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Affect Account of Disposition Effect and Consequences for Stock Prices

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Highlights

- Reviews previous research and explanations of the disposition effect in stock markets
- Claims disposition effect is driven by non-professional stock investors buying in upmarkets or buying popular stocks
- Specifies the important role of affect for non-professional investors' proneness to the disposition effect
- Possible consequences for stock prices are that price trends are either intensified or attenuated by the balance between sellers prone to the disposition effect and buyers.

ABSTRACT
We review previous research demonstrating the disposition effect in stock markets, its explanations, and unresolved issues. Our main contribution is an affect account of the disposition effect followed by an individual-level analysis of the consequences for stock prices. We claim that the main drivers of the disposition effect are non-professional investors buying in upmarkets or buying popular stocks. The non-professional investors set a short-term aspiration level that is subsequently adjusted depending on anticipatory feelings of hope or fear induced by price movements. They selling when anticipated elation is strong enough to be preferred to anticipatory hope. A downward price trend triggers anticipatory feelings of fear of losing. A potential future loss may still not lead to selling a loser. Deferring selling is also augmented by that non-professional investors shield themselves from negative information. Selling is made when anticipated disappointment of realizing the loss is strong enough to be preferred to anticipatory fear. Price trends are either intensified or attenuated by the balance between sellers prone to the disposition effect and buyers.

Key words: Disposition effect, stock price, trading, affect

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Early research in behavioral finance demonstrated that investors are prone to judgmental biases (Gärling et al., 2009; Hirshleifer, 2001) that potentially are threats to the efficiency of financial markets (Fama, 1970, 1998). This motivated additional research showing that judgmental biases are less frequent among professional investors than among lay people investing in stock markets or among non-investors (e.g. students) (e.g. Feng & Seaholes, 2005; Hon-Snir et al., 2012). Judgmental biases may then not be a threat to market efficiency unless the number of lay investors is large. It is still remains to determine whether lay investors' judgmental biases have market influences, for instance in stock markets influences on trading volume and price volatility (Coval & Shumway, 2005; Gärling, 2011).

In recent years the research by Gigerenzer and his collaborators (e.g., Gigerenzer & Gaissmaier, 2011; Todd et al., 2012) has clarified that judgmental biases are frequently the outcomes of (fast and frugal) heuristics that are adaptive under the circumstances they are applied. It may even be argued that when full information is not available (as seldom is the case), lay investors applying such heuristics in financial markets would outperform expert investors using other methods in the arsenal of financial economics (e.g. Bayesian updating, expected-value maximization). Therefore, it is important to assess what influences lay investors' judgmental biases have in financial markets.

In this paper our aim is to suggest whether, why and how prices are influenced by one of the most well-documented judgmental biases in stock markets, the disposition effect implying that losers are hold too long and winners too short (Shefrin & Statman, 1985). The paper proceeds as follows. In the next section we review previous research demonstrating the disposition effect, its explanations, and unresolved issues. The following sections present our main contribution consisting of an affect account of the disposition effect followed by an individual-level analysis of the consequences the disposition effect may have for stock market prices. A final section summarizes and discusses our findings.

The Disposition Effect

Empirical Evidence

The disposition effect was first identified empirically by Shefrin and Statman (1985). They noted that the US tax regulations at the time made it profitable to sell losing stocks early and winning stocks late. They therefore posited that some market participants take advantage of the tax regulations by selling losers early and winners late, whereas consistent with the disposition effect, other do the reverse: sell losers late and winners early. A third group that may be substantial in size includes those who never trade. In analyses of two data sets consisting of records of individuals´ stock trading over time and aggregate time-series data on mutual fund trades (where the tax regulations have minor effect), the observed patterns of gain and loss realization suggested both the prevalence of the disposition effect and tax considerations.

Odean (1998) acknowledged that in several studies published after 1985, indirect evidence had been accumulating for the existence of the disposition effect. In his reported empirical study the goal was to obtain conclusive evidence from detailed individual records of daily holdings and trading of stocks. Realizing the importance of taking into account whether or not stocks are possible to sell, a ratio was constructed of realized gains (sold stocks at prices higher than purchase prices divided by selling opportunities at a price higher than the purchase price). By comparing this ratio to the analogously constructed ratio for losses (sold stocks at prices lower than purchase prices divided by selling opportunities at a price lower than the purchase price), the disposition effect was demonstrated in that the ratio for gains

was larger than the ratio for losses. An exception was the end of the taxation period when investors were more likely to sell losers due to taxation reasons.

