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## **Position-sizing Effects on Trader Performance: An experimental analysis**

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## Position-sizing Effects on Trader Performance: An experimental analysis<sup>1</sup>

### Abstract

Non-academic literature on stock and futures trading emphasizes the importance of “money management”, here defined as “how much of available capital is to be allocated in a specific market position”, also called position size. The effect of position size was experimentally studied by letting two groups trade fictitious capital through a series of trades, with only one variable available for manipulation by the participants, that is, how much of available capital to be put at risk in each and every trade. The treatment group had received a three-hour lecture in position sizing, risk management, and psychological biases, whereas the control group did not. The results showed that participants in the treatment group lost all their money to a lesser extent ( $p < .01$ ) than those in the control group. However, the treatment group did not gain significantly higher profits than the control group. Traders being able to gain money over the long run were taking smaller positions than losing and bankrupt traders were ( $p < .0001$ ). By receiving a theoretical education, without any practical training, the risk for a trader of going bankrupt when trading simulated stocks was decreased to a tenth.

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## **Position-sizing Effects on Trader Performance: An experimental analysis**

### *Background*

Buying and selling stocks and derivatives have increased enormously over the last decade. An occupation, earlier restricted to a few well-situated capital owners, has now become almost a national movement, involving a majority of the Swedes. There are reports estimating 80% of the Swedes, 16 years of age and above, to be shareholders, directly in the markets or indirectly by pension funds (Modig, 2001).

The stock market is a popular subject of discussion at work, at home, and in the tabloids. Media are reporting of people gaining huge amounts in the markets, but also giving hindsight descriptions of how one could have made millions, or more recently, how much capital that was lost in the latest decline. During the last quarter of 1999 and first quarter of 2000, when stock market indices around the Western world soared to new highs, there seemed to be one question on everyone's mind; what stock should I buy to get the best profit? However, since March 2000, during the decline, the focus has somewhat changed to how one should avoid getting ruined. Why do some people succeed in the markets, while others are going bankrupt? Some possible clues can be found when reviewing the psychological research that has been made within the domain of behavioral finance.

When participants of the markets are studied in real life, they seem to present a number of shortcomings, one of them can be characterized as overconfidence (Scott, Stumpp & Xu, 1999). Camerer and Lovallo (1999) found that overconfidence presented by business managers leads to excessive business entry. When the results were based on the participants' abilities, individuals tended to overestimate their relative success and enter more frequently. This was not because of irrational information processing or neglecting the competition they were up against. They were just overconfident about their relative skill. Studies made by Kahneman and Tversky (1973) show that humans have a tendency to overestimate the probability of one's forecasts. Among other reasons, such as a prolonged bull-market, huge financial resources and numerous media reports of rising markets and big gains, an overconfidence effect could be a contributing factor to the great

number of “new” and inexperienced investors entering the stock and derivatives markets.

Investors adjust their expectations slowly (Daniel, Hirshleifer, & Subrahmanyam, 1998), and as a possible effect, they did not see when the bull-market turned into a bear-market, leading to holding on to their positions longer than expected.

Further, when we as humans make decisions under uncertainty, our choices are influenced by the way we describe, “frame”, the situation rather than the absolute value of the result. When we perceive the situation as a losing scenario, a negative framing, we tend to be risk seeking. Consequently, if a scenario is perceived as positive we will become risk-averse (Kahneman & Tversky, 1979). This could have caused investors to take greater risks during the big decline than they otherwise would judge as reasonable. Altogether, these human foibles make investing or trading in the stock markets a difficult task. How could one possibly become a successful market player?

One of the recipes of success, at least according to non-academic literature, is to control one’s risk and utilize proper “money management”. The definition of money management is not perfectly clear and according to trading coach Van K. Tharp, it is not “risk control” per se, “diversification” or “how one makes trading decisions” as sometimes stated (Tharp, 1998). Risk control and maximization of profits is rather a result of implementing money management strategies. Tharp emphasizes that money management or position-sizing (this term will be used in the following) answers the question: “How much?” or “How many?” (Tharp, 1997). In the meaning of “how much of available capital is to be put at risk?” or “how many contracts or shares are to be bought?” In this paper the following definition of money management will be used: Money management determines how much of available capital is to be allocated in a specific market position, that is, the number of shares bought or percentage of total capital spent.

Author/trader Jack Schwager has published two bestsellers, *Market Wizards* (1993) and *New Market Wizards* (1994) where approximately forty exceptionally successful traders were interviewed. These traders were chosen on the basis of consistently high annual return or extraordinary growth:

I was looking for people who had attained "incredible" achievements in the market, such as a 12-yr average

annual return of 45% with only a 5% max draw-down (Gil Blake), or turning \$30,000 into \$80 million (Marcus) etc. The methodologies used was[sic] NOT a precondition but rather an information item I sought out. (Schwager, 2000).

There was not one particular method of analyzing the markets, nor one sole buy-sell strategy that could account for how these traders could be so prosperous. However, one common trait in their approach towards the markets was their ability to manage risk. Earlier during their careers some of them had, completely or almost, lost their trading capital. The one thing separating these future “market wizards” from other losers was their ability to learn from their mistakes by analyzing the risks they had taken, to develop and launch strategies for never letting themselves get stuck in the loss-trap again.

