INVESTORS' DECISION TO TRADE STOCKS – AN EXPERIMENTAL STUDY

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An experimental study

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Abstract

This paper experimentally examines the behavior of investors when buying and selling stocks. This behavior was tested under different conditions, among them restrictions on asset holdings or different information conditions. Basic financial theory suggests that subjects buy and sell according to expectations regarding the future prices of assets. On the other hand, behavioral biases, such as the disposition effect, suggest that subjects are affected by past performance of assets.

In a series of experiments, subjects were asked to allocate a given endowment among six assets. All the assets had the same normal distribution. The results show that when subjects were not restricted regarding the number of assets they were allowed to hold and were given information only on the asset they hold, the holding time for losing and winning assets was the same, indicating that there was no effect of past performance. On the other hand, when subjects were required to hold three assets at all times and replace one asset on each round, they tended to sell losing assets too soon and hold winning assets too long. The results also show that subjects who are given information on market returns tend to sell winning assets (relatively to the market) too soon and hold losing assets too long.

JEL Classification: G11, G14.

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1 Introduction

The pioneering work of Shefrin and Statman (1985) shows that investors in markets tend to sell winning transactions too soon and hold losing transactions too long. They named this effect the disposition effect. The goal of the current paper is to experimentally examine the effect of an asset's past performance on trading decisions made by subjects under different conditions.

The experiment procedure extends the experimental studies of Weber and Camerer (1998) and of Chui (2001). The subjects were asked to invest at least 50% of their portfolio in six different assets with the same normal distribution over a period of 20 rounds. Subjects were divided into three groups. Subjects in Group 1 could buy and sell assets without any restrictions on trading. Subjects in Group 2 had to hold three assets in each round and were required to sell and buy at least one asset in each round. As a result of this restriction, subjects were more active in the experiment. Subjects in Group 3 were unrestricted (as in Group 1) with one distinction; they were provided information on the average return of all the assets (market performance).

In most studies in this field, the reference point is the asset purchase price or the asset price in the last period, while in the current study market performance was also used as a reference point. In the paper, we compared the behavior of subjects under the three conditions and analyzed the effect of restrictions and different information on investors' trading decisions. The rest of the paper is organized as follows. Section 2 provides a review of the relevant literature. Section 3 defines the assumptions and hypotheses of the study. Section 4 describes the experimental procedure, and Section 5 presents the results. Finally, Section 6 summarizes and concludes.

2 Literature review

In an efficient capital market, the tendency to buy or sell an asset should be affected by expectations regarding the future prices of assets rather than by their past performance. Shefrin and Statman (1985) analyzed data that included information on private accounts in commercial banks in the US and on buying and selling of mutual funds in the period 1961-1981. They found that investors tend to sell winning (in relation to the purchase price) transactions too soon and hold losing transactions too long; they named this phenomenon the disposition effect.

The disposition effect has been considered from three different perspectives in the research literature: by using market data, by using investor data and through empirical studies.

Odean (1998) examined 10,000 private accounts in investment banking in the US. He found that private investors sell a profitable stock 1.68 times more than a losing stock. Investors kept profitable stocks 104 days on average and losing stocks 124 days on average. The results also showed that investors' strategies were not optimal. The return on the stocks they sold was higher than the return on the stocks they kept. Odean concluded that private investors are influenced by the disposition effect[1]. Additional studies that used data on private and professional investors also showed the existence of the disposition effect.

Other empirical works have found that professional investors are less affected by the disposition effect than are private investors (Shapira and Venezia (2000), Dhar and Zhu (2002)). Locke and Mann (2000) observed that professional investors with lower

[1] For further support see also Lakonishok and Smidt (1986) and Bremer and Kato (1996)

performance are more affected by the disposition effect. Heisler (1994) found that professional investors on the Chicago stock exchange are affected by the disposition. Brown et al (2002) noted that investing over a longer period of time and with higher amounts reduces the disposition effect. Grinblatt and Keloharju (2001)) discovered that investors tend to sell stock with minor losses rather than stock with high losses.