A short-coming of analyses of market data is that they do not conclusively permit identification of investors´ motives for selling. For instance, Odean (1998) noted several rational motives for holding losers and selling winners including rebalancing a portfolio to restore diversification when the prices of some of the stocks in the portfolio go up, selling stocks after price increases due to positive news believing that these are now reflected in the price, and avoiding trading costs for selling losers. Odean (1998) provided arguments against each of these alternative explanations. Yet, it took a pioneering experimental study conducted by Weber and Camerer (1998) to provide conclusive evidence for the disposition effect as well as for one of its theoretical explanations (see below). In the study participating students made repeated portfolio choices by deciding to buy or sell stocks at randomly determined prices. In another condition stocks in the portfolio were automatically sold and participants given the opportunity to buy them back. The results confirmed the disposition effect in that fewer stocks were sold at prices below than above buying prices, and fewer stocks were sold when prices went down than when they went up. In the experiment no prices reverted, thus selling winners and holding losers were clearly not optimal. The observation that participants did not buy back automatically sold losers furthermore rejected that beliefs in price reversion played an important role. In a computerized replication (Chui, 2001) the disposition effect was observed despite that stronger incentives for optimal performance were added. The disposition effect was also demonstrated in a computerized market experiment in which students traded assets (Kirchler et al., 2005). The results showed that winners were sold earlier than losers. An optimistic framing of future returns (presumably similar to beliefs about price reversion) was found to defer selling losers compared to a pessimistic framing. In a brain-imaging study Frydman et al. (in press) obtained partial neural support for the assumption made in explanations of the disposition effect (Barberis & Xiong, 2009, 2012; Shefrin & Statman, 1985) that utility is directly derived from realizing gains and losses.

In the early research (e.g. Odean, 1998; Shefrin & Statman, 1985), it was tacitly assumed that professional investors would not be prone to the disposition effect. Whether this is true has been the focus of several subsequent studies. A review by Feng and Seaholes (2005) warrants the conclusion that the disposition effect is uniformly documented for many investor groups (see in particular Grinblatt & Keloharju, 2000). Yet, as they noted, few of the previous studies analyzed data at the individual-investor level. To remedy this, Feng and Seaholes (2005) used data on individual investors´ stock transactions during several years. A disposition effect was observed for the whole sample, but investor sophistication, assessed independently of the trading records, and trading experience assessed from the trading records together eliminated the reluctance to sell losers but only reduced the tendency to sell winners too early. In analyses of individual trading records during a 5-year period, Dhar and Zhu (2006) found that wealthier individuals, employed investors, and trading experience reduced the disposition effect. Locke and Mann (2005) noted that advices given to investors are to not hold losers. They still found that in a high-frequency trading environment, professional actors violate predetermined exit rules by holding losers longer than winners. A suggested explanation was that the traders, expecting to earn a profit, tend to disregard or disbelieve negative information. Analyzing comprehensive records of trades during a five-year period, Talpsepp (2011) demonstrated the disposition effect for local investors but a reverse disposition effect (losers sold earlier than winners) for foreign investors. The proposed explanation was that either traders in a less familiar market are more loss averse or they are more sophisticated. Hon-Snir et al. (2012) conducted an on-line survey of one group of professional investors and another heterogeneous group of investors. The disposition effect was measured by agreement responses to two statements concerning preferences for selling

winners and losers. On this self-report measure the disposition effect was found to decrease with trading experience but the professional investors were not less prone to the disposition effect than the heterogeneous group of investors was.

In summary, the evidence for the disposition effect in stock (and other) markets is strong. Being a professional investor with trading experience seems to reduce the effect, at least the reluctance to sell losers. No study has however provided an estimate of the proportion of investors not prone to the disposition effect. In a stock market there is also likely to be a large number of participants who never trade and therefore do not expose themselves to the disposition effect.

Explanations

In their theoretical explanations of the disposition effect, Odean (1998), Shefrin and Statman (1985), and Weber and Camerer (1998) all draw on prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). A common assumption in these explanations is that disutility is derived from realized losses incurred by selling an asset at a lower price than paid, not from potential (paper) losses not yet realized (Barberis & Xiong, 2009, 2012). Conversely, utility is derived from realized gains obtained by selling an asset at a higher price than paid. Three features of prospect theory are deemed relevant: (1) Evaluations of options (called prospects) are made compared to a neutral reference point such that values below are coded as losses and values above are coded as gains. The explanations offered for the disposition effect differ in what is considered to be the reference point, the (break-even) price at which the stock was purchased, the highest previous price (i.e., what could have been gained), or an average of previous prices. An aspiration price (preferred returns on the investment) may alternatively be considered to be a reference point. (2) The concave-convex form of prospect theory´s value function explains why people are risk averse in the domain of gains and risk seeking in the domain of losses. A realized gain is hence preferred to an uncertain gain with the same expected value thus possibly foregoing a larger gain, whereas an uncertain loss is preferred to a certain loss with the same expected value thus taking the risk of a possibly larger loss. If the expected values are not the same, this pattern of risk aversion versus risk seeking should not be expected. Since objective odds are not known to stock investors, they should however not be able to accurately calculate the expected values. Thus, the magnitude of the gain or loss outcome is likely to have a strong effect (but see Dacey & Zielonka, 2008, who propose an explanation also incorporating the probability weighting function of prospect theory). Still, under some circumstances (e.g. a positive market sentiment) investors may be overoptimistic (Moore et al., 1999), inferring that the odds associated with positive returns are higher than objectively assessed. If the market sentiment is pessimistic (Nofsinger, 2005) higher odds than objective may instead be associated with negative returns. Such changes in odds would presumably change the strength of the disposition effect. (3) The prospect theory value function is approximately twice as steep for losses than for gains. This is referred to as loss aversion and has been evoked as an explanation of several similar judgmental biases including the endowment effect (Kahneman, Knetsch, & Thaler, 1990), that is, the reluctance to sell something in possession, the status quo (Samuelson & Zeckhausen, 1988), default (Johnson et al., 1992) or omission biases (Baron & Ritov, 1994), that is, the overvaluation of what one possesses compared to what one would obtain by giving it up, and the sunk cost effect or escalation (Arkes, 1984; Staw, 1981), that is, the tendency to persist in choosing a failing course of action. Loss aversion is however not considered necessary for the explanation of the disposition effect, although, as Weber and Camerer (1998) noted, if the reference point is the current stock price and equal odds are associated with future gains and losses, loss aversion would make selling the stock the

