The Courage of Misguided Convictions

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The field of modern financial economics assumes that people behave with extreme rationality, but they do not. Furthermore, people's deviations from rationality are often systematic. Behavioral finance relaxes the traditional assumptions of financial economics by incorporating these observable, systematic, and very human departures from rationality into standard models of financial markets. We highlight two common mistakes investors make: excessive trading and the tendency to disproportionately hold on to losing investments while selling winners. We argue that these systematic biases have their origins in human psychology. The tendency for human beings to be overconfident causes the first bias in investors, and the human desire to avoid regret prompts the second.

There is one important caveat to the notion that we live in a new economy, and that is human psychology . . . which appears essentially immutable.

Alan Greenspan
Chair of the U.S. Federal Reserve Board
Speech at the University of California at Berkeley
September 4, 1998

Behavioral models of financial markets consider not only how people should act but also how they do act. People do not always behave rationally, and although departures from rationality are sometimes random, they are often systematic. For example, far more people overestimate, rather than underestimate, their driving ability (Svenson 1981).

Consideration for the observed traits of economic agents is not entirely new. In 1738, Daniel Bernoulli noted that people behave as if they are risk averse (see Bernoulli 1954). Prior to Bernoulli, most scholars considered it normative behavior for people to value a gamble at its expected value. Today, economists usually assume people are risk averse. Economists of the 19th century believed that, ideally, the present and the future should be treated equally, but they observed that generally people value present consumption more highly than future consumption (Loewenstein 1992). Today, economists usually assume that people discount the utility of future consumption. In reality, people are not always risk averse, nor do they always discount the future. Millions of people engage in regular risk-seeking activity, such as buying lottery tickets; others "bite the bullet" to be done with unpleasant experiences that they might otherwise delay. Risk aversion and discounting future consumption are sufficiently pervasive behaviors, however, that these behaviors are standard assumptions in economic models.

In recent years, psychologists have identified ways in which people systematically depart from optimal judgment and decision making. Behavioral finance enriches economic understanding by incorporating these aspects of human nature into financial models. Doing so is consistent with the tradition, if not the practice, in financial economics in the past several decades. Behavioral theories, like traditional theories, provide formal hypotheses and predictions that can be empirically tested.

We describe empirical tests of the predictions of two behavioral finance theories. Shefrin and Statman (1985) extended the prospect theory of Kahneman and Tversky (1979) to predict that investors, because of their desire to avoid regret, will tend to hold their losing investments too long and sell their winners too soon; they labeled this tendency the "disposition effect." Odean (1998b) predicted that, because of their overconfidence, investors will trade too frequently and thereby reduce their returns.[1]

The Data

A national discount brokerage house provided the data for the studies we summarize. The primary data set was 10,000 randomly selected accounts that

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were active in 1987 (those with at least one transaction). The data included trading and position records for these accounts from January 1987 through December 1993; 162,948 trades were reported. Each record included an account identifier, a buy/sell indicator, the number of shares traded, the commission paid, and the principal amount.

Price and return data are from the 1993 CRSP daily stock file for NYSE, Amex, and Nasdaq stocks. The tests were limited to stocks for which this information was available. Of the 10,000 accounts, 6,380 made 97,483 common stock trades (49,948 purchases and 47,535 sales); 62,516,332 shares were traded (31,495,296 shares, with a market value of $530,719,264, were purchased, and 31,021,036 shares, with a market value of $579,871,104, were sold). Average monthly turnover was 6.5 percent.[2] With 10 being the decile of the companies with the largest capitalizations, the average size decile was 8.65 for a purchase and 8.68 for a sale.

The Disposition Effect

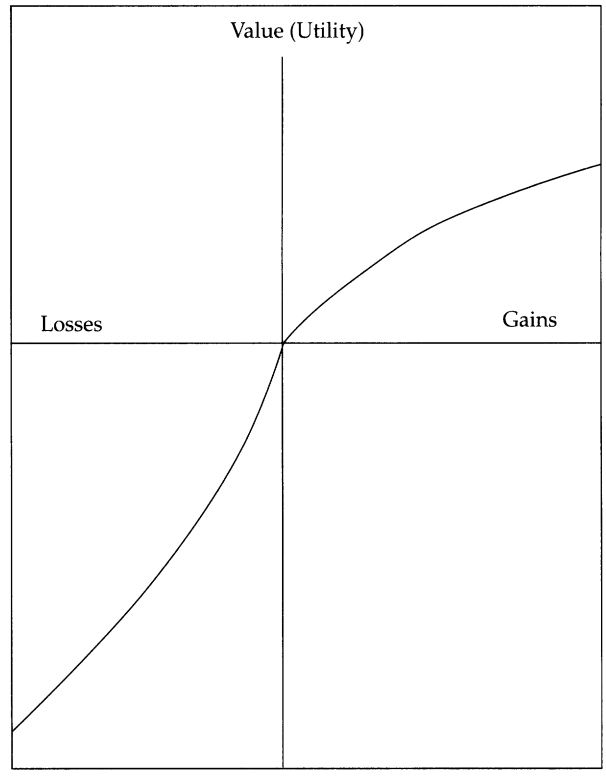
The disposition effect is one implication of extending Kahneman and Tversky's prospect theory to investments. Under prospect theory, when faced with choices involving simple two- and three-outcome lotteries, people behave as if maximizing an S-shaped value function, as depicted in **Figure 1**. This value function is similar to a standard utility function except that it is defined on the basis of gains and losses rather than levels of wealth. The function is concave in the domain of gains and convex in the domain of losses. It is also steeper for losses than for gains, which implies that people are generally risk averse.

