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"Buy on the Rumor:" Anticipatory Affect and Investor Behavior

Abstract

In this paper we demonstrate a relationship between investor psychology and security pricing around anticipated events. Taking a multidisciplinary approach, we pull together research in the finance, psychology, and neuroscience literature. Event-studies in the finance literature demonstrate anomalous security (stock, commodity, bond, or option) price movements around the dates of anticipated security-related events. From the neuroscience literature we demonstrate correlations between reward anticipation and the arousal of affect (feelings, emotions, moods, attitudes, and preferences). From the cognitive psychology literature we extract evidence for the central role of affect in motivating investing behavior. We briefly outline an investment strategy for exploiting the event-related security price pattern described by the trading strategy, "buy on the rumor and sell on the news."

Keywords: affect, expectation, behavior, market, event

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Introduction

The traders' aphorism "buy on the rumor and sell on the news" (BRSN) describes a strategy for exploiting a frequently observed financial market price pattern. This pattern (BRSN) is characterized by security prices rising prior to and falling subsequent to positively anticipated events. Security prices are, paradoxically, often observed to decline following an event outcome that is equal-to or better-than "expectations." We argue that investors' expectations of rewarding event outcomes are inflated by a neuro-affective biasing process. A disproportionate number of positively anticipated events will yield disappointing event outcomes.

Investors often gamble both on an event outcome and on the anticipated price appreciation as a result of that positive outcome. Anticipation of reward generates a positive affect state. Positive affect motivates both increased risk-taking and increased purchasing behaviors. As the anticipated potential reward approaches in time, investors' positive affect is increasingly aroused. Following the delivery of an expected reward, investors' affect regresses to neutral. This post-event net decrease in positive affect leads to more risk-averse, protective investing behaviors such as selling (consummate with the new, less positive, affect-state).

Many naïve investors are not aware that a positive event outcome does not necessarily cause security price appreciation. Naive investors may be surprised by their high levels of risk exposure when the euphoric affect that guided the accumulation of their high-risk positions dissipates following the event. Their diminished euphoria motivates increased caution (risk aversion) and investment repositioning (selling) of high-risk positions. In this market environment, a general increase in selling causes negative price pressure. Price decline alone augments investors' negative affect and increases risk aversion.

Several technical considerations are relevant to this discussion. There is often a price impact resulting from news reports forecasting future security-related events. According to the efficient market theory, investors quickly price security-relevant news. For the BRSN pattern to represent price inefficiency, news about the positive future event must have a delayed impact on investing behavior. We do not have a sufficient number of documented cases to statistically validate the existence of the BRSN pattern as an anomaly. We generalize statistical evidence of event-related anomalies from others' studies to support our model. We eschew a discussion of cognitive biases. Descriptions of individual judgment biases inconsistent with rational decision-making are related in Hilton (2001), Schiller (1998), and Kahneman and Riepe (1998). We utilize research directly linking affect-states to behavior. For purposes of simplification, we refer to anxiety and depression as negative affect states and to euphoria and relief as positive affect states.

This paper is structured as follows. We discuss both the movements of Apple Computer Inc.'s stock (AAPL) around its MacWorld tradeshows and the rise and fall of the Chinese B-share markets in early 2001 to provide illustrative evidence of the BRSN pattern in a variety of market situations. We review pricing anomalies related to a general conformity in investors' behavior such as under- and overreaction. We explain the effects of anticipatory affect on cognitive judgment and decision-making. After next integrating psychology and neuroscience research findings regarding reward anticipation and pursuit, we attribute the BRSN pattern to the influence of both anticipatory affect and disappointment on investor behavior. Finally, we briefly outline a hypothetical investment strategy for exploiting the BRSN pattern.

BRSN Examples

There is a surprising variety of both securities and events with which to illustrate the BRSN pattern. First we demonstrate a BRSN pattern surrounding Apple Computer Inc.'s (AAPL) MacWorld tradeshow on January 7, 2002. Next we demonstrate the remarkable price appreciation prior to and the price fall subsequent to the deregulation of the Chinese B-share markets in June 2001. Another striking example of the BRSN pattern, the Palm Inc. spin-off from 3Com Inc. in March 2000, is discussed by Barberis and Thaler (2001) and by Dremen (2001). The BRSN pattern is also seen in Pixar Inc. stock around the Pixar studio's movie releases (Tam, 2001).

