Disposition effect and gender

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Abstract

Investors seem to hold on to their losing stocks to a greater extent than they hold on to their winning stocks. This well-document behavioral regularity is termed disposition effect (Shefrin and Statman 1985). We set an experiment to replicate results from a previous study of the disposition effect (Weber and Camerer 1998), and further show that a subject's gender may interfere with the effect's detection.

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1. Introduction

Investors seem to hold on to their losing stocks to a greater extent than they hold on to their winning stocks. This well-document behavioral regularity is termed disposition effect (Shefrin and Statman, 1985). The effect is usually explained by utility assumptions of loss aversion (Kahneman and Tversky, 1979). When judging gains and losses relative to a starting reference point (such as purchasing price), investors are risk averse toward gains and risk seeking toward losses (Weber and Camerer, 1998).

A changing reference point also alters the disposition effect. Yet once one allows the reference point to shift there is no extra need for assuming loss aversion (Grinblatt and Han, 2002). A complete rationale for the disposition effect taking changing reference points into account demands extending Kahneman and Tversky's prospect theory to consider risky choices in an intertemporal framework. Here Loewenstein and Prelec (1992) generalize discounted utility theory and set an intertemporal prospect theory. They also sketch an explanation for the disposition effect, though they do not consider changing reference points. It is as follows. The value function is convex in the loss domain, and then losses are less than proportionately painful. And gains yield marginally increasing returns. Thus there are incentives to holding on to the stock. The incentives are reversed on the gain side, motivating investors to quickly sell stocks that have gained in value (Loewenstein and Prelec, 1992, p. 594). (Comprehensive references on the disposition effect are provided elsewhere (Weber and Camerer, 1998)).

An alternative to intertemporal loss aversion in explaining the disposition effect is plain mean-reversion. Investors might keep losing stocks just because they rationally guess they will gain in value in future.

Ultimate tests proving the disposition effect in actual markets are difficult because investors' decisions and expectations cannot be controlled in there. Experiments can be run instead. An experiment can be designed to match individual investors' trading decisions with the prices at which they buy the stocks. Here we replicate such an experiment (Weber and Camerer, 1998) only to find that a subject's gender interferes with the disposition effect's detection.

Generally gender differences may be involved in risk-taking (Byrnes *et al.*, 1999). If anything, women are more risk-averse. Yet experimental studies suggest women's risk aversion to be framing dependent (Schubert *et al.*, 2000). In line with the latter we find the disposition effect in female subjects to vary with changing reference points.

Section 2 presents the hypotheses to be tested. Section 3 describes the experiment design. Section 4 presents results. And Section 5 concludes.

2. Hypotheses

It only makes sense to talk about winning and losing stocks relative to a particular reference point. In Shefrin and Statman (1985) investors judge gains and losses relative to an initial purchasing price. They argue that the investors keep losing stocks because the pain of a further loss is less than the pleasure of recovering the purchasing price. But the disposition effect vanishes if the reference point is current price. If investors adjust their reference points as stock prices change, they make no distinction between winning and losing stocks. So a changing reference point matters for the disposition effect's presence.

The hypotheses in Weber and Camerer's (1998) experiment are as follows.

H1 Subjects sell more (less) stocks when the sale price is above (below) the purchasing price.

H2 Subjects sell more (less) stocks when the sale price is above (below) the previous price.

Selling a stock requires a deliberate action. Yet one can imagine an automatic selling at the end of a period. Here subjects will repurchase the stocks at the same price they were automatically sold for. Since rational investors will make no distinction between deliberate and automatic selling it is implied that

H3 Subjects selling stocks deliberately show greater disposition effect than subjects selling stocks automatically.

Here we will find hypotheses H1 and H3 to hold. Yet H2 will collapse for female subjects.