Critical to this value function is the reference point from which gains and losses are measured. Usually, the status quo is taken as the reference point, but

> there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo. . . . A person who has not made peace with his losses is likely to accept gambles that would be unacceptable to him otherwise. (Kahneman and Tversky, pp. 286–287)

For example, suppose an investor purchases a stock that she believes to have an expected return high enough to justify its risk. If the stock appreciates and she continues to use the purchase price as a reference point, the stock price will then be in a more concave, risk-averse part of the investor's value function. The stock's expected return may continue to justify its risk, but if the investor lowers her expectation for the stock's return somewhat, she will be likely to sell the stock. If instead of appreciating, the stock declines, its price is in the convex, risk-seeking part of the value function. Here, the investor will continue to hold the stock even if its expected return falls lower than would have been necessary for her to justify its original purchase. Thus, the investor's belief about expected return must fall farther to motivate the sale of a stock that has already declined rather than one that has appreciated. Similarly, suppose an investor holds two stocks. One is up, and the other is down. If he is facing a liquidity demand and has no new information about either stock, he is more likely to sell the stock that is up.

Figure 1. Prospect Theory Value Function



Throughout this study, investors' reference points are assumed to be their purchase prices. Although the results presented here appear to vindicate that choice, for some investments, particularly those held for a long time over a wide range of prices, the purchase price may be only one determinant of the reference point. The price path may also affect the level of the reference point. For example, a homeowner who bought his home for $100,000 just before a real estate boom and had the home appraised for $200,000 after the boom may no longer feel he is "breaking even" if he sells his home for $100,000 plus commissions.[3]

Taxes. Investor reluctance to realize losses is at odds with optimal tax-loss selling for taxable investments. For tax purposes, investors should postpone taxable gains by continuing to hold their profitable investments. They should capture tax losses by selling their losing investments, although not necessarily at a constant rate. Constantinides (1984) showed that when there are transaction costs and no distinction is made between short-term and long-term tax rates (as was approximately the case for 1987–1993 for U.S. federal taxes[4]), investors should gradually increase their tax-loss selling from January to December. Dyl (1977), Lakonishok and Smidt (1986), and Badrinath and Lewellen (1991) reported evidence that investors do sell more losing investments near the end of the year.

Shefrin and Statman proposed that investors choose to sell their losers in December as a self-control measure. They reasoned that investors are reluctant to sell for a loss but recognize the tax benefits of doing so. The end of the year is the deadline for realizing these losses, so each year, investors postpone realizing losses until December, at which time they sell losers before the deadline passes.

Methodology. To determine whether investors sell winners more readily than losers, one cannot simply look at the number of securities sold for gains versus the number sold for losses. Suppose investors are indifferent to selling winners or losers? Then, in an upward-moving market, they will have more winners in their portfolios and will tend to sell more winners than losers even though they have no preference for doing so. To test whether investors are disposed to sell winners and hold losers, therefore, one must look at the frequency with which they sell winners and losers relative to their opportunities to sell each.

By going through each account's trading records in chronological order, we constructed a portfolio of securities for which the purchase date and price are known. Clearly, this portfolio represented only part of each investor's total portfolio. Most accounts will have contained securities that were purchased before January 1987 for which the purchase price was not available, and investors may also have had other accounts that were not part of the data set. However, although the portfolios constructed from the data set were only part of each investor's total portfolio, the selection process is unlikely to have biased the partial portfolios toward stocks for which investors had unusual preferences for realizing gains or losses.

For each day that a sale took place in a portfolio of two or more stocks, we compared the selling price for each stock sold with its average purchase price to determine whether that stock was sold for a gain or a loss. Each stock that was in that portfolio at the beginning of that day but was not sold was considered to be a paper (unrealized) gain or loss (or neither). We determined whether it was a paper gain or loss by comparing its high and low price for that day (as obtained from CRSP) with its average purchase price. If both its daily high and low were above its average purchase price, we counted it as a paper gain; if they were both below its average purchase price, we counted it as a paper loss; if its average purchase price lay between the high and the low, we counted it neither as a gain nor a loss. On days when no sales took place in an account, no gains or losses, realized or paper, were counted.

For example, consider two investors, Borgg and Wellbaum, who have stocks in their portfolios as depicted in **Table 1**. Borgg had five stocks in his portfolio. A and B were worth more than he paid

Table 1. Calculation of Proportion of Gains and Losses Realized

Category	Borgg	Wellbaum
Positions		
Holdings	A, B, C, D, E	F, G, H
Winners	A, B	F, G
Losers	C, D, E	H
Sales		
Sales on Monday	A, C	None
Sales on Wednesday	None	F
Calculation of gains and losses		
Paper gains	1 (B)	1 (G)
Paper losses	2 (D, E)	1 (G)
Realized gains	1 (A)	1 (F)
Realized losses	1 (C)	0

for them; C, D, and E were worth less. Wellbaum had three stocks in her portfolio. F and G were worth more than she paid for them; H was worth less. On Monday, Borgg sold shares of A and C. On Wednesday, Wellbaum sold shares of F. Borgg's sale of A and Wellbaum's sale of F were counted as realized gains. Borgg's sale of C was a realized loss. Because B and G could have been sold for a profit but were not, they were counted as paper gains. D, E, and G were paper losses. So, for these two investors over these two days, two realized gains, one realized loss, two paper gains, and three paper losses were counted.

We summed realized gains, paper gains, realized losses, and paper losses for each account and across accounts. Then, we calculated two ratios:

$$\text{Proportion of gains realized (PGR)} = \frac{\text{Realized gains}}{\text{Realized gains} + \text{Paper gains}};$$

$$\text{Proportion of losses realized (PLR)} = \frac{\text{Realized losses}}{\text{Realized losses} + \text{Paper losses}}.$$

In the example of Borgg and Wellbaum, PGR equaled 1/2 and PLR equaled 1/4.

A large difference in the proportion of gains realized and the proportion of losses realized indicates that investors are more willing to realize either gains or losses.

Any test of the disposition effect is a joint test of the hypothesis that people sell gains more readily than losses and of the specification of the reference point from which gains and losses are determined. Some possible choices of a reference point for stocks are the average purchase price, the highest purchase price, the first purchase price, or the most recent purchase price. The findings of this study were essentially the same for each choice; thus, we report results for average purchase price.