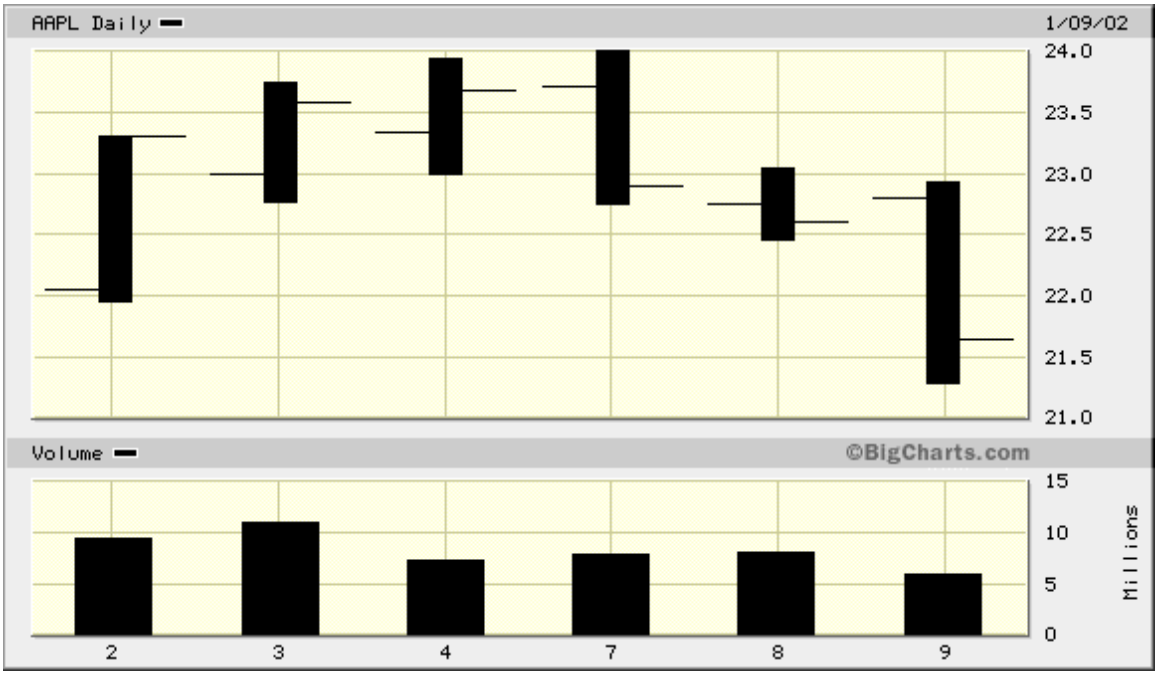
Apple Computer Inc. (AAPL) often demonstrates a BRSN pattern around its trade shows. The following excerpt is from a Wall Street Journal article appearing on January 3, four days before Apple's anticipated new iMac unveiling at the 2002 MacWorld trade show:

> The Cupertino, Calif., company's stock increasingly has been caught in a strange cycle: In recent years, the shares have run up strongly in advance of product debuts -- and declined thereafter. In a December study from Morgan Stanley, analyst Gillian Munson found that in three of five cases after Apple launched a new computer since 1997, its shares slipped. Of those three occasions, the stock fell an average 19% in the ensuing six months, she noted.
>
> This time around, the peculiar pattern could well be happening again. Apple's shares have risen steadily in recent weeks, from just under $15 in early October, driven at least in part by anticipation of new products at Macworld. At 4 p.m. Wednesday in Nasdaq Stock Market trading, the shares were up a healthy $1.40, or 6.39%, at $23.30. (Tam, 2002).

The following AAPL six-day daily price chart demonstrates the BRSN pattern. *AAPL shares peaked at a 6-week price high on the morning of the new iMac release* at the San Francisco MacWorld trade show on Monday January 7, 2002.

Figure 1

Daily AAPL price chart (Open, High, Low, Close) from January 2 to January 9, 2002.



Note: Downloaded from Bigcharts.com January 27, 2002.

The Wall Street Journal article describing this situational BRSN pattern for AAPL shares did not prompt adequate arbitrage to inhibit the pattern from recurring. AAPL shares declined more than 15% in the five days following the trade show.