preferred option over holding the stock. Avoiding a potential loss is thus preferred to obtaining an equally large gain.

The prospect theory explanation of the disposition effect has been criticized on several grounds (e.g., Barberis & Xiong, 2009; Ben-David & Hirshleifer, 2012; Hens & Vlcek, 2011; Kaustia, 2010). An alternative explanation not presupposing the prospect theory value function was proposed by Barberis and Xiong (2012). If investors are impatient, they would prefer to realize smaller (paper) gains earlier rather than waiting for larger gains. This may thus account for selling paper gains too early. Impatience is a common finding in research on temporal discounting (Frederick, Loewenstein, & O'Donoghue, 2002). Conversely, the preference is to defer realizing losses.

Shefrin and Statman (1985) also evoked mental accounting theory (Thaler, 1999) as part of the explanation of the disposition effect, implying that investors treat an individual stock as a separate "mental account". When investors are unwilling to close a mental account (selling the stock) at a loss, it counteracts that they by means of a swap substitute a winner for a looser. An implication is that the disposition effect applies to individual stocks in a portfolio only if treated separately (Shefrin & Statman, 2000). In general, treating a decision as separate, isolated from other related decisions (e.g. in portfolio construction) has been referred to as narrow (versus broad) framing (Barberis et al., 2006; Kahneman & Lovallo, 1993) or bracketing (Read et al., 1999). Kumar and Lim (2008) showed that when investors traded stocks simultaneously (referred to as cluster trading and employed as a measure of narrow framing) compared to sequentially, the disposition effect was reduced. In following up on this Lim (2006) argued that narrow framing reflects "hedonic editing" (Linville & Fischer, 1991; Thaler & Johnson, 1990), that is, the tendency to treat potential choice outcomes as integrated or segregated in order to maximize value. For instance, if two or more losses are segregated, due to the diminishing sensitivity of the prospect theory value function, they would be experienced as worse than if integrated, whereas the reverse would be true of two or more segregated gains. In empirical support Lim (2006) found that investors were more likely on the same day to bundle sales of losers than sales of winners.

Unresolved Issues

Odean (1998) noted that an alternative explanation of that investors hold losers and sell winners is that they believe in price reversion (that today´s losers outperform today's winners in the future). If future returns are expected to be higher for losers than winners, such beliefs would be justified. This was however not supported by the evidence presented in Odean (1998) and in Weber and Camerer (1998). We will argue below that the disposition effect only applies to sellers (as the prospect theory explanation implies), whereas buyers may adopt a momentum strategy of buying winners or a contrarian strategy of buying losers. As noted by Hens and Vlcek (2011), prospect theory cannot however both explain the disposition effect and that those investors prone to the disposition effect bought the stock in the first place. They assume that the parameters (risk attitude, decision weights) do not change for buying and selling decisions. Yet, as we point out below, choosing to buy one of several offered stocks is likely to differ from selling one or a few held stocks in the portfolio. A paradoxical implication is furthermore that investors would buy stocks that increase in price after having sold them. Strahilevitz et al. (2011) found that repurchases of sold stocks were frequent but primarily only after prices had gone down. As they noted, there are several reasons why one is unwilling to buy at a higher price something previously sold. One reason is that repurchases would exaggerate disappointment and regret due to the experienced foregone gain by selling the stock too early.

Another issue concerns the definition of the reference point in prospect theory. Note that the existence of a reference point is a necessary part of the explanation of the disposition

effect. As noted above, different definitions have been proposed. The most common definition (e.g. Henderson, 2012; Odean, 1998; Shefrin & Statman, 1985), to which we adhere, is the buying price (selling at this price is referred to as the break-even price). If the inflation is minimal during the holding period this is an economic sound definition. Yet, psychologically other definitions are conceivable. If memory fails (not unlikely in an experimental setting), the reference point may be an average of previous prices (Weber & Camerer, 1998). Other possibilities include that the highest or lowest price is the reference point, thus fueling disappointment and regret added to or substituting for the evaluation of the economic outcome. The reference point may also depend on the price trend, raising when it is upward and falling when it is downward. This is perhaps more properly referred to as an aspiration level. It is also an example of updating. Baucells et al. (2011) developed and tested a model of reference point updating. Kliger and Kudryavtsev (2008) showed empirically that updated reference points based on quarterly earnings announcements accounted for the disposition effect.