Commissions and dividends may or may not be considered when determining reference points or profits and losses. Although investors may not consider commissions when they remember what they paid for a stock, commissions do affect capital gains and losses. And because the normative standard to which the disposition effect is being contrasted is optimal tax-motivated selling, we added commissions to the purchase price and deducted commissions from the sales price, except where noted. In determining whether the stocks that were not sold on a particular day could have been sold for a gain or a loss, the commission for the potential sale was assumed to be the average commission per share paid when the stock was purchased.[5] We did not include dividends when determining which sales were profitable because dividends do not affect capital gains and losses for tax purposes. All gains and losses were calculated after adjusting for splits.

The primary finding of these tests, that investors are reluctant to sell their losers and prefer to sell winners, was unaffected by the inclusion or exclusion of commissions or dividends.

Results. The data in this study show that investors did sell a higher proportion of their winners than of their losers. **Table 2** reports the proportions of gains and losses realized throughout the average year, for January through November, and for December.

Suppose investors frequently realize small gains and less frequently take large losses. Then, they may be selling similar proportions of the values of their gains and losses, although they are realizing gains at a higher rate on a trade-counted basis. The data indicate that investors are not, however, realizing gains and losses this way. The average PGR and PLR per account can be calculated by measuring losses, gains, potential losses, and potential gains in terms of dollars rather than shares or trades. The dollar-based PGR (averaged across accounts) was found to be 0.58, and the average dollar-based PLR (averaged across accounts) was found to be 0.42.[6]

In Table 2, the ratio of PGR to PLR for the year is a little more than 1.5, which indicates that a stock whose value was up was more than 50 percent was more likely to be sold from day to day than a stock whose value was down. In Weber and Camerer's (1998) experimental studies of the disposition

Table 2. Proportion of PGR and PLR

Proportion Realized	All Months	January–November	December
PLR	0.098	0.094	0.128
PGR	0.148	0.152	0.108

Note: Realized gains, paper gains, realized losses, and paper losses were aggregated over 1987–1993 and across all accounts in the data set. The *t*-statistic tested the null hypotheses that, assuming that all realized gains, paper gains, realized losses, and paper losses result from independent decisions, the differences in proportions are equal to zero.

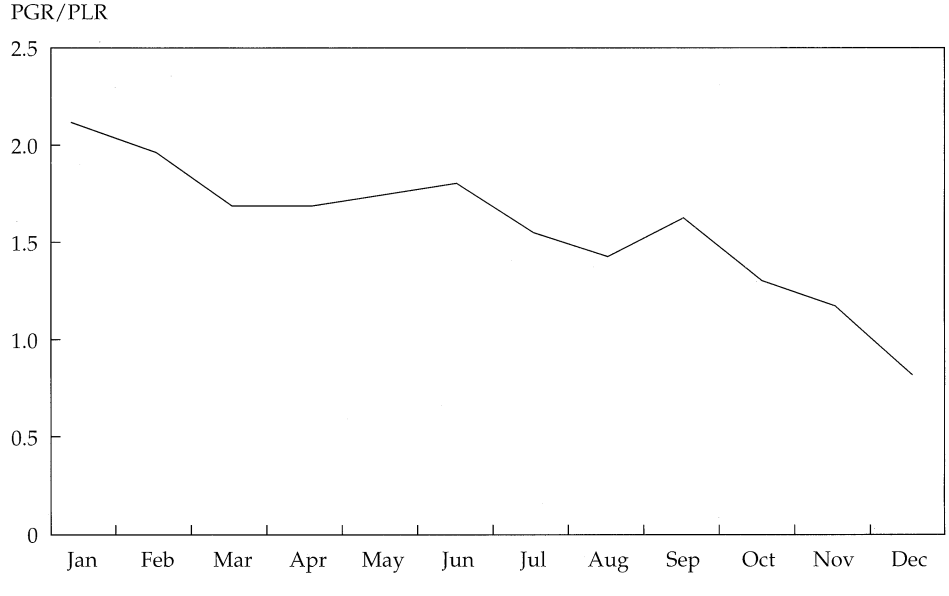
effect, a stock that was up was also about 50 percent more likely to be sold than one that was down. **Figure 2** charts the ratio of PGR to PLR for each month in our study. The ratio declines from 2.1 in January to 0.85 in December. This decline is consistent with Constantinides' tax-loss selling model and suggests that at least some investors pay attention to tax-motivated selling throughout the year. From January through November, however, the observed ratio of PGR to PLR is reliably greater than 1.[7]

The results described here hold up to a classic principle of scientific inquiry: They are robust to out-of-sample testing. Specifically, subsequent to Odean (1998a), we obtained trading records for 78,000 households for 1991–1996 from the same discount brokerage house used for the previous study. (These data are described in more detail in the section titled "Additional Tests of Overconfidence.") For this new data set, we found the PGR measure to be 0.1442 and the PLR measure to be 0.0863. During this sample period, stocks that had increased in value were approximately 65 percent more likely to be sold than stocks that had declined in value.

Alternative Reasons to Hold Losers and Sell Winners. Previous research offers some support for the hypothesis that investors sell winners more readily than losers, but this research is generally unable to distinguish among various motivations investors might have for doing so. [8] Recent studies have found evidence of the disposition effect in the exercise of company stock options (Heath, Huddart, and Lang 1999), in the sale of residential housing (Genesove and Mayer 1999), and among professional futures traders (Locke and Mann 1999), Israeli investors (Shapira and Venezia 1998), and Finnish investors (Grinblatt and Keloharju 1999). We believe the disposition effect based on loss aversion best explains the tendency for investors to hold losers and sell winners. In this section, we present evidence that allows us to discount competing explanations for this investor behavior.

Anticipation of changes in tax law. One reason investors might choose to sell winners rather than losers is that they anticipate a change in the tax law that will increase capital gains tax rates. The Tax Reform Act of 1986 made such a change. If investors were selling off winners in 1986 in anticipation of higher tax rates, they might have entered 1987 with a larger percentage of losers in their portfolio than usual. Because such stocks were purchased prior to 1987, the stocks would not show up in the portfolios reconstructed here. Therefore, the rate at which winners were being realized relative to losers could have been lower in the investors' total portfolios than in the partial reconstructed portfolios. As old stocks were sold and new ones purchased, however, the partial portfolios would have become more and more representative of the total portfolios. So, if a sell-off of winners in anticipation of the 1986 tax law affected the observed

Figure 2. Ratio of PGR to PLR by Month



rate at which gains and losses were realized in the partial portfolios, that effect should have been greater in the first part of the sample period than in the last part. However, the ratio PGR/PLR is virtually the same for the 1987–90 and 1991–93 periods.