A large-scale BRSN pattern developed in the spring and summer of 2001 in the Chinese B share stock markets. Historically the Chinese B share markets were reserved for foreign investors (and their U.S. Dollars). The Chinese A share markets were open to local investors (and their Yuan). The B share markets were undervalued compared to the A share markets. Shares of the same corporations typically traded on the B-share markets for between one-half and one-fifth of their price on the A-share markets as of mid-February 2001. The Chinese government announced on February 19, 2001 that it would allow local Chinese investors to invest in the B share markets. The date for the deregulation was set for June 1, 2001. In "China B-market move hailed by analysts," on February 20, 2001, CNN.Com ran a news article anticipating great profits for B market investors when local Chinese money began to flow into the market:

> "This is an extremely positive step," says Merrill Lynch chief economist Andy Xie. "It's going to significantly boost trading volumes and liquidity, and it will encourage investors to arbitrage in the markets, which will lead to much greater efficiency." Xie says there is $60 billion held in bank deposits in China, which is unable to be traded because of the former restrictions [dollars only in B share markets]. He adds that the B share market is worth just $8 billion and has only 114 firms listed on its boards -- many of them poor quality -- while the A share market is worth closer to $600 billion.

Figure 2

Daily closing price chart of the Shanghai B-share index from March 1, 2001 through September 1, 2001.

Note: Downloaded from Bloomberg.com September 1, 2001.

The Chinese markets were the world's best performing in the year 2000 ("China…," CNN.Com). Many Chinese investors were flush with cash and optimistic about the economic future of China. The consequences of $60 billion potentially flowing into a B share market capitalized at $8 billion are enormous. The risks of such a market deregulation were largely unknown and there was little global experience with such a situation. Via arbitrage, the flood of money into the B share market anticipated for June 1, 2001 should have equalized the share prices of companies trading on both the A and B markets, raising the B shares and lowering the A shares. As June 1, 2001 approached, the B share indices (Shanghai and Shenzhen) appreciated rapidly. The attached chart (figure 2) is a daily closing price chart depicting the Shanghai B share index. *Both the Shanghai and Shenzhen B share indices reached their all-time highs during the first 15 minutes of trading on June 1, 2001.* Expectations of quick profit were too high, and investors' disappointment led to B share selling that continued for several months. Figure 2 depicts three months of pre-event stock index rise and post-event decline illustrating the classic BRSN pattern.

BRSN Evidence

Recent research demonstrates that there are periods of nonrandom price movement in the financial markets around security-related events. Comprehensive reviews of asset pricing anomalies are available in Hirshleifer (2001) and Barberis and Thaler (2001). A review of studies documenting event-related market inefficiency (specifically under- and overreaction) is found in Daniel, Hirshleifer, and Subrahmanyam (1998). Trueman, Wong, and Zhang (2001) demonstrate event-based repeating price patterns around the earnings reports of internet companies from 1998 to 2000.

Most event studies analyze data from unexpected rather than expected events. One recent event-study of internet stock earnings reports (Trueman, Wong, and Zhang, 2001) analyzes a large sample of positively anticipated earnings announcements. Trueman et al. analyzed the security price movements around the earnings releases of 393 internet firms over 1,875 firm-quarters between January 1998 and August 2000 (the height of the internet stock bubble). Trueman, Wong, and Zhang (2001) showed that purchasing an internet stock five days prior to its earnings and then selling that stock at the open on the day immediately following the earnings release yielded an average market adjusted return of 4.9 percent. Shorting the same stock at the open the day after its earnings release yielded an average market-adjusted return of 6.4 percent when the short was covered at the market close five days later.

Unexpected Events: under- and overreaction

Well-documented market anomalies with neuro-affective causality similar to that of the BRSN pattern are documented in both the under- and overreaction and the momentum anomalies literature. We argue that investors' event anticipation arouses the innate neural networks governing reward pursuit. The occurrence of an unexpected event is not known to activate this network in a predictable fashion. Consistently anomalous security price movements following unexpected events indicate the existence of an as-yet-undefined neuro-affective process related to surprise. In event-studies of surprising unexpected events, both under- and overreaction to news shocks are well-documented.

Psychological models of the overreaction, underreaction, and momentum anomalies are common. Barberis, Schleifer, and Vishny (1996) formulate a model of security price over- and under-reaction to information when investor judgment is biased by conservatism and the representativeness heuristic. Daniel, Hirshleifer, and Subramanyam (1998) explain event-related security price anomalies according to the cognitive biases of investor overconfidence and self-attribution. Daniel and Titman (2000) explain the superior returns of a momentum investing strategy over the past 35 years as the result of investors' overconfidence bias. Dremen and Lufkin (2000) present evidence that investor under- and overreaction exist and are part of the same psychological process. Shiller (1998) suggests that descriptions of overreaction and underreaction are not likely to be good psychological foundations upon which to organize a general theory of economic behavior. Cognitive biases inadequately identify the behavioral motivations causing price anomalies.