A challenge in all empirical studies has been to independently assess whether gains are sold earlier and losers late (or never). This follows from that the disposition effect has been assessed based on the relation between the frequency of selling winners and the frequency of selling losers. In prospect theory a sure gain is preferred to an uncertain gain with the same expected value (unless the probability of the uncertain gain is very small, in which case the reverse tends to be true, see Tversky & Kahneman, 1992). Only if expected value is known would it therefore be possible to infer a disposition effect for gains. In our treatment below we define the disposition effect for gains as selling when prices continue to increase. One problem with this definition is that in an empirical market study prices may be affected when winners are sold. In a theoretical analysis a fundamental price is still possible to define without having to assume it is known to the sellers (or buyers). The same definition is also applied to losers (i.e., holding a stock despite that its fundamental price decreases).

The disposition effect implies that losers are not sold until becoming winners (or can be sold at the break-even price). As noted by Henderson (2012), this may however not always be a reasonable implication. Perhaps a loser at some point in time signals very low odds of reverting, in which case selling may become the preferred option. The paper loss may also be as high, as well as increasing, as to make it extremely painful to hold a loser. In the following we propose a weak form of the disposition effect, implying that offering a loser for sale is deferred until the loss has reached some value.

Affect Account of the Disposition Effect

The disposition effect has been treated as a bias, that is, a deviation from a normative stance in financial economics based on expected utility theory. Non-expected utility theories such as prospect theory and different extensions of this theory have been evoked as explanations. Consistent with the reviewed evidence sophisticated professional investors seem to act rationally, whereas less sophisticated professional investors seem to have "prospect theory preferences" making them prone to the disposition effect. Although we do not rule out the proposed explanations based on prospect theory, it seems plausible that another main driver of the disposition effect is non-professional investors influenced by feelings.

We claim that non-professional investors due to that they have anticipatory feelings of hope dominating anticipatory feelings of fear are attracted to buy stocks in times of an upmarket (Kubinska, Markiewics, & Tyszka, 2012). They may also be attracted to buy a particular popular stock. A positive mood due to other influences (a sunny weather, a windfall salary payment) may occasionally strengthen buying intentions. The non-professional investors are optimistic about earnings in a short time. If constructing a portfolio of single stocks, they are furthermore likely to diversify insufficiently (Hedesström, Svedsäter, &

Gärling, 2004, 2007). We also propose that they do not set a sell price in advance. Yet, they have an aspiration level roughly defining what they expect to earn. The aspiration level is labile such that it is adjusted by anticipatory hope balancing anticipatory fear induced by price movements. Thus, if an upward price trend is pronounced and consistent, this may result in slanting the balance in the direction of the hope of earning. This would then boost the aspiration level. A price trend exhibiting high volatility may conversely induce more fear of losing such that the aspiration level is reduced. When the aspiration level is reached and if the market allows, anticipating elation or pride, the investors sell at a price equal to or above the aspired gain. If the price trend is stable such that the aspiration level is increased, a sell decision is reached later than if price volatility is high. For the same price trend we expect lower average sell prices. If no or too small downward adjustments are made of the aspiration level, the price may start to go down before the set aspiration level is reached. A downward price trend elicits anticipatory feelings of fear of losing. Yet, selling decisions are deferred as long as this is balanced by a hope of price reversion. High price volatility is likely to boost hope such that selling is further deferred. Selling may also be deferred because non-professional investors shield themselves from negative information (Karlsson, Loewenstein, & Seppi, 2009). A stock is eventually sold at a lower average price if the downward price trend is volatile than if it is stable.

We now propose a more detailed account based on affect. Influences of affect are documented both indirectly by market data (Lucey & Dowling, 2005), directly by physiological measurements of investors in the field (Lo & Repin, 2002; Fenton-O´Creary et al., 2012), in laboratory studies using brain scanning (Knutson et al., 2008; Frydman et al., in press), and in experiments showing effects of affect images (MacGregor et al., 2000). As illustrated in Figure 1 we suggest a classification of affect in stock markets distinguishing between (1) changes in a (pleasant-unpleasant) current mood that despite being due to circumstances incidental to stock-price movements may still influence investor decision making (Isen, 2000; Schwartz, 2000), (2) anticipatory feelings of hope and fear due to stock-price movement (Lopes, 1987; Shefrin & Statman, 2000), and (3) anticipated feelings of elation and disappointment (or pride and regret[1]) associated with decisions to realize gains and losses (Mellers, 2000). Although mood has a possible direct effect on decisions, the anticipatory feelings have effects on decisions that are mediated by the anticipated feelings. We further propose that when prices go up, anticipatory hope motivates buying that triggers anticipated elation which increases faster than anticipatory hope. A decision to sell is made when the former exceeds the latter.