Desire to rebalance. Lakonishok and Smidt suggested that investors might sell winners and hold losers in an effort to rebalance their portfolios. For example, if one stock in an investor's portfolio appreciates considerably, the investor may sell part of that holding and buy others to rebalance the portfolio. In that case, the investors who sell winners would be likely to make new purchases. To eliminate trades that could have been motivated by a desire to rebalance, we calculated PGR and PLR by using only sales and dates for which no new purchase was made for a portfolio on the sale date or during the following three weeks. When sales motivated by a desire to rebalance were eliminated in this way, we found that investors continued to prefer to sell winners. Once again, investors realized losses at a higher rate than gains in December.

Belief that the losers will bounce back. Another reason investors might sell winners and hold losers is that they expect the losers to outperform the winners in the future. An investor who buys a stock because of favorable information may sell that stock when it goes up on the theory that the information is now reflected in the price. On the other hand, if a stock goes down, the investor may continue to hold it on the theory that the market has not yet come to appreciate the information. Investors might also choose to sell winners and hold losers simply because they believe prices may revert to the mean. Whether such beliefs are justified can be tested *ex post*.

To test whether the losing stocks that investors hold outperform the winners they sell, Odean (1998a) calculated market-adjusted returns for losing stocks held and winning stocks sold subsequent to each sales date. For winners that were sold, he calculated market-adjusted returns (the average return in excess of the CRSP value-weighted index) starting the day after the transaction for the next 84 trading days (four months), 252 trading days (one year), and 504 trading days (two years). For the same horizons, he calculated market-adjusted returns subsequent to paper losses. That is, for stocks held for a loss in portfolios from which sales did take place, market-adjusted returns were calculated starting the day after the sale for the next 84, 252, and 504 trading days.

For winners that were sold, the average excess return over the following year was a highly statistically significant 3.4 percent more than it was for losers that were not sold.[9] (Winners sold subsequently outperformed paper losses by 1.03 percent over the following four months and 3.58 percent over the following two years.) Investors who sell winners and hold losers because they expect the losers to outperform the winners in the future are, on average, mistaken. The superior returns to former winners noted here are consistent with Jegadeesh and Titman's (1993) finding of price momentum in security returns at horizons of up to 18 months.[10]

Attempt to limit transaction costs. Harris (1988) suggested that investors' reluctance to sell losers may result from their sensitivity to higher trading costs at lower stock prices. To contrast this hypothesis to the disposition effect, one can investigate the rates at which investors purchase additional shares of stocks they already own. If investors are avoiding the sale of losing investments because of the higher transaction costs associated with selling low-price stocks, the expectation is that they also are avoiding the purchase of additional shares of these losing investments. In fact, we found that investors are more inclined to purchase additional shares of their losing investments than additional shares of their winning investments. In our sample, investors were almost 1.5 times more likely to purchase additional shares of any losing position they already held than any winning position.

Belief that all stocks revert to the mean. The results presented so far do not distinguish the disposition effect of prospect theory from the mistaken belief that losers will bounce back to outperform current winners. Both prospect theory and a belief in mean reversion posit that investors will hold their losers too long and sell their winners too soon. And both predict that investors will purchase a greater number of additional shares of losers than of winners. A belief in mean reversion should, however, apply to stocks that an investor does not already own as well as those an investor does own, whereas prospect theory would apply only to the stocks the investor owns. That is, a belief in mean reversion implies that investors will tend to buy stocks that previously declined even if they do not already own those stocks, whereas prospect theory makes no prediction in this case. Odean (forthcoming 1999) found that the same group of investors as studied here tended to buy stocks that had on average outperformed the CRSP value-weighted index over the previous two years. This result appears to be inconsistent with a pervasive belief in mean reversion.

Overconfidence and Excessive Trading

Reconciling the volume of trading observed in equity markets with the trading needs of rational investors is difficult. Rational investors make periodic contributions and withdrawals from their investment portfolios, rebalance their portfolios, and trade to minimize their taxes. Those possessed of superior information may trade speculatively, but rational speculative traders will generally not choose to trade with each other. Thus, rational trading needs are unlikely to account for a 1998 turnover rate on the NYSE of 76 percent.

We believe there is a simple and powerful explanation for high levels of trading on financial markets—overconfidence. Human beings are overconfident about their abilities, their knowledge, and their future prospects. Odean (1998b) showed that overconfident investors trade more than rational investors and that doing so lowers their expected utilities.[11] Greater overconfidence leads to greater trading and to lower expected utility.

Overconfidence increases trading activity because it causes investors to be too certain about their own opinions and to not consider sufficiently the opinions of others. The result is an increase in the heterogeneity of investors' beliefs, and as Harris and Raviv (1993) and Varian (1989) pointed out, heterogeneous beliefs are needed to generate significant trading. Overconfident investors also perceive their actions to be less risky than generally proves to be the case.

The study reported in this section tested whether a particular class of investors, those with accounts at discount brokerages, trade excessively, in the sense that their trading profits are insufficient to cover their trading costs. The surprising finding is that not only do the securities these investors buy not outperform the securities they sell by enough to cover trading costs but, on average, the securities they buy underperform those they sell. This result held even when trading was not apparently motivated by liquidity demands, tax-loss selling, portfolio rebalancing, or a move to lower-risk securities.

Although investors' overconfidence in the precision of their information may contribute to this finding, it is not sufficient to explain it. These investors must be systematically misinterpreting information available to them. That is, they do not misconstrue simply the precision of their information; they misconstrue its very meaning.