Behavioral Conformity

In this section we cite evidence for the influence of investor behavior on price movement. Stereotyped investor behaviors emerge out of innate neural networks. Group-wide anticipatory affect induces conformity in investment strategies (e.g. the timing of buying and selling behaviors). Conformity in investment strategies minimizes mathematical complexity in security prices and contributes to price trends. In this section we discuss evidence for investors' behavioral conformity (a.k.a. herding behavior) during price trend formation.

The Oxford mathematicians, Johnson et al. (2001), developed a contrarian trading strategy that bet against the directional trading activity of the majority of market agents in the USD/Yen Forex market during the preceding hour. They closed their position at the end of the subsequent hour. Following this strategy, they report an approximately 54% prediction success rate in the USD/Yen Forex market from 1990 to 1999 (Johnson et al.). This simple strategy of betting against the price pressure from the previous hour yields statistically nonrandom accuracy. Chan (2001) found that a large stock price change, unsupported by news, on average was followed by a statistically anomalous price trend reversal over the next month. Chan and Johnson et al. illustrate the price trend reversals that often occur when a majority of market agents follow the same investing strategy (buying or selling), unsupported by new information.

Similar investing behaviors cause unilateral price pressure and initiate a price trend. Empirical data from studies with MBA students confirm a behavioral tendency to reinforce existing price trends (Schacter, Oulette, Whittle, and Gerin, 1987). Individuals in Schacter et al's study increased security-purchasing behavior during a market uptrend and increased selling behavior when presented with an up-to-date chart demonstrating a partial trend reversal (approximately 25% reversal). Both the price trend prior to an event and the post-event trend reversal are reinforced. Schacter et al.'s study does not give insight into the psychological mechanisms behind his students' irrational behavior, but it does demonstrate the behaviors that reinforce price trends and accelerate brief trend reversals.

Schacter et al. (1987) demonstrate investors' tendencies to reinforce existing price trends and brief price reversals. Statistical support for the idea of a general conformity in investors' behavior preceding price trend reversals ("contrarianism") comes from Johnson et al. (2001) (on an hourly) and Chan (2001) (on a monthly basis). Johnson et al. (2001) demonstrate mathematically the behavioral conformity observed by Schacter et al.

According to Barberis and Thaler (2001), Chopra, Lakonishok, and Ritter (1992) and La Porta et al. (1997) provide compelling evidence in support of the idea that investors make irrational forecasts of future cashflows. If excessive optimism or pessimism is driving these irrational forecasts, then earnings announcement dates should provide the impetus for correction. Barberis and Thaler find that the data does indeed show anomalous corrective activity following earnings announcements from these companies.

Mood is also presumed to influence security-purchasing behavior. One common finding involves the role of cloud cover, as a proxy for negative mood-states, on reducing purchasing behavior. Hirshleifer and Shumway (2001) (similar to Saunders (1993)) found that cloud cover in the city of a country's major stock exchange is correlated with low daily stock index returns in 26 national exchanges. Kamstra, Kramer, and Levi (2000a) show that disrupted sleep patterns after transitions to and from daylight savings time are related to stock returns. Kamstra, Kramer, and Levi (2000b) find that stock returns are significantly related to season, and they suggest that deterministic variations in the length of day contribute to this finding. Seasonal and weather factors contribute to conformity in investor behavior (presumably via mood).

Affect and Decision Making

Understanding the affective basis of investing behavior provides insight into the origins of security price trends and reversals. Since behavior is often assumed to arise from judgment and decision making processes, we examine research into the affective basis of decision making. Judgment and decision-making are traditionally considered to be consequentialist processes in the social science literature (e.g. expected utility theory). Consequentialism assumes that decision-makers assess the consequences of possible choice alternatives before deciding upon a course of action. Research in the field of cognitive psychology demonstrates systematic irrationalities in human judgment and decision-making inconsistent with consequentialism (cited in Hilton, 2001; Schiller, 1998; Kahneman and Riepe, 1998 [to name a few]).

We eschew a general discussion of the cognitive basis of judgment and decision-making in this paper. The role of affect in judgment and decision-making is well documented in recent research ((Loewenstein, Loewenstein, Weber, and Welch, 2001; Mellers, Schwartz, and Ritov, 1999; Mellers, Schwartz, Ho, and Ritov, 1997). Affective models of decision-making such as decision affect theory (Mellers et al., 1997) or the risk-as-feelings hypothesis (Loewenstein et al.) considerably expand upon expected utility theory.