Russell (1980, 2003) posits that affects either are neutral or have any other value in a dimensional system defined by the axis pleasure-displeasure and activation-deactivation. In Figure 2 we assume that hope-fear varies along an axis oblique to the main axes, whereas elation-disappointment varies along an axis orthogonal to hope-fear. We further assume a preference order elation > hope > disappointment > fear (Västfjäll & Gärling, 2006). When prices go down an anticipatory fear of loss triggers anticipated disappointment of selling the loser. Fear is increasing over time at a rate lower than the less aversive anticipated disappointment. When the latter exceeds the former a feeling of relief from anticipatory fear is experienced motivating selling the loser.

[1]We do not elaborate further on the distinction between different anticipated positive or negative feelings related to whether or not the outcome is perceived to depend on the decision made by the investor (e.g., Zeelenberg et al., 2000).

Consequences for Stock Prices

Frazzini (2006) found that, in the presence of investors prone to the disposition effect, stock prices under-react to news, thereby resulting in a post-event drift of market prices. Grinblatt and Han (2005) developed an equilibrium-price model that links the disposition effect to the momentum tendency of past winners to outperform past losers. Odean (1998) identified several possible consequences the disposition effect may have for market prices including to account for the observed positive correlations between price changes and trading volume (Bremer & Kato, 1996; Ferris, Haugen, & Makhija, 1988; Karpoff, 1987; Kaustia, 2004; Lakonishok & Smidt, 1986). However, since these consequences to an unknown degree depend on the trading of other market participants, Odean (1998) concluded that the economic effects of the disposition effect is likely to be confined to individual investors. In support for this conclusion, Odean (1998; see also Das, 2012) showed that due to the disposition effect investors obtain lower returns. In a similar vein Weber and Camerer (1998, p. 344) noted that "Volume is usually high during the run-up, and thin on the crashes … Disposition effects may help explain these facts. For example, high run-up volume occurs because subjects eagerly sell winners … As prices fall, … offers often appears, far above the bottom-fishing bids, as sellers post hopeful offers to sell at break-even prices…" Yet, an individual-level analysis needs to consider in more detail the interaction between sellers prone to the disposition effect and potential buyers.

In this section both the availability of sellers and buyers and their interaction are considered. Noting that since the disposition effect is observed for selling stocks, we (i) distinguish between the role of seller (in which some market participants are prone to the disposition effect) from the role of buyer in which some execute a momentum strategy of buying winners (Hong & Stein, 1999) and others, believing in price reversion, execute a contrarian strategy of buying losers (Grinblatt & Keloharju, 2000). The differences in buying and selling decisions should be noted. Buying stocks is commonly a choice among a large number of options that requires searching and evaluating information from many different sources. It is likely that information about the stocks´ future prospects are dominating. In contrast, selling is a decision made for a single stock or a limited number of stocks in a portfolio. The past performance of the stock(s) is then likely to be more salient. Furthermore, we assume (ii) that market participants (correctly or incorrectly) believe that prices follow an upward, downward or no trend (Andreassen, 1990; Barberis, Shleifer, & Vishny, 1996). An upward price trend implies that stocks are more likely to be winners and a downward price trend that they are more likely to be losers. In the case of an upward trend with increasing prices we define the disposition effect such that stocks are sold to momentum buyers at a price which is lower than the higher prices materialized when the trend continues. In the case of a downward trend with decreasing prices, we define the disposition effect such that stocks are not sold (or sold late at a lower price) to contrarian buyers willing to buy.

Combining (i) and (ii) we analyze the interaction between sellers (prone to the disposition effect) and (momentum or contrarian) buyers when there is a fundamental upward or downward price trend[2]. Our conjecture is that if there are enough buyers the prevalence of the disposition effect (1) intensifies the upward price trend and (2) attenuates the downward price trend. It seems to follow straight-forwardly from the definition of the disposition effect that if there are a sufficient number of (momentum) buyers when the prices go up, the prices would increase further. In contrast, when the price trend is downward the prices will be upheld if there are an insufficient number of sellers despite (contrarian) buyers willing to buy.

[2]We assume that a stock´s fundamental upward or downward price trend is started and maintained after arrival of positive news about company earnings (e.g. Cutler et al., 1989). This is a simplification but does not limit the possibility to generalize our results. Other possibilities are noted later.

In the following analysis we assume that some investors prone to the disposition effect use heuristics in making sell decisions as we detailed in the immediately preceding section. We further assume that investors prone to the disposition effect are only a fraction of all investors holding a stock and we therefore consider how the stock price depends on changes in this fraction.

