Aspiration Levels and Risk Taking by Government Bond Traders

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Abstract

The management of risk is important in financial institutions. In particular, investment houses dealing with volatile financial markets such as foreign exchange or government bonds may find it difficult to maintain "proper" levels of risk taking. On one hand, firms encourage traders to take risks in trading government bonds, but on the other, they promote risk aversion since they value reputation as careful and solid investors rather than having a reputation of risk takers.

Government bond traders work in a very volatile and fast moving market. They are compensated by a base salary plus a bonus which relates to the profit and loss (P&L) they create for the firm on the securities they trade. Recent models of risk taking (Kahneman and Tversky, 1979; March and Shapira, 1992; Shapira, 1995) suggest that risk taking is affected by the targets or reference points that people use to evaluate risky prospects. Such targets can be set by "objective" grounds, that is, based on some rational economic considerations of profitability. However, often the targets are set in a "comparative" sense, that is, by comparison to the performance of other similar firms. The above models suggest some alternative ways in which targets may affect risk taking. These predictions are tested using data on actual purchase and sell decisions made by government bond traders. Implications for risk management are discussed.

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The consequences of risk taking at the level of individuals, groups or organizations engender much debate in the social sciences. The ways in which society and its members deal with risk are often ambiguous or dialectical and may have multiple meanings. However, there appears to be a consensus on the meaning of risk in financial settings. The riskiness of a financial security is often described by its volatility, and defined in classical decision models by the variance of the outcome distribution. Popular financial indicators such as the Dow-Jones Index or the Standard and Poor's 500, fluctuate according to patterns which cannot be predicted. Changes in these indexes (or in the price of a certain security) create a distribution which implies risk. Forty years ago, Markowitz (1959) formulated the modern theory of finance using a-mean-variance approach. He assumed that investors preferred to invest in projects or securities with high means and low variances. Indeed, the essence of financial decision making lies in the tradeoffs between risk and return. In recent years, the analysis of several anomalies in financial markets has raised questions as to whether a measure of a distribution (such as variance) truly captures the notion of risk.

We can also learn about risk taking by examining behavior in other settings, for instance how general managers take risks, but as March and Shapira (1987) commented, until the mid 1980s there were relatively few studies of risk taking in the context of managerial decision making. In the last 15 years some large scale studies of risk taking by managers have been conducted (MacCrimmon and Wehrung, 1986; Shapira, 1995), and models of risk taking in organizations have been developed (Bromiley, 1991; Kahneman and Lovallo, 1993; March and Shapira, 1992).

One of the major aspects of these models is the conjecture that risk taking is context dependent. This paper addresses this issue, focusing on the effects of shifts in aspiration level on risk taking. The analyses focus on the behavior of individual traders but there are implications for the management of risk at the organizational level. The increasing volatility in financial markets over the last decade makes financial institutions vulnerable to risks taken by individual managers and traders. The case of Nick Leeson who brought down the 250 years old Barings Bank shows that risk management is vital for the survival of financial institutions. Similar incidents occurred at such institutions as the Daiwa Bank, Salomon Brothers, Kidder Peabody and the municipality of Orange County in California. The frequency of such incidents may be higher than previously assumed and the implications of non monitored risky decision making procedures for the survival of financial institutions, should be scrutinized with utmost care and attention (New York Times, 1995). Research in the organizational field have not paid much attention to such issues, although other aspects such as speculative bubbles (Abolafia and Kilduff, 1988) and survival of financial services firms (Zaheer and Mosakowski, 1997) were examined. The present paper focuses on the behavior of managers and traders in such institutions and discusses the implications for risk management at the firm's level.

Risk Attitudes and the Context of Decisions: A Theoretical Framework

Classical approaches to decision making assume that most people are risk averse. Markowitz (1952) suggested that risk attitudes may vary if one considers gains versus losses. Kahneman and Tversky's (1979) prospect theory developed this point further, by arguing that agents are risk averse in gains and risk seeking in losses. There are two main features proposed in the value function suggested by prospect theory: different valuation of gains and losses of the same

monetary amount and the existence of a reference point from which prospects are evaluated as either gains or losses. These provide the context that affects risk tendencies.

Prospect theory assumes that the status quo provides a natural reference point but claim that other reference points can exist. Indeed, aspiration level and other targets may also play such a role (March & Simon, 1993; March and Shapira, 1987). Based on a large study of managerial perspectives on risk taking, Shapira (1995) found that managers tune to two reference points when they think of risk. One point is a target for performance; the other, a point signifying survival. It appears that two comparisons organize managerial thinking about whether or not to take a risk. The first is a comparison between some performance level or position (e.g., profit, liquidity, sales) and an aspiration level for it. Most of the managers who participated in Shapira's (1995) study were more inclined to take risks when they were faced with failure to meet targets than when targets were achieved. Executives also tend to take riskier actions when their own positions or jobs are threatened than when they are secure. A second comparison is between the present position of an organization and its demise. Managers exhibit strong feelings that survival should not be risked, and most of the interviewees said they would not take risks where a failure could jeopardize the survival of the firm. They realize however, that if a competitor threatens the market position of the firm, they have to take one of two risks: taking new risky strategies on the one hand, and not surviving on the other.

It appears that a strong position leads to conservative risk taking behavior in order to minimize the danger of falling below a target. However, the higher one's asset position relative to a target, the lower the danger from any particular amount of risk. In contrast, performance below a target level is likely to lead to a greater tendency to take risks, in the hope of increasing the probability of reaching the target. Of course, the worse the position, the more the danger reflected

in the downside risk. It appears therefore, that the value attached to alternatives differing in risk may depend not only on whether they are "framed" as gains or losses but also on which of two targets (the "success" target or the "survival" target) emerges as the relevant reference point.

Attention and risk taking: A model. These ideas were used in developing a model of risk taking (March and Shapira, 1992) that is presented in Figure 1. The vertical axis describes risk taken as variance of bets and the horizontal axis measures the decision maker's cumulated resources. The variance, or risk taken, depends both on the amount of current resources and on the history of reaching that amount. Risk taking is assumed to be controlled by two simple "decision" rules. The first rule, applied whenever cumulated resources are *above* the focal reference point as follows: variability is set so that the risk taken increases monotonically with distance above the reference point. This rule provides an interpretation of the phenomenon of risk aversion in the positive immediate neighborhood of an aspiration level or threat of death. A variant of this rule implies that the probability of landing below the reference point equal to some fixed number, so that the relation between distance from the reference point and risk is linear.

Insert figure 1 about here

The second rule applies whenever cumulated resources are *below* the focal reference point: variability is set so that risk taken increases monotonically with (negative) distance from the focal point. A specific linear version of this rule could set the probability of landing some fixed distance *above* the target equal to some fixed number. This rule is commensurate with the tendency to be risk seeking for losses. The more current resources are below the reference point, the greater the risk required to reach the target.

Two reference points are assumed to govern risk taking: an aspiration level for resources that adapts to experience (Lewin, Dembo, Festinger, and Sears, 1944) and a fixed survival point at which resources are depleted (March and Shapira, 1992). The model differs therefore from a strict aspiration-level conception of goals by introducing a second critical reference point, the survival point, and by assuming that the focus of attention shifts between these two reference points (March and Shapira, 1987, 1992). The above two rules make risk-taking behavior sensitive to the risk taker position (or expected position) relative to a performance target on the one hand, and as to a survival point on the other. In addition, risk taking is affected by whether the decision maker focuses on the survival reference point or the aspiration-level reference point.

Shifts in Aspiration Level. The aspiration level determines whether an outcome is defined as success or failure. In addition to the rules described above, *shifts* in aspiration level also affect risk taking. Consider for example a person whose resource position is X_1 in Figure 2. Assume that this person was focusing on his aspiration level, AL_1 and had then taken a risk that turned out to be a failure and landed him at asset position X_2 in Figure 2. The person is now below his original aspiration level, and the riskiness of his next decision depends on whether he would or would not change his aspiration level to, say, AL_2. If he changes his aspiration level to AL_2, then his next risk taking action will be more modest than it would have been had his aspiration level stayed at AL_1

Insert figure 2 about here

It is of interest to find out under what conditions would people change their aspiration level. In the tradition of the behavioral theory of the firm (Cyert and March, 1992), reference points or aspiration levels are assumed to adapt to performance. Some effects of shifts in reference points

were discussed within the framework of prospect theory. Tversky and Kahneman (1986) presented subjects with hypothetical choices where outcomes were framed so as to induce a shift in reference point. For instance they told subjects "Assume yourself richer by $300 (or $500) than you are today." They then asked the subjects to make choices between a sure gain (or loss) and an uncertain gain (or loss) and demonstrated that subjects responses were "...highly sensitive to changes in reference point" (1986: S259). It is possible however, that self-initiated changes in aspiration level, may not coincide with induced changes. Prospect theory's notion of a reference point was motivated, in part, by Helson's (1964) adaptation-level theory. According to his theory people may adapt to new reference points quite quickly. This may be the case when pure attitudes to money are examined, but as Kahneman and Tversky (1979) noted, at times people may change their reference points rather slowly. Thaler and Johnson (1990) demonstrated the lingering effect of the desire to break-even on gambling decisions, a well- documented finding in the race tracks. The reluctance to change behavioral patterns that serve as reference points in the allocation of one's retirement payments and health benefits were documented in Samuelson and Zeckhauser's (1988) study who labeled the phenomenon "The status quo bias".