Anticipatory affect refers to those emotions and feeling states that are immediate, visceral reactions to perceived risk, uncertainty, or potential reward (Loewenstein et al., 2001). Loewenstein et al. note that feelings about risk and cognitive risk perceptions often diverge. Cognitive assessments of risk tend to focus on both probabilities of possible outcomes and assessments of possible outcome severity. In risky situations anticipatory affective reactions often exert a dominating influence on behavior (over cognitive reactions) and frequently produce behaviors that are not adaptive. In addition, emotions often produce behavioral responses that depart from what individuals view as the best course of action (Loewenstein et al.).

Affective assessments of risk and potential reward are impacted by three factors according to Loewenstein et al.: the vividness with which consequences can be imagined, personal exposure to or experience with outcomes, and a past history of conditioning (2001). These affective assessments of risk are modified by the time-course of the decision, the vividness and associations the risky scenario induces, and one's evolutionary preparedness for certain emotional reactions (Loewenstein et al.).

Loewenstein et al. suggest that feelings of fear or worry in the face of decisions under risk or uncertainty have an all-or-none characteristic: they may be sensitive to the possibility rather than the probability of negative consequences. For example, the thought of receiving an electric shock is enough to arouse individuals emotionally, but the precise likelihood of being shocked has little impact on the level of arousal (Loewenstein et. al.). The vividness of a potential reward or catastrophe is more affectively arousing than the probability of it actually occurring.

Over distant time perspectives, choices reflect a rational preference for a reward according to a log-linear discount rate (Winston and Woodbury, 1991). Myopic discounting refers to the tendency to increasingly favor small proximate rewards over large distant rewards as the event time for the small proximate reward approaches (Winston and Woodbury). A potentially rewarding event is regarded more positively and its rewards are pursued more aggressively (hyperbolically) as the event approaches in time. Gray (1999) demonstrates that myopic discounting also occurs during the avoidance of punishments (preference for a larger distant punishment).

Investors deal with the possibilities of loss and reward daily. Investors cognitively assess outcome probability and potential severity. Affectively, investors feel possible outcomes more acutely if they are more vivid or imaginable. The vividly imagined possibility of imminently achievable wealth and material success in an impulsive and inexperienced investor will lead to a strong drive to invest in (e.g. buy) the associated security. Likewise, the vividly imagined possibility of personal poverty or market panic will generate the desire to divest (e.g. sell). Affect is more strongly aroused as a feared or anticipated event approaches in time. Investors likewise find it difficult to incorporate the statistical probability of emotionally exceptional outcomes into their judgment. All investors experience the impact of their affect on their behavior, but experienced investors are more likely to cognitively attenuate their affect-driven behavioral impulses.

Expectations and Anticipatory Affect

In the following paragraphs we discuss the role of anticipatory affect in biasing investors' expectations. Anticipation is generally studied in relation to single expected events of uncertain outcome (such as a gambles). Anticipation of reward generates a positive affect state (a useful simplification). Affect biases decision-making. Frustration of expectations induces negative affect. Negative affect incites risk-averse, protective behaviors (such as closing investment positions or inhibiting further investment).

MacGregor, Slovic, Dremen, and Berry (2000) find that subjective affect and imagery influence judgment in predicting industry group financial performance. MacGregor et al. speculate that affect and imagery may be the only judgmental bases on which individuals are able to rely when information about a financial offering is vague. Vague information about decision alternatives may lead individuals to rely more heavily on their affective assessments.

Evidence from the psychology literature indicates that both desiring and expecting a particular experimental outcome not only biases one's memory retrieval but also the reconstruction of existing memory traces (McDonald and Hirt, 1997). Study participants prompted to expect an outcome conflicting with their desires gave no weight to the expectancy in recall and seemed to actively attempt to refute the implications of that expectancy by recalling inconsistent information more accurately (McDonald and Hirt). BRSN may be such a consistent pattern because it represents a powerful correlation between our desires (security price appreciation) and our expectations (imminent monetary reward). In situations where expectations and desires are synchronized, dissonant perceptions arouse mental mechanisms of defense that guard against the conscious awareness of potential frustration.

Mellers et al. (1999) discovered that individuals can accurately forecast the emotions they will experience after either outcome of a gamble. Investors may correctly anticipate how they will feel if the outcome of an investment is negative, but they may either not be aware of or deny the potential difficulty in controlling their behavior when that outcome arouses strong reactive affect states.