Weber and Camerer (1998) conducted a laboratory experiment to test the disposition effect in a controlled environment. They presented subjects with six assets and information on the chances of winning and losing. The subjects were allowed 14 trading rounds. The results support the disposition effect hypothesis, since 60% of the selling orders were for profitable stocks and only 40% of the selling orders were for losing stocks. The reference point was the asset's purchase price and its price in the previous round. The return on the stocks sold by the subjects was higher than the return on the stocks they kept.

Chui (2001) conducted an experiment similar to that of Weber and Camerer, which involved punishing investors with low trading performance, and also found the existence of the disposition effect. Oehler at el (2002) conducted a market experiment with 12 to 18 subjects and 16 trading periods. The market price was fixed by participants' trading behavior, and the stock's economic price was fixed by a binomial function with known parameters. The findings support the disposition effect.

Boebel and Taylor (2000) tested the disposition effect using the average purchase price and the price in the previous round as reference points. They found no effect when the average purchase price was the reference point and a minor effect when the price in the previous round was the reference point.

One explanation for the disposition effect is based on prospect theory (Kahneman and Tversky, 1979), which claims that subjects act as risk averse investors with respect to gains and risk seekers with respect to losses. When the asset price increases, investors face two alternatives: to sell the asset and gain a sure amount or to keep the asset and face risk. A risk averse investor prefers the sure amount and therefore will sell the asset. When the asset price decreases, investors face two alternatives: to sell the asset and face sure loss or to keep the asset and face risk. In this case, the investor acts as a risk seeker, preferring the risk and therefore keeping the asset.

The second explanation is based on mean reversion (Andreassen, 1998). According to this approach, the price of assets converges to the mean. Investors tend to keep losing assets and sell winning assets since they believe in tendencies toward change, meaning that today's losing assets will show a profit in the future and today's winning assets will show losses in the future.

3 Hypotheses

The first hypothesis of this study deals with the amount of time subjects decide to hold losing and winning assets. The holding period was calculated from the purchase point until the selling point of the asset (the point at which the investor has no holdings of the asset). When purchasing and selling occur a few times, the holding time is calculated as the weighted average of the times from the purchase points to the selling points[2].

[2] See also Schlarbaum (1978a, 1978b) and Shapira and Venezia (2000)

The first test of the past performance effect is whether a subject holds losing assets longer than winning assets. Next, we defined realized profit (loss) if the market price is higher (lower) than the purchase price and the asset was sold. We defined total profit (loss) as the realized and unrealized profit (loss).

In a second test[3] we calculated the proportion of times gains were realized (PGR) and proportion of time losses were realized (PLR) for each subject.

The following two equations present the calculations of PGR and PLR:

$$(1)\ \mathrm{PGR} = \frac{realized\_profit}{realized\_profit + unrealized\_profit}$$

$$(2)\ \mathrm{PLR} = \frac{realized\_loss}{realized\_loss + unrealized\_loss}$$

The third test examined the effect of last round performance on subjects' investment decisions. For each subject we calculated the probability of buying and selling an asset, with profit or loss in the last round. With no past performance effect, we expect to find no difference between the probabilities.

Using the three tests above, our base hypothesis assumes that there is no difference between trading winning and losing assets.

Hypothesis: The disposition effect.

H0: Subjects are not affected by the disposition effect.

(1) Subjects hold losing and wining assets for the same amount of time.

(2) Subjects show the same trend in selling winning and losing assets and so

PLR = PGR.

(3) The probability of buying profitable (losing) assets in the last round is no different from the probability of selling profitable (losing) assets in the last round.

4 The Experiment

The experiment was divided into three cases (see translated instruction in appendix A). Each subject[4] participated in only one of the three. The subjects "played" 20 rounds and were given feedback following each allocation round, as well as historical information from all the preceding rounds.

Subjects did not receive information on the distributions of the assets; however, they were given information on historical prices (and returns) during five periods (see appendix B) prior to the beginning of the experiment (from period -5 to -1).