Helson's (1964) adaptation level theory is a psychophysical theory, focusing on the mechanisms that describe human responses to changes in external stimuli. In contrast, Lewin et al. (1944)'s conception of aspiration level is one of choice and volition. In some cases the predictions derived from these two perspectives can differ but in others they are similar. Lant (1992) examined the adjustment of aspiration level in a behavioral simulation and found that aspirations generally adjust to performance (see also March, 1988). The model presented in Figure 2, indicates, however, that there may be cases where aspirations do not adjust to performance. Consider for example a student who has a B average and suddenly gets an A in a major test. Would such a

student adjust his aspiration to match his recent (but not representative) level of performance? It is possible to put the weight on an extreme level of performance and adjust the aspiration level to it, but that may not be a good strategy. Counterevidence, assuming rapid adjustment to extreme (but unlikely) levels of performance, may be related to Tversky and Kahneman's (1974) representativeness mechanism. People who use this heuristic do not follow the "regression to the mean" effect correctly, and are influenced by discrete events that may lead them to raise their aspirations levels based on one extreme event.

Thus, a variety of different mechanisms may underlie the relations between aspiration level and performance. In particular, life in organizations is marked by the rewards and penalties that people receive, and by those that they expect to receive. The salience of the relations between performance and rewards was attested in a statement by a financial analyst who commented: "Being the only analyst to recommend a certain stock, if you're right it singles you out as a star. If you are wrong, it won't be forgotten" (Shapira, 1995: 56). Furthermore, often targets set in organizations may be open to re-negotiation. This may be true especially in cases of longitudinal research and development projects, as noted by Garud and Van de Ven (1992) in their analysis of the re-negotiation of targets in the Cochlear Implants project at the 3M corporation. Kahneman (1993) suggested that there may be multiple reference points for evaluating performance. However, the existence of different anchors may lead in turn, to a "political" interpretation of otherwise naive organizational processes such as promotions (Friedman and Shapira, 1988). As noted by Shapira (1995), managerial risk taking is affected not only by the outcomes of decisions but by the ramifications of these outcomes and decisions. Examination of the setting and changes of aspiration levels in organizations is therefore tainted by the particular context in which risks are taken and decisions are made.

Economics textbooks identify long-run profit maximization as the underlying motivation of individuals and firms. Under this notion, only cumulative performance should count and short term targets should have a secondary (if any) effect on motivation. Given the fluctuations of performance in any given short period of time, reliance on short-term goal achievement is not a guide under "rational' models of decision under risk. Nevertheless, several studies have shown that in managing their portfolios people often behave in a myopic manner, focusing on the short rather than on the long term (Benartzi & Thaler, 1999). The focus on the short term is much more pronounced in the way the current traders operate. As mentioned before, unlike investors, they make their money on observing temporary opportunities in the market and on commission. While they have annual targets, it is the daily performance that matter to them most. As one trader claimed: "you are only good as your last trade". Another trader echoed the same feeling by saying "mood on the floor changes 200 times a day". The existence of goals in organizations is a major characteristic of modern corporations and several studies (cf., Greve, 1998; Mezias, 1988; Shapira, 1995) have demonstrated the important effects of targets on the behavior of firms and individuals in organizations.

According to the model described above, risk taking behavior is affected by the decision maker's current asset position relative to the reference points; the amount of risk taken increases with distance from the respective reference point.

Proposition 1. The further away a decision maker's asset position is from his/her target (aspiration level or survival) the more risk he/she takes.

The model also suggests, in line with prospect theory, that risk taking is asymmetric with regard to gains and losses.

Proposition 2. A decision maker who focuses on aspiration level and has fallen below that target by a certain amount takes a larger risk than if he /she were above the target by the same amount.

As noted earlier, there are different reference points and targets that can affect risk taking. Such reference points can be: Prior performance of the same individual, prior performance of other individuals in similar positions. In addition, performance along different time periods, such as one's performance on the previous day or the last week may also affect one's aspiration level and consequent risk taking. In particular, decision makers in organizational settings may use different reference points in evaluating theirs and other persons' performance for a variety of goals that relate, among other things, to internal politics or other organizational reasons.

Proposition 3. Decision makers in organizational settings are guided by different targets and aspiration levels in taking risks.

Effects of Shifts in Aspiration Level on Risk Taking: A Field Study

To examine the ways in which targets affect risk taking, data on the behavior of Government bond traders in a large New York City investment banking firm were collected.

Financial textbooks (Sharpe, Alexander and Bailey, 1999) analyze the major variables underlying the valuation of bonds. However, only scant attention has been given in previous research to analysis of the behavior of traders or market makers. Yet, specialists at the New York Stock Exchange, scalpers in future markets and government bond traders use their *judgment* in arriving at decisions. Conceivably, if markets are efficient such judgments may be inconsequential as those who have faulty judgment may be "eliminated." This may not fully characterize the situation in the trading profession. Traders in such firms operate in very dynamic, high risk environments. Sometimes they work under real time pressure similar to the short decision times

described by Silber (1984) in his analysis of scalpers' behavior. Holding positions for a long time on a certain security may be detrimental. Indeed, in 1987 a mortgage trader held to his position for a long time without disclosing it, and eventually lead to a loss of a few hundred million dollars for his brokerage firm. (New York Times, 1995)

Top managements of such financial institutions aim at maximizing profits and minimizing risks. The positive relation between risk and return suggests that if traders are not encouraged to take risks (in a prudent way, of course), returns may not be as high as desired. The management of risk requires striking a delicate balance between risky and conservative actions. Understanding the model underlying traders' behavior may allow their superiors to control excessive risk as well as encourage prudent risk taking. Since targets play a major role in guiding the behavior of employees in such institutions, it is important to examine the ways in which targets affect the ways traders make risky decisions.

METHODS

Research Site

The study was conducted in one of the 10 largest investment banking firms on Wall Street. The firm is active in all forms of financial services. This study focused on the behavior of government bond traders. The data were collected in three forms: Observations, interviews and analyses of actual trading records.

Data Sources

Observations. To get acquainted with the nature of work of the traders I went to the trading floor to observe their behavior. I visited to the trading floor 6 times and stayed there for about 3 hours each time. These traders are seated in a large trading floor where other traders also have offices. They use computer terminals on which information is displayed. Traders observe the

prices of bonds they specialize in (specialization is determined by maturity dates of the bonds) and respond to requests by salespersons (representing clients) seated in another section of the same large room. Traders can also execute buy and sell decisions using funds allocated to them by the firm. Traders who trade solely for the firm are called proprietary traders In the firm where this research was conducted, traders were compensated by a base salary plus an annual bonus that depends on their performance. Annual performance appraisal is made in early January and the ensuing coveted bonuses are paid in February. In the year preceding the study, a sales agent seated just one row behind the traders, got a bonus close to $2 million and a couple of the traders got bonuses close to $1 million.

Interviews. I held interviews with 10 traders, the head of the Government Bonds trading desk, the head of the Zero Coupons desk, the head of the Corporate Bonds trading desk, the Executive Vice President for Risk for the entire company and 4 senior vice presidents in the financial services group. Each interview lasted about an hour. The interviews were held during working hours and interviews with the traders were interrupted occasionally when traders were required to make decisions.

Transaction Data. The data represent the entire trading and transaction records of some 20 government bonds traders, over a period of 80 days in 1990. All in all, the data include about 400,000 transaction records. The data for each transaction comprise the details of the particular security, the time of trade, the price at the time of transaction, the dollar value of the position the trader had, and the profit and loss (P&L) of the trader from the transaction. On their computer screens, traders are provided with information on the positions of the different bonds they hold. They can easily see whether they are above or below their targets. The prices get updated whenever a buy or sell decision is executed. In addition, traders can update their positions any time

they wish. Traders start each day with a display showing their opening positions, namely, the closing values of the prior trading day. Changes in the values of these positions, such as buy or sell decisions (by them or others) are recorded and a profit or loss figure is calculated following each transaction. Due to the possibility of high losses, traders are required to provide their supervisor with a printout of their positions at the end of the trading day. In addition to information about their own holdings, traders enjoy a variety of other information on display such as information from the New York Stock Exchange, currency markets and futures and options markets in Chicago. Some traders observe information on as many as eight computer screens simultaneously. Note that no summary statistics like the Dow-Jones Index exists for government bonds, , although some companies create a certain portfolio of bonds so they can track its performance. There is also no summary measure of the total volume of activity of government bonds.