#### *About Losses and Gains*

If a trader has a long position, then prices need to rise before he/she is gaining any profit. If the trader is short, then prices must decline to make him/her a profit. The market moves regardless of the position of one particular trader. In order to make money trading, one must be positioned on the right side when prices are moving. There is an indefinite number of methods used around the globe, to increase probability of getting positioned on the right side. However, nobody knows for certain whether the market will rise or decline.

When the market moves against the trader’s position and he/she decides it is time to close the trade, the price movement multiplied by position size determines the size of the loss. Accordingly, the risk can be estimated as the drop from entry point to exit point, that is, the difference between actual buying price and predetermined selling price multiplied by the number of shares sold. Following this reasoning, the potential profit that one can receive depends on price rise and position size. Mastering these two concepts “Cut your losses short” and “Let your profits run” seems to be the common denominator making the “market wizards” so successful, rather than having a high percentage of winning trades, being able to pick the “right” stock or ignoring a losing trade.

When a loss is realized there is an obvious mathematical rule regarding drawdowns affecting recovery that sometimes is overlooked. If losing 1,000 SEK out of a total of 10,000 SEK (a 10%

loss), then to get even, there is a need of a 11.1% increase on the remaining 9,000 SEK. The larger the loss, the greater profit must be obtained to recover (see Table 1). A 30% loss requires a profit on remaining capital of 43%. That is more than twice as much as the broad “Generalindex” of Stockholm Stock Exchange rose during the eleven years from the beginning of 1990 to the end of 2000 (an average of approx. 16% annually; “Generalindex” rose from 1231 points at 1989-12-29 to 4735 points at 2000-12-29, a total increase of 285%). Taking losses bigger than that requires extraordinary profit compared to index, and still that is just to recover!

Table 1. *Drawdown effects*

Size of draw-down on initial capital	Percent gain to recover
5%	5,3%
10%	11,1%
15%	17,6%
20%	25,0%
25%	33,3%
30%	42,9%
40%	66,7%
50%	100 %
60%	150 %
70%	233 %
80%	400 %
90%	1000 %

The importance of cutting losses short is obvious. If the trader is unable to survive in the markets on a near term basis, then he/she will not be around when opportunities arise to make money on the long term. Again, the price movement multiplied by position size determines the size of the loss. The greater the number of shares, that is, the position size, the greater the loss. The quotations below, from Schwager (1993), reflect a top trader’s view on managing risk.

Risk management is the most important thing to be well understood. Undertrade, undertrade, undertrade is my second piece of advice. Whatever you think your position ought to be, cut it at least in half [Bruce Kovner] (Schwager, 1993, p. 82)

To sell an asset that is losing money is definitely a measure being questioned. Weekly, there are experts and analysts participating in talk shows and news broadcasts on national television, reassuring small savers to ". . . just sit tight", ". . . if you sell now, you'll sell at the bottom" and ". . . speculating in stocks is a long term business". However, it can be somewhat arduous to maintain this strategy when there have been down moves from peak to trough of 75% on a stock, by itself representing 40% of the major index when trading at all time high (Ericsson B, 2000-03-06 -- 2001-03-17, Stockholm Stock Exchange, Sweden). Especially hard, when fund managers and "the big money" have been selling the stock the entire journey down. This can be seen as the number of shareholders more than doubled, from 272,000 to 586,400, during the decline throughout the year (Sundin & Sundqvist, 2001).

Nevertheless, for those trading the stock markets there is little advise to follow but to buy. The short selling recommendations are very few, as are the recommendations to sell in order to take profits. According to U.S. statistics: of 28,000 recommendations by brokerage-house analysts, 99% of those recommendations on U.S. companies were "strong buy", "buy" or "hold". Only 1% of the time, analysts recommended "sell" (Thomson Financial/First Call Corp., 2001.) The "dot-com" companies' rise and fall, another trying example for the long term buy-and-hold strategist, seems to validate a more than 70-year-old biography quotation: "The big money in booms is always made first by the public- on paper. And it remains on paper" (Lefèvre, 1923/1993, p. 265).

Further, when trading options and futures, which are time limited by their nature, there is no choice. A paper loss will become real, since there is someone else, the counterpart, who will close the trade for you. To close a trade with an unrealized loss or not is a topic by itself, but will not be addressed any further in this paper.

#### *Previous Research and Theory*

Why does not everybody minimize losses and maximize profits? Traditionally, economic theory is based on the idea that market



operators are rational and therefore make rational decisions. Feelings and biases do not influence the operators' judgement, only relevant information effects their behavior. Decision-makers decide on basis of the probability of each alternative outcome and select the alternative giving the maximum return. This view is not supported without exception (Seborá & Cornwall, 1995; Bell, Raifa & Tversky, 1988).