Upward Price Trend

Assume that for an investor *i*

$$p_{ijt} = q_{ij} + d_{ijt} \qquad t = 0, 1, 2, \ldots \qquad (1),$$

where p_{jt} is the current price for stock *j* at time *t* and q_{ij} the price for stock *j* at which the investor *i* bought the stock. We define $d_{ijt} \equiv p_{jt} - q_{ij}$ such that if the investor sells the stock at the current price, $d_{ijt} < 0$ is a realized loss, $d_{ijt} = 0$ a neutral break-even outcome, and $d_{ijt} > 0$ a realized gain. We assume that a particular investor *i'* prone to the disposition effect has an aspiration level such that at time *t* his or her sell price for stock *j* is given by $p^*_{i'jt} = q_{ij} + d^*_{i'jt}$ where $d^*_{i'jt} \equiv p^*_{i'jt} - q_{ij}$. Thus, when p_{jt} increases to $p^*_{i'jt}$ such that $d_{i'jt}$ reaches $d^*_{i'jt}$, the gain is perceived to be sufficiently attractive to sell the stock. We want to show next under which circumstances an upward price trend is changed by the disposition effect. Assuming the price trend is linear over time *t*, it may be decomposed as follows

$$p_{jt} = p_{j0} + (1 + \Delta b)bt \qquad b, p > 0; t = 1, 2,\ldots \qquad (2),$$

where p_{j0} is the price from which the price trend starts, *b* the slope of the fundamental upward price trend, and Δb the change in slope of the price trend when the investor is prone to the disposition effect. Figure 1 illustrates that a momentum investor buys the stock when a fundamental upward price trend (broken line) starts. Being prone to the disposition effect, the investor sells the stock share before the upward price trend ends. If there is only one seller and only one buyer offering to buy at the price (*bt*) the seller asks, then $\Delta b = 0$, that is, the observed price trend does not deviate from the fundamental upward price trend. For a linear price trend the transactions are evenly spaced along the time axis if d^*_{ijt} is constant.

Assume next that at *t* there are m_{jt} momentum buyers of stock *j* held by investor *i* and that the potential buyers´ bid prices are normally distributed with the mean *bt* (the fundamental price at *t*). Since the share-holding investor at each time *t* can sell at a price higher than *bt,* this would lead to overshooting of the upward price trend ($\Delta b > 0$). Note that the share-holding investor would still earn less than if selling later since p_{jt} always exceeds $p_{j,t+1}$.

Now assume there is a constant number $s_j + r_j$ shares of stock *j* that each is held by a different investor[3]. At time *t*, s_{jt} shareholders are prone to the disposition effect and therefore willing to sell. Their sell prices p^* are assumed to be normally distributed with the mean *bt*. This assumption is justified if the stock was bought at different prices *q* in the past and d^* varies. The remaining r_{jt} shareholders are not willing to sell. We propose that

$$\Delta b = u(m_{jt} - s_{jt})/(s_{jt} + r_{jt})$$

where $(m_{jt} - s_{jt})/(s_{jt} + r_{jt})$ is the relative demand and *u* its impact on the price. We assume tha *u* increases with the variability of buyers' and sellers' reservation prices due to uncertainty about the fundamental price. After substituting in equation 2, setting $p_{j0} = 0$, and simplifying

[3]The derivations will be the same if instead fewer shareholders hold more than one share.

$$p_{jt} = [1 + u(m_{jt} - s_{jt})/(s_{jt} + r_{jt})]bt \qquad p, b, m, r, s, u > 0 \qquad (3)$$

Equation 3 implies that p_{jt} follows the fundamental upward price trend bt if for all t the number of buyers (m_{tj}) equals the number of sellers (s_{jt}). p_{jt} will increase linearly at a higher rate than the fundamental upward price trend ($\Delta b > 0$) if the difference between the number of sellers and number of buyers is positive and constant. It will increase linearly at a lower rate ($\Delta b < 0$) if the difference is negative and constant.

If it is assumed that the ratio s_{jt}/r_{jt} is constant[4] but the number of buyers varies over time, the linear increase will change. Figure 1 exemplifies how the change may look if there are fewer buyers than sellers when the price trend starts (due to under-reaction to the news), increasing to reach a maximum (due to over-reaction to the news), and finally again decreasing (due to e.g. liquidity constraints). Thus, the price first undershoots the underlying price trend, then overshoots, and finally undershoots again.

Downward Price Trend

During a downward price trend d is negative implying that the stock can only be sold at a loss. We assume that there are (contrarian) investors (c_{jt}) who are willing to buy. Their bid prices are normally distributed with mean bt. Shareholders (s_{jt}) prone to the disposition effect are not willing to sell until d (the paper loss) reaches an unacceptable value $d^{\#}_{ijt} \equiv p^{\#}_{ijt} - q_{ij}$. We propose that for $b < 0$; c, p, q, r, s, $u > 0$

$$p_{jt} = \begin{cases} [1 + u(c_{jt} - r_{jt})/(s_{jt} + r_{jt})]bt & \text{if } 0 > d^{\#}_{ijt} > p_{jt} - q_{ij} \\ [1 + u(c_{jt} - r_{jt} - s_{jt})/(s_{jt} + r_{jt})]bt & \text{if } d^{\#}_{ijt} \leq p_{jt} - q_{ij} < 0 \end{cases} \qquad (4).$$

The number of contrarian buyers may be fewer than momentum buyers[5] but still exceed the number of sellers (r_{jt}) who are willing to sell. This results in undershooting of the downward price trend because the remaining shareholders (s_{jt}) prone to the disposition effect are not willing to sell unless $d^{\#}$ is equal to or exceed d. If the number of buyers remains the same, the sellers may then exceed the number of buyers which thus results in overshooting of the downward price trend. As exemplified in Figure 2, undershooting of the downward price trend (keeping up the price) is thus followed by a falling price that overshoots the downward price trend.