ANALYSIS

Descriptive Features of Traders' Work

The working day at the Government Bonds Trading Desk starts with a daily meeting early in the morning with a general analysis of the market and the setting of general strategy for the day. Each trader has limits on the amount of money he can hold in securities that he buys (called long positions) as well as obligations he makes (i.e., selling short). At the end of the trading day each trader has to report on his outstanding positions to the Head of the desk.

The work pace of the traders is unrelenting from the moment they come to work until they leave. They work continuously with no break, eating lunch at their desks. The intensity of their activity is captured to some degree by the number of trades they make as well as by the number of times they update their screens on their positions. For instance, trader 2's average daily number of updates is 120 but on August 30th he made 343 updates, a high number that can be explained by

Iraq's invasion of Quwait. Not all high numbers of updating are strictly a reflection of single events like this. Another example of these activities is presented in Figure 3, for trader 4. The number of updates he made varied from day to day and peaked at 4793 on August 1. He admitted "I love P&L, I am a P&L assessor, I like to know where I stand, it's like being on the race track". His P&L varied considerably throughout the period (see Figure 4). His cumulative P&L over the entire 80 day period, presented in Figure 5, amounted to about 4 million dollars, and his cumulative P&L for the year is estimated to be three times as much. Such performance can lead to annual bonuses of up to one million dollars.

Insert figures 3, 4, and 5 about here

The bond traders are provided with all the data they need in real time. The feedback they get from their own decisions is instantaneous. The availability of these data, coupled with other analyses carried out in their firm, implies that in comparison with other types of financial managers, they should be more familiar with the normative theories of finance. Consequently, they are more likely to perceive risk in terms of volatility, rather than only as downside risk. They also have firm ideas about the correlation between risk and return. On the other hand, since they work on data which are virtually continuous in time, and since they are provided with their profit and loss figures, it is likely that the latter may serve as natural reference points or targets which affect their decisions.

Data Analyses

At any point in time there are about 250 to 300 Government Bonds traded on the market. As noted earlier, traders specialize in different notes based on their maturity dates. These dates are

divided to 4 periods: 0-2 years bills, 2-5 year notes, 5-10 year notes and 10-30 years bonds. Within each specialty grouping traders can hold a portfolio of fifty to sixty securities, but most of them did not hold more than 30 at the time of the study. One trader from each group was sampled for analyzing some aspects of the effects of different anchors on individual traders' behavior. Presentation of the analyses is arranged in units of time, that is, the effect of targets on risk taking are analyzed by: time of year, analyses based on daily performance and analyses on performance within a day. In addition, analyses of the different securities throughout the 80 day period were carried out separately.

Time of year and risk taking

The importance of targets in affecting risk attitudes and propensities was evident in the traders' behavior. Their profit and loss figures have a profound effect on their behavior. In the interviews I held with these traders and their supervisors, all of them said that the model's assumption that traders focus on their aspiration level (e.g. Figure 1) describes their behavior perfectly and in particular toward the end of the year. Traders whose cumulated P&L is positive and above target, would generally take fewer actions in November and December so as not to risk their anticipated bonus. On the other hand, traders who performed poorly, whose P&L is negative in the period approaching November and December, would engage in voluminous activity in an effort to reverse their position and the chance that they will be dismissed.

The time of the year effect has been also documented in other studies. For instance, Chevalier and Ellison (1997) showed how mutual fund managers tend to alter the riskiness of their portfolios at the end of the year in an attempt to increase the inflow of investments to the fund.

Daily performance and risk taking

The analysis of the daily performance of the traders focuses on the dollar value of their buy and sell decisions and their risk exposure. Several market factors in addition to traders' profit and loss figures can affect the risks a traders takes. If the P&L on day **t** is considered as a target or reference point, then the P&L on day **t+1** is considered either a gain or a loss vis-a-vis this target. According to the model in Figure 1, if the trader focuses on the P&L of day **t** as a target, then the larger (in absolute value) the P&L on day **t+1**, the more risk the trader would be willing to take on day **t+2**.

An indication of risk taking activity is the total dollar value of the securities bought or sold by the trader. To test the effect of P&L on the subsequent day's total dollar value, a regression of the absolute total dollar value of the traded securities on day **t+1** was run on the P&L of day **t**. The regression was run separately for days where the P&L was positive and days were the P&L was negative. The results are presented in Table 1.

Insert Table 1 about here

The riskiness of a fixed income security is determined among other things by the time it takes to recover the original investment. Therefore, a $100,000 invested in 6 month treasury bills is less risky than $100,000 invested in a 5 year treasury note. In addition, government bonds pay interest in the form of coupons, every 6 months. Thus, one needs to adjust this cash flow for current valuation. The common way of adjusting the time element is called in finance *duration,* which is measure by the weighted average of the length of time until the remaining payments are made (Sharpe et. al., 1999: 424). In general, the higher the duration, the riskier the investment.

The above analyses were therefore adjusted to include duration by multiplying the dollar value of each position by its respective duration, yielding a variable labeled "risk exposure". The results are also presented in Table 1, and the general picture is the same. Risk exposure is highly correlated with the previous day's P&L especially for days when the P&L was negative.

Profit and loss and risk taking: A within a day analysis

A variant on the notion of the opening price adjustment model suggests that the cumulative P&L a trader has during the day may affect his activity during the last part of the day. In particular, traders hedge their positions by looking at the prices of the futures on their bonds. The Chicago Board of Trade exchange closes at 2pm Central Time, hence 3pm Eastern Time may serve as a demarcation point. Presumably, the P&L a trader has accumulated by 3pm will affect his behavior from that time until the end of the day (which is usually between 4:30 and 5pm).

To examine this effect, the cumulative P&L by 3pm was regressed on the dollar value of buy and sell decisions between 3pm and 4:30pm, which is the time of the day when the trading day in New York winds down. The analysis was carried out separately for days where the P&L was positive (by 3pm) and the days it was negative. The results are presented in Table 2. They

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Insert Table 2 about here

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indicate that negative P&L by 3pm leads to significantly more activity (as measured by the absolute value of the buy and sell decisions) for 3 of the 4 traders. The effect is marginal for one trader and diminishes for the other traders in days when the P&L at 3pm was positive.

Understanding traders' behavior-the updating decision

In addition to traders' profit and loss figures several market factors can affect the number of trades and updates. If the P&L on day **t** is considered as a target or reference point, then the P&L

on day **t+1** is considered either a gain or a loss vis-a-vis this target. According to the model in Figure 1, if the trader focuses on the P&L of day **t** as a target, then the larger (in absolute value) the P&L on day **t+1**, the more risk the trader would be willing to take on day **t+2**. Although the number of updates per se is not a direct measure of risk taking it may serve as a proxy. Obviously, if a trader is interested in taking risks he would engage in a search for trades, whereby if he seeks to avoid risks, he would prefer to "sit" on his positions and would not engage in much search.

To test this hypothesis a regression of the number of updates was run on the P&L from the previous day. The data of each trader was split for the days where the P&L was positive and those in which it was negative. The median correlations obtained were .15 ($p < .005$) for the positive P&L, and .25 ($p < .001$) for the negative P&L, measured as absolute deviations. Thus, it appears that the larger the previous day's P&L is, the more updates are performed the next day. Furthermore, the numbers of updates is larger if the previous day's P&L was negative (see Table 3).

Insert Table 3 about here

The above analysis tested risk taken as a function of P&L deviation from zero. At times however, zero P&L may not be the relevant target, rather, it is possible that the prior day's P&L is the relevant one. That is, assume that a trader made a P&L of $5000 on a particular day. If the next day's P&L is merely a positive $4000, he may consider that a loss, relative to his prior (and higher) P&L. To test this interpretation of a target, a regression of the number of updates on day **t+2** was run on the incremental change in P&L (that is the P&L at day **t+1** minus the P&L on day **t**). This regression was run separately for the days when the incremental P&L was positive and the days it was negative. The results are presented in Table 3 and reveal a similar pattern, the median

correlations were .16 ($p < .005$) for the positive incremental P&L, and .31 ($p < .001$) for the days when the incremental P&L was negative.

The effects for dollar value are even stronger than the effects on the number of updates especially in days following these with negative P&L.