Overconfidence. Studies of the calibration of subjective probabilities have found that people tend to overestimate the precision of their knowledge (Alpert and Raiffa 1982; Fischhoff, Slovic, and Lichtenstein 1977[12]). Such overconfidence has been observed among many professionals: clinical psychologists (Oskamp 1965), physicians and nurses (Christensen-Szalanski and Bushyhead 1981; Baumann, Deber, and Thompson 1991), investment bankers (Staël von Holstein 1972), engineers (Kidd 1970), entrepreneurs (Cooper, Woo, and Dunkelberg 1988), lawyers (Wagenaar and Keren 1986), negotiators (Neale and Bazerman 1990), and managers (Russo and Schoemaker 1992).[13]

Miscalibration is only one manifestation of overconfidence. Researchers have also found that people overestimate their ability to do well on tasks, and these overestimates increase with the importance of the task to the person (Frank 1935). People are also unrealistically optimistic about future events. They expect good things to happen to them more often than to their peers (Weinstein 1980; Kunda 1987). They are even unrealistically optimistic about pure chance events (Marks 1951; Irwin 1953; Langer and Roth 1975).

Moreover, people have unrealistically positive self-evaluations (Greenwald 1980). Most individuals see themselves as better than the average person and as better than others see them (Taylor and Brown 1988). They rate their abilities and their prospects higher than those of their peers. For example, when a sample of U.S. students—average age 22—assessed their own driving safety, 82 percent judged themselves to be in the top 30 percent of the group (Svenson). And 81 percent of 2,994 new business owners thought their businesses had a 70 percent or better chance of succeeding, but only 39 percent thought that any business like theirs would be so likely to succeed (Cooper, et al.).

In addition, people overestimate their contributions to past positive outcomes; they recall information related to their successes more easily than information related to their failures. Fischhoff wrote that "they even misremember their own predictions so as to exaggerate in hindsight what they knew in foresight" (1982, p. 341). And when people expect a certain outcome and the outcome then occurs, they often overestimate the degree to which they were instrumental in bringing it about (Miller and Ross 1975). Taylor and Brown argued that exaggerated beliefs in one's abilities and unrealistic optimism may lead to "higher motivation, greater persistence, more effective performance, and ultimately, greater success" (p. 199). These beliefs can also lead to biased judgments.

Overconfidence in Financial Markets. In a market with transaction costs, one would expect

rational informed traders who trade for the purpose of increasing returns to increase returns, on average, by at least enough to cover their transaction costs. That is, over the appropriate horizon, the securities these traders buy should outperform the ones they sell by at least enough to pay the costs of trading. If, however, speculative traders are informed but overestimate the precision of their information (one form of overconfidence), the securities they buy may outperform those they sell but possibly not by enough to cover trading costs. If these traders believe they have information but actually have none, the securities they buy should perform, on average, about the same as those they sell, before factoring in trading costs. That is, overconfidence in only the precision of unbiased information should not, in and of itself, cause expected trading losses beyond the loss of transaction costs.

If in addition to being overconfident about the precision of their information, investors are overconfident about their ability to interpret information, they may incur trading losses beyond transaction costs. For instance, suppose investors receive useful information but are systematically biased in their interpretation of that information; that is, the investors hold mistaken beliefs about the mean, instead of (or in addition to) the precision, of the distribution of their information. If they unwittingly misinterpret information, they may choose to buy or sell securities that they would not have otherwise bought or sold. They may even buy securities that, on average and before transaction costs, underperform the ones they sell.

Methodology. To test for overconfidence in the precision of information, our approach was to determine whether the securities bought by the investors in this data set outperformed those they sold by enough to cover the costs of trading. To test for biased interpretation of information, the approach was to determine whether the securities they bought underperformed those they sold when trading costs were ignored. We examined return horizons of four months, one year, and two years following each transaction.[14] We calculated returns from the CRSP daily return files.

To calculate the average return to securities bought (sold) in these accounts over the T (T = 84, 252, or 504) trading days subsequent to the security's purchase (sale), we indexed each purchase (sale) transaction with a subscript i, i = 1 to N. Each transaction consisted of a security, j_i, and a date, t_i. If the same security was bought (sold) in different accounts on the same day, each purchase (sale) was treated as a separate transaction. Market-adjusted returns were calculated as the security return less the return on the CRSP value-weighted index. The market-adjusted return for the T trading days subsequent to a purchase was calculated as

$$R_{P,T} = \frac{1}{N}\sum_{i=1}^{N}\left[\prod_{\tau=1}^{T}(1 + R_{j_i,t_i+\tau}) - \prod_{\tau=1}^{T}(1 + R_{VW,t_i+\tau})\right],$$

where

$R_{P,T}$ = the market-adjusted return on portfolio P from Day 1 to T

$R_{j,t}$ = the CRSP daily return for security j on date t

$R_{VW,t}$ = the daily return for the CRSP value-weighted market index on date t

(Note that return calculations began the day after a purchase or a sale to avoid incorporating the bid–ask spread into returns.)

In this data set, the (equally weighted) average commission paid when a security was purchased was 2.23 percent of the purchase price. The average commission on a sale was 2.76 percent of the sale price.[15] Thus, if one security was sold and the sale proceeds were used to buy another security, the total commissions for the sale and purchase averaged about 5 percent. The average effective bid–ask spread was 0.94 percent.[16] The average total cost of a round-trip trade was thus about 5.9 percent. In short, an investor who sells some securities and buys others because he expects the securities he is buying to outperform the ones he is selling will have to realize, on average and weighting trades equally, a return nearly 6 percent higher on the security bought to cover trading costs.

The first hypothesis was that over horizons of four months, one year, and two years, the average returns to securities bought minus the average returns to securities sold were less than the average round-trip trading costs of 5.9 percent. This hypothesis is what we expected if investors are overconfident about the precision of their information. The first null hypothesis was that this difference in returns is greater than or equal to 5.9 percent. This null is consistent with rationality. The second hypothesis was that for the same horizons (and ignoring trading costs), the average returns to securities bought were less than those to securities sold. If this hypothesis were to hold, the implication is that investors must actually misinterpret useful information. The second null hypothesis was that average returns to securities bought are greater than or equal to those sold.