3. Experiment design

Subjects were asked to make portfolio decisions prior to each of 14 periods. They had to buy or sell six stocks (A, B, C, D, E, and F) at pre-announced prices. Each subject was endowed with fictitious 60,000 Brazilian *reais* (~ US$25,000). A stock had to be bought at R$10,000 each. Subjects could neither borrow nor sell short, and were not allowed to diversify their portfolios. (No real money were involved, unlike in Weber and Camerer's where a tiny fraction of gains was paid; but even with no monetary reward we were able to reproduce their results.)

Prices were generated randomly rather than being the result of subjects' actions. This aims at isolating a possible disposition effect (where there is a tendency to buy and sell at distinct prices) from the process of price formation. Prices were then announced on two stages. (1) Each period a price could rise or fall according to the probabilities in Table 1. Subjects were informed of these chances of price rising or falling, but they still had to guess which stock (A–F) had which probability of price increase. They reported their guesses on a questionnaire distributed in white sheet for male and pale-pink sheet for female subjects. (2) Being known whether an increase or drop were involved, the size of price rise or fall (whether R$1, R$3, or R$5) was determined randomly. Figure 1 shows the resulting price series.

Two experiments were run to consider deliberate selling (experiment I) and automatic selling (experiment II). Experiment I was conducted over four sessions. Here subjects were sampled from 90 business undergraduates and 16 real estate business graduates from the Pontifical Catholic University of Parana, Brazil. Of these, 52 were female and 54 were male. Experiment II was run with two groups of business undergraduates. The first group was made up of 35 students (11 males and 24 females), and the second one had 35 students (16 males and 19 females). (Details of our experiments have been omitted since we closely mimic those of Weber and Camerer (1998).)

4. Results

To examine H1 we consider a first-in-first-out (FIFO) setting, where the stocks sold are those bought at the beginning. To consider H2 we take a last-in-first-out (LIFO) setting, where the stocks sold are those bought at the end of previous period.

Table 2 shows results for the FIFO setting. Overall the disposition effect is present. Here our null hypothesis is the number of sales with gain to be less or equal to the number of sales with loss. We found 63 percent of all trades to result in gains and only 34 percent to end up in losses. Trading stocks D and E were exceptions, exactly as in Weber and Camerer's. (A Z statistics of 13.30 was significant at less than one percent.)

Table 3 shows more stocks to be sold as the previous prices increase. More than half of all trades (60 percent) occur taking the last price as reference (Z = 8.28, $p < 0.01$). Thus the disposition effect is heightened when the purchasing price is compared to previous prices. Yet table 4 shows the disposition effect to vanish when automatic selling is allowed. Relatively more trades yield losses (50.1 percent). This confirms H3 and is also in line with Weber and Camerer's findings.

H3 can also be evaluated for individual subjects by means of a disposition coefficient $\alpha = (S_+ - S_-)/(S_+ + S_-)$, where S_+ (S_-) is the number of sales following a higher (lower) price at the previous period. The coefficient is zero if the number of stocks sold on with gain matches the number sold on with loss, in which case there is no disposition effect. The coefficient is +1 (−1) if a subject sells on following a gain (loss). For experiment I, we found α_I = 0.095 (t = 1.80, p = 0.075, one-tailed t-test). And for experiment II, the disposition coefficient was not significantly different from zero (α_{II} = −0.0023).

Considering gender differences does not matter for sale decisions using the purchasing price as a reference point. Here the disposition effect in male and female subjects shows no significant difference (Tables 5a and 5b).

Yet gender interferes with H2. When reference point is the previous price the disposition effect still occurs with males but vanishes for female subjects (Tables 6a and 6b). For male subjects α = 0.351 (t = 4.41, $p < 0.01$, one-tailed t-test). And for the average of 52 female subjects the coefficient is negative, but nonsignificant for a one-tailed t-test (α = −0.172).

We speculate that female decisions violating H2 are brain-wired. According to empathizing-systemizing theory (Baron-Cohen, 2002), due to superior visuospatial memory (i.e. the ability to remember the relative locations of objects) women do a first-class job of remembering landmarks. This contrasts with reading maps, which is a specialty of the male "systemizing" brain. Thus male and female brains might interpret changing reference points differently. Yet the issue is only likely to be settled using brain-scanning experiments, such as fMRI.

