Affect Account of Disposition Effect and Consequences for Stock Prices

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February 21, 2014

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Highlights

- The disposition effect in stock markets refers to that winners are hold too short and losers too long.
- Previous experimental and non-experimental research demonstrating the disposition is reviewed.
- It is claimed that one driver of the disposition effect is non-professional stock investors buying in upmarkets or buying popular stocks.
- An account is proposed of how affect influences non-professional investors’ proneness to the disposition effect.
- Consequences for stock prices are proposed to depend on the balance between disposition-effect-prone sellers and buyers.

ABSTRACT

The disposition effect in stock markets refers to that winners are hold too short and losers too long. Previous experimental and non-experimental research demonstrating the disposition effect is reviewed. We claim that one driver of the disposition effect is non-professional investors buying in upmarkets or buying popular stocks. In order to account for this, we propose that they set a short-horizon aspiration level that is subsequently adjusted depending on anticipatory feelings of hope or fear induced by price movements. In an upward price trend the disposition-effect-prone investors sell 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 is sold 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 disposition-prone sellers and buyers.

Key words: Disposition effect, stock price, trading, affect
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Research in behavioral finance demonstrated early that investors are prone to judgmental biases (Gärling et al., 2009; Hirshleifer, 2001) that are potential 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. This still remains to be determined, for instance in stock markets where judgmental biases may influence 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 be argued that when full information is not available (as seldom is the case), investors applying such heuristics in financial markets would outperform investors using analytical methods (e.g. Bayesian updating, expected-value maximization). Also for this reason it is important to assess the influences lay investors have in financial markets.

In this paper our aim is to examine whether, why and how prices are influenced by one of the most well-documented judgmental biases in stock markets, the disposition effect referring to the common observation that winners are hold too short and losers too long (Shefrin & Statman, 1985). In the next section we review previous research demonstrating the disposition effect and its proposed explanations. 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.

Evidence and Explanations for 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, others 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 for realized gains (sold stocks at prices higher than purchase prices divided by selling opportunities at prices higher than purchase prices). By comparing this ratio to the analogous ratio for realized losses (sold stocks at prices lower than purchase prices divided by selling opportunities at prices lower than purchase prices), 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 tax 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 selling winners and holding losers 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 they are reflected in the price, and avoiding trading costs for selling losers. Odean (1998) provided empirical arguments against each of these alternative explanations. Believing in price reversion (that today’s losers outperform today’s winners in the future) was another suggested alternative explanation. If future returns are expected to be higher for losers than winners, such beliefs would be justified. It took a pioneering experimental study conducted by Weber and Camerer (1998) to provide conclusive evidence for the disposition effect as well as for its proposed primary explanation (see below). In the study participating students made repeated portfolio choices by deciding to buy or sell stocks at randomly determined prices. 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. In one condition stocks in the portfolio were automatically sold and participants given the opportunity to buy them back. 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 even when 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 the early research (e.g. Odean, 1998; Shefrin & Statman, 1985), it was tacitly assumed that professional investors were 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 being wealthier, being an employed investor, and having 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 violated 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 selling losers, respectively. 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.

An important issue addressed in some studies is what consequences the disposition effect has on the stock market. 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 the observed positive correlation between price changes and trading volume (Bremer & Kato, 1996; Ferris et al., 1988; Karpoff, 1987; Kaustia, 2004; Lakonishok & Smidt, 1986). However, since these consequences to an unknown degree depend on other market participants’ trading, Odean (1998) concluded that the economic effects of the disposition effect are 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. 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…”.

In summary, the evidence for the disposition effect in stock markets is strong. Being a professional investor with trading experience seems to reduce the effect. In a stock market there are presumably also a large number of participants who never trade and therefore do not expose themselves to the disposition effect. Research has not investigated in detail the consequences the disposition effect may have for trading volumes and price movements in stock markets and why the disposition effect has negative wealth effects for individual investors.