As stated earlier, our choices are influenced by how a situation is framed. A problem is positively framed when the options at hand generally have a perceived probability to result in a positive outcome. Negative framing occurs when the perceived probability weighs over into a negative outcome scenario. In one of Kahneman and Tversky's (1979) experiments, the participants were to choose one of two scenarios, a 80% possibility to win \$ 4,000 and the 20% risk of not winning anything as opposed to a 100% possibility of winning \$ 3,000. Although the riskier choice had a higher expected value ( $\$ 4,000 \times 0.8 = \$ 3,200$ ), 80% of the participants chose the safe \$ 3,000. When participants had to choose between a 80% possibility to loose \$ 4,000 and the 20% risk of not losing anything as one scenario, and a 100% possibility of losing \$ 3,000 as the other scenario, 92% of the participants picked the gambling scenario.

This framing effect, as described in Kahneman and Tversky's (1979) Prospect theory, occurs because individuals over-weight losses when they are described as definitive, as opposed to situations where they are described as possible. This is done even though a rational economical evaluation of the two situations lead to identical expected value. People tend to fear losses more than they value gains. A \$ 1 loss is more painful than the pleasure of a \$ 1 gain (Kahneman & Tversky, 1991). Describing a loss as certain, and therefore more painful, will inflict investors trying to avoid such a loss. As a consequence, they will take a greater risk and gamble in a losing situation, holding on to the position in hope that prices will recover. In a winning situation the circumstances are reversed. Investors will become risk averse and quickly take profits, not letting profits run. This goes for the professional investment managers as well (Olsen, 1997), and this is not only a tendency in the Western world (Sharp & Salter, 1997).

Costs, that is, losses, made at an earlier time may predispose decision-makers to take risks. They are more risk seeking than they would be if they had not made the earlier loss (Zeelenberg & van Dijk, 1997). This effect is referred to as "the sunken cost

effect” and results in organizations and individuals “throwing good money after bad” in order to make up for the loss (Ghosh, 1995). The loss already incurred makes the context equivalent of a negative frame, but with an increased commitment, for example, buying more shares makes a recovery possible, although uncertain. Nothing new under the sun, especially in the markets:

. . . I did precisely the wrong thing. The cotton showed me a loss and I kept it. The wheat showed me a profit and I sold it out . . . . Of all speculative blunders there are few greater than trying to average a losing game. Always sell what shows You a loss and keep what shows You a profit. That was so obviously the wise thing to do and was so well known to me that even now I marvel at myself for doing the reverse. (Lefèvre, 1923/1993, p. 154)

Investors and traders, shifting in risk tolerance according to positively and negatively framed situations, show no risk aversion, but an aversion against losses. Loss aversion applies when one is avoiding a loss even if it means accepting a higher risk (Tversky & Kahneman, 1986). The preference for risky actions to avoid an impending loss over less risky options just to minimize the loss and “bite the bullet” can be explained by “loss aversion” (Thaler & Johnson, 1990).

Weber and Camerer (1998) describe selling assets that have gained value and keeping assets that have lost value as “Disposition effect” in a recent experimental study. The disposition effect is based on two characteristics of prospect theory, namely the tendency of individuals to value gains and losses relative to a reference point and further, the tendency to be risk-seeking in situations where a loss might occur and risk averse in situations where a certain gain is possible. Weber and Camerer’s study showed that participants did sell their winners and kept their losers.

Being poor Bayesians, is that our lot, or is this disposition effect possibly alterable? Is it conceivable adopting the behavior of the “market wizards” or at least avoiding the most flagrant mistakes? Is it determined by chance if one is behaving like Nick Leeson, trading Baring’s Bank into bankruptcy, or like Michael Marcus, who went bankrupt in the beginning of his career and later turned \$30,000 into \$80 millions?

### *Hypotheses*

The trading and investing industry is growing bigger and bigger. Not only in the U.S., but in Europe as well. More and more companies are focusing on education of traders/investors. It is probably not a question if, but when, this will unfold in Sweden.

The prospects from the companies offering training and education are packed with promises of greater wealth and market success, but few of the methods have been verified empirically. Training-packages, addressing individuals, emphasizing “money management”, sometimes called asset allocation or position-sizing, have very little scientific support. However, there is evidence of the importance of how assets are allocated. Asset allocation is even more important than stock selection or timing. Brinson, Singer, and Beebower (1991) found asset allocation policy to be of primary importance, accounting for 91.5% of the differential return of the pension funds.

The reason for conducting this study was to provide evidence for the importance of position-sizing, that is, how much of one’s assets that is allocated at each trade, on trading performance. With the comment of “market wizard” Bruce Kovner (see p. 8) in fresh memory, the following hypotheses are made:

- (1) Participants going bankrupt (losing all their capital) will take larger position sizes than those being able to maintain some or all of their initial capital.
- (2) Participants losing money, but not all of it, will take larger position sizes than those being able to gain money over the long run.

Further, is it possible to teach traders/investors not to lose all their money and to make profits from trading the markets?

- (3) Participants receiving lectures in position-sizing, risk management, and psychological biases (treatment group) will take smaller position sizes on an average than participants not receiving such lectures (control group).
- (4) Participants receiving lectures in position-sizing, risk management, and psychological biases (treatment group) will lose all their money to a less extent than participants not receiving such lectures (control group).
- (5) Participants receiving lectures in position-sizing, risk management, and psychological biases (treatment group) will as

a group gain higher profits than participants not receiving such lectures (control group).