At the beginning of the experiment, each subject was allocated an initial endowment of 1000 N.I.S (New Israeli Shekels). Subjects were instructed to allocate their funds to any of the assets in any proportion.

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[3] This test is based on Odean (1998), Odean (1999) and on Dhar and Ning (2001).
[4] The participants were students from Ben-Gurion University and the Open University of Israel. Their average age was 24.

In all the cases, six assets (A, B, C, D, E and F) were presented to subjects. At each point, the buying order was denoted by a number that was added to the name of the asset (for example, A1 for the first purchase of A, A2 for the second purchase of A, and so on). The return for each asset was randomly selected from the normal distribution, with expected value of 3% and standard deviation of 10%. The returns were drawn independently for each asset and each subject. No short selling was allowed.

The study was comprised of three experimental cases:

***Case 1*:** Subjects had to invest at least 50% of their portfolio value in the assets.

***Case 2*:** Subjects had to invest a least 50% of their portfolio value in the assets, as in Case 1. On each round, they were forced to hold only three assets, sell all the holdings of one asset and buy another asset at the end of each round. Each asset in the portfolio had to be a minimum of 10% of the entire portfolio.

***Case 3*:** Case 3 was identical to Case 1, except that subjects were given information on market return (the average of the six assets).

The experiment was computerized and lasted approximately one hour. Each round was followed by an on-screen report of the portfolio value (see appendix C). Specifically, for each asset information provided included unit purchase price, unit market price, total market value in the portfolio, weight in the portfolio, daily return and accumulated return.

Each subject was also informed of the value of his or her holdings, which included market value of the assets plus cash. In Case 3 subjects were told the daily and accumulated return of the market (the average of the six assets).

Subjects were told that in round 19 (one round before the end), they would be given the option to sell their holdings at prices higher than 3% of the market value. Rounds 19 and 20 were not included in the data analysis. At the end of the experiment, the subjects' holdings were sold at the market price. Payment for the experiment was 1.5% of final value of the subject's portfolio[5].

5 Results

Table 1 summarizes the average holding time for winning and losing assets in all the rounds and for all the subjects. The reference point is the asset's purchase price.

<Insert Table 1 about here>

The average proportion of gains realized (PGR) and the proportion of losses realized (PLR) were calculated for all cases (see equations 1 and 2). Table 2 presents the results:

<Insert Table 2 about here>

According to the results shown in Table 1, in Cases 1 and 3 no difference was found between the average number of days subjects held winning and losing assets. In these cases, subjects held losing and wining asset for the same amount of time, indicating that there was no disposition effect (Hypothesis: we can't reject H0 (1)). Case 2 exhibits a reverse disposition effect, meaning that the number of days losing assets were held was lower than the number of days winning assets were held.

[5] The average payment was 26 N.I.S (Approximately 6$)

Table 2 shows that PGR does not differ from PLR for Cases 1 and 3, indicating that there is no disposition effect (hypothesis: we can't reject H0 (2)). In Case 2, PLR is higher than PGR, indicating a reverse disposition effect, as found in Table 1.

These findings can possibly be explained by momentum trading behavior (e.g., Grinblatt et al., 1995). Under momentum investment strategies, investors buy recent winning stocks and sell recent losing stocks. This behavior is inverted in the disposition effect.

Table 3 presents the percent of rounds in which subjects sell and buy winning and losing assets in all cases.

<Insert Table 3 about here>

Table 3 shows that in Case 1, subjects sold and bought losing and winning assets at the same rate, indicating that there is no effect. In Case 2, subjects tended to buy recent winning assets and sell recent losing assets. Subjects in Case 2 were forced to hold three assets at the same time and change one of the assets on each round. The results indicate that in this case momentum trading behavior was stronger than the disposition effect. Hence, subjects bought recent winning stocks and sold recent losing stocks. In Case 3 subjects tended to buy losing assets more than winning asset.