McDonald and Hirt (1997) report that affective preference correlates with self-forecasts of investing behavior. Mellers et al. (1997) find that gamblers' choices are closely related to the strategy of selecting the monetary gamble associated with the better expected feeling. People prefer the gamble that, on average, gives them the greatest emotional satisfaction (Mellers et al., 1999). There is evidence that affective preferences drive buying and selling behaviors (Raaij, Veldhoven, and Warneryd, 1988). Anticipation of security-related

reward induces positive affect. Investors are thus predisposed to invest in (purchase) those securities that they feel good about (positive affect). Investors are more likely to purchase a security for which they can anticipate a rewarding future event.

Reward Pursuit

Recent neuroscience and neuroimaging literature demonstrates the arousal of brain regions associated with affect during the anticipation of punishment or reward. The brain's affective reward centers generate the subjective positive emotions and feelings associated with reward. The negative emotions and feelings associated with punishment are generated by the affective punishment centers. Affect-arousal is proportional to the size (quantity) of the anticipated reward and one's expectancy (desire) for the reward (Miller and Cohen, 2001).

The behaviors generating the BRSN patterns in the markets may have unconscious affective origins. Information can be cognitively analyzed at a level including emotional/affective meaning without reaching awareness (Amini et al., 1996). Knutson, Adams, Fong, and Hommer (2001) find subcortical localization of affect states during brain scans in subjects offered monetary reward incentives. The conscious awareness of activity in one's biological affective centers is often limited to vague subjective experiences of "feelings." During anticipation of monetary reward, the brain's affective circuits may direct behavior independently from conscious awareness and cognitive control.

During laboratory gambling experiments, the brain's affective centers are responsive to changes in both the size and probability of a potential reward. Changes in the size (quantity) of a potential reward or punishment are more emotionally activating than proportional changes in the probability of receiving the reward or punishment (Miller and Cohen, 2001). The activity of the affective centers in functional MRIs increases proportionally to the size of anticipated rewards or punishments (Breiter, Aharon, Kahneman, Dale, and Shizgal, 2001; O'Doherty, Kringlebach, Rolls, Hornak, and Anders, 2001).

Increasing the size of an anticipated monetary reward leads to both higher self-reported pre-reward ratings of "happiness" and increased affective reward center activity in the brain (Knutson et al., 2001). Larger anticipated rewards stimulate greater positive affect. Miller and Cohen (2001) found that, in addition to size, level of expectancy (desire) for the reward also increases affect-arousal proportionally.

Mellers et al. (1997) designed experiments to measure individuals' affect states after a gamble. In their first series of experiments, Mellers et al. measured the emotional response to receiving a cash reward or punishment. They found that as the probability of receiving a monetary reward during a gamble *decreased*, individuals' expressed level of elation when receiving the reward *increased* (Mellers et al.). The inverse was true for punishments. They also found that surprising wins are more elating than expected wins, and surprising losses are more disappointing than expected losses (Mellers, Schwartz, and Ritov, 1999).

Neuroimaging demonstrates the difference in affective arousal between expected and unexpected monetary gain. The affective centers of the brain show no increased activity from baseline upon receipt of a monetary reward if the subject has been conditioned to expect it (Schultz, Dayan, and Montague, 1997; Berns, McClure, Pagnoni, and Montague, 2001; Miller and Cohen; Suri and Schultz, 2001). A signal heralding the imminent delivery of monetary reward will arouse positive affect, but the delivery of the expected reward itself causes no change in affect-state after one has been conditioned to expect it (Spanagel and Weiss, 1999). As a subjective correlate to these observations, Mellers et al. (1997) find that the reported experience of elation when receiving a reward is decreased if the reward was expected.

An unexpected cue signaling the imminent delivery of an unexpected reward is as affect-arousing as the delivery of an independent unexpected reward itself (Suri and Schultz, 2001). We conclude from the above findings that unexpected news heralding a positive security-related event is affectively arousing, whereas

occurrence of the anticipated event itself arouses little affect (less than was aroused by the announcement of the forthcoming event).

Interestingly, when a conditioned stimulus (cue) is delivered but is not followed by the expected reward, then the brain will show *inhibited* activity (decreased dopaminergic neuronal firing) in the reward-oriented neural circuitry at the precise time when the expected reward usually occurred following the cue (Schultz et al., 1997). If the event does not proceed as indicated, then an inhibitory affective reaction occurs.

Positive affect drives purchasing behavior (Raaij et al., 1988). We assert that the reduction of positive affect (secondary to termination of positive anticipatory affect after expected reward delivery) will lead to decreased purchasing (from its pre-event, positive affect-induced level). Following an expected event outcome and in the absence of proximate good news to anticipate, any decrement in affect-state will prompt post-event *selling* behavior.