Possible factors contributing to the way the participants decide on position size, other than receiving a lecture, are gender and prior knowledge of trading/investing. In an experimental study, Powell and Ansic (1997) investigated differences in financial decision-making. The results showed that females are less risk seeking than males. Further, Myagkov and Plott (1997) found risk seeking to diminish with experience, contrary to Prospect theory. In what way will these factors affect the results of this study?

- (6) Women will lose all their money to a less extent than men.
- (7) Women will as a group gain higher profits than men.
- (8) Participants with prior experience of trading/investing will lose all their money to a less extent than participants with less experience.
- (9) Participants with prior experience of trading/investing will as a group gain higher profits than participants with less experience.

## Method

### *Participants*

The effect of position-sizing was studied during simulated stock trading, by measuring the performance of participants recruited from Uppsala University. Information about the study was given in a few classes among economics, law, and psychology majors. On public bulletin boards within the departments, notes were posted and anyone interested could sign up during September/October 2000. No prior knowledge of trading/investing was required. Participants were notified by phone how they would participate and that the remuneration could be lost if performing poorly.

A total of 62 students were randomly assigned into three groups: 20 + 20 were assigned to the three-hour lecture on position-sizing, and 22 were assigned to the control group. The participants were asked to state their knowledge of trading/investing in the stock markets as *no knowledge*, *some knowledge* or *active trader/investor*.

Of the 40 participants assigned a lecture, 3 did not show up at the lecture and 5 were not able to participate in the simulations (e.g., because of illness or non-compliance). Two forms of the participants in the control group were suspected to have been

tampered with, and these two results were therefore not included in any computations. Totally, 10 individuals (16%) were dropouts, and the remaining 52 participants, 18 female and 34 male students (see Table 2), were ranging in age from 19-56 years (mean age = 24.9 years).

Table 2. *Distribution of gender and prior knowledge of trading/investing (N = 52)*

Gender/Knowledge	Treatment	Control
Female	8	10
Male	24	10
Active Traders	5	4
Some knowledge	8	6
No knowledge	19	10

### *Design*

The participants were randomly assigned into three groups. Two experimental groups and one group acting as a control. The experimental groups were given a three-hour lecture at separate occasions and, in order to minimize the effect of the lecturer, by separate lecturers. The curriculum was the same for both groups. Both lecturers used the same content, including position-sizing, risk management, and psychological biases, according to Appendix 1.

### *Procedure*

Trading in the stock markets was simulated by letting participants (also called traders in the following) allocate fictitious money in a series of offered stock-investing opportunities. Every trading opportunity had to be taken. Intention was not to imitate the markets per se, but to represent a trader using a systematic approach, that is, trading system. It was of no importance to the participants to be able to pick a stock, possess knowledge about a specific company, decide time frame of the trades or even have an opinion of the direction of the markets. Neither was there any need to decide when to buy or to sell the offered stock. Only one factor, how much of available capital to be put at risk in each and every trade, was available for manipulation by the participants.

Allowed position size ranged from minimum 0.5% of available capital to maximum 100%. Trading on margin was not allowed. All trading opportunities were on the buy side, no short selling available. Colored marbles randomly drawn out of a bag determined the outcome, that is, size of loss or gain of each trade.

The administrator of the simulation sessions pulled a marble out and every marble drawn was replaced into the bag, maintaining the probability of gains and losses.

The simulated trading sessions were administered on two levels. Participants started level 1 with an initial capital of 10,000 fictitious Swedish kronor (fSEK). Probability and size of gains/losses on level 1, that is, the first marble-bag, were according to Table 3, representing a trading system with both probabilities of wins and expected value being in the trader's favor. Level 2, according to Table 4, represents a trading system where the expected value again, but not the probability, was in the trader's favor, thus reflecting the characteristics of a trend-following trading system. The participants were informed of the probability and size of gains/losses before starting the simulation.

Each level of simulation ended after fifty consecutive trades. If the trader, at some point during simulation, lost all of his/her capital before executing fifty trades, the simulation stopped and the trader was not allowed to continue trading, neither on the present level nor the next. The simulation also stopped if the trader's accumulated gains reached a total capital of 500% or more of starting capital, for example, 10,000 fSEK growing to 50,000 fSEK.

Table 3. *Probability of winning and losing trades in level 1*

Level 1			
Winning trades		Losing trades	
Percentage	Amount	Percentage	Amount
55%	1:1	35%	-1:1
5%	10:1	5%	-5:1
Σ 60%		Σ 40%	

To be able to participate at level 2, traders were required to increase total capital to 150% of starting capital, or more. If accumulated gains reached a total of 500% of starting capital, or more, traders were automatically qualified to participate at level 2. The amount at the end of level 1 made up the starting equity on level 2. The more money the traders made at the first level, the more money they had to invest at the next.