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. In a brain-imaging study Frydman et al. (in press) obtained partial neural support for this assumption essential for the explanation of the disposition effect (Barberis & Xiong, 2009, 2012; Shefrin & Statman, 1985). Three features of prospect theory are then deemed relevant: (1) Evaluations of outcomes 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 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 (expected returns on the investment) may alternatively be considered to be a reference point. (2) The concave-convex form of prospect theory’s value function used to evaluate outcomes explains why people are risk averse for gains and risk seeking for 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 risking a possibly larger loss. If the expected values are not the same, this pattern of risk aversion versus risk seeking would be overridden. Since objective odds are not known to stock investors, the magnitude of gains or losses 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 et al., 1990), that is, the reluctance to sell something one possesses, 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 a necessary part of 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 et al., 2002). Conversely, the preference is to defer realizing losses. However, realizing losses may frequently be preferred to deferring 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 held in a portfolio. An implication is then 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 a following up study 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.

Gains and losses in prospect theory imply a good-bad evaluation (Russell, 2003). Such an evaluation may trigger affect (change in mood or feelings). An issue is then whether primarily good-bad evaluations, primarily affect or both are drivers of the disposition effect. Summers and Duxbury (2012) tested an early proposal by Shefrin and Statman (1985) that anticipated feelings of regret or disappointment motivates holding losers and anticipated rejoicing or elation selling winners too early. In two experiments they found indirect support by
demonstrating a disposition effect for a single stock only when purchased by the participants themselves which is a known prerequisite for feelings of regret. Direct support was obtained in additional experiments by means of ratings of experienced rejoicing, elation, regret, and disappointment.

In the following section we develop an affect account of the disposition effect building on these previous attempts. It complements but does not exclude an explanation based on prospect theory.

**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 grounded in expected-utility theory. A non-expected utility theory (prospect theory) has been evoked as explanation. Consistent with the evidence reviewed above, sophisticated professional investors seem to act more rational, whereas less sophisticated professional and non-professional investors seem to have “prospect-theory preferences” making them prone to the disposition effect. Although we do not rule out prospect theory as an explanation, it seems plausible that another main driver of the disposition effect is affect, probably most strongly among non-professional investors. We further argue that the disposition effect only applies to sellers (as the prospect-theory explanation implies), whereas buyers may adopt either a momentum strategy of buying winners or a contrarian strategy of buying losers (Svedsäter et al., 2009). As noted by Hens and Vlcek (2011), prospect theory cannot both explain the disposition effect and that investors prone to the disposition effect purchased the stock in the first place. It is then presupposed that buying and selling decisions have the same determinants (risk attitude, decision weights). However, buying stocks is commonly a choice among several options that requires searching and evaluating information from many different sources about future prospects. In contrast, selling is a decision made for a single stock or limited number of stocks in a portfolio. The past performance of the stock(s) may then dominate. Such a difference between buying and selling is not inconsistent with that affect influences decisions (Strahilevitz et al., 2011). Thus, it does not necessarily refute an affect account. Yet, in the following we only consider in more detail the determinants of sell decisions.

In the prospect-theory explanation of the disposition effect, different definitions of the reference point have been evoked. The most common definition (e.g. Henderson, 2012; Odean, 1998; Shefrin & Statman, 1985) is the purchase price (selling at this price is referred to as the break-even price). This is an economic sound definition if the inflation is minimal during the holding period. Other definitions are still conceivable. If the purchase price is not remembered (not unlikely in an experimental setting), the reference point may be an average of previous prices (Weber & Camerer, 1998). Another possibility is that the highest or lowest previous price is the reference point. The reference point may also depend on the price trend, raising when it is upward and falling when it is downward. Baucells et al., (2011) developed and tested a model of reference point updating. Neugebauer and Selten (2006) find support that feedback has an impact on investors’ decision. Kliger and Kudryavtsev (2008) showed empirically that updated reference prices based on quarterly earnings announcements accounted for the disposition effect. In our proposed affect account, an accepted realized gain or unacceptable potential loss corresponding to an aspiration price that varies dynamically with stock-price movements over time is based on the difference between the current price and the purchase price.

