wilcoxon
Deutsche mark	2.00	3.60	9.77	13.18	*-29.9*	*-55.9*
Swiss franc	2.00	4.33	10.12	14.93	*-36.7*	*-68.7*
Live cattle	6.00	12.00	20.42	28.13	*-35.5*	*-46.9*
Pork bellies	9.00	21.00	25.51	36.91	*-27.2*	*-36.4*

Panel B: Holding times for trades: gains versus lossses by size of revenue per contract

Pit	absolute per contract trade revenue ($y)	median trade holding time gains	median trade holding time losses	average trade holding time gains	average trade holding time losses	t-stat	Wilcoxon
Deutsche mark							
	$y > 100$	13.20	18.00	35.52	40.62	***-8.6***	***-15.6***
	$50 < y \leq 100$	5.00	6.72	12.68	15.26	***-9.8***	***-20.4***
	$25 < y \leq 50$	2.34	4.00	7.38	9.60	***-12.8***	***-23.6***
	$10 < y \leq 25$	1.00	1.00	3.58	5.02	***-17.0***	***-28.2***
	$0 < y \leq 10$	1.57	2.03	5.66	7.03	***-7.4***	*-10.6*
	$y = 0$	0.00		1.88			
Swiss franc							
	$y > 100$	11.00	16.48	28.96	34.13	***-11.2***	***-25.0***
	$50 < y \leq 100$	3.50	6.00	9.96	13.65	***-15.3***	***-27.5***
	$25 < y \leq 50$	2.00	3.00	6.06	9.08	***-17.1***	***-30.5***
	$10 < y \leq 25$	1.00	1.00	3.34	5.36	***-18.1***	***-30.3***
	$0 < y \leq 10$	1.70	2.45	6.25	7.56	***-5.4***	*-9.1*
	$y = 0$	0.00		1.78			
Live cattle							
	$y > 100$	50.18	57.23	59.28	65.69	***-5.9***	***-6.7***
	$50 < y \leq 100$	20.00	29.88	34.44	43.14	***-13.9***	***-16.0***
	$25 < y \leq 50$	8.67	14.79	20.81	28.57	***-18.3***	***-23.1***
	$10 < y \leq 25$	4.00	8.67	14.11	20.88	***-19.3***	***-27.2***
	$0 < y \leq 10$	1.00	4.00	9.47	13.73	***-15.9***	***-24.7***
	$y = 0$	0.00		3.12			
Pork bellies							
	$y > 100$	30.81	48.80	45.28	59.85	***-14.5***	***-16.8***
	$50 < y \leq 100$	12.00	24.00	25.98	37.38	***-14.4***	***-18.5***
	$25 < y \leq 50$	5.50	14.22	17.71	28.72	***-14.7***	***-20.7***
	$10 < y \leq 25$	2.00	9.09	14.03	22.09	***-10.9***	***-19.0***
	$0 < y \leq 10$	4.00	9.00	16.60	22.66	***-6.1***	***-9.3***
	$y = 0$	0.00		4.18			

Note: The table reports trade holding times. The holding time for a position increases by one minute at the start of each minute. As a trader adds to a position, the average hold time for each contract in the position is reduced to reflect the shorter holding time of the newest contracts. As positions are reduced but not eliminated, the hold time of the remaining position increases since additional time has passed. Intraminute trades have a hold time of zero, and do not change the average holding times of previously existing positions.

Table 5. Comparison of exit possibilities for gains & losses.

		number of prior opportunities to exit trade at gain or loss		average position size during potential exit minutes: gain vs. loss		average absolute mark-to-market during potential exit minutes: gain vs. loss	
Trade sign	number of trades	mean	median	mean	median	mean	median
Deutsche mark							
Positive	115,903	17.3	4.0	11.4	5.2	$1,264	$157
Negative	84,983	22.2	6.0	13.5	6.0	$1,499	$203
		t-test	-26.1	*t-test*	-21.3	*t-test*	-3.2
		Wilcoxon	-48.1	*Wilcoxon*	-22.4	*Wilcoxon*	-34.1
Swiss franc							
Positive	94,281	17.8	4.0	9.51	4.8	$1,187	$195
Negative	68,118	25.3	7.0	11.72	5.0	$1,800	$272
		t-stat…..	*-35.14*		*-24.3*		*-10.2*
		Wilcoxon….	*-55.57*		*-22.4*		*-37.5*
Live cattle							
Positive	59,955	29.4	10.0	16.1	8.7	$1,019	$220
Negative	40,338	37.0	17.0	19.1	10.0	$1,143	$297
		t-stat…..	*-26.5*		-17.4		*-3.7*
		Wilcoxon….	*-37.1*		-22.3		*-27.4*
Pork bellies							
Positive	20,973	32.4	13.0	6.8	4.0	$624	$210
Negative	13,760	40.0	22.0	7.7	4.7	$708	$248
		t-stat…..	*-15.5*		*-8.8*		*-4.4*
		Wilcoxon….	*-21.8*		*-11.2*		*-9.0*