Table 4. *Probability of winning and losing trades in level 2*

Level 2			
Winning trades		Losing trades	
Percentage	Amount	Percentage	Amount
10%	1:1	56%	-1:1
6%	2:1	10%	-2:1
4%	3:1	4%	-3:1
3%	5:1		
3%	10:1		
2%	20:1		
2%	30:1		
Σ 30%		Σ 70%	

A profit of 1:1 implies that the trader wins an amount equal to the amount risked. For example: A trader starts with 10,000 fSEK, and he/she puts 1,500 fSEK at risk in the first stock offered. If it is a win of 1:1, then he/she has gained 1,500 fSEK and his/her new balance is 11,500 fSEK. Had the trade been a losing trade of -5:1, the trader would have only 2,500 fSEK left to trade with [10,000 - (5 x 1,500)] when offered the second stock.

Every participant received 100 SEK cash (approximately USD 10) as payment before starting the simulated trading session. The money was theirs to keep, given one restriction: If the trader at some point of the simulation lost all of his/her fictitious capital, he/she had to pay the money back, immediately. On the other side if the trader was able to increase the starting capital at level 2 into 500% of starting capital or more (e.g., 15,000 fSEK increased to 75,000 fSEK or more), his/her payment was raised to 200 SEK cash (approximately USD 20).

In short, the benefit of increasing the trading capital was at the first level, to get to level 2, at the second level, to get a higher remuneration. The disadvantage of losing all the fictitious money was to pay the fee back.

All of the simulations took place in a small study/classroom and lasted 60 – 90 minutes. Number of traders participating at the same time ranged from one to six. The participants filled wins and losses, amount at risk and equity balance into a form themselves

after a brief instruction. The person administrating the simulations was facing the participants, so he could see them and their forms. Participants were not allowed to talk to each other or look at each other's form.

#### *Outcome Measures*

The primary outcome measure was the amount of fictitious Swedish kronor (fSEK) as scored on the distributed form. This score was used to determine "survivability" and the number of traders able to earn money trading over the long run.

A trader who, at some point during simulation, reached a total capital of zero fSEK or less, that is, lost all of his/her money, was defined as bankrupt and did not "survive" trading the markets. Consistently, traders increasing total capital to an amount greater than the initial 10,000 fSEK were defined as winning traders, able to trade profitably over the long run. Remaining participants, who lost money (decreasing total capital to less than 10,000 fSEK) but not all of it, were defined as losing traders.

There was a lot to gain (a remuneration of 200 SEK) for the traders meeting the profit objective on level 2, but there was not much to lose even if they lost all but 1.00 fSEK of their trading capital. As long as they had just a little fictitious capital left, they were entitled to keep their 100 SEK remuneration. This could cause traders to totally abandon their position-sizing strategy, when time was running out, in order to meet the objective. To have a profit objective that must be met within a tight timeframe and not really need to take the consequences if wrong is not a realistic scenario. In order to reflect a more realistic image of the trader's position-sizing strategies, focus was shifted from the outcome of the very last trade to a trade earlier in the sequence. The trade in focus was set to the forty-fifth trade at each trader's final level. A number close enough to the final trade, yet far enough away from risking to be strongly influenced by a "make or brake" bet. All the participants who lost their total capital did so considerably prior to the forty-fifth trade. They have therefore, most probably, not unjustly been defined as bankrupt.

#### *Statistical Analyses*

All computations were performed on the data from the forty-fifth (the fifth last) trade. The two treatment subgroups, each receiving a three-hour lecture, were compared to each other in order to



determine if they differed significantly in means of number of bankrupt traders, or by means of accumulated trading capital.

Average position-size differences between bankrupt/surviving and losing/winning traders were computed by use of one-tailed *t*-tests. This method of analysis was also used when comparing the position size of the treatment and control group.

The difference between treatment and control group, regarding the number of participants going bankrupt and the number of participants being able to gain money by trading were computed by chi-square analysis.

Trading in the stock markets is associated with both losses as well as gains. There are not many traders who have been able to trade over a longer period of time, without taking any losses. On the other hand, every now and then, many of them have had opportunities to make a substantial profit.

An essential requirement to receive a profit from an opportunity is to be ready to take the chance when it occurs. If one does not have the money to take it, the opportunity is gone. Therefore, it is of utmost importance to survive in the short term, so one is able to stay around for the next opportunity for a good profit.

Consequently, it was of greater theoretical importance to this study whether a trader lost his/her entire stake or was able to survive in the market by trading stocks, than the absolute amount gained. This was the reason for primarily using data at nominal level and chi-square analyses. Accordingly, a 10,001 fSEK difference between a bankrupt trader and a winning trader is more important than a difference between one trader gaining 560,000 fSEK and another trader gaining 570,001 fSEK.

In the real world, a trader losing all his/her money can not be compensated by huge gains of another trader. On the contrary, in the light of one's own failure, the knowledge of other traders' success will most probably make the grapes taste even sourer. Nevertheless, the difference between the two means of total capital accumulated by the treatment and control group, respectively, was computed by use of one-tailed *t*-tests.

Analysis of variance, chi-square analysis and *t*-test explored the effect of prior knowledge of trading/investing in the stock markets and gender.