Influences of affect in stock markets 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 imaging (Knutson et al., 2008; Frydman et al., in press), and in experiments showing influences of
Affect images on trading decisions (MacGregor et al., 2000). A clearer definition of affect is still needed. As illustrated in Figure 1, we suggest such a definition distinguishing between (1) changes in a (pleasant-displeasant) current mood that, despite being influenced by circumstances incidental to stock-price movements, may still influence investor decision making (Isen, 2000; Schwarz, 2000), (2) anticipatory feelings of hope of earning and fear of losing due to stock-price movements (Lopes, 1987; Shefrin & Statman, 2000), and (3) anticipated feelings of elation and disappointment (or pride and regret1) associated with decisions to realize gains and losses (Mellers, 2000). We further suggest that whereas current mood may have a direct effect on decisions, anticipatory feelings have effects on decisions through anticipated feelings. When prices go up anticipatory hope triggers anticipated elation associated with selling a winner. Conversely, when prices go down anticipatory fear triggers anticipated disappointment associated with selling a loser. We propose that a decision is made when anticipated elation is equal strong as anticipatory hope or anticipated disappointment is equally strong as anticipatory fear. In the following we develop the rationale for this proposition.

Russell (1980, 2003) posits that core affects are elemental building blocks of all types of affect including current mood, anticipatory feelings, and anticipated feelings. More precisely, core affect is a “neurophysiological state consciously accessible as the simplest raw (nonreflective) feelings evident in moods and emotions” (Russell, 2003, p. 148). Corroboration comes from recent neuro-imaging research (e.g., Wilson-Mendenhall et al., 2013). Core affects are always accessible, either being neutral or having any other value in a dimensional system defined by the axis pleasure-displeasure and activation-deactivation. Several different methods of measuring affect (self-reports, peripheral physiology, startle responses, EEG, brain imaging with fMRI or PET, face expressions measured with EMG) support a dimensional description although all the methods do not converge on the two dimensions of pleasure and activation (or arousal) (Mauss & Robinson, 2009). The two-dimensional system of pleasure and activation is illustrated 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 the preference order elation > hope > disappointment > fear (Västfjäll & Gärling, 2006).

Our claim is that non-professional investors with anticipatory feelings of hope dominating anticipatory feelings of fear are attracted to purchase stocks in upmarkets (Baker & Wurgler, 2007; Kubinska et al., 2012). They may alternatively be attracted to purchase a particular popular stock. A positive current mood due to other influences (a sunny weather, a windfall salary) may occasionally strengthen such purchase intentions. If constructing a portfolio these investors’ strong preferences for one or a few popular stocks are furthermore likely to lead to insufficient diversification (Baltussen & Post, 2011).

We propose that the non-professional investors have an aspiration price for selling winners that is reached when anticipated elation associated with the outcome of a sell decision is equally strong as anticipatory hope. When the aspiration price is reached the investors anticipating elation want to sell. Yet, the aspiration price is not fixed but adjusted by the balance between anticipatory hope and anticipatory fear induced by price movements. Thus, if an upward price trend is pronounced and non-volatile, this results in slanting the balance in the direction of anticipatory hope. This would then boost the aspiration price. A price trend exhibiting high volatility may conversely induce more anticipatory fear such that the

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1We 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). For a loser Summers and Duxbury (2012) did not find a clear difference between regret and disappointment, nor for a winner between elation and rejoicing when the participants had or had not made the purchase themselves.
aspiration price is reduced. If the increasing price trend is stable such that the aspiration price is increased, a sell decision is likely to be reached later than if price volatility is high (see below).

A stock price may start to decrease before the aspiration price is reached. A downward price trend then elicits anticipatory feelings of fear of losing. 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 be plausible and is not consistent with empirical observations. We propose that sell decisions are deferred until anticipated disappointment is equally strong as anticipatory fear. Anticipatory fear may still for some time be suppressed by anticipatory hope of price reversion or high volatility of price decreases. Selling may also be deferred because investors prone to the disposition-effect shield themselves from negative information (Karlsson et al., 2009).