The disposition effect may be caused by cognitive illusion (intertemporal loss aversion) but one cannot at first discard rational mean-reversion. Table 7 shows girls doing 61 percent of their purchases after the stocks had their prices increased. They thus think that rising prices will tend to persist in future, i.e. price changes across the stocks were

positively autocorrelated. Yet boys show behavior consistent with mean-reversion (negative autocorrelation).

5. Conclusion

Whether the disposition effect is due to cognitive illusion (such as loss aversion) or rational behavior (mean-reversion) remains unsettled. Yet the experiment in this paper shows that girls do not keep losing stocks and sell winners as the reference point shifts from the purchasing price to the previous price. We speculate this might be related to the fact that male and female brains interpret changing reference points differently.

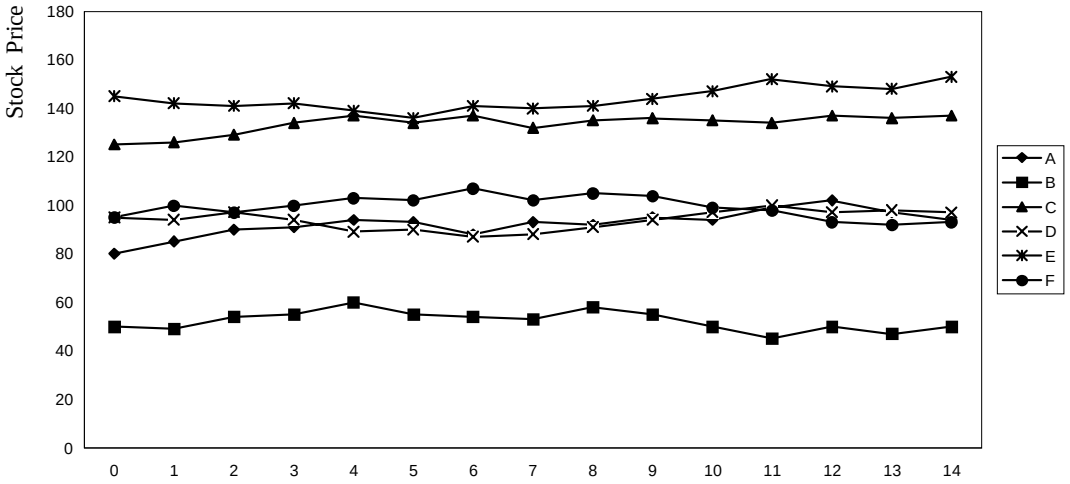

Figure 1. Stock prices pre-announced in the experiment

Table 1. Probabilities of Stock Price Increase

Stock	A	B	C	D	E	F
Probability of Price Increase (%)	35	45	50	50	55	65
Symbol	– –	–	0	0	+	+ +

Table 2. Testing H1. Sales with the Purchasing Price as the Reference Point

Stock	A	B	C	D	E	F	Overall*
	Total %	Total %	Total %	Total %	Total %	Total %	Total %
Sales with Gain	314 *81*	210 *54*	253 *87*	167 *46*	127 *44*	219 *68*	1290 *63*
Even		50 *13*					50 *2*
Sales with Loss	72 *19*	128 *33*	39 *13*	197 *54*	159 *56*	101 *32*	696 *34*
Total	386	388	292	364	286	320	2036

Note

* $Z = 13.30$, p-value < 0.01 for the test of gains (1290) versus losses (696)

Table 3. Testing H2. Sales at *t* Using Previous Prices at *t* – 2 and *t* – 1 as Reference Points
Experiment I: Deliberate Sales

Price Trend / Stock	A	B	C	D	E	F	Overall*	%
t – 2 *t* – 1								
G G	84	65	57	61	65	30	362	
L G			20	42		16	78	
– G	107	101	102	103	82	74	569	
Total	191	166	179	206	147	120	1009	*60*
G L	25	24	6		11	28	94	
L L	47	37	17	26	39	34	200	
– L	72	77	39	65	50	72	375	
Total	144	138	62	91	100	134	669	*40*

