Psychology in Financial Markets – The Disposition Effect

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The Disposition Effect and Empirical Evidence

Using the term disposition effect, Shefrin and Statman (1985) describe the phenomenon, that investors in financial markets, if compared to an optimal trading strategy, tend to hold stocks that have lost in value too long, whereas they sell winnings too fast. Over the time a lot of essays about the disposition effect have been published and a bunch of theories and models in psychology and behavioral economics have tried to show if and why investors behave that way.

Genesove and Mayer (2001) were able to show a disposition effect in the real estate market and Odean (1998) shows a significant tendency for investors in financial markets to hold losers (i.e. stocks that have a price lower than the price it was bought for) longer than winners (i.e. stocks that have a higher price than the initial buying-price). With data from 10.000 discount-broker-accounts in the US from 1987 to 1993 he was able to compute the percentage of gains realized (PGR) and the percentage of losses realized.

$$PGR = \frac{realized\ gains}{realized\ gains + paper\ gains}$$

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$$PLR = \frac{realized\ losses}{realized\ losses + paper\ losses}$$

If the ratio $\frac{PGR}{PLR} > 1$, investors sell relatively more winners than losers, which is an indication for the disposition effect. Odean (1998) finds a significant indication for the disposition effect: $\frac{PGR}{PLR} = 1.51$ for the whole period.

One can argue that these outcomes do not necessarily indicate a psychological or behavioral phenomenon, because external effects could have made the trading strategy of keeping losers and selling winners optimal. Weber and Camerer (1998) conducted an experiment to obtain an isolated view on the disposition effect. Over several periods students had to decide whether to invest in different stocks and when to sell them. The stock prices followed a statistical trend, so that in each period the price went up or down by a known fixed amount, but with an unknown fixed probability that was different for each of the stocks. Therefore the investment's expected value is strictly positively correlated with the probability of the price going up. The best trading strategy is to invest in the stocks that had the best performance until a given moment, because these stocks have the highest chance to be those with the highest expected value. Note that this trading strategy is contrary to the disposition effect. If investors follow the disposition effect, they hold losers and sell winners. In this setting, following the optimal trading strategy is to hold winners and sell losers. Using this experimental design, Weber and Camerer (1998) were able to show a disposition effect for most of the probands. Why are investors unwilling to sell losers but sell winners? To detect a reason, Weber and Camerer (1998) had a second experiment that was different only in one aspect: if in the first experiment investors had to execute all trading activities by themselves, in the second experiment all stocks were sold after every period and could be rebought for the same price as they were sold. Without any transaction costs, economic theory predicts, that there is no difference in the behavior between both groups. But Weber and Camerer (1998) show that the group of ”automatic sellers” had a smaller tendency to the disposition effect as those who had to execute sales by themselves. The difference between automatic and self-induced selling seems to be important in the investment decisions of investors.

The Disposition Effect and Theoretical Explanations

After pointing out that the disposition effect exists in the real market as well as in an experimental environment we now give the theoretical ideas to explain why investors act that way. The theory of regret aversion as defined by Bell (1982) and Loomes and Sugden (1982) says that individuals take future feelings into account when they make decisions. On the one hand they earn pride if an investment turns out to be good ex-post (i.e. if they gain sth.), on the other hand they feel regret if a decision is bad ex-post (i.e. they suffer a loss). In both scenarios, individuals compare the ”is” state of the world with an antithetic ”fictitious” state of the world (Muerman and Volkman (2006)). That means if one investment rises in price (i.e. is a winner), the individual compares his decision to buy the stock with the worst state of the world where he would have suffered a loss. The investor will now sell the stock to ensure the feeling of pride about having made the right decision. On the other hand, he will hold on to losers to avoid the feeling of regret about having made a false decision. As long as the loss is not realized, there is still a chance, that it turns out to be a winner. If investors act like that, the disposition effect is the consequence. The term ”Regret Aversion” is also used by Thaler (1980) to describe that ”[. . .] whenever choice can induce regret consumers have an incentive to eliminate the choice.” This could explain the finding of Weber and Camerer (1998) that the disposition effect is more distinct if individuals have to take the selling-decision by themselves. For them, realizing a loss creates regret, so they try to avoid it if possible. A second approach for explaining the disposition effect is the mental-accounting theory by Thaler (1985). He argues, that investors do not have their whole portfolio in mind when deciding to sell or buy stocks. For every position in their portfolio they have a separate mental account, each evaluated separately from the others. Together with the above mentioned theory of regret aversion the disposition effect can be explained. If the investor does not feel pride or regret regarding his whole portfolio, but separately for each position, he will keep losers and sell winners to avoid regret and seek pride. Positive effects rising from an optimal trading strategy are not taken into account.