In the following we formalize our propositions for a single stock either increasing or decreasing with the difference \( d \) between the current stock price \( P \) and the purchase price \( Q \). For simplicity we assume that anticipatory hope \( H \) increases linearly with \( d \) at slope \( b_H \) and intercept \( a_H \), and that anticipatory fear \( F \) decreases linearly with \( d \) at slope \( b_F \) and intercept \( a_F \). Anticipatory hope increases at a lower rate than anticipatory fear decreases \( (b_H < -b_F)^2 \). Furthermore, hope still exceeds fear for some time after the price starts to decrease \( (a_H > a_F) \). The weighted difference or balance between hope and fear \( B_{H-F} \) increases with \( d \) as follows:

\[
B_{H-F} = \begin{cases} 
0.50(b_H - b_F)d + a_H - F & \text{if } d \geq -a_H - F / [0.5(b_H - b_F)]; \ 0 < b_H < -b_F; a_H - F > 0 \\
((1 - c)b_H - cb_F)d + a_H - F & \text{if } d < -a_H - F / [0.5(b_H - b_F)]; \ 0.50 \leq c \leq 1 
\end{cases}
\] (1)

We further assume that the balance \( B_{E-D} \) between elation \( E \) and disappointment \( D \) increases linearly with the difference between the current stock price and the purchase price \( d \). The balance is equal \( (B_{E-D} = 0) \) at the purchase price. Thus,

\[
B_{E-D} = b_{E-D}d 
\] (2)

The upper graph in Figure 3 illustrates equations 1 and 2. As equation 1 specifies, the balance between anticipatory hope and fear increases linearly from a positive value \( (a_H - F) \). The line representing equation 2 is crossed at \( d^* = P^* - Q \) where the positive elation-disappointment balance is equal to and therefore preferred to the positive hope-fear balance. \( P^* \) is then the lowest price at which the investor wants to sell a winner. When the current price decreases below the purchase price, anticipatory hope decreases and anticipatory fear increases at a higher rate. At the crossing point \( d^* = P^* - Q \) the negative elation-disappointment balance is equal to and therefore preferred to the negative hope-fear balance. \( P^* \) is then the highest price at which the investor is prepared to sell a loser. Equation 3 (see lower graph in Figure 3 for \( c > 0.50 \)) formalizes how preference for selling \( (S) \) varies with the difference between the current stock price and the purchase price \( d \):

\[
S = (b_{E-D} - b_{H-F})d - a_{H-F} 
\] (3)

This is a necessary part of the derivation. It is not inconsistent with that the investors purchased the stock. It is furthermore not inconsistent with the general observation that fear plays an important role in decision making (Bechara et al., 1997).
Equations 1, 2 and 3 capture our intuitions that a winner is sold when its current price is at least as much higher than the purchase price such that the anticipated elation from selling the winner equals the anticipatory hope of earning more. Note that the constraints on the parameters in equations 2 and 3 guarantee this to happen. In contrast, a loser is sold when its price is at least as much lower than the purchase price such that the anticipated disappointment from selling equals the anticipatory fear of losing more. Only one parameter (the weight $c$ placed on anticipatory fear when price goes down) accounts for changes in the propensity to sell at a loss. Setting $c$ to 0.50 would lead to that the loser is never sold ($S < 0$ for $d < d^+$). Any higher value of $c$ would lead to selling the loser ($S > 0$). A larger $c$ may furthermore be chosen such that the loser is sold later than the winner.

Preference for selling results in that the investors submit asking prices. Yet, transactions only take place if there are buyers. This may result in a sell price higher than $P^+$ or lower than $P^-$. No sell transactions by investors prone to the disposition effect are expected in the interval between these prices.

**Consequences for Stock Prices**

In order to understand the consequences the disposition effect has for stock prices, both the availability of sellers and buyers and their interaction need to be considered. Since the disposition effect is observed for selling stocks, we (i) distinguish between the role of seller (in which some 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). Furthermore, we assume (ii) that investors similarly believe that prices follow an upward, downward or no trend\(^3\) (Andreassen, 1990; Barberis et al., 1996). In the case of a trend with increasing prices, the disposition effect implies that stock shares are sold to momentum buyers at a price which is higher than the purchase price. Shareholders prone to the disposition effect sell the stock earlier at a price below the highest price at which shareholders not prone to the disposition effect sell. In the case of a downward price trend, the disposition effect implies that stocks are either not sold or sold to contrarian buyers willing to buy at a lower price than the purchase price and lower than the price at which shareholders not prone to the disposition effect sell the stock. Combining (i) and (ii), in the following we analyze the interaction between sellers (prone to the disposition effect) and (momentum or contrarian) buyers when there is an upward or downward price trend. Our conjecture is that if there are enough buyers the prevalence of the disposition effect intensifies an upward price trend and attenuates a downward price trend. It seems to follow straight-forwardly from the definition of the disposition effect that if there is a sufficient number of (momentum) buyers when the prices go up, the prices would increase further. In contrast, when the trend is downward the prices will be upheld if the number of sellers is insufficient despite there are (contrarian) buyers willing to buy. The strength of the influence depends on the proportion of shareholders prone to the disposition effect.

