

# The Behavior of Individual Investors\*

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The bulk of research in modern economics has been built on the notion that human beings are rational agents who attempt to maximize wealth while minimizing risk. These agents carefully assess the risk and return of all possible investment options to arrive at an investment portfolio that suits their level of risk aversion. Models based on these

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assumptions yield powerful insights into how markets work. For example, in the Capital Asset–Pricing Model—the reigning workhorse of asset–pricing models—investors hold well-diversified portfolios consisting of the market portfolio and risk-free investments. In Grossman and Stiglitz’s (1980) rational expectations model, some investors choose to acquire costly information and others choose to invest passively. Informed, active, investors earn higher pre-cost returns, but, in equilibrium, all investors have the same expected utility. And in Kyle (1985), an informed insider profits at the expense of noise traders who buy and sell randomly.

A large body of empirical research indicates that real individual investors behave differently from investors in these models. Many individual investors hold under-diversified portfolios. Many apparently uninformed investors trade actively, speculatively, and to their detriment. And, as a group, individual investors make systematic, not random, buying and selling decisions.

Transaction costs are an unambiguous drag on the returns earned by individual investors. More surprisingly, many studies document that individual investors earn poor returns even before costs. Put another way, many individual investors seem to have a desire to trade actively coupled with perverse security selection ability!

Unlike those in models, real investors tend to sell winning investments while holding on to their losing investments—a behavior dubbed the “disposition effect”. The disposition effect is among the most widely replicated observations regarding the behavior of individual investors. While taxes clearly affect the trading of individual investors, the disposition effect tends to maximize, rather than minimize, an investor’s tax bill, since in many markets selling winners generates a tax liability that might be deferred simply by selling a losing, rather than winning, investment.

Real investors are influenced by where they live and work. They tend to hold stocks of companies close to where they live and invest heavily in the stock of their employer. These behaviors lead to an investment portfolio far from the market portfolio proscribed by the CAPM and arguably expose investors to unnecessarily high levels of idiosyncratic risk.

Real investors are influenced by the media. They tend to buy, rather than sell, stocks when those stocks are in the news. This attention-based buying can lead investors to trade too speculatively and has the potential to influence the pricing of stocks.

With this paper, we enter a crowded field of excellent review papers in the field of behavioral economics and finance (Rabin, 1998; Shiller, 1999; Hirshleifer, 2001; Daniel, Hirshleifer, and Teoh, 2002; Barberis and Thaler, 2003; Campbell, 2006; Benartzi and Thaler, 2007; Subrahmanyam, 2008; and Kaustia, 2010a). We carve out a specific niche in this field—the behavior of individual investors—and focus on investments in, and the trading of, individual stocks. We organize the paper around documented patterns in the investment behavior, as these patterns are generally quite robust. In contrast, the

underlying explanations for these patterns are, to varying degrees, the subject of continuing debate.

We cover five broad topics: the performance of individual investors, the disposition effect, buying behavior, reinforcement learning, and diversification. As is the case with any review paper, we will miss many papers and topics that some deem relevant. We are human, and all humans err. As is the case for individual investors, so is the case for those who study them.

## 1. THE PERFORMANCE OF INDIVIDUAL INVESTORS

### 1.1 The Average Individual

In this section, we provide an overview of evidence on the average performance of individual investors. In [Table 1](#), we provide a brief summary of the articles we discuss. Collectively, the evidence indicates that the average individual investor underperforms the market—both before and after costs. However, this average (or aggregate) performance of individual investors masks tremendous variation in performance across individuals.

In research published through the late 1990s, the study of investor performance focused almost exclusively on the performance of institutional investors, in general, and, more specifically, equity mutual funds.<sup>1</sup> This was partially a result of data availability (there was relatively abundant data on mutual fund returns and no data on individual investors). In addition, researchers were searching for evidence of superior investors to test the central prediction of the efficient markets hypothesis: investors are unable to earn superior returns (at least after a reasonable accounting for opportunity and transaction costs).