Insert Table 3 about here

Aspiration adjustment and risk taking: different P&Ls as targets

According to Hypothesis 3, traders use different reference points and targets. Two reference points have a primary role in affecting traders behavior: Price differences and P&L differentials. The first refers to the price difference from the most recent buy or sell decision made by any trader. Recall that traders are not investors and they make their profits based on such differences even if the spreads are small. In addition to price differences, traders are affected by the implications of these price differences for their P&L. Although P&L is a direct function of price differences, the way P&L figures get displayed may have different implications. For instance, suppose a trader updated his position on a security he bought 3 weeks ago and then updated it again. These "partial" P&L figures enter his daily P&L calculation even if he did not execute a buy or sell decision on that security. As mentioned earlier, P&L is calculated on a daily basis, and at the beginning of each day the trader has his positions on all securities posted and marked with the previous night closing prices. At the beginning of every day, P&L is set to zero. Obviously, the real P&L is calculated by comparing the actual buy and sell prices, and the daily adjustments do not change it since it is a simple linear summation. For instance, suppose a trader bought a security for $x and then updated it 3 times. On the first update price went up by a certain

amount, on the second update it dropped double that amount and on the third update it returned to the buying price. If the trader then sold the security for $x, there would be zero P&L. Nevertheless, each update would have shown a temporary relative gain or loss in P&L. These temporary P&L figures may affect the trader differently than if he would tune only to the original buy (or sell) figure. However, since a trader may hold a security for a long time, the original price may not appear to be the only relevant figure for making a sell decision. Considering a more "temporary" P&L may appear to be more salient in contemplating such a decision.

Traders may be affected by different reference points regarding security prices and relevant P&Ls. Obviously, the opening positions they have when they come to work in the morning can serve as anchors for subsequent buy and sell decisions. A buy price of a certain security can serve as an anchor for a sell decision of that security. Furthermore, since traders can sell short, a sell price can serve as a reference point for a future sell decision. In addition, as the traders update their positions frequently, these updated prices can serve as natural anchors for subsequent buy or sell decisions. Three models of P&L differentials can potentially affect traders' decisions.

(a) Rapid adjustment. Under this model, following Helson's (1964) adaptation level theory, the price observed at point t is compared to the most recent price quote (coming from a sell or buy decision made by any trader). The relevant difference in prices can be described as:

$$\Delta P = P_t - P_{t-1}, \quad \text{where } P = \text{price}, t = \text{time}$$

The relevant difference in P&L is the difference in P&L between the current P&L and most recent P&L prior to the last activity on any security. Since P&L is the target of every trader, the use of this model marks a rather rapid adjustment of targets to performance (cf., Lant, 1992).

(b) Difference from the opening price. This model suggests that in trying to maximize his P&L, the trader compares the price of a security to the opening price of the day. Only if a certain

difference exists will a buy or sell decision be executed. The relevant price difference can therefore be described as

$$\Delta P = P_t - P_o \qquad \text{where P = price, t = time, o= opening price}$$

The relevant difference in P&L here is the cumulative P&L from the opening of the day to the current activity. Such a model is consistent with some patterns of risk taking described in Thaler and Johnson's (1990) notion of the desire to break even. They showed that toward the end of a certain period of time (such as a day at the races) risk takers may want to break even, a tendency that can lead to risk prone behavior. The relevant concept from this framework is that the reference period is the entire day. Thus, the opening price can serve as an anchor. Under such a model, the aspiration level is unchanged throughout the day, and no adjustments are made.

(c) Periodic adjustment. A third model suggests that adjustments in aspiration level are not done instantaneously but periodically. A natural candidate for such an adjustment process is an anchor based on the previous buy or sell decision of the trader himself. On almost all days, traders update their positions much more frequently than they make actual buy or sell decisions (see Figure 3). A periodic adjustment of aspiration level should be anchored on the less frequent action, i.e., the previous buy or sell decision, rather than on the most recent updated price. The relevant price difference for this model is described as

$$\Delta P = P_t - P_{t(s,B)}$$

where $P_{t(s,B)}$ signifies the most recent price, based on a buy or sell decision, of a specific security.

The relevant difference in P&L is the difference between the P&L values of the most recent buy or sell activity carried out by the trader himself. Unlike model 1 (rapid adjustment) price updates (based on buy or sell decisions by other traders) do not affect the P&L, and are not deemed relevant in affecting the trader's behavior. This model also differs from Model 2 where the

reference point stays fixed. Here the reference point changes in line with actual performance and therefore fits the March and Shapira (1992) notion of adjusting aspirations to performance.

Empirical tests. To examine the three models of aspiration adjustments, actual dollar values of buy and sell decisions were regressed on the different adjustment models parameters. In so doing a distinction has been made between price differences and P&L differentials. The following generic regression equation was run for each trader:

$$\text{Exposure}=\Delta P\&L+\Delta P_t+D_{(B,S)}$$

Where ΔP&L is the difference in P&L accumulated from the relevant reference point (which differ according to the above models) up to the current decision, ΔP_t is the most recent price difference on the specific security traded, and $D_{(B,S)}$ is dummy variable signifying whether the activity was a buy or sell decision.

Three regressions were run for each trader based on the above three models that define different reference points for the relevant P&L. For several traders more than one regression equation yielded significant results indicating that at different points in time, traders pay attention to different reference points in considering the relevant P&L for the decision at hand. Table 4 presents the most typical results (in terms of the highest R^2) of the four traders who were sampled.

Insert Table 4 about here

As can be seen, traders 1 and 2 were anchored on the opening price of the day, trader 3 on the most recent price and trader 4 on the price of his most recent buy or sell decision. Due to the lare sample size of trading decisions, all t values were highly significant (p <.0001). The median R^2 for all regressions was 13% and the significance level varied by model and trader.

Aspiration adjustment and risk taking: A within a security analysis

Each trader deals with approximately 20 to 30 securities in a certain range of maturity dates. These securities' prices change continuously. To provide a sense of these dynamics, Figure 6, describes the continuous change in the price of a certain security (A bond with 8.5% interest rate maturing in June 1994). Figure 7 describes continuous changes in the dollar value of this security and Figure 8 portrays the changes in the P&L trader 4 has made while buying and selling the security over the 80 day period.

Insert Figures 6, 7 and 8 about here

I examined the effects of cumulative changes in the bond price, as well as the trader's cumulative P&L on this security, on his cumulative buy or sell decisions of the security. To that end each of the variables were coded +1 if there was a positive change, 0 if there was no change and -1 if there was a negative change. The regression yielded the following equation:

$$\Delta Buy = -.13 - .19\ \Delta Price - .39\ \Delta P\&L$$

The equation implies that the more the price went up the less the trader bought this security. Furthermore, the more his P&L from trading this security went up, the less he bought this security.

DISCUSSION

The outcome of any transaction in terms of its profit or loss is uncertain and risky, and the way management tries to control risk is by setting clear procedures. The entire government bonds department of the firm in this study meets every morning to review the current status of financial markets. At the end of every day, each trader has to submit a report on his positions so that the entire department's exposure can be determined. Reports from different departments

(such as government bonds, corporate bonds, equities, etc.) are sent to the Executive Vice President for risk management who evaluates the risk exposure of the entire company at least every evening.

In addition, other procedures are set. For instance, traders have different limits on the amounts they can trade and the exposure of their positions. A formula that translates the exposure to the value in terms of a particular government note is used for establishing a benchmark for comparison . The trading limits are considered very important since if they are not kept, management can lose control. A story can illustrate the issue of trading limits. On the Friday following Thanksgiving Day, financial markets are open but the volume of activity is usually low. On that Friday, a year after the data in this study were collected, the head of the government bonds trading desk went out of town. Around 2 p.m. he got a call from a trader who sold short a large amount of 10 year notes that morning hoping to buy such notes at a lower price later in the day. Yet, the market was thin and he couldn't do it successfully. He called the head of the Government Bonds trading desk to ask for his advice and to acknowledge getting out of his trading limits in doing that deal. The head of the desk told him to do nothing, but immediately thereafter called his deputy and told him to hedge the position against potential loss. The next Monday, when the trader came in he fired him on the spot. He did so not because he was worried about potential loss (although he was), but because he couldn't afford to let that trader continue working once he broke the trading limit without asking for permission.

One can of course raise the question whether the trader would have been fired if his action had led to profit. Yet, understanding the way markets work and setting appropriate rules to guard against potential large losses may be the right way to go. Indeed, the case of Nick Leeson, the trader who brought down the 250-year-old Barings bank can be clearly explained by

the model in Figure 2. In the last period of his trading Leeson's assets slid down approaching his survival point. Since he focused on his aspiration level and hoped to recover his earlier winning position, he took a huge risk and landed below his (and the bank's) survival point. Leeson's case looms large in the minds of managers of financial institutions. It was the unfamiliarity of Leeson's bosses with the future markets, coupled with his apparent successful record that led to loose control and the eventual demise of the bank.