**Upward Price Trend**

Assume that for the investor $i$

$$P_{t} = Q_{t} + d_{t}, \quad P_{t}, Q_{t} > 0; \ t = 0, 1, 2, \ldots \infty$$

\(^3\)An upward or downward price trend is started and maintained after arrival of news about company earnings (e.g. Cutler et al., 1989). The disposition effect does not cause the price trend but may influence its strength and duration.
where $P_{jt}$ is the price for stock $j$ at time $t$ and $Q_{ij}$ the price for stock $j$ at which the investor $i$ bought the stock. Since $d_{ij} = P_{jt} - Q_{ij}$ as defined above, if the investor sells the stock at the price $P_{jt}$, $d_{ij} < 0$ is a realized loss, $d_{ij} = 0$ a neutral break-even outcome, and $d_{ij} > 0$ a realized gain. Consistent with equation 1, for a particular investor $i'$ prone to the disposition effect his or her lowest sell price for stock $j$ at time $t$ is given as $P^{+}_{ijt} = d^{+}_{ijt} + Q_{ij}$. We want to show next under which circumstances an upward price trend is changed by the disposition effect. Assume there is a latent upward price trend that is linear over time $t$. It may then be decomposed as follows

$$P_{jt} = P_{j0} + (1 + \Delta b_t) b_t$$

$b, P_{j0} > 0$ (5),

$P_{j0}$ is the price from which the price trend starts, $b$ the slope of the upward price trend, and $\Delta b_t$ the change in slope at time $t$ when the investor is prone to the disposition effect. If there is only one seller and only one buyer buying at the price $P^{+}_{ij} = (P_{j0} + b t)$ the seller asks, then $\Delta b_t = 0$, that is, the upward price trend would not be changed. If at time $t$, $m_{jt} > 1$ momentum buyers of stock $j$ bid normally distributed prices with the mean $P^{+}_{ij} = (P_{j0} + b t)$, then this would lead to overshooting of the upward price trend ($\Delta b_t > 0$) since the investor can sell at a higher price. Note that the seller would still earn less than if selling later since $P_{j,t+1}$ would exceed $P_{jt}$.

Now assume there is a constant number $s_j + r_j + h_j$ shares of stock $j$ that each is held by a different investor$^4$. At time $t$, $s_j$ shareholders prone to the disposition effect are willing to sell if $P_{jt}$ is equal to their aspiration price $P^{+} = d^{+} + Q$. The remaining $r_j$ shareholders are only willing to sell at a higher price. Shareholders $h_j$ never trade but have an impact on the relative demand. We propose that

$$\Delta b_t = u_t(m_{jt} - s_j)/(s_j + r_j + h_j)$$

$m_{jt}, r_{jt}, s_{jt}, u_t > 0$ (6),

where $(m_{jt} - s_j)/(s_j + r_j + h_j)$ is the relative demand and $u_t$ its impact on the price at time $t$. After substituting in equation 5 and simplifying

$$P_{jt} = P_{j0} + [1 + u_t(m_{jt} - s_j)/(s_j + r_j + h_j)] b_t$$

Equation 7 implies that $P_{jt}$ follows the upward price trend $b t$ if for all $t$ the number of buyers $m_{jt}$ equals the number of sellers $s_j$. $P_{jt}$ will increase linearly at a higher rate ($\Delta b_t > 0$) if the difference between the number of sellers and number of buyers is positive and constant. It will increase linearly at a lower rate ($\Delta b_t < 0$) if the difference is negative and constant. If the ratio $s_j/r_{jt}$ is constant$^5$ but the number of buyers varies over time, the linear increase will change. The upper graph in Figure 4 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 price trend, then overshoots it, and finally coincides with it.