Another way to explain why investors tend to hold losers and sell winners is the theory of self control. Hoch and Loewenstein (1991) as well as Thaler and Shefrin (1981) describe agents as an organisation and their decision-making as a conflict between two opposed preferences in that organisation. On the one hand there is a myopic ”doer”. He is able to take action and make decisions, but his utility function is only defined for one period. On the other hand there is a farsighted ”planner” who lives for several periods but cannot take immediate action or decisions. His utility function is dependent on the aggregated utility of the doers in all periods. Combining this theory with the theory of regret aversion, a doer is not going to sell any losers because that would make him feel regret. That feeling is shifted into future periods which do not effect his utility function. On the other hand, winners are sold to feel pride. The only thing the planner can do is to set rules and restrictions such as buying stop-loss-options or predefine a fixed investment path. The doer is then forced to follow the predefined path.

That last theoretical framework for the explanation of the disposition effect that will be mentioned here is a prospect theory model defined by Barberis and Xiong (2009). Prospect theory was developed by Kahneman and Tversky (1979) as an alternative to expected utility theory. The aim was to predict the actual decision of agents. There are three main differences to expected utility theory: first, the argument of the utility function is the gain or loss from a particular decision rather than final wealth. Second, the utility function is divided in two parts around a reference point. In the area of losses the function is convex, mirroring that agents are risk-seeking for losses. As they are risk-averse over winnings, the utility-function is concave in the area of gains. Therefore the value function is S-shaped, as shown in Figure 1. The third difference takes into account, that in experiments probands showed a tendency to overestimate small probabilities and underestimate high and moderate probabilities. Therefore probabilities are weighted according a weighting-function. This feature is not used in the following model, because Barberis and Xiong (2009) argue that "[...] [one cannot] expect probability weighting to be central to the link between prospect theory and the disposition effect."

Let $\tilde{G} \sim (p_1, x_1; p_2, x_2; ...; p_n, x_n)$ be a lottery that pays x_i with the probability p_i $(i = 1, ...n)$. If probability-weighting is not applied, the Prospect Theory utility from that lottery is

$$V(\tilde{G}) = \sum_{i=1}^{n} p_i v(x_i) = E[v(x_i)]$$

with the value-function $v(x_i)$

$$v(x_i) = \begin{cases} x^\alpha & \text{for } x \geq 0 \\ -\lambda(-x)^\alpha & \text{for } x < 0 \end{cases}$$

defining the utility. Note that the reference point is zero for this function: $v(x_i = 0) = 0$. Barberis and Xiong (2009) define a model in which an investor with utility similar to $v(x_i)$ makes investment decisions over several periods. He can either invest his initial wealth W_0 in a risk-free asset which pays no interest or in a risky asset whose price follows a path through a binomial tree. With the probability of 0.5 the price will rise (fall) at a fixed rate R_u (R_d). To ensure that there is an incentive to invest in the risky asset, assume that the expected return from the risky asset is higher than the return of the risk-free asset: $R_u + R_d > 2$. Two different approaches are considered. In the first approach, the agent gets utility from annual gains only,[1] i.e. from the winnings or losses he was able to earn through several periods until a predefined end-period. This model does not predict a disposition effect. In the second approach, the agent gets utility through every gain or loss he realizes.[2] That is, everytime he sells an asset with a win (loss), he receives utility (disutility). In this setting, prospect theory is shown to predict the disposition effect.