The reference point in Cases 1 and 2 was the asset's accumulated return. In Case 3, in contrast, subjects were provided information on accumulated market returns (the average return from six assets).

Table 4 presents the average holding time for losing and winning assets and the PGR and PLR for Case 3. The reference point is the accumulated market return. If an

asset's accumulated return is above (below) the accumulated market return, the asset is a winning (losing) asset.

<Insert Table 4 about here>

Table 4 shows that when the reference point was market return, the number of days losing assets were held was higher than the number of days winning assets were held, and the PGR was higher than PLR, indicating the existence of the disposition effect. The profit or loss relative to the alternatives (market return in this case) affected the number of holding days per subject in the direction of disposition effect.

The results shown in Table 4 can explain the results for Case 3 in Table 3. We found a disposition effect relative to the market, indicating that subjects tended to sell wining assets more than losing asset. Table 3 shows that subjects tended to sell last period winning assets more than last period losing assets (50.8% and 27.6% respectively, T-test = 3.67, $p<0.01$). In 74.8% of the cases in which an asset loses in the last period, its return was below the market in the last period, and in 79.1% of the cases in which an asset wins in the last period, its return was above the market in the last period.

We can say that in the last round subjects tended to sell wining assets more than losing assets since losing assets are below the market and wining assets are above the market. These results fit with the finding that subjects tended to hold losing assets (relative to the market) longer than wining assets (relative to the market), as shown in Table 4.

6 Conclusions

This paper has experimentally examined the effect of an asset's past performance on subjects' current decisions under different conditions and by using different reference points. When subjects were given no restrictions on the number of assets they can hold, no effect was found. However, when subjects were forced to hold three assets at a time and replace one asset with another on each round, they tended to sell losing transactions too soon and hold winning transactions too long. Moreover, subjects tended to buy recent winning assets and sell recent losing assets. These results indicate that under restrictions, subjects are biased by the momentum effect and not by the disposition effect.

Most of the studies on the disposition effect used the asset's purchase price as the reference point. However, in real life situations, subjects are exposed to market information. To examine the effect of market information, in one of the cases subjects were given information on market return. The results indicate that the profit or loss relative to the alternatives (market return, in this case) affects the number of days subjects hold assets in the direction of the disposition effect.

It is important to emphasize that the current research does not prove the existence of the disposition effect or of momentum behavior. The main contribution of the current research is to demonstrate that the disposition effect or momentum behavior can be a product of trading conditions.

An interesting implication of this research is the effect of market conditions on subject behavior. While no effects were found for any restriction except minimum investment, when subjects were forced to buy and sell assets they were biased by

momentum behavior, and when they had complete information (including market return) they were biased by the disposition effect.

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Tables

Table 1: Average holding time for all rounds.

	Performance	Rounds	Average Holding days
Case 1	Profit	241	3.17
	Loss	125	3.16
	T-test (p-value)		t = 0.008 (p =0.497)
Case 2	Profit	225	2.71
	Loss	168	2.06
	T-test (p-value)		t = 3.34 (p < 0.01)
Case 3	Profit	250	3.31
	Loss	78	3.28
	T-test (p-value)		t = 0.08 (p = 0.467)

Table 2: Average PGR and PLR

	PGR	PLR	T-test (p-value)
Case 1	0.287	0.273	t =0.19 (p = 0.42)
Case 2	0.376	0.56	t = 1.73 (p=0.053)
Case 3	0.321	0.231	t = 1.19 (p= 0.13)

Table 3: Percent of rounds for buying and selling losing and winning assets.

	Action	Losing asset	Winning asset
Case 1	Sell	53.8%	49.3%
	Buy	46.2%	50.7%
	T-test (p-value)	t =0.526 (p = 0.30)	t =0.125 (p = 0.45)
Case 2	Sell	61.5%	40%
	Buy	38.5%	60 %
	T-test (p-value)	t =1.56 (p = 0.07)	t =2.167 (p = 0.025)
Case 3	Sell	27.6%	50.8%
	Buy	72.4%	49.2%
	T-test (p-value)	t = 3.99 (p < 0.01)	t =0.27 (p =0.39)

Table 4: Average holding time, PGR and PLR for Case 3 – with market return as reference point.