Note
G = gain, L = loss
* $Z = 8.28$, p-value < 0.01

Table 4. Testing H3. Sales at *t* Using Previous Prices at *t* – 2 and *t* – 1 as Reference Points
Experiment II: Automatic Sales

Price Trend / Stock	A	B	C	D	E	F	Overall*	%
T – 2 *t* – 1								
G G	206	138	153	135	130	56	818	
L G	0	0	21	88	0	21	130	
– G	234	173	207	223	179	105	1121	
Total	440	311	381	446	309	182	*2069*	*49.9*
	0	0	0	0	0	0	0	
G L	104	78	32	0	41	88	343	
L L	66	143	68	62	111	145	595	
– L	170	257	162	129	152	273	1143	
Total	340	478	262	191	304	506	*2081*	*50.1*

Note
* $Z = -0.20$, p-value = 0.42

Table 5a. Female Sales Using the Purchasing Price as a Reference Point

Stock	A	B	C	D	E	F	Overall*
	Total %	Total %	Total %	Total %	Total %	Total %	Total %
Sales with Gain	141 *71*	76 *44*	97 *78*	78 *39*	51 *38*	82 *61*	*525* *55*
Even		23 *13*					23 2
Sales with Loss	57 *29*	73 *42*	27 *22*	120 *61*	83 *62*	53 *39*	*413* *43*
Total	198	172	124	198	134	135	961

Note

* $Z = 3.69$, p-value < 0.01 for the test of gains (525) versus losses (413)

Table 5b. Male Sales Using the Purchasing Price as the Reference Point

Stock	A	B	C	D	E	F	Overall*
	Total %	Total %	Total %	Total %	Total %	Total %	Total %
Sales with Gain	173 *92*	134 *62*	156 *93*	89 *54*	76 *50*	137 *75*	*765* *71*
Even		27 *13*					27 *3*
Sales with Loss	15 *8*	55 *25*	12 *7*	77 *46*	76 *50*	45 *25*	*280* *26*
Total	188	216	168	166	152	182	1072

Note

* $Z = 14.97$, p-value < 0.01 for the test of gains (765) versus losses (283)

Table 6a. Female Sales at t Using Previous Prices at $t - 2$ and $t - 1$ as Reference Points
Experiment I: Deliberate Sales

Price Trend \ Stock	A	B	C	D	E	F	Overall*	%
$t-2$ $t-1$								
G G	34	16	19	24	21	7	121	
L G			8	19		3	30	
– G	39	31	33	43	30	22	198	
Total	73	47	60	86	51	32	349	44
G L	20	11	3		8	17	59	
L L	37	21	14	18	24	19	133	
– L	57	46	27	48	32	43	253	
Total	114	78	44	66	64	79	445	56

Note

* $Z = -3.44$, p-value < 0.01

The null (sales with gain) of less then or equal to 50 percent cannot be rejected

Table 6b. Male Sales at t Using Previous Prices at $t-2$ and $t-1$ as Reference Points
Experiment I: Deliberate Sales

Price Trend \ Stock	A	B	C	D	E	F	Overall*	%
$t-2$ $t-1$								
G G	50	49	38	37	44	23	241	
L G			12	23		13	48	
– G	68	70	69	60	52	52	371	
Total	118	119	119	120	96	88	660	75
G L	5	13	3		3	11	35	
L L	10	16	3	8	15	15	67	
– L	15	31	12	17	18	29	122	
Total	30	60	18	25	36	55	224	25

Note
* $Z = 14.63$, p-value < 0.01

Table 7. Gender and Mean-Reversion

	Subject's Gender	Prices Rising at $t-1$ (%) G	Prices Falling at $t-1$ (%) L
Purchases at t	Overall	47	53*
	Male	34	66**
	Female	61	39

Notes
To check for mean-reversion, we test whether subjects buy more losing stocks (L) than winners (G)
* $Z = 1.62$, p-value < 0.10
** $Z = 7.43$, p-value < 0.01

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