While the study of institutional investor performance remains an active research area, several studies provide intriguing evidence that some institutions are able to earn superior returns. [Grinblatt and Titman \(1989\)](#) and [Daniel et al. \(DGTW, 1997\)](#) study the quarterly holdings of mutual funds. Grinblatt and Titman conclude (p.415) “superior performance may in fact exist” for some mutual funds. [DGTW \(1997\)](#) use a much larger sample and time period and document (p.1037) “as a group, the funds showed some

<sup>1</sup> A notable exception to this generalization is [Schlarbaum, Lewellen, and Lease \(1978\)](#), who analyze the round-trip trades in 3,000 accounts at a full-service US broker over the period 1964–1970. They document strong returns before trading costs, but after costs returns fail to match a passive index. One concern with these results is that the authors analyze the internal rate of return on round-trip trades, which biases their results toward positive performance since investors tend to sell winners and hold losers (the disposition effect). This dataset is also used in [Cohn et al \(1975\)](#), [Lease, Lewellen, and Scharbaum \(1974\)](#), [Lewellen, Lease, and Scharbaum \(1977\)](#).

**Table 1** Summary of articles on the performance of individual investors

Article	Dataset	Main Finding
Anderson (2008)	Swedish Online Broker 1999–2002	Lower income, poorer, younger, and less well-educated investors invest a greater proportion of their wealth in individual stocks, hold more highly concentrated portfolios, trade more, and have worse performance.
Andrade, Chang, and Seasholes, (2008)	Taiwan Margin Accounts 1994–2002	Stocks bought by individual investors in week $t$ go on to earn strong returns in week $t+1$ . Stocks sold go on to earn poor returns.
Barber and Odean (2000)	US Discount Broker 1991–1996	The average individual investor underperforms a market index by 1.5% per year. Active traders underperform by 6.5% annually.
Barber and Odean (2001)	US Discount Broker 1991–1996	Men trade more than women, and, as a result, the returns earned by men are lower than the returns earned by women. Both men and women tend to underperform a market index.
Barber et al. (2009)	Taiwan Stock Exchange 1995–1999	The aggregate losses of individual investors are economically large (roughly 2% of GDP).
Barber et al. (2011)	Taiwan Stock Exchange 1992–2006	Day traders with strong past performance go on to earn strong returns, though only about 1% of all day traders are able to predictably profit net of fees.
Barber, Odean, and Zhu (2009a)	TAQ 1983–2001	Measures order imbalance using signed small trades in TAQ. Weekly order imbalance positively predicts returns at short horizons (1–2 weeks) and negatively predicts returns at long horizons (2–12 months).
Cohn et al. (1975)	Full-Service US Broker 1964–1970	Investors earn strong returns before fees, but transaction costs yield portfolio returns that are similar to those available from passive investment strategies.
Coval et al. (2005)	US Discount Broker 1991–1996	Investors with strong past performance go on to buy stocks with strong returns in the week after purchase.
Døskeland and Hvide (2011)	Oslo Stock Exchange 1994–2005	Investors overweight stocks in the industry in which they are employed despite the diversification disadvantages of doing so and negative abnormal realized returns.
Dorn et al. (2005)	German Broker 1995–2000	Risk tolerant investors hold less diversified portfolios and trade more. Those who think themselves more knowledgeable than the average investor trade more aggressively.
Feng and Seasholes (2008)	Chinese Broker 1999–2000	Turnover of men and women is the same after controlling for factors such as number of stocks owned and men and women earn similar returns.