Discussion and Conclusions

In this paper we reviewed attempts to account for the disposition effect as deviations from expected value theory, in particular in terms of having prospect theory preferences in combination with narrow framing of single stocks in a portfolio. We argue that at least part of the explanation is instead that there are non-professional investors either buying in an upmarket or buying popular stocks. They are influenced by anticipatory hope dominating anticipatory fear of losing. Buying triggers anticipated elation of selling at a price exceeding the buying price. Selling is made when anticipated elation increases to dominate anticipatory hope. It is still conceivable that the stock price (or the market) turns downward before this happen such that the investors prone to the disposition effect start to incur potential losses.

[4]This assumes that the proportion of buyers prone to the disposition effect remains constant and equal to the proportion among the holders of the stock.

[5]Contrarian buyers are not assumed to be prone to the disposition effect in their role of sellers.

Selling is deferred until anticipated disappointment of selling at a loss becomes a relief from anticipatory fear of losing.

We also attempted to show how stock prices are affected by investors prone to the disposition effect. Positive or negative news (e.g. announcements of company earnings) start and maintain price trends in stock markets (Cutler, Poterba, & Summers, 1989). We do not claim that such price trends are caused by the disposition effect. Yet, we argue that there are conditions under which the disposition effect has consequences for both upward and downward price trends. These consequences are most likely changing over time due to changes in differences between number of buyers and number of sellers.

There is no reason to completely exclude a role of the disposition effect in stock markets when price movements occur for other than fundamental reasons (e.g. war threats, bank crises). If such upward price movements are large enough to make investors prone to the disposition effect offering their stock shares for sale, then a sufficient number of momentum buyers would likely intensify the upward movement. Conversely, investors prone to the disposition effect would attenuate a downward price movement by not offering their stock shares for sale. We only discuss these effects for single stocks. Yet, if the whole market turns upwards, more non-professional investors prone to the disposition effect would likely be attracted to buy, thus increasing the influence of the disposition effect on stock prices. A herding tendency among non-professional investors (Hirshleifer & Teoh, 2003; Sias, 2004) may further strengthen the influence of the disposition effect. Furthermore, some buyers are speculators betting on a continued upward price trend or a price reversal. Because these buyers are likely to bid higher prices than rational investors executing a momentum or contrarian investment strategy, the price trends would be even more pronounced when share-holding investors prone to the disposition effect offer their stocks for sale.

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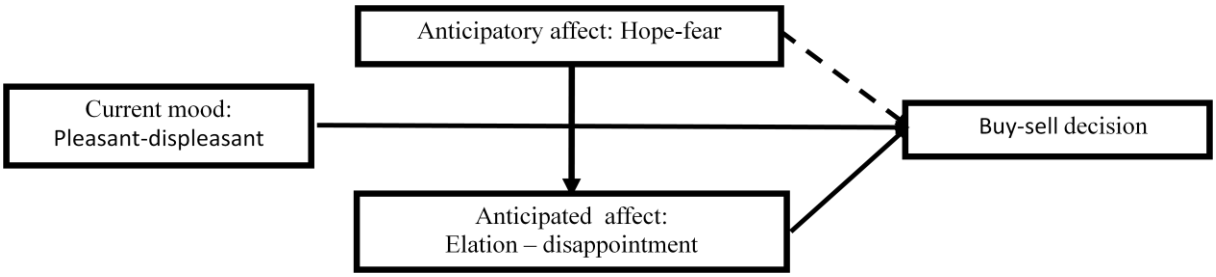

Figure 1. Affect influences on buy-sell decisions in stock markets.

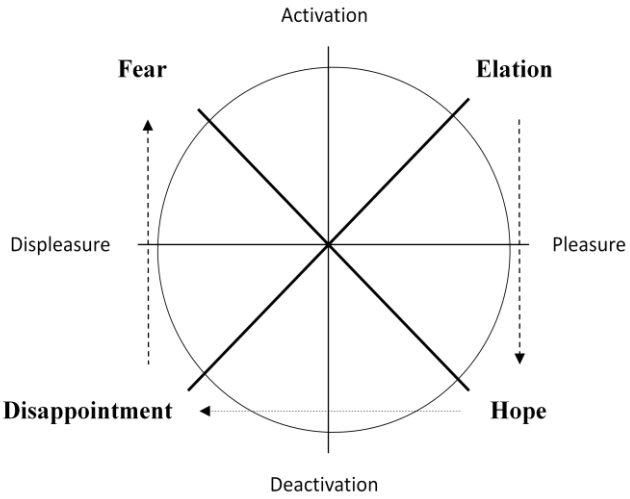

Figure 2. Affect grid including fear-hope and the preference order between the affects.