Note: The table provides statistics comparing intra-trade activity for winning versus losing trades. All trades held at least one minute that resulted in a gain or a loss are included (intra-minute trades and trades with zero profit are excluded). The first set of statistcis report the mean and median number of prior opportunities to exit trades with the same result as the eventual result (i.e., a gain or a loss). The second set of statistics report mean and median position sizes during those potential opportunities to exit the trade with the same result. Finally, the last set of results provide the mean and median maximum mark-to-market (negative for losses, positive for gain, in absolute value) during those potential opportunities to exit the trade at a loss or gain, respectively.

Table 6. Forward and backward-looking measures of position-reducing trade quality

		Forgone Revenues ($)						Percentage of revenue realized	
	Benchmark:	Closing price		10 minutes ahead		"perfect foresight"			
Trade sign	number of trades	mean	median	mean	median	mean	median	mean	median
Deutsche mark									
Positive	115,903	-6.08	-5.18	0.65	0.00	294.23	178.63	72.97%	87.97%
Negative	84,983	-7.99	1.68	-1.80	0.83	300.18	189.06	67.23%	76.47%
		t-stat.…..	*0.97*		*4.71*		*-3.82*		*39.25*
		Wilcoxon….	*-4.06*		*-4.64*		*-8.80*		*41.75*
Swiss franc									
Positive	94,281	-9.28	-9.72	-0.35	-2.03	390.75	233.33	72.83%	87.71%
Negative	68,118	-19.76	0.00	-2.58	0.00	388.20	243.71	66.16%	74.10%
		t-stat.…..	*3.46*		*2.91*		*1.12*		*41.08*
		Wilcoxon….	*-1.71*		*-6.15*		*-4.56*		*44.38*
Live cattle									
Positive	59,955	3.65	0.00	-2.41	0.00	97.55	60.03	75.14%	95.75%
Negative	40,338	-8.72	-2.17	-1.07	0.00	89.65	59.00	69.73%	83.33%
		t-stat.…..	*12.54*		*-4.54*		*11.55*		*25.78*
		Wilcoxon….	*10.71*		*-7.95*		*6.05*		*25.68*
Pork bellies									
Positive	20,973	-16.29	-5.88	-8.80	-5.00	145.17	100.85	76.14%	98.30%
Negative	13,760	-2.76	0.00	-2.15	0.00	153.12	116.01	72.49%	91.14%
		t-stat.…..	*-5.45*		*-7.53*		*-4.89*		*10.39*
		Wilcoxon….	*-4.79*		*-13.10*		*-6.92*		*9.60*

Note: Foregone revenue represents potential regret on the part of the trader. For example, when a trader buys to offset an existing short position, if the benchmark price is lower than the price of the offset, the trader "forgoes" the opportunity to offset the trade at the lower price. A negative value for foregone indicates the trader offset the trade at a price better than the benchmark. We report foregone income using three alternative benchmark prices: the closing price of the day, the market price 10 minutes after the trade, and a "perfect foresight" price, which is the best possible price that could have been obtained subsequent to the trade on the same day. Percentage of revenue realized is a measure of how well the trader could have done if they had gotten out earlier. If they close out at the peak, the percent realized is 100. If they make zero on a trade then the percent realized is 0, unless the trade was never in the money. For negative revenue trades, the opposite is calculated; e.g. was the trade executed at a better price than the worst mark. If a losing trade is closed out at the bottom, the percent realized is 100.

Table 7. Risk-adjusted performance (RAP) distributions.

Pit (# of traders)	mean daily income for the median trader within the quartile ($)	95th percentile potential loss for the median trader within the quartile ($)	RAP for the median trader within the quartile
Deutsche mark (109)			
lowest quartile RAP	(205.09)	4,523.38	(0.050)
below median RAP	518.57	9,231.49	0.058
above median RAP	472.06	3,223.28	0.142
highest quartile RAP	1,100.50	3,398.11	0.359
Swiss franc (86)			
lowest quartile RAP	(240.07)	5,148.33	(0.019)
below median RAP	300.69	7,752.35	0.043
above median RAP	1,048.57	6,609.09	0.151
highest quartile RAP	1,518.79	3,593.09	0.401
Live cattle (97)			
lowest quartile RAP	(68.65)	2,355.45	(0.023)
below median RAP	336.51	3,447.36	0.090
above median RAP	372.68	2,002.80	0.165
highest quartile RAP	559.93	1,334.18	0.381
Pork bellies (35)			
lowest quartile RAP	33.30	5,780.00	0.018
below median RAP	1,212.45	5,798.79	0.147
above median RAP	750.26	2,995.61	0.259
highest quartile RAP	549.51	1,014.52	0.548