## Results

### *Total sample*

The variance in trading performance was considerable. A range of 871,000 fSEK was obtained, with a maximum debt of -6,500 fSEK as the worst result, to a maximum account of 864,500 fSEK as the best. The mean outcome for the 52 participants was 79,616 fSEK (SD = 170,029 fSEK) and the median = 14,025 fSEK. Ten participants (19.2 %) went bankrupt, that is, lost all their fictitious capital, another 6 participants (11.5 %) lost money but not all of it, and the remaining 36 participants (69.2 %) were able to gain money by trading.

### *Comparing the treatment groups*

For the two treatment groups (receiving a lecture), the number of bankrupt/surviving and losing/winning traders were compared by Chi-square test, resulting in non-significant differences ( $\chi^2 = 2.42, p = .12$ ; Yates corr. = 0.68,  $p = .41$ , and  $\chi^2 = 1.01, p = .31$ ; Yates corr. = 0.39,  $p = .53$ , respectively). The group means ( $M_{\text{group1}} = 97,658$  fSEK,  $M_{\text{group2}} = 24,677$  fSEK) did not either differ significantly ( $t = 1.37, p = .18$ ). Thus, there was no significant effect related to the two lecturers and the two groups receiving a lecture. Thus, they were considered to be equivalent and therefore collapsed into one group when compared to the control group in the following computations.

### *Position size of bankrupt, losing, and winning traders*

The participants were not asked about what kind of position-size strategies they used. Even without knowing if they used any strategies at all, some conclusions can be drawn by looking at their series of position sizes. There are several different ways the traders have taken their positions. Some traders used a constant fSEK-value position size, regardless of current total capital, while some others used a constant percentage of current total capital. Further, there seem to be traders varying the percentage of their position size, for example, some of them were increasing their position size after a losing trade, while others were doing the opposite, that is, increasing the size of their position after a series of winning trades.

How much of available capital that was put at risk in one separate trade ranged from minimum allowed position size of 0.5% of available capital to the maximum possible size of 100%. At level 1, representing a trading system with expected value of 0.45 (i.e., a

gain of 0.45 fSEK per 1 fSEK put at risk), position sizes of 20% or more were sometimes taken. This was done, even though such a big position could be the last position taken, if a -5 to 1 losing trade came up.

The bankrupt traders were apparently taking higher risks. They were risking 22.9% on an average trade at level 1, while the surviving traders were risking 6.6%. This difference was significant ( $t = 19.3, p < .0001$ ) indicating that the larger the position size, the greater the risk of going bankrupt. When calculating differences between the losing and winning traders, it was found that the former took positions of 15.0% on the average compared to 6.0% for the latter ( $t = 16.7, p < .0001$ ).

The tendency described above was similar at level 2 (expected value of 0.91). Bankrupt traders were risking 23.7% while surviving traders were risking 3.7% ( $t = 15.6, p < .0001$ ). Losing and winning traders were risking 6.5% and 3.8% respectively ( $t = 4.1, p < .0001$ ). Accordingly, Hypothesis (1) and Hypothesis (2) were confirmed.

#### *Position size in the treatment and control groups*

Receiving a lecture had an effect on the treatment group to take smaller position sizes than the control group at both levels, supporting Hypothesis (3). Thus, position sizes for the treatment group were 5.5% at level 1 and 3.6% at level 2. For the control group, the position sizes at level 1 and level 2 were 12.0% and 5.3%, respectively. The differences between the two groups were significant at both level 1 ( $t = 14.8, p < .0001$ ) and level 2 ( $t = 3.0, p < .001$ ).

All in all, the traders who received a lecture took smaller positions, than those in the control group, and the traders that took the smaller positions did not only survive in the simulated market, but were also able to gain money over the long run. The average position sizes of the different groups of traders are presented in Table 5.

Table 5. Average position size over groups of traders

Group of Traders	Level 1		Level 2	
	M	SD	M	SD
Winning	6.0%	7.8%	3.8%	5.2%
Losing	15.0%	14.0%	6.5%	15.1%
Surviving	6.6%	8.0%	3.7%	5.1%
Bankrupt	22.9%	18.5%	23.7%	29.9%
Treatment	5.5%	7.5%	3.6%	6.9%
Control	12.0%	12.3%	5.3%	9.8%

The only variable available for manipulated by the participants were the size of their position. None of the traders did risk exactly the same amount, trade by trade, at exactly the same time as someone else. As a consequence, except for some of the traders going bankrupt, there were not two traders getting the same amount of capital. Accordingly, how big or small capital a trader would get in the end was primarily determined by the size of the trader's position.

*Profits and losses in the treatment and control groups*

The participants in the treatment group lost all their money to a lesser extent (2 out of 32 = 6.3%) than those in the control group (8 out of 20 = 40.0%) and thereby confirming the fourth hypothesis ( $\text{Chi}^2 = 9.03, p < .01, \text{Yates corr.} = 6.98, p < .01$ ). From the Chi-square table, the conditional odds of going bankrupt, if being in the treatment group or not, were derived and used to calculate the odds ratio. This resulted in the odds of going bankrupt, for the treatment group, to 1 to 10 compared to the control group. Or to put it another way: the risk of losing all his/her capital was ten times greater if the trader had not been given a lecture in position-sizing, risk management, and psychological biases.