The Barings bank example echoes the argument made in this paper, namely, to properly manage risk in organizations and in particular in financial institutions, setting clear procedures may not be sufficient. An effort needs to be made to understand traders' behavior. Since no procedures cover all possible contingencies, constructing a model of traders' behavior may prove useful in indicating at potential problem areas. For instance, as noted earlier, the traders argued that the model explains their behavior perfectly in the months of November and December. Yet, from the perspective of the firm, it doesn't matter if it is April or November. The firm attempts to make profits throughout the year. What matters to the firm are the market conditions. To that end they need to properly handle the personal risk tendencies of the traders who either expect to get a large bonus or are worried about getting fired. Traders behave differently in April and November even though the official compensation policy is based on their cumulative annual performance. The head of the government bond trading desk is keenly aware of "end of the year" problem, and attempts to exert extra control over traders whose cumulative performance in November lags behind. At the same time, he attempts to push his successful traders to take more risks than they are inclined to, so as not to jeopardize their chances of getting a high bonus.

The data show that targets in the form of annual targets and daily targets affect behavior in line with other studies that documented the effects of historical targets or aspiration levels on

risk (Greve, 1998). It should be noted however, that the rapidly changing environment in the bond market is rather unique. Recall the trader who updated his positions almost 5000 in one day and you notice that in this business one day a significant time horizon. It is intriguing to ask in this respect whether the traders behave in a rational manner. Given that the official compensation policy is based on annual performance why should traders be worried about short term performance. First, large daily losses can sometime be reprimanded, but even more so, the culture on the trading floor is captured by the rapid changes and the feeling that it is the last trade that really counts. In such an environment, time horizons become shorter and the focus of the traders on short term aspirations cannot be described as not rational.

Implications for Risk Management

The analyses show that the behavior of the traders is captured by the framework of the model. That is, they operate so as to maximize their income but the targets have a strong effect on their behavior. More problematic is the management of risk in the company as a whole. In the interviews I held with the vice presidents in charge of the trading desks as well as with risk management in the company as a whole, it became clear that top management is risk averse. What top management is interested in is a smooth, steady performance, and not a volatile one that may "rock the boat." This conservative attitude leads to a close monitoring of traders' positions. Indeed, the head of the Government Bonds Trading Desk argues often with top management about the need to be more flexible regarding daily losses. Granted, performance evaluation is very important but the frequent reminder of one's P&L on one's screen, may lead to risk taking behavior that departs from what may be pursued from a more global risk taking strategy. As one trader said, the slogan that describes their attitude is, " You're only as good as your last trade." Obviously, the risk taken by the traders is affected by their asset positions and their aspiration levels, and those in

turn, are heavily influenced by the bonuses and penalties they expect to get for their performance. Further analyses of the effects of P&L on traders' behavior should attempt to model these effects by examining the dynamic characteristics of their operations. Examining the ways in which aspiration levels get modified in line with changes in P&L may provide a better understanding of the traders' behavior and may lead to a more sound and balanced strategy in firms' risk taking behavior.

References

Abolafia, M. Y. and Kilduff, M.
1988 "Enacting market crisis: The social construction of a speculative bubble." Administrative Science Quarterly, 33: 177-193.

Arrow, K. J
1965 "Aspects of the Theory of Risk Bearing." Helsinki: Yrjo Jahnssonis Saatio.

Baker, G., M. Jensen, and K. Murphy
1988 "Compensation and incentives: practice vs. theory." Journal of Finance, 43: 593-616.

Benartzi, S. and R. H. Thaler
1999 "Risk Aversion or Myopia: The Fallacy of Small Numbers and Its Implications for Retirement Savings," Management Science, 45, 364-381.

Bromiley, P.
1991 "Testing a causal model of corporate risk-taking and performance", Academy of Management Journal, 34, 37-59.

Chevalier, J. & G. Ellison
1997 "Risk taking by mutual funds as a response to incentives." Journal of Political Economy, 105, 1167-1200.

Cyert, R. and J.G. March
1992 "A behavioral theory of the firm". (2nd ed.) Oxford: Blackwell.

Friedman, A. and Z. Shapira
1988 "Beliefs about promotion decisions." Working paper: Hebrew University.

Garud, R. & Van de Ven, A.
1992 "An empirical evaluation of the internal corporate venturing process." Strategic Management Journal, 13: 93-109.

Greve, H.
1998 "Performance,aspirations, and risky organizational change." Adminstrative Science Quarterly, 43, 58-86.

Helson, H.
1964 "Adaptation level theory." New York: Harper.

Heisler, J.
1994 "Loss Aversion in a Futures Market: An Empirical Analysis", The Review of Futures Markets. 13, 793-815.

Kahneman, D.
1993 "Reference points, anchors, norms and mixed feelings." Organizational Behavior and Human Decision Processes, 51: 296-312.

Kahneman, D. & Lovallo, D.

1993 "Timid choices and bold forecasts: A cognitive perspective on risk taking." Management Science, 39: 17-31.

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

Lant, T.
1992 "Aspiration level adaptation: An empirical exploration." Management Science, 38: 623-644.

Lewin, K., T. Dembo, L. Festinger, and P. Sears.
1944 "Level of aspiration" In J.M. Hunt (Ed.), Personality and the Behavior Disorders (Volume 1.), 333-378. New York: Ronald

MacCrimmon, K. R. and D. A. Wehrung.
1986 "Taking Risks: The Management of Uncertainty." Free Press: New York.

March, J. G.
1988 "Variable risk preferences and adaptive aspirations." Journal of Economic Behavior and Organization.

March, J. G. and Z. Shapira.
1987 "Managerial perspectives on risk and risk taking." Management Science, 33: 1404-1418.

March, J. G. and Z. Shapira
1992 "Variable risk preferences and the focus of attention." Psychological Review, 99: 172-183.

March, J. G. and H. Simon
1993 "Organizations." (2nd Ed.) Oxford: Blackwell.

Markowitz, H. M.
1952 "The utility of wealth." Journal of Political Economy, 60: 151-158.

Mezias, S.
1988 "Aspiration level effects: An empirical investigation." Journal of Economic Behavior and Organization, 10: 389-400.

New York Times
1995 "Men who shook the foundations." Feb 28, p. D8.

Samuelson, W. & Zeckhauser, R.
1988 "Status quo bias in decision making." Journal of Economic Behavior and Organization, 1: 7-59.

Shapira, Z.
1986 "Risk in managerial decision making" Unpublished ms. Hebrew University.

Shapira, Z.
1995 "Risk taking: A managerial perspective." Russell Sage Foundation: New York.

Sharpe, W., G. Alexander, & J. Bailey.
1999 "Investments." (6th edition). Prentice Hall: NJ.

Silber, W.
1984 "Marketmaker behavior in an auction market: An analysis of scalpers in future markets." Journal of Finance, 39: 937-953.

Thaler, R. H. and E. J. 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.

Tversky, A. & Kahneman, D.
1974 "Judgment under uncertainty: Heuristics and biases." Science, 185: 1124-1131.

Tversky, A. & Kahneman, D.
1986 "Rational choice and the framing of decisions." Journal of Business, 59: S251-S278.

Zaheer, S. and Mosakowski, E.
1997 "The dynamics of the liability of foreignness: A global study of survival in financial services. Strategic Management Journal, 18: 439-464.

Table 1

Absolute dollar value and risk exposure of traded
securities as a function of prior day P & L (correlations)

day **t** / day (**t+1**)	Positive P & L	Negative P & L
Dollar Value	.34	.47
Risk Exposure	.50	.53

Table 2

Effects of cumulative P & L by 3pm on absolute dollar value
and risk exposure of traded securities from 3-4:30 pm (correlations)

State at 3pm / Activity 3-4:30pm	Positive P & L at 3 pm	Negative P & L at 3 pm
Dollar Value	.09	-.28
Risk Exposure	.08	-.23

Table 3

Number of updating decisions as a function of
the prior day P & L and ΔP & L (correlations)

	Positive P & L on day t	Negative P & L on day t
Updates on day (t+1) as a function of P&Lt	.15	.25
Updates on day t+1 as a function of D(P&L)t	.16	.31

Table 4

Risk Exposure as a function of different ΔP&Ls as aspiration levels

trader #	Most recent ΔP&L	$t^*_{(\Delta P\&L)}$	R^2
1	$\Delta P\&L_0$	4.36	20%
2	$\Delta P\&L_0$	5.11	21%
3	$\Delta P\&L_{t-1}$	4.4	18%
4	$\Delta P\&L_{t(b/s)}$	2.76	21%

* The *t* value shows the significance level of the ΔP&L coefficient.