Note: RAP is trader mean daily income divided by the trader's 95th percentile potential loss. The 95th percentile potential loss is found by finding the largest negative marking to market on each day the trader traded in the sample. Then the 95th percentile of the distribution of these daily statistics is the 95th percentile potential loss.

Table 8. Income and holding times across trader success rankings

	Quartiles defined by RAP ranking					Quartiles defined by Income ranking			
holding time: t (minutes)	highest RAP traders	above median traders	below median traders	lowest RAP traders	holding time (minutes)	highest income traders	above median traders	below median traders	lowest income traders
	mean revenue per contract ($)					mean revenue per contract ($)			
Deutsche mark									
$t < 1$	8.44	9.26	5.19	8.63	$t < 1$	7.91	8.64	4.03	8.73
$1 \leq t < 2$	9.17	11.08	7.36	6.99	$1 \leq t < 2$	9.26	9.83	6.69	6.90
$2 \leq t < 3$	8.02	9.02	5.84	8.33	$2 \leq t < 3$	8.01	7.50	5.80	8.45
$3 \leq t < 5$	6.78	6.75	5.66	7.13	$3 \leq t < 5$	6.71	6.28	4.97	6.31
$5 \leq t < 10$	4.90	4.68	3.56	5.57	$5 \leq t < 10$	5.01	3.36	0.15	4.49
$10 \leq t$	14.87	5.14	5.94	(11.52)	$10 \leq t$	9.11	4.35	19.42	(19.45)
Swiss franc									
$t < 1$	13.67	12.36	10.70	18.52	$t < 1$	12.67	13.54	13.96	19.14
$1 \leq t < 2$	14.30	14.75	20.91	14.38	$1 \leq t < 2$	14.04	18.13	15.02	13.59
$2 \leq t < 3$	12.08	10.40	22.05	17.87	$2 \leq t < 3$	10.96	16.44	16.37	16.44
$3 \leq t < 5$	12.52	11.99	21.09	7.38	$3 \leq t < 5$	12.61	14.87	9.01	7.93
$5 \leq t < 10$	7.49	7.71	13.69	8.28	$5 \leq t < 10$	8.15	10.44	3.86	7.40
$10 \leq t$	7.87	7.59	5.19	(15.99)	$10 \leq t$	11.78	(0.40)	(1.21)	(18.04)
Live cattle									
$t < 1$	5.09	6.74	6.32	6.19	$t < 1$	5.79	5.65	5.92	6.46
$1 \leq t < 2$	7.05	10.11	11.02	10.00	$1 \leq t < 2$	8.39	9.75	8.20	9.11
$2 \leq t < 3$	7.87	8.42	11.84	6.26	$2 \leq t < 3$	8.80	8.70	7.71	4.46
$3 \leq t < 5$	6.79	10.38	11.34	5.60	$3 \leq t < 5$	8.74	8.87	4.52	7.51
$5 \leq t < 10$	7.97	9.00	10.48	7.52	$5 \leq t < 10$	9.00	7.81	7.97	8.29
$10 \leq t$	12.39	6.25	5.84	0.78	$10 \leq t$	8.09	3.55	5.12	0.95
Pork bellies									
$t < 1$	17.24	17.72	16.25	15.93	$t < 1$	16.04	17.83	19.16	13.03
$1 \leq t < 2$	24.45	31.22	30.99	33.09	$1 \leq t < 2$	31.73	25.39	42.62	8.96
$2 \leq t < 3$	24.32	26.78	27.56	18.15	$2 \leq t < 3$	24.92	25.59	25.27	21.88
$3 \leq t < 5$	26.31	24.05	33.57	35.73	$3 \leq t < 5$	29.46	24.33	44.38	22.61
$5 \leq t < 10$	23.16	23.96	28.00	33.83	$5 \leq t < 10$	23.29	21.08	48.24	23.19
$10 \leq t$	20.41	18.12	17.68	(4.26)	$10 \leq t$	17.24	17.19	9.11	(2.61)

Note: The table reports the mean gain per contract for trades, sorted by holding times, for traders grouped by their rank based on success. The first five columns report mean gains for trader ranks based on total income for the six-month sample period; the second five columns report mean gains for trader ranks based on risk-adjusted income (mean daily income divided by ex-post 95th percentile Value-at-Risk).