**Table 1** Summary of articles on the performance of individual investors (Continued)

Article	Dataset	Main Finding
Gao and Lin (2011)	Taiwan Stock Exchange 2002–2009	During periods with unusually large lottery jackpots, individual investor trading declines.
Glaser and Weber (2007)	German Broker 1997–2001	Link “better-than-average” overconfidence to trading propensity. Investors who think that they are above average in terms of investment skills or past performance trade more.
Graham et al. (2009)	UBS Survey of US Investors 1999–2002	Investors who feel competent trade more often and have more internationally diversified portfolios. Competence is based on self-assessment questions regarding investors’ comfort with “investment products, alternatives, and opportunities”.
Grimblatt and Keloharju (2000)	Finnish Central Securities Depository 1995–1996	The portfolios of foreign investors outperform the portfolios of households.
Grimblatt and Keloharju (2009)	Finnish Stock Exchange 1995–2002	Link “overestimation” overconfidence and sensation seeking to trading activity. Overconfidence is measured by comparing self-assessments of skill to test outcomes. Speeding tickets are used as an instrument for sensation seeking.
Grimblatt, Keloharju, and Linnainmaa (2012)	Finnish Stock Exchange 1995–2002	Stocks bought by high-IQ investors earn strong returns at horizons up to one month.
Grimblatt, Keloharju, and Linnainmaa (2011)	Finnish Stock Exchange 1995–2002	High-IQ investors are more likely to hold mutual funds and larger numbers of stocks.
Huang (2010)	US Discount Broker 1991–1996	Investors are more likely to buy a stock in an industry if their previous investments in this industry have earned a higher return than the market.
Hvidkjaer (2008)	TAQ 1983–2005	Measures order imbalance using signed small trades in TAQ. Order imbalance measured over the last several months negatively predicts returns at horizons of 1 to 24 months.
Ivkovic and Weisbenner (2005)	US Discount Broker 1991–1996	Investors earn strong returns on stock trades of local companies.
Kaniel et al. (2012)	NYSE CAUD file 2000–2003	Individual investors earn abnormal returns during earnings announcement periods.
Kaniel et al. (2008)	NYSE CAUD file 2000–2003	Order imbalance of retail traders positively predicts the returns on stocks in the following month.

**Table 1** Summary of articles on the performance of individual investors (Continued)

Article	Dataset	Main Finding
Kelley and Tetlock (in press)	Market Center Data 2003–2007	The daily order imbalance of retail traders positively predicts the returns on stocks at horizons up to 20 days.
Korniotis and Kumar (in press)	US Discount Broker 1991–1996	Demographically based measures of cognitive ability predict variation in investor returns.
Korniotis and Kumar (2009)	US Discount Broker 1991–1996	Older investors, though more knowledgeable about investment, have inferior stock selection ability.
Linnainmaa (2010)	Finnish Stock Exchange	Poor performance of individual investors can be traced to their limit orders. Market orders by individual investors earn strong returns.
Massa and Simonov (2006)	Swedish Security Register Center 1995–2000	Investors earn strong returns on portfolio holdings that are professionally or geographically close to them.
Odean (1999)	US Discount Broker 1987–1992	Stocks bought by individual investors go on to earn poor returns, while stocks sold go on to earn strong returns.
Seasholes and Zhu (2010)	US Discount Broker 1991–1996	Discusses methodological issues in the estimation of cross-sectional differences in investor performance. Documents the strong returns on local stocks are not robust to reasonable variations in methodology.

selection ability". In these studies, the stock selection ability of fund managers generates strong before-fee returns, but is insufficient to cover the fees funds charge.<sup>2</sup>

In financial markets, there is an adding up constraint. For every buy, there is a sell. If one investor beats the market, someone else must underperform. Collectively, we must earn the market return before costs. The presence of exceptional investors dictates the need for subpar investors. With some notable exceptions, which we describe at the end of this section, the evidence indicates that individual investors are subpar investors.

To preview our conclusions, the aggregate (or average) performance of individual investors is poor. A big part of the performance penalty borne by individual investors can be traced to transaction costs (e.g. commissions and bid-ask spread). However, transaction costs are not the whole story. Individual investors also seem to lose money on their trades before costs.

The one caveat to this general finding is the intriguing evidence that stocks heavily bought by individuals over short horizons in the US (e.g. a day or week) go on to earn strong returns in the subsequent week, while stocks heavily sold earn poor returns. It should be noted that the short-run return predictability and the poor performance of individual investors are easily reconciled, as the average holding period for individual investors is much longer than a few weeks. For example, Barber and Odean (2000) document that the annual turnover rate at a US discount brokerage is about 75% annually, which translates into an average holding period of 16 months. (The average holding period for the stocks in a portfolio is equal to the reciprocal of the portfolios' turnover rate.) Thus, short-term gains easily could be offset by long-term losses, which is consistent with much of the evidence we summarize in this section (e.g. Barber, Odean, and Zhu, 2009a).