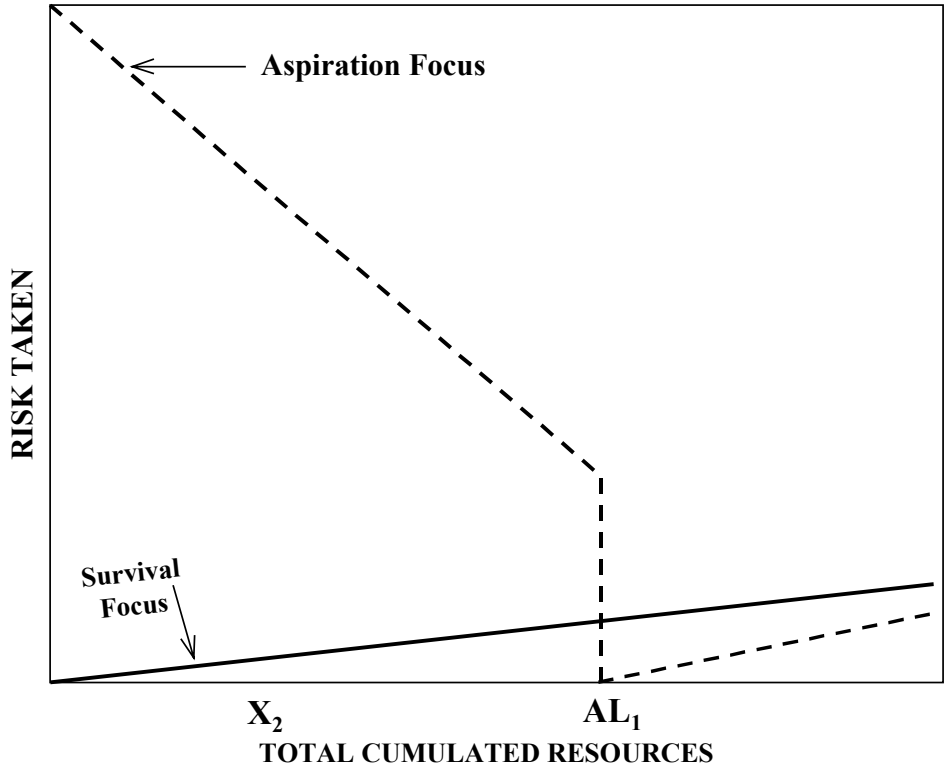

Figure 1. Risk as a function of cumulated resources for fixed focus of attention. (Reprinted from March and Shapira, 1992).

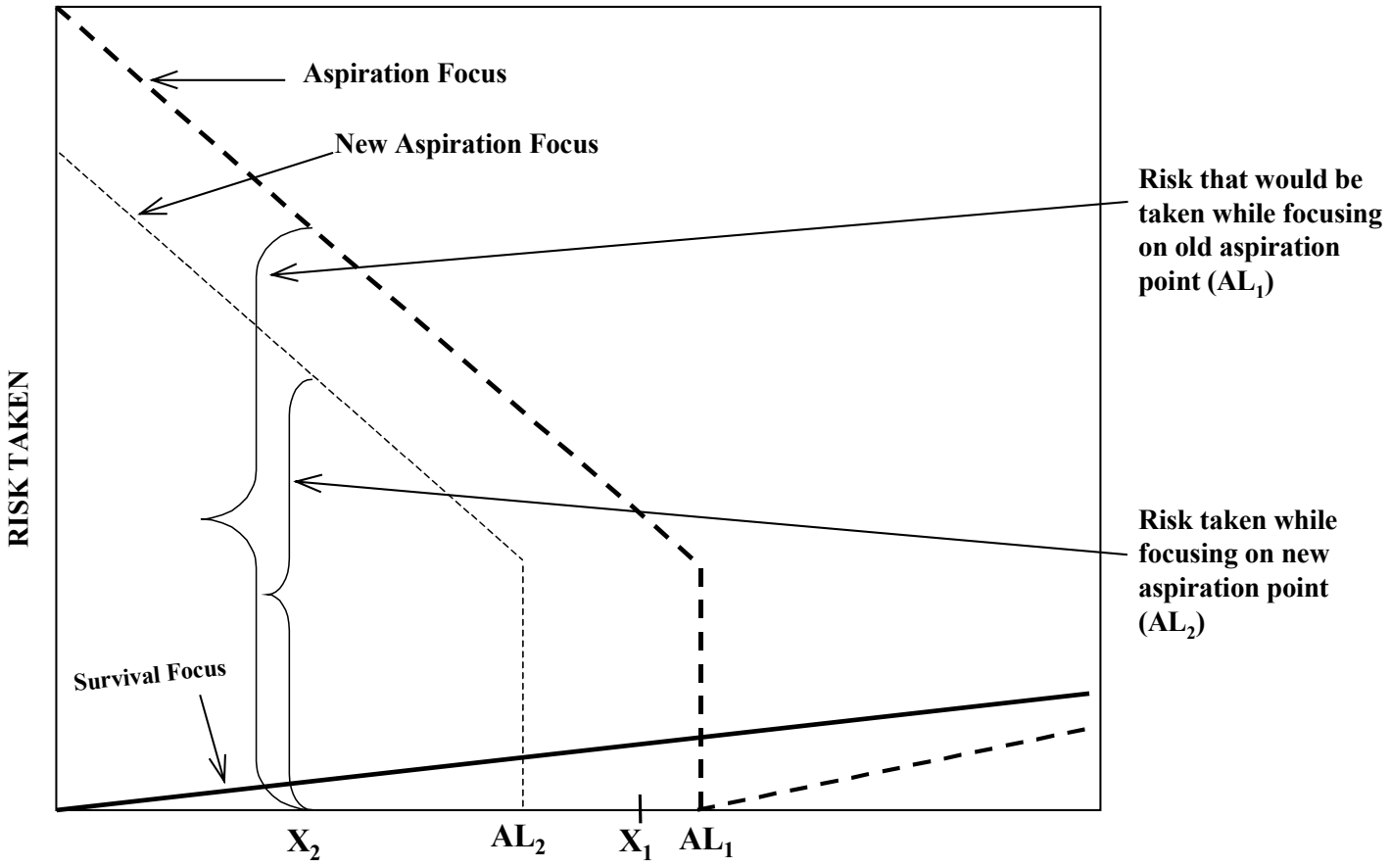

Figure 2. Effects of change in aspiration level on risk taking.