	Performance	Average
Case 3 holding time	Holding time Winning	3.15
	Holding time Losing	4.53
	T-test (p-value)	$t = 5.1$ ($p < 0.01$)
Case 3 PGR and PLR	PGR	0.39
	PLR	0.25
	T-test (p-value)	$t = 1.63$ ($p < 0.06$)

Appendix A: Experiment Translated Instructions – Treatment 1.

- *Welcome to an experiment in decision-making.*
- *In the experiment you will be asked to invest an amount of 1000 N.I.S you will get from the experiment organizers in number of assets.*
- *You are asked to invest at least 50% of your money at the assets.*
  {This sentence was presented in treatments 1 and 3. In treatment 2 subject were told that they have to hold in each round 3 assets and that the minimum weight if each asset should be 10% of the portfolio}
- *At the time of the experiment you will participate in 20 investment rounds. In each round you will be asked to buy and sell 6 assets (A,B,C,D,E and F).*
- *In the end of the experiment you will be paid according to your portfolio's value. The payment would be 1.5% of your portfolio's final value.*
- *Before the experiment we will get the chance to practice the buying and selling with no payment.*

The experiment

- *In the upper left side of the screen you will find a window of your "portfolio's state". In this window you can find the values of your holdings (the assets) and the amount of cash you have.*
- *In the lower screen you will find the "trade data". You can find a table, which presents data of the last 5 trade days for the six assets. For each asset you will find the: market price, daily return and the accumulated return from the beginning of the experiment (time zero).*

- *In order to start the trade you should press the "next day" button. After pressing the button the "trade data" window will open with the start point (time 0) data. In the right side of the screen you will see a "buying window". You are asked to enter your buying orders in this window. Please mark the assets you are interesting to buy and write the amount you are interesting to invest buy using the amounts up and down arrows. In the end press the O.K button.*

- *After pressing the O.K button you will get in the upper left side of the screen the state of your investments. In this window you will see for each asset in your portfolio the following data: unit purchasing price, market price, the weight of each asset in the portfolio (the asset total value in the portfolio divided by the portfolio value), the assets' daily return and the accumulated return from the time of buying. You will also see the amount of cash you still have, the portfolio market value (the value of all of your assets accordingly to the market prices), and the value of your holdings (assets value+ cash).*
  {In treatment 3 subjects were also told that the will see the daily return of the market portfolio (the average of the 6 assets) and for each asset also the market portfolio accumulated return (from the asset's buying sound)}

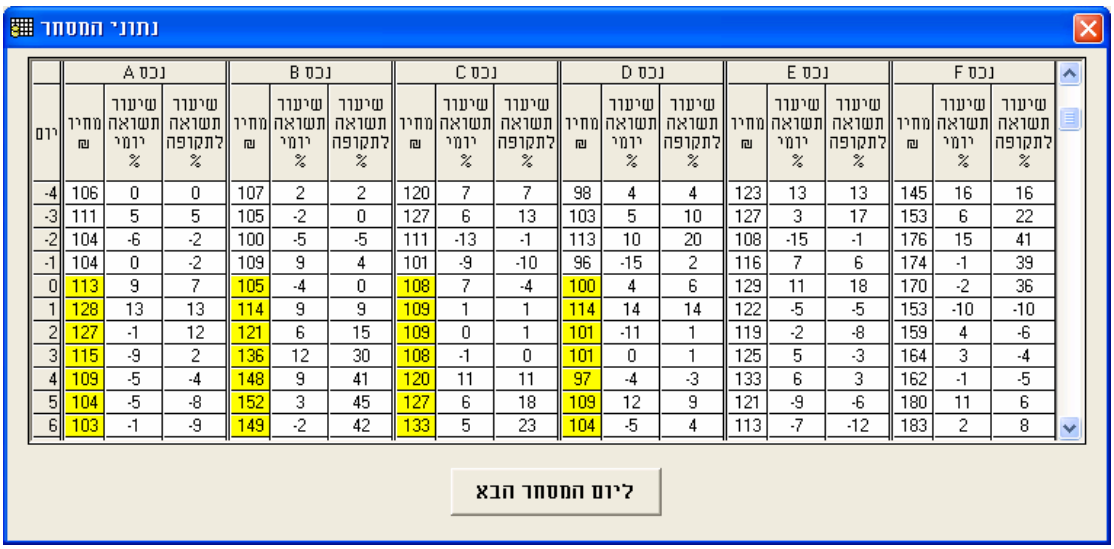
- *Now you are asked to press again the "next day" button. After pressing the button the "trade data" window will open with the first day (time 1) data.*
  In the upper right side you will see a "selling" window. If you are interesting to sell one or more of the assets, you are asked to mark the assets and the amount of selling and than press O.K. If you are not interesting to sell please press O.K.