It should be noted that all of the evidence we discuss in this section focuses on pre-tax returns. To our knowledge, there is no detailed evidence on the after-tax returns earned by individual investors, because no existing dataset contains the account-level tax liabilities incurred on dividends and realized capital gains. Nonetheless, we observe that trading generally hurts performance. With some exceptions (e.g. trading to harvest capital losses), it is safe to assume that *ceteris paribus* investors who trade actively in taxable accounts will earn lower after-tax returns than buy-and-hold investors. Thus, when trading shortfalls can be traced to high turnover rates, it is likely that taxes will only exacerbate the performance penalty from trading.

<sup>2</sup> See also Fama and French (2010), Kosowski et al. (2006), and citations therein. Later in this paper, we discuss evidence from Grinblatt and Keloharju (2000) and Barber et al. (2009) that documents strong performance by institutions in Finland and Taiwan, respectively.

### 1.1.1 Long-Horizon Results

Odean (1999) analyzes the trading records of 10,000 investors at a large discount broker over the period 1987–1993. Using a calendar-time approach, he finds that the stocks bought by individuals underperform the stocks sold by 23 basis points (bps) per month in the 12 months after the transaction (with  $p$ -values of approximately 0.07) and that this result persists even when trades more likely to have been made for liquidity, rebalancing, or tax purposes are excluded from the analysis. These results are provocative on two dimensions. First, this is the first evidence that there is a group of investors who systematically earn subpar returns *before costs*. These investors have perverse security selection ability. Second, individual investors seem to trade frequently in the face of poor performance.

Barber and Odean (2000) analyze the now widely used dataset of 78,000 investors at the same large discount brokerage firm (henceforth referred to as the LDB dataset). Unlike the earlier dataset, which contained only trading records, this dataset was augmented with positions and demographic data on the investors, and the analysis here focuses on positions rather than trades. The analysis of positions, from a larger sample of investors (78,000 vs. 10,000) and a different time period (1991–1996 vs. 1987–1993), provides compelling evidence that individual investors' self-managed stock portfolios underperform the market largely because of trading costs.

Barber and Odean (2000) sort households into quintiles based on their monthly turnover from 1991 to 1996. The total sample consists of about 65,000 investors, so each quintile represents about 13,000 households. The 20% of investors who trade most actively earn an annual return net of trading costs of 11.4%. Buy-and-hold investors (i.e. the 20% who trade least actively) earn 18.5% net of costs. The spread in returns is an economically large 7 percentage points (pps) per year.

These raw return results are confirmed with typical asset-pricing tests. Consider results based on the Fama–French three-factor model. After costs, the stock portfolio of the average individual investors earns a three-factor alpha of  $-31.1$  bps per month ( $-3.7$  pps annually). Individuals who trade more perform even worse. The quintile of investors who trade most actively averages an annual turnover of 258%; these active investors churn their portfolios more than twice per year! They earn monthly three-factor alphas of  $-86.4$  bps ( $-10.4$  pps annually) after costs.

Grinblatt and Keloharju (2000) analyze two years of trading in Finland and provide supportive evidence regarding the poor gross returns earned by individual investors. The focus of their investigation is whether certain investors follow momentum or contrarian behavior with respect to past returns. In addition, they examine the performance of different categories of investors. Hampered by a short time series of returns, they do not calculate the returns on portfolios that mimic the buying and selling behavior of investors. Instead, they calculate the buy ratio for a particular stock and investor category on day  $t$ , conditional on its future performance from day  $t+1$  to day  $t+120$ , and test the null hypothesis that the buy ratio is equal for the top and bottom quartile of future performers. For households, the buy ratio for the top quartile is greater than the buy ratio for the bottom quartile



on only 44.8% of days in the two-year sample period ( $p=0.08$ ). For Finnish financial firms and foreigners, the difference in the ratios is positive on more than 55% of days. Individual investors are net buyers of stocks with weak future performance, while financial firms and foreigners are net buyers of stocks with strong future performance.