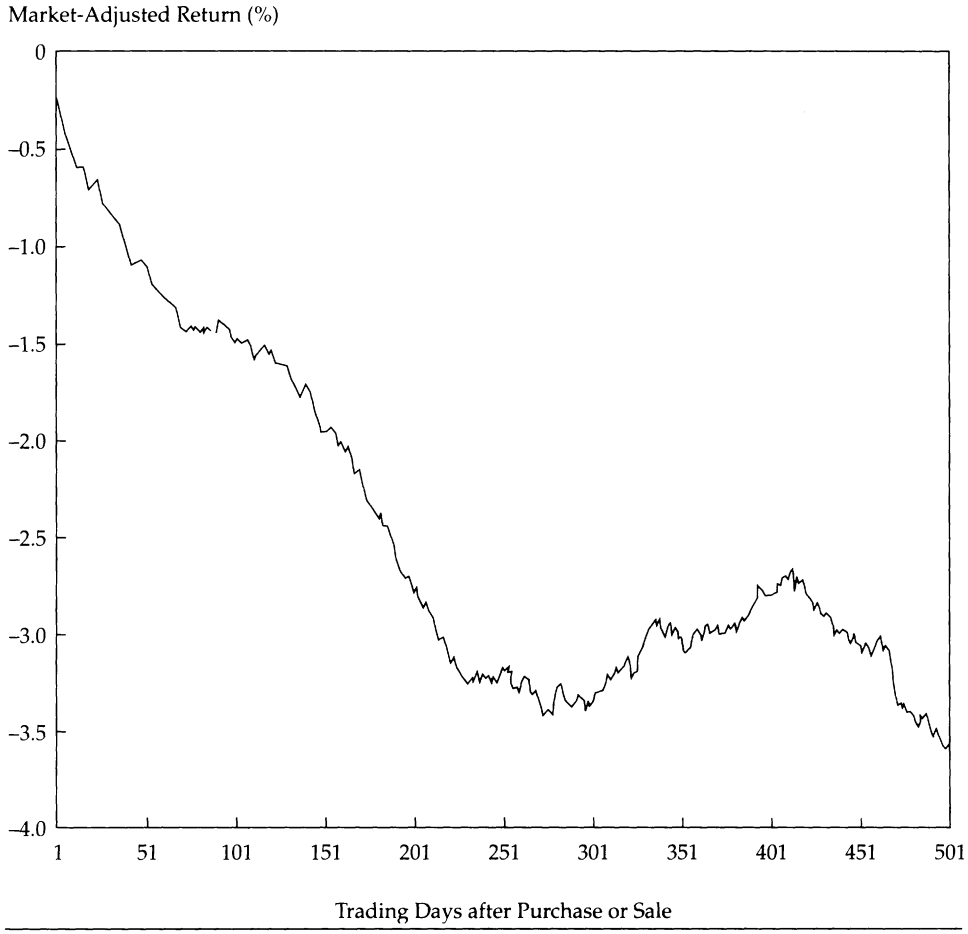
Results. For all three follow-up periods, the average subsequent market-adjusted return to stocks that were bought is less than the return to stocks that were sold. **Figure 3** provides a graph of the difference between the market-adjusted returns to stocks that were bought and the market-adjusted returns to stocks that were sold. Regardless of the horizon, the stocks that investors bought underperformed the stocks that they sold. (This outcome was true also when actual returns were calculated instead of market-adjusted returns.) Not only do investors pay transaction costs to switch stocks, but the stocks they buy underperform the ones they sell. For the four-month (84-trading-day) horizon, the average market-adjusted return on a purchased stock was 1.45 percentage points (pps) lower than the average market-adjusted return on a stock sold. For the one-year (252-trading-day) horizon, the underperformance was 3.2 pps, and for the two-year (504-trading-day) horizon, the shortfall was slightly greater, 3.6 pps.

The first null hypothesis—that the expected returns to stocks purchased are at least 5.9 percent (the average cost of a round-trip trade) greater than the expected returns to stocks sold—is comfortably rejected ($p < 0.001$ for all three horizons). The second null hypothesis—that the expected returns to stocks purchased are greater than or equal to those of stocks sold (ignoring transaction costs)—is also comfortably rejected ($p < 0.001$, $p < 0.001$, and $p < 0.002$ for horizons of, respectively, four months, one year, and two years).

These investors did not make profitable trades.

Of course, investors trade for reasons other than to increase profits. They trade to meet liquidity demands, to move to more (or less) risky investments, to realize tax losses, and to rebalance their portfolios. Odean (forthcoming 1999) examined trades for which these alternative motivations for trading had been largely eliminated. The "speculative" trades included (1) only sales and purchases in which a purchase was made within three weeks of a sale (such transactions are unlikely to be liquidity motivated because investors who need cash for three or fewer weeks can borrow more cheaply

Figure 3. Market-Adjusted Returns Subsequent to Buys minus Market-Adjusted Returns Subsequent to Sells



Notes: Day 0 is the day of a buy or sell. There were 49,948 buys and 47,535 sells.

than by selling and buying stocks—for example, by using credit cards); (2) only sales that were for a profit (that is, the stocks were not sold to realize tax losses and were not short sales); (3) only sales of an investor s complete holding in the stock (so, most of these sales were not motivated by a desire to rebalance a portfolio because of an appreciated stock); and (4) only sales and purchases in which the purchased stock was from the same or a smaller size decile as the stock sold (based on CRSP size deciles for the year of the transaction). Because size has been shown to be highly correlated with risk, this last restriction was intended to eliminate most instances in which an investor intentionally buys a stock of lower expected return than the one being sold in hopes of reducing risk.

When all these alternative motivations for trading were eliminated, Odean (forthcoming 1999) found that investors actually performed worse in all three evaluation periods. Over the four-month horizon, speculative purchases underperformed speculative sells by 2.5 pps; over the one-year horizon, by 5.1 pps; and over the two-year horizon, by 8.6 pps. Sample size was greatly reduced, however, and statistical significance was slightly lower following the eliminations. Nonetheless, both null hypotheses could be comfortably rejected (for the first null hypothesis, as $p < 0.001$ for all three horizons; for the second null hypothesis, at $p < 0.001$, $p < 0.001$, and $p < 0.002$ for, respectively four months, one year, and two years).