Table 9 - Correlations between trader loss realization characteristics and subsequent success

Pit	Number of traders in both samples (trading in each six months)	July - December Success Measure	Correlation type	Correlation between 2nd six-month success measure and January- June trade holding times: mean holding time	Correlation between 2nd six-month success measure and January- June trade holding times: median holding time	Correlation between 2nd six-month success measure and January - June potential loss - trades held more than 10 min: mean exposure	Correlation between 2nd six-month success measure and January - June potential loss - trades held more than 10 min: median exposure
Deutsche mark	100	RAP	**Pearson**	**-0.36**	**-0.24**	**-0.26**	**-0.23**
			(p-value)	*0.00*	*0.01*	*0.01*	*0.02*
			Spearman	**-0.58**	**-0.43**	**-0.36**	**-0.26**
			(p-value)	*0.00*	*0.00*	*0.00*	*0.01*
		Income	**Pearson**	**-0.24**	**-0.13**	**-0.17**	**-0.11**
			(p-value)	*0.02*	*0.19*	*0.08*	*0.27*
			Spearman	**-0.39**	**-0.21**	**-0.21**	**-0.15**
			(p-value)	*0.00*	*0.03*	*0.03*	*0.14*
Swiss franc	82	RAP	**Pearson**	**-0.08**	**-0.07**	**-0.05**	**-0.01**
			(p-value)	*0.47*	*0.55*	*0.64*	*0.93*
			Spearman	**-0.50**	**-0.49**	**-0.28**	**-0.16**
			(p-value)	*0.00*	*0.00*	*0.01*	*0.15*
		Income	**Pearson**	**-0.13**	**0.00**	**-0.11**	**0.00**
			(p-value)	*0.25*	*0.96*	*0.33*	*1.00*
			Spearman	**-0.32**	**-0.25**	**-0.14**	**-0.01**
			(p-value)	*0.00*	*0.02*	*0.20*	*0.94*
Live cattle	91	RAP	**Pearson**	**-0.25**	**-0.21**	**-0.26**	**-0.27**
			(p-value)	*0.01*	*0.04*	*0.01*	*0.01*
			Spearman	**-0.28**	**-0.20**	**-0.18**	**-0.22**
			(p-value)	*0.01*	*0.05*	*0.09*	*0.04*
		Income	**Pearson**	**0.05**	**0.07**	**-0.22**	**-0.19**
			(p-value)	*0.65*	*0.49*	*0.04*	*0.07*
			Spearman	**0.08**	**0.14**	**-0.06**	**-0.14**
			(p-value)	*0.43*	*0.19*	*0.54*	*0.20*
Pork bellies	32	RAP	**Pearson**	**-0.46**	**-0.46**	**-0.31**	**-0.29**
			(p-value)	*0.01*	*0.01*	*0.09*	*0.11*
			Spearman	**-0.54**	**-0.53**	**-0.23**	**-0.13**
			(p-value)	*0.00*	*0.00*	*0.20*	*0.47*
		Income	**Pearson**	**0.01**	**0.06**	**0.22**	**0.42**
			(p-value)	*0.95*	*0.75*	*0.22*	*0.02*
			Spearman	**0.03**	**0.09**	**0.22**	**0.38**
			(p-value)	*0.88*	*0.64*	*0.24*	*0.03*

Note: the table reports correlations between proxies for loss realization aversion during the first six months, and success measures for the second six months, for the traders active during both six-month periods.

Table 10: Subsequent success of traders ranked on first period loss realization characteristics