Disappointment

In the first half of the BRSN scenario, some informational cue is circulating among investors heralding the future occurence of a positive event (the reward). Receiving this cue generates a positive emotional reaction in investors. Positive affect both biases outcome probability assessments and incites investors (particularly inexperienced investors) to gamble on the event outcome. The use of inflated probability assessments (expectations) of potential reward predisposes investors to post-event disappointment.

Gray (1971) did research on the affective and physiological experiences related to the absence of an expected reward ("frustrated expectations"). Gray found that, in rats, the physiological signs of frustrated expectations are identical to those after punishment. Rats' behavioral and physiological changes indicated a profound anxiety or fear state when they did not receive a stimulus-cued reward of the same size that they had been conditioned to expect. Gray notes that delivery of a food reward that is a fraction of the size of what experimental rats are conditioned to expect, though still larger than what they are capable of eating, induces an anxiety state. A parallel affect state (anxiety) may exist in investors when their bloated event expectations are not met, even when an event outcome is overall positive for the security. This anxiety secondary to "not-as-good-as-expected" news may contribute to post-event selling behavior.

Mellers et al. (1997) demonstrate the negative affect induced when a monetary gain is less than expected. Mellers et al. discovered that in 50/50 gambles, gains can be disappointing (if a greater gain is missed) and losses can be elating (if a larger loss is avoided). Perceptions and framing effects determine the resulting affect-state of the participants. A positive affective response will result if the outcome is greater than the anticipated gain. A neutral or negative affective reaction will follow if the outcome is equal to or worse than the highest anticipated gain.

Since many security investors are, in fact, gambling on the security price when they invest prior to a potentially rewarding security-related event, negative post-event security price movement (even in the case of better-than-expected event outcomes) will lead to disappointment and predispose investors to sell.

When the expected event outcome occurs, no affect is aroused. Anticipatory positive affect vanishes at the time of reward delivery. There is thus a net decrease in positive affect-state to a more neutral level. Isen (1990) reports that positive affect increases risk-taking behaviors when possible negative consequences are not prominent in the decision frame. Assuming that positive affect and risk-taking increase proportionally, we assert that a decrease in positive affect will decrease risk-taking behaviors and increase fiscal conservatism. These shifts motivate readjustment of one's portfolio to accommodate one's new (decreased) risk tolerance. Any decline in affect-state increases cognitive awareness of risks and leads to portfolio readjustment within parameters of individual risk tolerance.

Event Selection

Investors' anticipation of loss or reward is often reflected in their behavior. Our BRSN-based investment strategy relies upon a collection of both qualitative and quantitative indicators. Qualitatively, we look for an event with vivid potential consequences (e.g. a blockbuster new product) and the possibility of a large reward for investors. We would like for the event and its potential rewards to be well-known among naïve, inexperienced investors. Ideally, the event we target is one that stands out as offering unique opportunities and rewards without obvious risks. Media reports should highlight the positive opportunity embodied in the event with little attention to the potential downside.

Quantitatively, we wait to observe market-adjusted positive price movement prior to the event. Sustained positive price pressure indicates buying in anticipation of the event. If the buying accelerates as the event approaches, then we have evidence of myopic discounting and affect-driven buying. Securities with high ratios of short interest are vulnerable to short squeezes during this pre-event period. Option premiums and volume often increase anomalously prior to the event.

Some event classes that are anticipated in security prices include: earnings reports, product releases, trade show presentations, and FDA meetings. On a global scale, national elections, government economic and commodity data releases, Federal Reserve Board announcements, government policy decisions, and G7 or OPEC policy statements may incite anticipatory and reactive security price movements.

Before executing our BRSN strategy, we first find a security-related event that meets the following criteria. With the following criteria met, the probability for pre-event price rise and post-event price decline is high.

1. Vivid and easily imagined potential reward
2. Wide public recognition of the potential reward
3. Minimal dissemination of information about the event's risks
4. Minimal investor conditioning to or experience with the event risks
5. Event is represented as a relatively novel/unique phenomenon
6. No other salient security-related events in the peri-event period
7. Acceleration of upwards price movement as the event approaches.
8. Above average security trading volume

There are two strategies that may be followed to exploit the BRSN pattern. The comprehensive strategy includes buying the security before the positively anticipated event. If a positive market-adjusted price movement is observed then one may enter a long position. The security can then be sold immediately prior to the event and shorted immediately following the event. A simpler strategy is to forgo pre-event purchasing and to short the security immediately following the event. By staying out of the market during the event, unnecessary risk is eliminated.