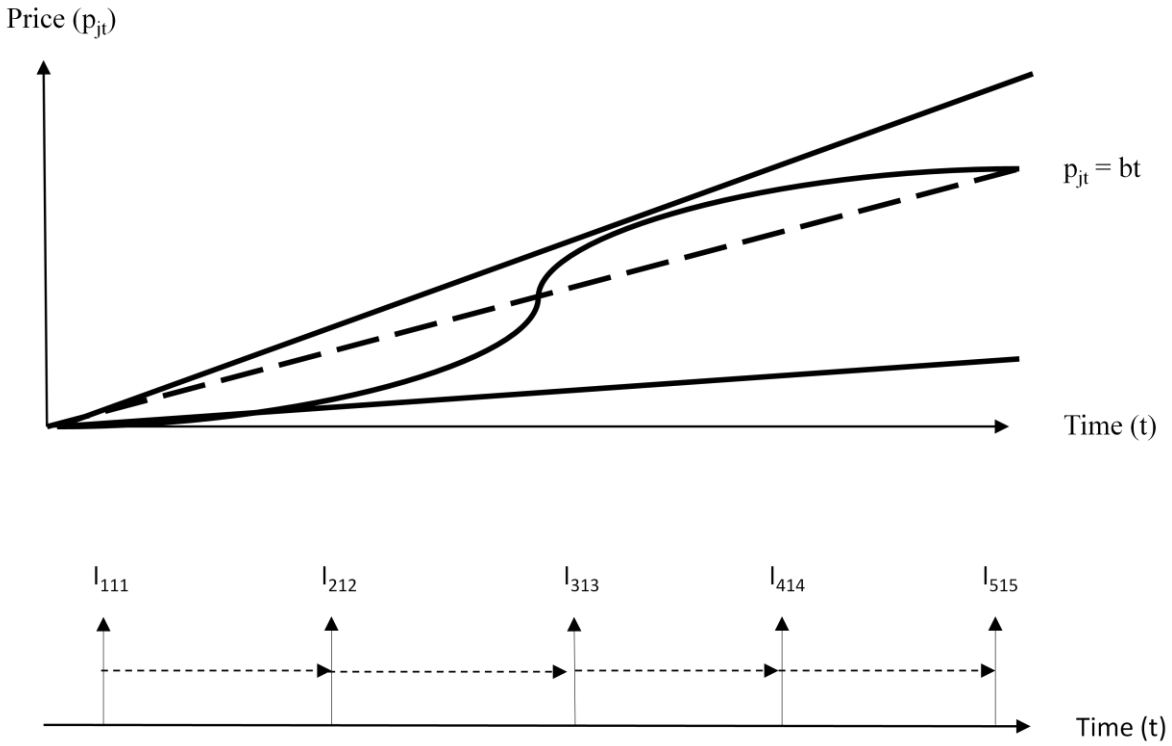

Figure 3. Upper graph shows three possible upward price trends (solid lines) deviating from the fundamental price trend (broken line); in lower graph I_{ijk} denotes investor *i* buying stock *j* at time *k* and then prone to the disposition effect selling at time *k* + 1 to investor $I_{i+1,j,k+1}$.

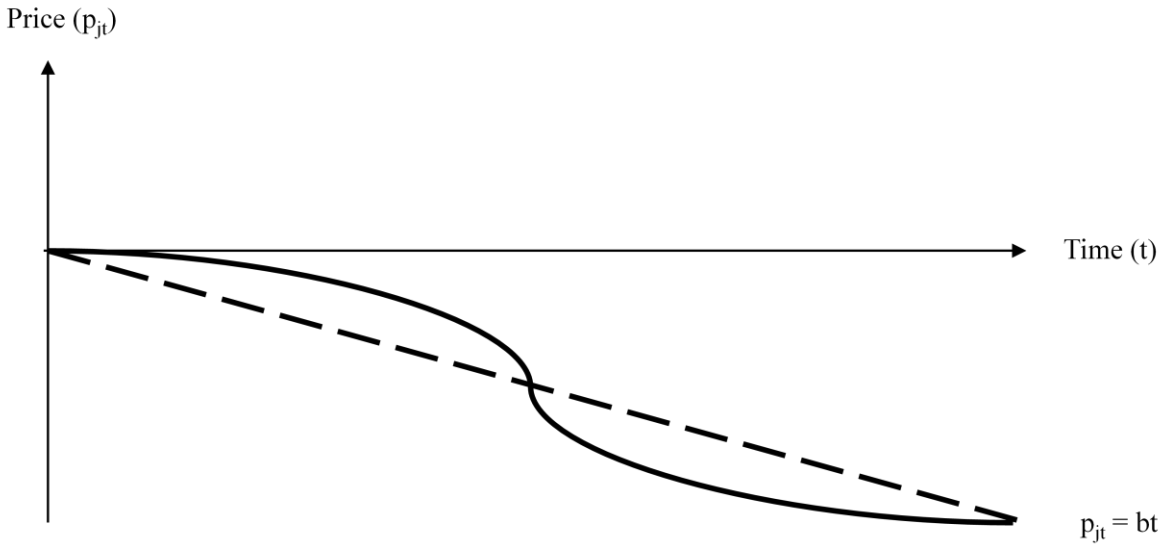

Figure 4. A possible downward price trend (solid line) deviating from the fundamental price trend (broken line).