Pit	First period (January - June) trader ranking for the median potential loss per contract on trades held longer than 10 minutes	traders in first period / traders remaining in 2nd period	Subsequent success: July - December Total gain for traders in quartile: mean total gain	median total gain	July - December daily gain for traders in quartile: mean daily gain	median daily gain	July - Dec. VaR (95% potential loss) for traders in quartile: mean VaR	median VaR	July - Dec. RAP (risk-adjusted performance) for traders in quartile: mean RAP	median RAP
Deutsche mark	1 - lowest exposure	27 / 26	47,894	29,494	409	400	2,265	1,465	0.215	0.164
	2 - next-lowest exposure	28 / 24	60,565	42,397	570	430	6,494	2,307	0.189	0.095
	3 - next-highest exposure	27 / 25	75,401	27,894	789	273	6,737	4,088	0.133	0.106
	4 - highest exposure	27 / 25	50,909	4,782	573	97	7,560	5,450	0.100	0.046
Swiss franc	1 - lowest exposure	21 / 20	36,658	14,121	371	308	2,789	2,085	0.151	0.091
	2 - next-lowest exposure	22 / 20	84,802	84,855	830	774	5,372	2,596	0.219	0.171
	3 - next-highest exposure	22 / 22	44,544	24,815	358	522	5,405	4,038	1.831	0.096
	4 - highest exposure	21 / 20	40,384	15,488	494	181	19,443	7,564	0.069	0.031
Live cattle	1 - lowest exposure	24 / 22	43,122	12,657	335	213	3,610	1,508	0.206	0.116
	2 - next-lowest exposure	25 / 25	60,088	22,383	622	219	3,330	2,312	0.219	0.211
	3 - next-highest exposure	24 / 24	25,392	15,361	270	249	2,265	1,468	0.118	0.118
	4 - highest exposure	24 / 20	18,534	6,279	225	182	2,963	2,390	0.093	0.067
Pork bellies	1 - lowest exposure	9 / 8	34,139	20,353	392	338	1,488	1,254	0.437	0.182
	2 - next-lowest exposure	9 / 8	60,459	50,526	593	457	3,219	2,416	0.307	0.179
	3 - next-highest exposure	9 / 8	72,631	52,521	318	463	2,143	2,320	0.096	0.262
	4 - highest exposure	8 / 8	96,246	89,150	1,131	1,014	6,173	5,544	0.201	0.176

Note: the table reports mean and median measures of traders success in the second six months of 1995, for trader ranked into four quartiles on the basis of a proxy for loss realization aversion during the first six months: the trader's median exposure (maximum potential loss) per contract on trades held longer than ten minutes. The first column reports the number of traders in each group for the first six months, and the number of traders remaining during the second six months. Total gain is the gross trading profit ($) for each trader during the second six month period.

Table 11: Subsequent success of traders ranked on first period loss realization characteristics

Pit	First period (January - June) trader ranking for median trade holding time	traders in first period / traders remaining in 2nd period	Subsequent success: July - December Total gain for traders in quartile: mean total gain	median total gain	July - December daily gain for traders in quartile: mean daily gain	median daily gain	July - Dec. VaR (95% potential loss) for traders in quartile: mean VaR	median VaR	July - Dec. RAP (risk-adjusted performance) for traders in quartile: mean RAP	median RAP
Deutsche mark	1 - shortest time	31 / 29	76,769	54,080	693	477	2,507	2,185	0.298	0.240
	2 - next-shorter time	21 / 20	55,002	18,998	525	411	3,301	1,671	0.219	0.140
	3 - next-highest time	30 / 26	74,824	8,666	757	121	8,353	4,210	0.076	0.059
	4 - longest time	27 / 25	23,391	4,817	324	123	8,651	9,006	0.038	0.044
Swiss franc	1 - shortest time	24 / 22	77,024	73,086	822	866	3,033	2,311	0.322	0.298
	2 - next-shorter time	20 / 20	36,410	3,291	208	222	4,292	2,779	1.987	0.096
	3 - next-highest time	21 / 21	56,232	36,970	668	641	13,951	5,425	0.074	0.056
	4 - longest time	21 / 19	32,275	12,559	289	226	11,866	5,842	0.038	0.044
Live cattle	1 - shortest time	24 / 23	28,891	4,161	328	149	1,722	561	0.227	0.273
	2 - next-shorter time	25 / 23	35,537	17,028	359	180	2,069	1,207	0.196	0.095
	3 - next-highest time	25 / 23	34,787	28,131	361	313	3,043	2,324	0.114	0.136
	4 - longest time	24 / 22	50,748	12,020	436	261	5,293	2,816	0.121	0.091
Pork bellies	1 - shortest time	9 / 9	51,099	42,926	505	413	1,515	1,177	0.389	0.351
	2 - next-shorter time	9 / 9	74,967	66,649	455	784	2,639	2,808	0.389	0.275
	3 - next-highest time	9 / 6	55,078	47,938	712	487	4,102	3,542	0.153	0.147
	4 - longest time	8 / 8	80,342	51,337	821	684	5,273	4,477	0.050	0.135

Note: the table reports mean and median measures of traders success in the second six months of 1995, for trader ranked into four quartiles on the basis of a proxy for loss realization aversion during the first six months: the trader's median holding time (minutes) per contract. The first column reports the number of traders in each group for the first six months, and the number of traders remaining during the second six months. Due to ties in median holding time, the number of traders in each group for the first six months is somewhat uneven, particularly for the dmark traders, where many traders in the "shortest time" group had a median holding time of four minutes. Total gain is the gross trading profit ($) for each trader during the second six month period.