As a rule-of-thumb, the number of days of anomalous price increase prior to the event is generally equivalent to the number of days of anomalous price decline following the event. One should cover the post-event short position after the same time period over which the security had anomalously risen (market-adjusted) prior to the event. We recommend diversification while following this strategy, as many attempts to profit from the BRSN pattern fail. BRSN is frequently referenced in hindsight, and exploitation of this pattern is not an easy task.

Discussion

The first of our tasks in this paper is to present both examples of and statistical evidence for repeating, anomalous security price movements surrounding anticipated events. We refer to the traders' aphorism "buy on the rumor and sell on the news" (BRSN) to describe this pattern. We discuss the role of affect in driving investment behavior and biasing expectations. We outline a strategy for identifying and exploiting investors' event-related expectations in the markets.

We explain the relevance of recent research in finance (event-studies and overreaction), mathematics (price reversals and complexity), psychology (affect and decision-making), and neuroscience (anticipation and expectancy) to our model of BRSN. Johnson et al. (2001) demonstrate a correlation between investors' behavior and repeating patterns in the financial markets. We cite evidence that affect directs the formation of expectancies and subsequent behavior during the anticipation of reward from monetary gambles, thus we link investors' emotional states to their investment behavior.

Individual events provide a temporal anchor upon which expectations are based. Information will have a greater impact on one's behavior if it is about the near future, has a strongly positive or negative affective quality, is well-known, and has potentially vivid consequences (easily visualized/imagined) (Loewenstein et al., 2001). As an anticipated event approaches in time, one's awareness of its vivid positive or negative implications increases. Anticipation of probable reward generates positive affect. Positive affect increases investors' risk-taking and purchasing behaviors. Positive affect exaggerates probability estimates of rewarding outcomes. Exaggerated security-related event expectations, when disappointed, precipitate selling.

The occurrence of the anticipated rewarding event will decrease an investor's affect-state from positive (during reward anticipation) to neutral. This attenuation of affect may prompt risk aversion regarding current portfolio weightings (accumulated while in a positive affect state). Secondary to decreased positive affect, one may be driven by a renewed sense of risk aversion to sell excess shares, thus culling risk exposure. Negative price movement leads to anxiety and negative affect in investors. Negative affect accelerates risk-averse, protective behaviors.

When the prepared investor is aware of the anticipatory affect surrounding an upcoming event (see the criteria above) and observes an affect-driven price change prior to the event, a BRSN-exploiting investment strategy may be implemented. It is possible that an inverse of the BRSN phenomenon may be found around negatively anticipated events. We would expect negative future events with the possibility of large, vividly perceived losses to be preceded by security selling and followed by security buying. There is, however, evidence in Isen (1990) that negative affect has a different influence on cognition than positive affect (not simply an inverse), so a separate model will likely be necessary to exploit negatively anticipated events.

Because of the large variety of qualitatively similar events that fit the model presented, it is difficult to gather comprehensive data to test our hypothesis. We make the assumption that the behavior of individuals in simulated stock markets or monetary incentive tasks mirrors that of investors in a real-time capital market. Much data remains to be gathered. As it stands, the psychological anomalies identified by behavioral finance remain largely unapplied to hedge fund or institutional investment strategies. Notable institutional exceptions are Fuller and Thaler Asset Management and Martingale Asset Management.

Fama (1998) states that a workable alternative model to market efficiency is facing a "daunting task." Such a model must specify biases in information processing that cause the same investors to under-react to some types of events and overreact to others (Fama). Shiller (1998) suggests that the psychological theories underlying behavioral finance cannot be simplified to the form requested by Fama. In answer to both Fama and Shiller, we suggest that investor affect is the substrate of biased information processing during the anticipation of loss or reward. We further suggest that the brain's affect-oriented neural circuitry is the etiology of many of the stereotyped "irrational" biases identified in the psychology and finance literature. Currently there are

sufficiently anomalous statistical data available from event-studies of discrete, affectively weighted, anticipated events to illustrate our theory in the financial markets.

We suggest that mathematical descriptions of individual cognitive biases are not useful in forming a comprehensive new paradigm for economic judgment and decision-making. A more systematic neuroanatomical approach toward elucidating the affective processes biasing judgment and decision-making is needed. We and others (Blakeslee, 2002) suspect that affect-based models of judgment and decision-making derived from neuroscience research will be integral to a generalizable model of economic decision-making.

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