- *After pressing O.K in the right side of the screen you will see a "buying window". You are asked to enter your buying orders in this window. Please mark the assets you are interesting to buy and write the amount you are interesting to invest buy using the amounts up and down arrows. You can buy new assets or asset you are all ready have. If you are buying assets you are already have, a number would be attached to the asset's name in order to separate between different buying transactions of the same assets (for example*

A1 for the first purchase of A, A2 for the second purchase of A and so on). Now press the O.K button.

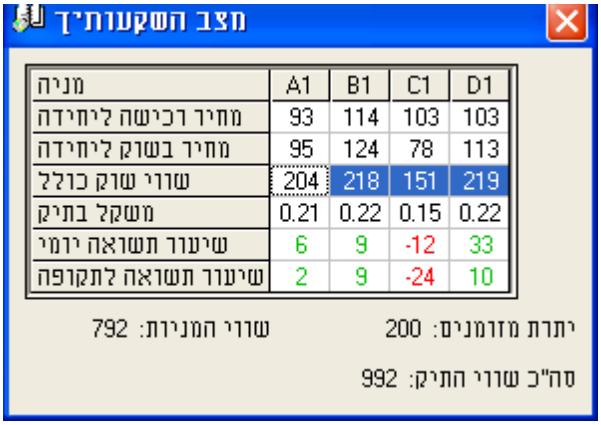
- *After pressing the O.K button, the you will be able to see in the window of your "portfolio's state" the state of each investment.*
- *Now you are asked to press again the "next day" button and get to the next round. You will be asked to trade for 20 rounds.*
- *One round before the last round will ask you to decide of you want to sell all of your asset and get 3% more of their market value. Of you like to sell all your assets please press YES in the window at the upper right side of the screen. If you want to go on to the last round press "NO".*
- *In the last round (round 20) we will sell all of your assets in their market price at the last round. We will add the amount of your cash to the value of the assets.*
- *At the end of the experiment you will see to following information:*
  - The value of your assets
  - The amount of cash.
  - Total value of assets and cash.
  - The payment for the experiment (1.5% of the total value of assets and cash).
- *Immediately after you will get the summary of your experiment we will pay cag money.*

Appendix B: History screen.



	Asset A		
Day	Price	Daily return	Accumulated return
-4	106	0	0
-3	111	5	5
-2	104	-6	-2
-1	104	0	-2
0	113	9	7
1	128	13	13
2	127	-1	12
3	115	-9	2
4	109	-5	-4
5	104	-5	-8
6	103	-1	-9

Appendix C: portfolio's state screen.



Asset	A1	B1	C1	D1
Purchasing	93	114	103	103
Market price	95	124	78	113
Total market	204	218	151	219
Weigh in	0.21	0.22	0.15	0.22
Daily return	6	9	-12	33
Accumulated	2	9	-24	10

Assets value: 792 *Cash Amount: 200*

Total portfolio value : 992