To analyse the first case, assume that the investor can make investment decisions from a starting period $t = 0$ until an end-period $t = T$. It can be shown that, to maximize his utility, the investor chooses an optimal wealth allocation for the period $t = T$. That means, that for every state of the world, he defines how much wealth he wants to have, given his budget constraint. It is not possible for the investor to have a negative wealth in any state of the world. Therefore there are three options to allocate wealth:

I. Choose an investment path that gives a return that is higher than the risk-free return

II. Choose an investment path that gives the same return as the risk-free return

III. Choose an investment path that gives a return smaller than the risk-free return, but greater than or equal to zero

[1] "A Model That Applies Prospect Theory to Annual Trading Profits"; Barberis and Xiong (2009)

[2] "A Model That Applies Prospect Theory to Realized Gains and Losses"; Barberis and Xiong (2009)

It can be shown that the investor either chooses I or a special case of III where his wealth is zero. Furthermore he allocates a higher level of wealth to those nodes in the binomial tree in which the price of the risky asset is high. In the lowest parts of the tree he chooses the wealth allocation $W_T = 0$. From the last period backward one can compute the optimal trading strategy to reach the wealth allocations given a state of the world.[3] In the beginning, the investor buys the risky asset because the expected return is high enough. Suppose now that the price of the asset falls. The agent is in the convex part of the value-function.[4] The investor has to adjust his portfolio so that on the one hand, his losses are not too high if the price falls again. On the other hand he wants to keep the chance of earning a small gain. Keep in mind, that the expected return of the risky asset is positive. He will therefore sell some of his assets. If in the beginning the price of the risky asset rises, the investor will buy more assets and the mechanism is analogous. Even if the price falls, the investor wants to have a positive return. On the other hand he wants to earn as much as possible. To ensure both, he will buy more risky assets. This is a behavior that differs from the disposition effect: the investors hold winners and sell losers.

In the second approach Barberis and Xiong (2009) allow the investor to receive utility everytime he sells some of his assets. Doing so, they give the investor the chance to insure himself against falling stock prices and to let him hope for rising stock prices. Assume the price of the asset went up after the first period. The investor is now in the concave part of the value-function. If the price goes up again, the investor will receive relatively low extra-utility because of the diminishing marginal utility. If the price falls, his losses are relatively big. By selling some of the assets, he can ensure some utility. This explanation works the other way around in the area of losses.

[3] cf. Figure 2
[4] cf. Figure 3

Connecting Empirical Evidence and Theoretical Explanation

There is a connection between the empirical findings and theories discussed. Weber and Camerer (1998) find a weaker disposition effect in the group where automatic selling applies. As described above mental-accounting in combination with regret aversion would usually lead to not selling at a loss. If in every period all positions in the portfolio are sold, no matter if at a gain or a loss, the investor can make an investment decision about his whole wealth in every period and mental-accounting is not present. One can argue that the feeling of pride or regret then applies on that whole wealth, because that is what the investor gets as a payout in every period.

The Prospect Theory model by Barberis and Xiong (2009) predicts no disposition effect if the investor receives utility from annual gains. Only if the investor can receive utility by realizing gains or losses a disposition effect can be shown. The agent then tries to avoid the realization of losses because he hopes, they turn into winners again. At the same time he realizes gains to ensure some utility. That connects to the theory of self control where a similar mechanism is at work. The doer tries to realize gains as fast as possible, whereas losses are shifted to future periods, hoping they become winners again. If the planner can restrict the doer through predefining an investment path, the disposition effect would vanish similar to the annual gains model of Barberis and Xiong (2009) where the investor defines different wealth allocations and then derivates his optimal investment path from that. If he once defined his investment path he has no incentive to deviate from it.