Figure 3: Number of Transactions for Trader 4

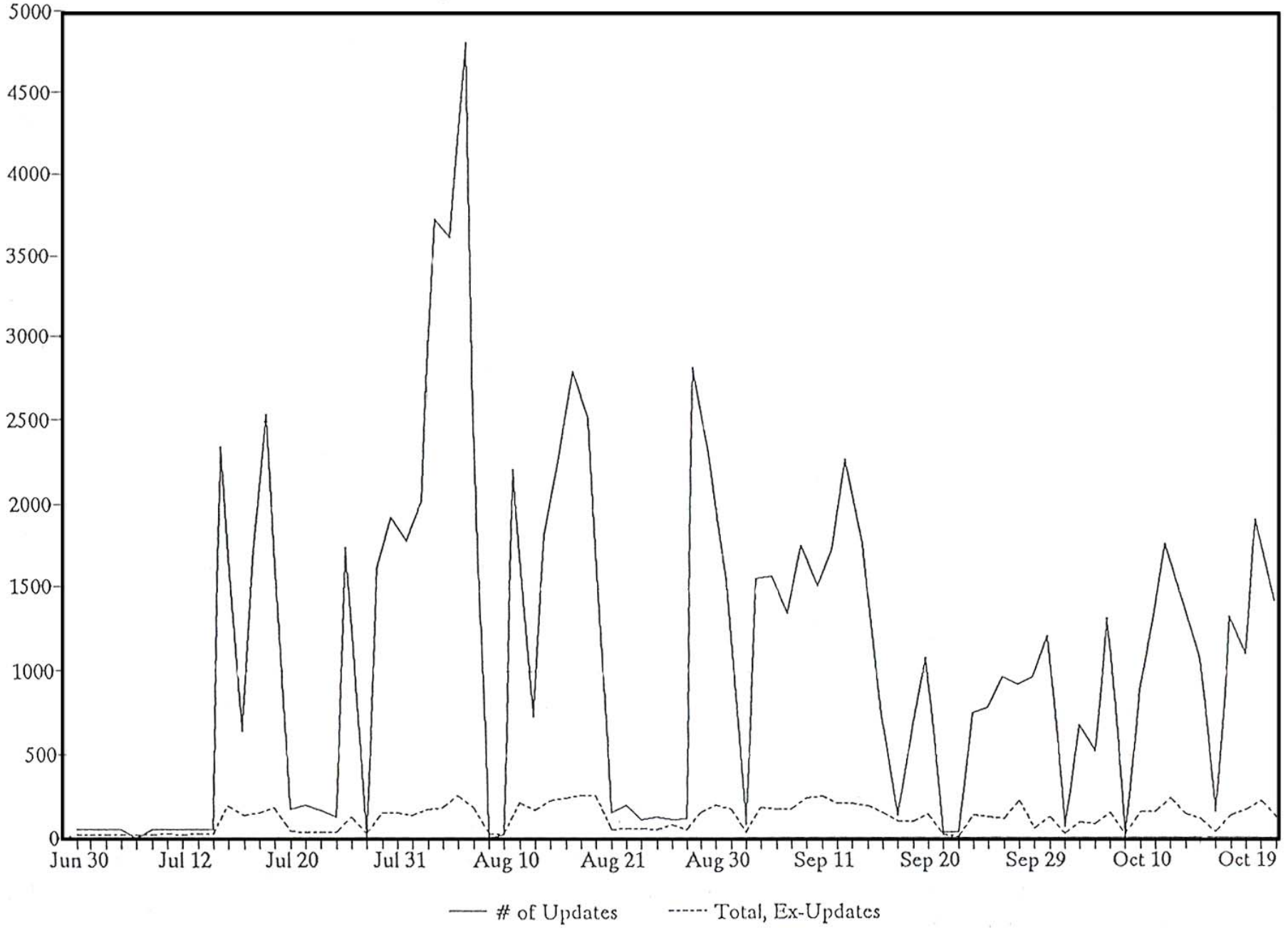

Figure 4: Profit/Loss for Trader 4
(in Thousnads of Dollars)

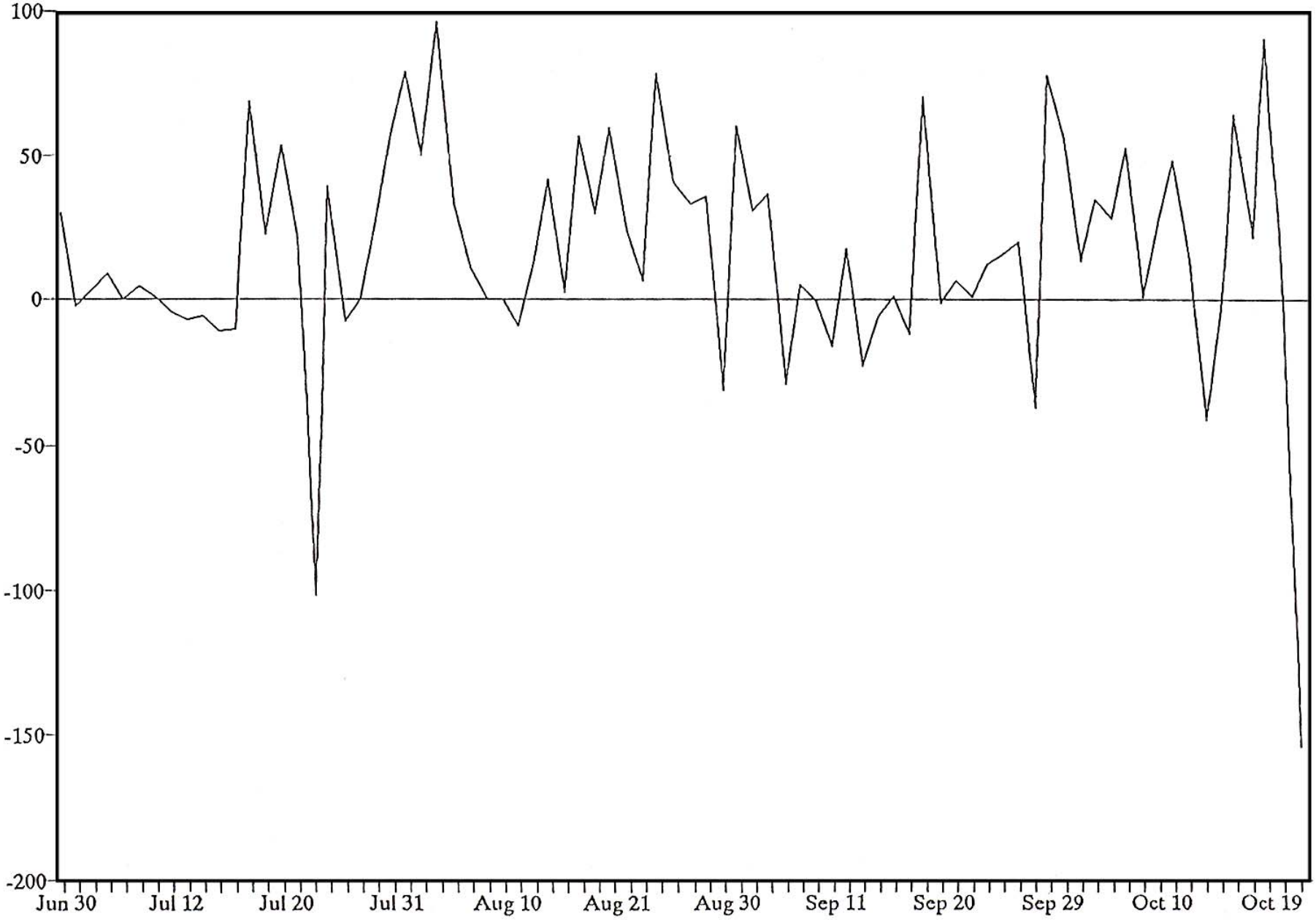

Figure 5: Cumulative P & L (Day 1-80) for trader 4

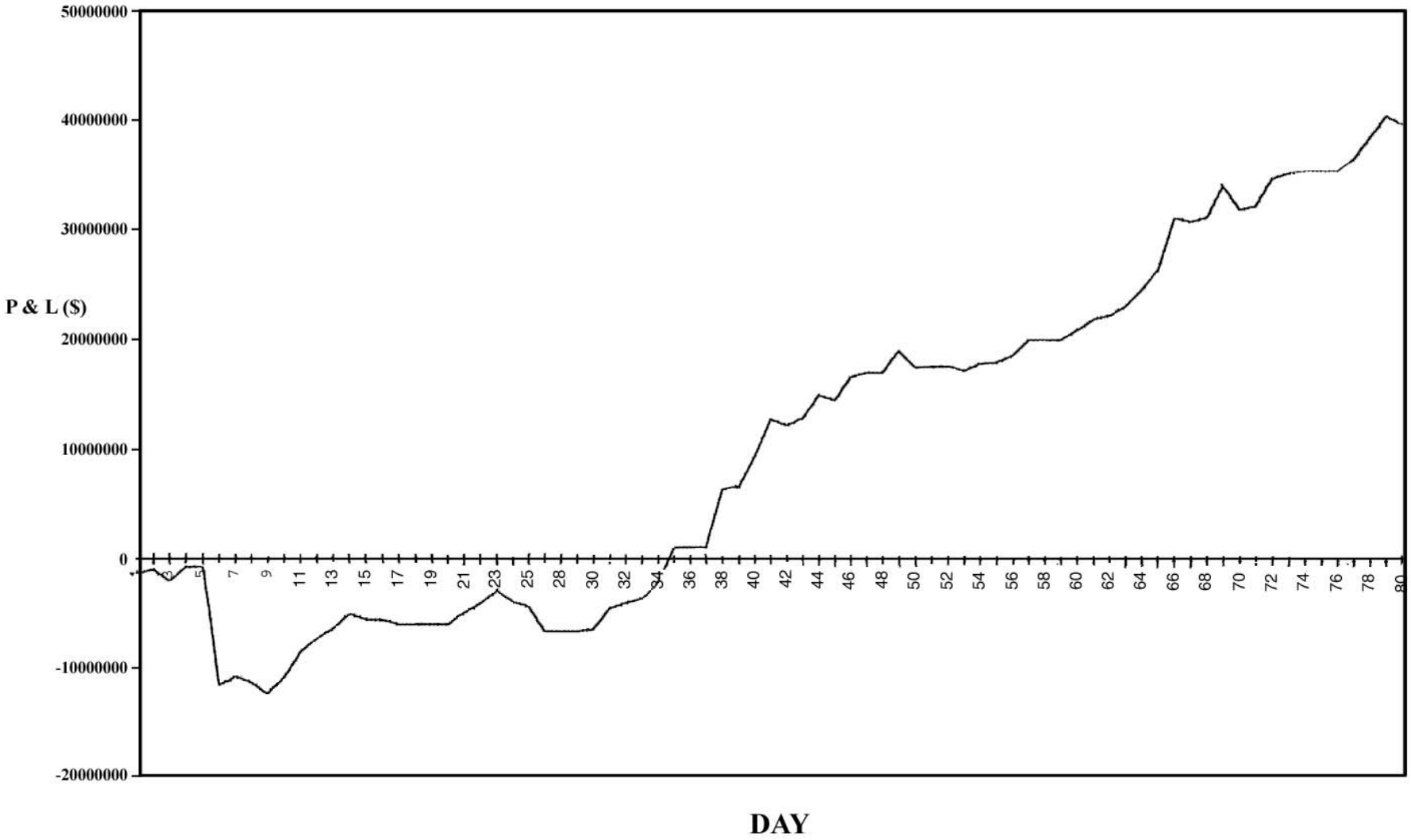

Figure 6: Continuous changes in price (security 8120694, day 1-80)