As was the case for the tests of the disposition effect, we were able to replicate these results out of sample. Subsequent to Odean (forthcoming 1999), we obtained trading records for 78,000 households for 1991–1996 from the same discount brokerage house used for the 1999 Odean study (the data are described in the next section). On average, the 1,082,106 stocks that these households bought reliably underperformed ($p < 0.001$) the 887,638 they sold by 2.35 pps over the 252 trading days subsequent to each transaction.

Overconfidence alone cannot explain these results. These investors appear to have had some ability to distinguish stocks that would subsequently perform better and worse. Unfortunately, they somehow got the relationship wrong.

Additional Tests of Overconfidence. Two tests of overconfidence remain to be examined—tests involving performance in relation to turnover and tests involving performance related to gender differences in investors.

Turnover and performance. Odean (1998b) predicted that the more overconfident investors are, the more they will trade and the more they will thereby lower their expected utilities. If overconfidence is an important motivation for investor trading, then one would expect that, on average, those investors who trade most actively will most reduce their returns through trading. As reported in Barber and Odean (forthcoming 2000), this expectation is borne out.

We examined trading and position records for 78,000 households with accounts at the same discount brokerage house that supplied the data described previously. The records were from January 1991 through December 1996 and included all accounts at this brokerage for each household. Of the sampled households, 66,465 had positions in common stocks during at least one month of the sample period; the remaining accounts held cash or held investments in securities other than individual common stocks. Roughly 60 percent of the market value in the accounts was held in common stocks. More than 3 million trades occurred in all the securities, and common stocks accounted for slightly more than 60 percent of all trades. In December 1996, these households held more than $4.5 billion in common stock. In addition to trade and position records, our data set also identified demographic characteristics, such as age, gender, marital status, and income, for much of the sample.

We partitioned the households into quintiles on the basis of the average monthly turnover of their common stock portfolios. Mean monthly turnover for these quintiles ranged from 0.19 percent (the low-turnover quintile) to 21.49 percent (the high-turnover quintile). Households in the high-turnover quintile earned a net annualized geometric mean return of 11.4 percent; households in the low-turnover quintile earned 18.5 percent.

Because the households in each quintile could (and did) vary as to the average risk characteristics of their portfolios, we compared the annual net return earned by each household with the annual net return that would have been earned had the household's beginning-of-the-year portfolio been held for a year without any trading, which is a reasonable measure of the impact of trading on returns. The quintile of households that traded most infrequently underperformed its counterpart buy-and-hold portfolio by, on average, a mere 0.25 pps annually, whereas the quintile of households that traded most frequently underperformed its counterpart buy-and-hold portfolio by, on average, a whopping 7.04 pps annually. This finding that the more investors trade the more they reduce their expected returns is consistent with the prediction that the more overconfident traders will trade more actively and earn less.

But we still have not examined directly whether overconfidence is motivating trading. For such a test, the behavior or groups with clearly different profiles of overconfidence is needed.

Gender, overconfidence, and performance. To test directly the role of overconfidence in motivating trading, we partitioned our data into two groups that psychologists have shown to differ in tendency toward overconfidence—men and women. Although both men and women exhibit overconfidence, men have been found to be generally more overconfident than women. Gender differences as to overconfidence are, however, highly task dependent (Lundeberg, Fox, and Punochar 1994). Although Lichtenstein and Fischhoff (1981) did not find gender differences in calibration of general knowledge, Lundeberg et al. argued that the reason is that gender differences in calibration are strongest for topics in the masculine domain (e.g., mathematics). Deaux and Farris wrote, "Overall, men claim more ability than do women, but this difference emerges most strongly on . . . masculine task[s]" (1977, p. 64). And several studies have confirmed this difference (Deaux and Emswiller 1974; Lenney 1977; Beyer and Bowden 1997). Specifically, Prince (1993) found that men are inclined to feel more competent than women do in financial matters. Indeed, casual observation reveals that men are disproportionately represented in the financial industry. We expected men, therefore, to be generally more overconfident than women about their ability to make financial decisions.

Additionally, Lenney reported that gender differences in self-confidence depend on the presence or lack of clear, unambiguous feedback. She stated that when feedback is

> unequivocal and immediately available, women do not make lower ability estimates than men. However, when such feedback is absent or ambiguous, women seem to have lower opinions of their abilities and often do underestimate relative to men. (p. 3)

Unfortunately, the stock market does not generally provide clear, unambiguous feedback—which is all the more reason to expect men to be more confident than women about their ability to make common stock investments.

Our prediction, then, was clear: We expected men, the more overconfident group, to trade more actively than women and, in doing so, to detract more than women from their net return performance.

As reported in Barber and Odean (1999), we found this prediction to hold true: In this study, men traded 45 percent more actively than women (76.9 percent versus 52.8 percent turnover annually), and men reduced their net annual returns through trading by 0.94 pps more than women. (Men underperformed their buy-and-hold portfolios by 2.652 pps annually; women underperformed their buy-and-hold portfolios by 1.716 pps annually.) We found the differences in the turnover and performance of men and women to be highly statistically significant and robust to the introduction of other demographic variables, such as marital status, age, and income.

Conclusion

One of the major contributions of behavioral finance is that it provides insights into investor behavior when such behavior cannot be understood under traditional theories. We tested two behavioral finance theories and found, as predicted, that investors tend to sell their winners and hold their losers. Also, as a result of overconfidence, investors trade to their detriment. Because these behaviors reduce investor welfare, understanding them is important for investors and for those who advise them.

But the welfare consequences of investor behavior extend beyond individual investors and their advisors to the market itself. Modern financial markets depend on trading volume for their very existence. It is trading—commissions and spreads—that pays for the brokers and market makers, without whom these markets would not exist. Traditional models of financial markets provide little insight into why people trade as much as they do. In some models, investors seldom trade or do not trade at all (e.g., Grossman 1976). Other models simply stipulate a class of investors—noise or liquidity traders—who are required to trade (e.g., Kyle 1985). Harris and Raviv (1993) and Varian (1989), however, pointed out that heterogeneous beliefs are needed to generate significant trading. And behavioral finance throws light on why and when investors form heterogeneous beliefs.