Further confirmation regarding the perverse trading ability of individual investors comes from Taiwan. Barber et al. (2009) analyze the trading records of Taiwanese investors over the period 1995–1999. They construct portfolios that mimic the trading of individuals and institutions, respectively. When portfolios are constructed assuming holding periods that range from one day to six months, the stocks bought by institutions (sold by individuals) earn strong returns, while stocks bought by individuals (sold by institutions) perform poorly. A long-short strategy that mimics the buying and selling of individual investors and assumes a holding period of 140 trading days earns a negative abnormal return of 75 bps per month before accounting for transaction costs ( $p < 0.01$ ).

The trading losses of individual investors in Taiwan are material. When one considers commissions and the transaction tax on sales, the aggregate trading losses of individuals are equal to 2.8% of total personal income in Taiwan and 2.2% of Taiwan's total GDP. Back-of-the-envelope calculations indicate the net returns earned by individual investors in aggregate are 3.8 pps below market returns. Three factors contribute (roughly) equally to the shortfall: perverse stock selection ability, commissions, and the transaction tax, with a somewhat smaller role being relegated to poor market timing choices.

The detailed trading information that we have on Finnish and Taiwanese investors is not available in the US. However, Hvidkjaer (2008) and Barber, Odean, and Zhu (BOZ, 2009a) use signed small trades from the TAQ database to infer the trading of individual investors in the US. The signing algorithm is a modified version of that proposed by Lee and Ready (1991), which identifies trades as buyer- or seller-initiated by comparing transaction prices to spreads. For each stock, both papers calculate a measure of order imbalance based on signed small trades (e.g., trades less than \$5,000). BOZ verify that this is a reasonable measure of individual investor trading activity. Using the LDB dataset and a second dataset from a full-service broker (1997–1999) (hereafter the FSB dataset), BOZ document order imbalance calculated from signed small trades is highly correlated with order imbalance from retail trades at these two brokers. Specifically, the correlation between order imbalance based on small trades in TAQ and order imbalance from the broker trading records is about 50%. In contrast, the correlation between order imbalance based on large trades (trades over \$50,000) and broker trading records is reliably negative. This evidence indicates that small trades are a good proxy for the behavior of individual investors during this period.<sup>3</sup>

<sup>3</sup> Given the adoption of price decimalization in 2001 and the spread of algorithmic trading, the proportion of volume traced to small trades has increased dramatically. We suspect these developments undermine the use of small trades as a proxy for the behavior of individual investors post-2001. O'Hara et al. (2011) confirm our suspicions.

Using small trades as a proxy for the trading of individual investors, both Hvidkjaer (2008) and BOZ (2009a) document that stocks heavily bought by individuals over horizons ranging from one month to one year go on to underperform stocks heavily sold by individuals. For example, Hvidkjaer sorts stocks into deciles based on signed small trade turnover (i.e. buys less sells divided by shares outstanding). At a formation period of six months, the top decile (stocks heavily bought) underperforms the bottom decile (stocks heavily sold) by 89bps per month ( $p < 0.01$ ).

### 1.1.2 Short-Horizon Results

Contrary to the long-run evidence discussed above, the returns earned by individual investors over short horizons (up to a week) appear to be quite strong. Kaniel, Saar, and Titman (KST, 2008) document individual investor trading *positively* predicts short-run returns. KST identify individual investor trades using the 2000–2003 NYSE's Consolidated Audit Trail Data (CAUD) files, which contains detailed information on all orders that execute on the exchange, including a field that identifies whether the order comes from an individual investor. Measuring order imbalance over a nine-week horizon, they document the top decile of stocks heavily bought by individuals earn market-adjusted returns of 16bps over the next 20 trading days (about a month), while the bottom decile (i.e. stocks heavily sold) earn  $-33$ bps. KST argue that their results are largely consistent with individual investors acting as "...liquidity providers to institutions that require immediacy" (p. 274). Analyzing the same data, Kaniel et al. (2012) find evidence consistent with informed trading by individual investors around earnings announcements. They document that the stocks bought in aggregate by individuals in the 10 days prior to an earnings announcement outperform those sold in aggregate by about 1.5% in the two days around the earnings announcement. They argue liquidity provision and private information contribute equally to the strong returns earned by individuals around earnings announcements.