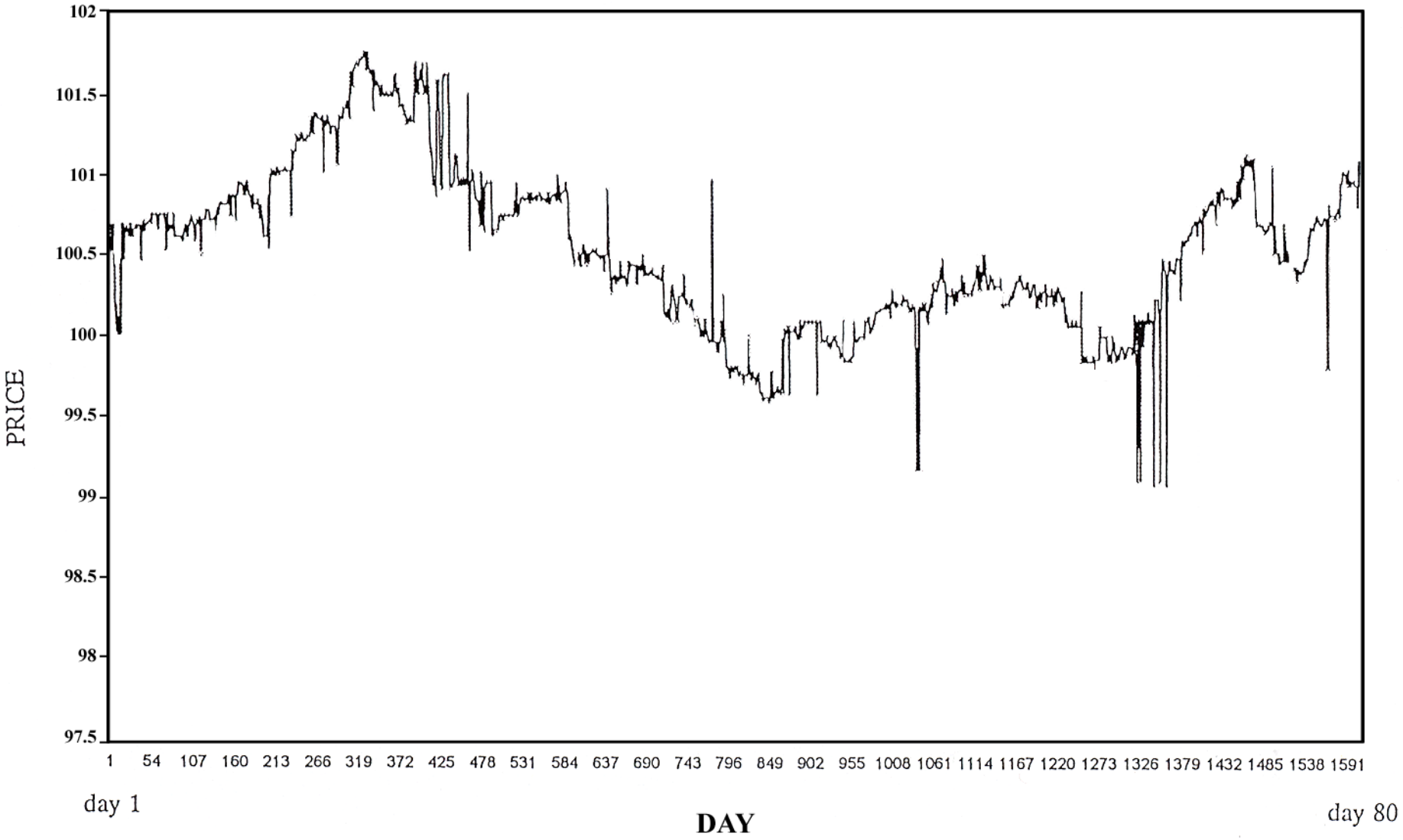

Figure 7: Continuous changes in face amount (security 8120694) trader 4 (day 1-80)

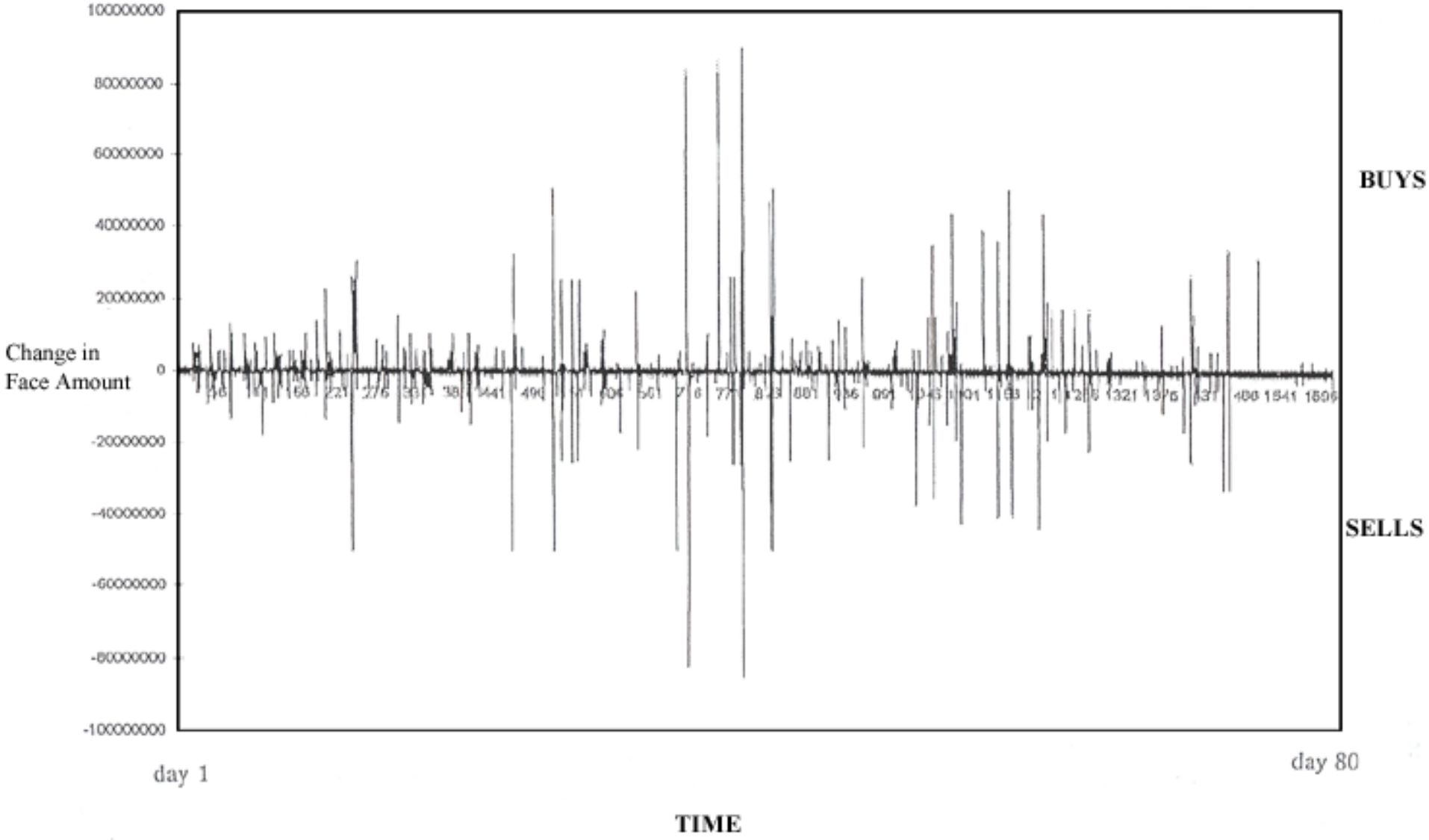

Figure 8: Cumulative P & L (security 8120694) trader 4 (day 1-80)