All in all, the disposition effect can be observed in real markets as well as in experimental settings. In all of the above mentioned theories, the disposition effect occures because the agent tries to avoid a negative feeling, either called disutility or regret. At the same time he seeks to receive a positive feeling (utility or pride). Selling winners works like an insurance against falling stock prices, whereas holding losers works like a gamble to get lucky and earn a gain. The main argument is that investors try to ensure utility by selling winners and shift disutility by keeping losers. Further experiments with an open time horizon may be interesting. One question is if subjects who are allowed to have utility from every sold asset realize their gains earlier than those with a predefined end-period like the model from Barberis and Xiong (2009) predicts. This could be investigated by giving probands the opportunity to leave the experiments whenever they want and give them a payment correlated to their earned returns.

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Appendix

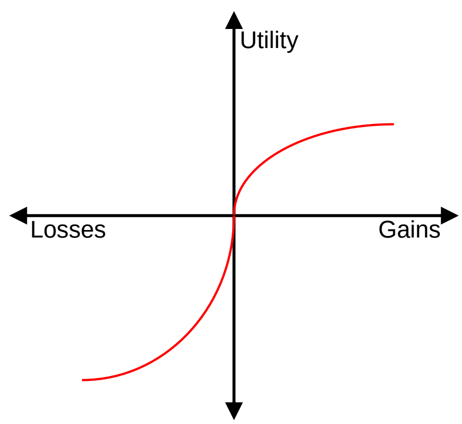

Figure 1: Prospect Theory value function $v(x)$

$v(x)$ is concave in the area of gains and convex in the area of losses. The smaller α, the more curved is $v(x)$

Asset Price					Wealth					Number of Assets				
t=0	t=1	t=2	t=3	t=4	t=0	t=1	t=2	t=3	t=4	t=0	t=1	t=2	t=3	t=4
				72,9					163,39					0
			62,7					94,7					6,8	
		54		55,6			64,25		46,47			3,5		0
	46,5		47,9			50,75		42,87			1,8		0,5	
40		41,2		42,4	40		41,27		40,34	1,7		0,2		0
	35,5		36,5			32,45		40,15			1,5		0	
		31,4		32,4			26,26		40,02			2,7		0
			27,9					16,51					5,2	
				24,7					0					0

Figure 2: Asset prices and trading strategy

One can see values for asset price, wealth and the number of assets an investor has. The investor maximizes his utility by choosing a wealth allocation for $t = 4$. The result is a trading strategy for every possible movement in the binomial tree. Marked in red is one possible path. Data: Barberis and Xiong (2009)

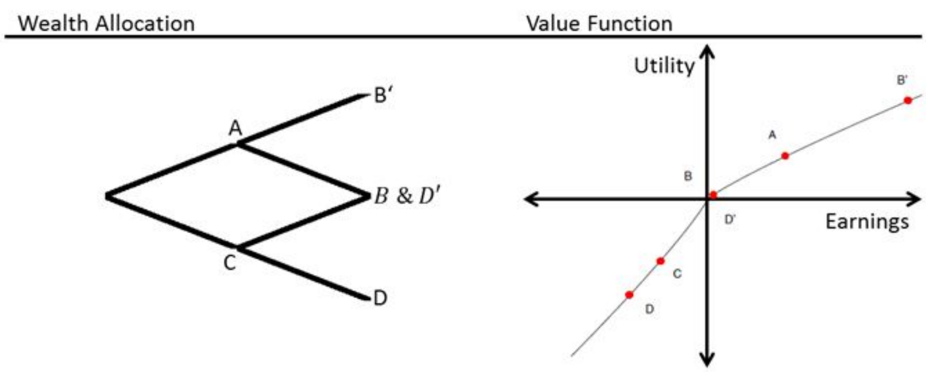

Figure 3: Wealth allocation and value function

The left side shows a possible wealth allocation for $t = 2$. The point A (C) refers to a situation in which the asset price rises (falls) in the first period. B' (D) refers to a situation in which the asset price rises (falls) two times in a row, whereas B and D' are situations in which the asset price first rises (falls) and then falls (rises). The right side shows the induced utility levels for each situation. One can see, that the investor has a negative utility only for the end-point D. For all others he has at least a slightly positive utility. Data: Barberis and Xiong (2009)