The three-hour lecture did also produce more winning traders, 26 out of 32 (81.3%), as compared to 12 out of 20 (60.0%) for the control group. However, this difference was non-significant ( $\text{Chi}^2 = 2.82, p > .05; \text{Yates corr.} = 1.85, p > .05$ ).

Neither did Hypothesis (5) receive statistical support ( $t = -1.11, p > .05$ ) when comparing mean amount of capital gained by trading. The treatment group ( $M = 58,888 \text{ fSEK}, SD = 152,480$ ) did not gain more as a group than the control group ( $M = 112,782 \text{ fSEK}, SD = 194,382$ ).

### *Effects of gender and prior knowledge of trading*

The treatment and control groups did not differ significantly in the distribution of gender ( $\text{Chi}^2 = 3.40, p > .05$ ; Yates corr. = 2.38,  $p > .05$ ) and prior experience  $H(2, N = 52) = .43, p > .05$ .

There was a main effect of Gender,  $F(1, 46) = 7.17, p < .05$ , Prior knowledge of trading/investing in the stock markets,  $F(2, 46) = 8.26, p < .001$ , and there was an interaction effect of Gender and Prior knowledge,  $F(2, 46) = 6.47, p < .005$ .

Tukey HSD post hoc-test confirmed Hypothesis (7) ( $p < .0001$ ) that female traders gained more capital ( $M = 249,938$  fSEK) than men did ( $M = 77,372$  fSEK). Having prior knowledge of trading/investing was of an advantage, if one was active trader ( $p < .001$ ) as opposed to less experienced traders. Participants stating they were active traders gained more ( $M = 392,720$  fSEK) than traders with some knowledge ( $M = 23,841$  fSEK) or no knowledge ( $M = 74,404$  fSEK). Thus, Hypothesis (9) was supported.

However, Hypotheses (6) and (8) were not confirmed. Chi-square analysis showed no significant difference between the number of women going bankrupt compared to men ( $\text{Chi}^2 = 1.17, p > .05$ ; Yates corr. = .51,  $p > .05$ ). There was neither any difference between the three conditions of prior knowledge of trading/investing  $H(2, N = 52) = 1.22, p > .05$ .

### **Discussion**

One purpose of this study was to find evidence for the importance of position sizing. The results showed that in order to survive trading in a simulated stock market, using a trading system with expected value of  $< 1.0$ , one should take positions in sizes of approximately 3.7% - 6.6% as the surviving traders, rather than 22.9% - 23.7% as the bankrupt traders. Further, to be able to increase one's account over the long run and actually make money by trading the simulated market, one should not risk much more than 6% as the winning traders did on an average. Accordingly, deciding how big one's position of shares should be was of crucial importance. If the participating traders would lose all their money, get into debt and not be able to trade anymore, or if they would gain profits of up to 871,000 fSEK, as the best performing trader did (an increase of 8,500%), was primarily determined by their position-sizing strategies, since position size was the only variable they could affect.

Of course, the results were also influenced by chance, since the outcome of a trade, to win or lose, was determined by randomly pulling a marble out of a bag. However, all the participants were trading the same positive-expectancy trading systems. They should all be able to gain money over the long run, but not everyone did. The traders participating in the same sessions, did all get the same trades, winners as well as losers, and no traders, other than some of those going bankrupt, did get the same results.

Even though this study focused on allocation made by individuals trading one type of commodities, these findings are in line with those of Brinson, Singer, and Beebower (1991) where the main determinant of the differential return of the pension funds was asset allocation.

Further, was it possible to teach traders to implement less risky and more profitable position-sizing strategies, so they could survive in the markets and gain money? Yes, as the results reveal, the fourth hypothesis was confirmed. The participants that received a lecture in position-sizing, risk management, and psychological biases did not lose all of their capital to the same extent as the control group. All in all, it gave a trader in the treatment group a tenfold bigger chance of surviving in the stock markets. If the traders can continue to trade over the long run, there is a greater chance of getting opportunities of great returns, than if they were standing by the sidelines. There was a tendency of more traders being able to trade profitable in the treatment group. Although this difference was not statistically significant, it is encouraging for further explorations.

However, the treatment group was not able to produce larger profits than the control group, when comparing the two groups' mean results. This outcome may be explained by the fact that the lecture mainly focused on how to cut losses short and to prioritize short-term survival first, in order to get long-term gains. Maybe, the first part of Larry Hite's basic rules about winning in trading was not emphasized enough, leading the treatment group to take too small positions? "(1) If You don't bet, you can't win. (2) If you lose all your chips, you can't bet." (Schwager, 1993, p. 189). Again, an explanation why the control group gained more as a group is probably position size. If you bet big you will lose big when you lose. Evidently, if you bet big you will win big when the draw goes your way.

For future studies and/or education, more emphasis should be directed toward maximizing gains, “letting the profits run”, for example, by hands-on training in position-sizing strategies.

Gender was a contributing factor in the results obtained by the participants. Women did gain more money than men, but they did not survive significantly better than men when trading a simulated market. If the findings of Powell and Ansic (1997) that women are risk averse when deciding in financial matters, was the reason for this, remains to be investigated.