**Downward Price Trend**

During a downward price trend $d_{jt}$ is negative implying that the stock can only be sold at a loss. We assume that there are contrarian investors ($c_{jt} > 0$) who are willing to buy at normally

$^4$The derivations will be the same if instead fewer shareholders each hold more than one share.

$^5$This would be the case if the buyers are prone to the disposition effect such that they subsequently sell the stock at a price below the highest price.
distributed prices with the mean \( P_j t + b t \). Shareholders \( r_{jt} \) not prone to the disposition effect are willing to sell, whereas shareholders \( s_{jt} \) prone to the disposition effect are not willing to sell until \( P^* = d^* + Q \). We propose that for \( b < 0 \) and \( c_{jt} > 0 \)

\[
P_{jt} = \begin{cases} 
  P_{jt} + [1 + u_t(c_{jt} - r_{jt})/(s_{jt} + r_{jt} + h_{jt})]b_t & \text{if } d^*_{jt} < d_{jt} < 0 \\
  P_{jt} + [1 + u_t(c_{jt} - r_{jt} - s_{jt})/(s_{jt} + r_{jt} + h_{jt})]b_t & \text{if } d_{jt} \leq d^*_{jt} < 0
\end{cases}
\] (8).

The number of contrarian buyers may be fewer than momentum buyers\(^6\) but still exceed the number of sellers \( r_{jt} \) willing to sell when \( d^*_{jt} < d_{jt} \). The downward price trend is undershoot because the remaining shareholders \( s_{jt} \) prone to the disposition effect are not willing to sell until \( d_{jt} \) is equal to \( d^*_{jt} \). 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 by the lower graph in Figure 4, keeping up the price is followed by a falling price that first undershoots then coincides with the price trend.

**Discussion and Conclusions**

In this paper we reviewed the empirical evidence for the disposition effect. We noted that the proposed primary explanation is that investors prone to the disposition effect have prospect-theory preferences combined with that they treat single stocks in a portfolio separately (narrow framing). We argue that at least in part the explanation is instead that investors prone to the disposition effect are primarily non-professional investors who buy in upmarkets or buy popular stocks because they are influenced by anticipatory hope of earning overriding anticipatory fear of losing. Buying triggers anticipated elation of selling at an aspiration price exceeding the buying price. Selling is considered when anticipated elation increases such that it is equal in strength to anticipatory hope. It is still conceivable that the stock price (or the market) turns downward before this happens such that the shareholders prone to the disposition effect start to incur potential losses. Selling is then deferred until anticipated disappointment is equal in strength to anticipatory fear of losing.

We also attempted to show how stock prices are affected by shareholders prone to the disposition effect. Positive or negative news (e.g. announcements of company earnings) start and maintain price trends in stock markets (Cutler et al., 1989). Thus, 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 the strength and duration of both upward and downward price trends. These consequences are most likely changing over time due to changes in relative demand, that is, the balance between the number of buyers and sellers.

A role of the disposition effect may also be observed 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 shareholders prone to the disposition effect offer their stock shares for sale, then a sufficient number of momentum buyers would likely intensify the upward price movement. Conversely, shareholders 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 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 these

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\(^6\)Contrarian buyers are not assumed to be prone to the disposition effect in their role of sellers.
shareholders (Hirshleifer & Teoh, 2003; Sias, 2004) may further strengthen the influence of the disposition effect.

Acknowledgements
Financial support for this research was obtained through grants to the Center for Finance, School of Business, Economics, and Law, University of Gothenburg, from the Swedish Agency for Innovation Systems (Vinnova) (#2010-02449).

References


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Figure 1. Affect influences on buy-sell decisions in stock markets.
Figure 2. A dimensional description of the core affects fear-hope and elation-disappointment. Arrows indicate their preference order.
Figure 3. Upper graph shows how changes in the balance between anticipatory hope and fear respectively between anticipated elation and disappointment are hypothesized to vary with the difference between current stock price and purchase price for an upward respectively downward price trend, and lower graph how the resulting changes in preference for selling would vary. For denotations, see text.
Figure 4. Hypothetical deviations (solid lines) from upward price trend (broken line in upper graph) and downward price trend (broken line in lower graph).