Similarly, BOZ (2009) document that small trade order imbalance from TAQ *positively* predicts returns over short horizons. Specifically, when order imbalance is measured at a weekly horizon, stocks heavily bought outperform for the subsequent two weeks before going on to underperform for the remainder of the year. It is difficult to attribute these patterns to liquidity provision, as the order imbalance in BOZ is based on signed rather than all trades. If a stock is bought at a price above the quoted spread, it is categorized as a buy, while if the stock is sold at a price below the quoted spread, it is categorized as a sell. This signing yields order imbalance measures that are based only on liquidity demanders rather than on liquidity suppliers, presenting a challenge for the KST liquidity provision story. Indeed the contemporaneous relation between returns and order imbalance is positive in BOZ (what one would expect when order imbalance is based on liquidity demanders), but negative in KST (what one would expect when order imbalance is based on liquidity providers). BOZ argue that the combination

of a positive relation between small trade order imbalance and short-horizon returns, followed by return reversals at long horizons, can be explained by the correlated sentiment-based trading of individual investors. In the short run, sentiment temporarily pushes prices above fundamental value, leading to predictable long-run return reversals.

Kelley and Tetlock (KT, *in press*) use data routed by retail brokers to two market centers over the period 2003–2007 to analyze the trading of individual investors. Brokerage firms route a significant fraction of their order flow (roughly 40%) to these market centers, and the data contain a code that classifies the order submitter as an individual or institution. Using a daily Fama–Macbeth regression approach, KT document that daily order imbalance of retail traders *positively* predicts returns at horizons up to 20 days. KT (*in press*) argue the strong returns over short horizons is evident in both market and limit orders. They conclude: “. . . retail market orders aggregate private information about firms’ future cash flows, whereas retail limit orders provide liquidity to traders demanding immediate execution.”

These four papers use somewhat different approaches, datasets, and time periods. All four present intriguing evidence that individual investors’ trades positively predict returns at short horizons in the US. There is an ongoing debate in the literature regarding the origins of this short-run predictability in the US.

In contrast to the consistent finding of short-run predictability in the US, the non-US evidence is mixed. Barber et al. (2009) document that individual investors in Taiwan incur losses over short horizons. Long-short portfolios that mimic the buy–sell trades of individual investors earn reliably negative monthly alphas of  $-11.0\%$ ,  $-3.3\%$ , and  $-1.9\%$  over horizons of 1, 10, and 25 days respectively. Andrade, Chang, and Seasholes (2008) document a similar result using changes in stocks held in margin accounts by individual investors in Taiwan over the period 1994–2002. In Andrade et al., stocks are sorted into quintiles based on their order imbalance in week  $t$ ; stocks heavily bought go on to earn poor returns ( $-23$  bps) in the following week, while those heavily sold earn strong returns (29 bps). Kaniel et al. (2008) speculate that their liquidity provision story does not apply to the Taiwan market, where individual investors dominate trading; roughly 90% of total trading volume can be traced to retail investors in Taiwan.

### 1.1.3 Market vs. Limit Orders

The evidence on the profitability of market versus limit orders of individual investors also yields conflicting results. Kelley and Tetlock (*in press*), which we discussed in the prior section, document short-term profits on retail trades emanating from both market and limit orders in the US. Linnainmaa (2010) documents losses on limit orders and gains on market orders in Finland. Barber et al. (2009) find the opposite result in Taiwan—short-term gains on passive orders and short-term losses on aggressive (quasi-market) orders.

Linnainmaa (2010) argues that individual investors perform poorly on their trades because informed traders pick off their limit orders. Assume sleepy individual investors

have unmonitored limit orders to sell a stock. A savvy investor learns of a good earnings announcement that will drive the stock's price higher. Armed with this earnings news, the savvy investor places market orders to buy the stock and profits in the short term by picking off the unmonitored limit orders of individual investors. Linnainmaa (2010) uses data from the Finnish Stock Exchange over the period 1998–2001 that allows him to identify whether an investor has placed a limit or market order. Consistent with the hypothesis that individual investors are picked off, he documents that the returns on individual investor trades that emanate from limit orders lose 51 bps on the day following trade and 3.3% over 63 days. In contrast, the returns on trades that emanate from market orders gain 44 bps on the day following trade and 3.5% over 63 days. In Finland, individual investors lose money on executed limit orders, but make money on executed market orders. When combined, the gains and losses leave individual investors in his sample with profits that are indistinguishable from zero.