Both behavioral theories tested offer insights into trading volume. The disposition effect says that investors will generally trade less actively when their investments have lost money. The overconfidence theory suggests that investors will trade more actively when their overconfidence is high. Psychologists find that people tend to give themselves too much credit for their own success and do not attribute enough of that success to chance or outside circumstance. Gervais and Odean showed that this bias leads successful investors to become overconfident. So, in a market where most investors are successful (such as today's long bull market), trading rises. Statman and Thorley (1999) found that over even short horizons, such as a month, current market returns predict subsequent trading volume.

Finally, the investor behaviors discussed in this article have the potential to influence asset prices.[17] The tendency to refrain from selling losers may, for example, slow the rate at which negative news is translated into price. The tendency to buy stocks with recent extreme performance could cause recent winners to overshoot. For biases to influence asset prices, investors must be systematic in their biases and willing to act on them.[18]

Our common psychological heritage ensures that we systematically share biases. We are disposed to hold our losers and sell our winners. And in our overconfidence, we act on our misguided convictions.

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Notes

1. Many of the results presented here were first reported in Odean (1998a, forthcoming 1999) and in Barber and Odean (1999, forthcoming 2000).
2. Turnover was estimated as one-half the average monthly equity value of all trades (purchases and sales) divided by the average equity value of all monthly position statements.
3. If purchase price is a major component but not the sole component of the reference point, it may serve as a noisy proxy for the true reference point. Using the proxy in place of the true reference point would make a case for the disposition effect being more difficult to prove. Therefore, if the true reference point were available, the evidence reported here would probably be even stronger.
4. Prior to 1987, the long-term capital gains tax rates were 40 percent of the short-term capital gains rates. For 1987–1993, long-term and short-term gains were taxed at the same marginal rates for low-income taxpayers. The maximum short-term rate at times exceeded the maximum long-term rate; in 1987, the maximum short-term rate was 38.5 percent and the maximum long-term rate was 28 percent. In 1988–1990, the highest income tax payers paid a marginal rate of 28 percent on both long-term and short-term gains. In 1991 and 1992, the maximum long-term and short-term rates were, respectively, 28 percent and 31 percent. In 1993, the maximum long-term and short-term rates were, respectively, 28 percent and 39.6 percent.
5. When we assumed that the commission for potential sales was the same percentage of principal as paid when the stock was purchased, the results did not significantly change.
6. Note that the PGR and the PLR measures depend on the average size of the portfolios from which they were calculated. When the portfolio sizes were small and when we calculated average account proportions rather than aggregate sample proportions, both of these proportions tended to be larger.
7. In the reported PLR and PGR calculations, realized and unrealized losses were tabulated on days that sales took place in portfolios of two or more stocks. One objection to this formulation is that for portfolios that hold only winners or only losers, an investor cannot choose whether to sell a winner or to sell a loser but only which winner or loser to sell. Another objection is that if an investor has net capital losses of more than $3,000 for the current year (in non-tax-deferred accounts), it may be normative for that investor to choose to sell a winner rather than a loser. Therefore, we repeated the analyses under the following additional constraints: that a portfolio hold at least one winner and one loser on the day of a sale for that day to be counted and that the net realized capital losses for the year to date in the portfolio be less than $3,000. When these constraints were imposed, the difference in PGR and PLR was greater for each analysis. For example, for the entire sample and the entire year (as in Table 2), the result was 10,111 realized gains, 71,817 paper gains, 5,977 realized losses, and 94,419 paper losses. Thus, the PLR was 0.060, the PGR was 0.123, their difference was 0.063, and the t-statistic for the difference in proportions was 47.
8. Starr-McCluer (1995) found that 15 percent of the stock-owning households interviewed in the 1989 and 1992 Surveys of Consumer Finances had paper losses of 20 percent or more. She estimated that in the majority of cases, the tax advantages of realizing those losses would have more than offset the trading costs and time costs of selling. Heisler (1994) documented loss aversion in a small sample of futures speculators. In a study of individual federal tax returns, Poterba (1987) found that, although many investors do offset their capital gains with losses, more than 60 percent of the investors with gains or losses realized only gains. Weber and Camerer reported experimental evidence of the disposition effect.
9. Here, and for the findings reported in the section titled "Overconfidence and Excessive Trading," we determined statistical significance by using a bootstrapping technique similar to the techniques discussed in Brock, Lakonishok, and LeBaron (1992); Ikenberry, Lakonishok, and Vermaelen (1995); and Lyon, Barber, and Tsai (1999). This procedure is described in greater detail in Odean (1998a) and Odean (forthcoming 1999).

10. At the time of this study, CRSP data were available through 1994. For this reason, we did not calculate two-year subsequent returns for sales dates in 1993.
11. Other theoretical treatments of overconfident investors are found in DeLong, Shleifer, Summers, and Waldmann (1991); Benos (1998); Kyle and Wang (1997); Daniel, Hirshleifer, and Subrahmanyam (1998); and Gervais and Odean (1999).
12. See Lichtenstein, Fischhoff, and Phillips (1982) for a review of the calibration literature.
13. For further discussion, see Yates (1990) and Lichtenstein, Fischhoff, and Phillips.
14. Benartzi and Thaler (1995) estimated the average investor's investment horizon to be one year; from 1987 to 1993, NYSE securities turned over about once every two years.
15. Weighting each trade by its equity value, rather than equal weighting, produced an average commission for a purchase (sale) of 0.9 (0.8) percent.
16. Barber and Odean (forthcoming 2000) estimated the bid–ask spread at 1.00 percent for individual investors for 1991–1996. Carhart (1997) estimated trading costs of 0.21 percent for purchases and 0.63 percent for sales made by open-end mutual funds in 1966–1993.
17. In the past two decades, researchers have discovered many anomalies that apparently contradict established finance theories. New theories, both behavioral (e.g., Barberis, Shleifer, and Vishny 1998; Daniel et al.) and rational (e.g., Berk 1995), have been devised to explain anomalies in asset prices. It is not yet clear, however, what contribution behavioral finance will make to asset-pricing theory.
18. Of course, there must also be limits to arbitrage (see Shleifer and Vishny 1997).

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