According to Myagkov and Plott (1997), risk seeking seems to diminish with experience. This view can be supported by the main effect of prior knowledge of trading/investing attained in this study. The active traders performed better than the traders with little or no experience. The study was carried out in a laboratory setting, with most participants having little or no prior experience of trading stocks. This can make generalization difficult and further research is needed in more realistic settings.

Further, the willingness to take risks is highly dependent of what is at stake. The only real money the participants could lose was the remuneration. A more realistic risk-taking behavior would probably be expressed if the participants were risking their own money while trading. However, this would, most probably, rise some ethical as well as practical difficulties.

In order to minimize the risk of anyone tampering with the data forms, future studies are encouraged to gather the data electronically, by using computer-generated versions of data forms.

Finally, being able to decrease the risk for a trader of getting ruined to a tenth, even if demonstrated only in a laboratory setting, is highly inspiring. With such small means as a three-hour lecture, only by verbal information on certain, well-known relationships, there can be more people being able to gain money by trading in the stock markets, as long as the behavior shown can be generalized “in vivo”. Further exploration of the importance of position-sizing is essential. Trading is not an easy game and most of us need all the support we can get to beat “our enemies”, in order to make better and more profitable decisions.

The speculator’s chief enemies are always boring from within. It is inseparable from human nature to hope and to fear. In speculation when the market goes against you hope that every day will be the last day – and you loose more than you should had you not listened to

hope – to the same ally that is so potent a success-bringer to empire builders and pioneers, big and little. And when the market goes your way you become fearful that the next day will take away your profit, and you get out – too soon. Fear keeps you from making as much money as you ought to. . . . Instead of hoping he (The successful trader) must fear; instead of fearing he must hope. He must fear that his loss may develop into a much bigger loss, and hope that his profit may become a big profit. It is absolutely wrong to gamble in stocks the way the average man does.” (Lefèvre, 1923/1993, p. 130)



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## Appendices

### **Appendix I**

#### *Curriculum position-sizing lecture*

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- **Streaks/Gamblers Fallacy.**  
When probability of winning is 50%, then there will be an equal number of wins and losses over a large number of draws. A common misconception is that this distribution will be maintained after every draw, that is, a winner will follow after a loser has been drawn. However, in a big sample of draws where the odds are 50/50 it is neither impossible nor uncommon to find a streak of 7 - 10 draws of equal value (e.g. a streak of losses). In such situation, using a Martingale-strategy (doubling the bet after each loss) could be a catastrophe. The streak of losses puts the gambler in a "sunken cost" situation, where he/she may become more risk seeking.
- **"Prospect theory"/"Disposition Effects"**  
Psychological research has found that most individuals are risk seeking when the situation at hand is perceived as a losing situation and risk-averse when the situation is perceived as a winning situation. We decide in accordance with "Prospect theory". We tend to keep our losers and sell our winners.
- **R – multiples.**  
"R" is the size of the risk in our ongoing or planned market position. Our losing trades should be small R-multiples and our winning trades large R-multiples. A low "hit-rate" (probability of winning/losing) with large winners and small losers (e.g. 10R winners and 1R losers) is preferable to a high probability of winning with small winners and big losers.
- **Expectancy/ expected value.**  
50% probability of a 2R winner and a 1R loss or 25% probability of a 6R winner and a 75% probability of a 1R loss? ( $0.5 \cdot 2 - 0.5 \cdot 1 = 0.5$  in contrast to  $0.25 \cdot 6 - 0.75 \cdot 1 = 0.75$ ). The rational investor exists in theory. A basic knowledge of computing the possibility of a certain gain is essential. The expected value is one of the most important statistical

parameters in contrast to probability of winning. When the trader is capable of computing the expected value, then he/she is in the position to estimate when the odds are in his/her favor.

- Drawdowns.

The first goal is surviving in short term in order to be able to make gains in the long run.

*"If you don't bet, you can't win. If you lose all your chips, you can't bet."*

Larry Hite

A loss of 2% requires a gain of ca: 3% on remaining capital in order to break even.

A loss of 30% requires a gain of ca: 43% on remaining capital in order to break even.

A loss of 50% requires a gain of ca: 100% on remaining capital in order to break even.

A loss of 90% requires a gain of ca: 1000% on remaining capital in order to break even.

The importance of cutting losses short is obvious. Large losses can be avoided if the trader only risk a small amount of capital in each and every trade and not letting a streak of losses compound into a big portion of initial capital.

- Position-sizing.

Adjust the size of the risk: a too large risk could make the trader bankrupt, a too small risk gives little possibility to get large profit. There is not *one* correct answer of how to size your position. This must be adjusted in accordance to the traders willingness to take risks, how comfortable he/she is with large drawdowns, etc.

In every game situation with positive expected value, there is a percentage of one's capital that will give optimal profit. On the long run, this percentage will give the player maximum gain. However, this percentage will also give the player very large drawdowns. A smaller position size than "optimal" will give smaller profit but smaller drawdowns. If the player takes even larger positions, then there is a great risk of going bankrupt. Regardless of risk level, it is essential to thoroughly study how much one is willing to lose in each and every situation and what the consequences are for such a loss.