The evidence from Taiwan is not consistent with that from Finland. Taiwan is an electronic limit order market. Barber et al. (2009) categorize the limit orders as passive or aggressive. Orders to buy with prices in excess of the most recent unfilled sell limit order are categorized as aggressive; those with an order price below the most recent unfilled buy limit order are categorized as passive. (Sell orders are categorized as passive or aggressive in a similar way.) One can view aggressive limit orders as roughly equivalent to market orders since the only way to demand execution in an electronic limit order market is to place an order with an aggressive price (e.g. be willing to buy at a high price or sell at a low price). At short horizons (of one to 10 days following the trade), individual investors make money on their passive trades, though the six-month returns are indistinguishable from zero. Individual investors lose money on their aggressive trades at both short and long horizons. This is in striking contrast to the results in Finland, where individuals lose money on limit orders and make money on market orders.

## 1.2 Cross-Sectional Variation in Performance

The performance of the average individual obscures tremendous variation in outcomes across individuals. Importantly, the cross-sectional variation in performance is predictable and can be traced to investment skill, cognitive abilities, investment style, location, and gender.

There is strong evidence of performance persistence among individual investors. Coval, Hirshleifer, and Shumway (CHS, 2005) use the LDB dataset to analyze performance persistence: Do investors with strong past returns go on to earn strong returns? They sort investors into deciles based on the performance of their buys during the first half of the sample period (1991–1993) and analyze the subsequent performance of their purchases in the second half of the sample period (1994–1996). Using buys during the latter period, CHS construct a calendar-time portfolio that mimics the buying of investors in each performance decile. The return spread between the top and bottom

performance deciles is about 5bps per day in the week following trade. This return spread does not account for transaction costs; round-trip spreads and commissions would easily wipe out a 25bps trading advantage. Nonetheless, the evidence of variation in investor skill is intriguing.

Barber et al. (2011) analyze the performance of day traders in Taiwan over the period 1992–2006. Day trading in Taiwan is quite common. Over 300,000 individual investors engage in day trading in the typical year, and their combined trading accounts for 17% of total trading volume. This is an ideal setting to analyze the performance of speculators, as day traders are certainly not trading for liquidity, rebalancing, or tax-related reasons (all reasonable motivations for trading). Furthermore, the large population of day traders allows for a more powerful identification of potentially skilled traders. To identify skilled (and unskilled) traders, BLO (2011) rank investors based on their day trading performance in year  $y$  and analyze their performance in the subsequent year ( $y+1$ ). The top 500 traders earn intraday returns on day trading that outperform the thousands of traders who perform poorly by over 60bps. As in CHS, there is strong evidence of cross-sectional differences in speculative ability though the magnitudes are much larger. The best traders, though a rare breed, earn gross abnormal returns of about 50bps per day, which is sufficient to cover a reasonable accounting for transaction costs.

Recent papers suggest cognitive abilities play an important role in investor outcomes. Korniotis and Kumar (in press) predict cognitive ability using a host of demographic variables (e.g. age, education, and social networks). Using the LDB dataset, they show that smarter investors outperform others by about 30bps per month (or 3.6% annually) both before and after accounting for transaction costs. Smarter investors earn returns net of trading costs that are on par with appropriate benchmark returns; they make good stock picks, but only good enough to cover their trading costs. Other investors underperform appropriate benchmarks by a bit more than 30bps per month (or 3.6% annually) after costs, with about half of the shortfall being traced to trading costs and half to bad stock selection.

In a closely related paper, Korniotis and Kumar (2009) use the LDB dataset to analyze the relation between age and performance. Motivated by the observation that cognitive abilities decline with age, the authors predict and find evidence to support the notion that investment performance declines with age.

Using data from Finland, Grinblatt, Keloharju, and Linnainmaa (GKL, 2012) analyze the relation between IQ and stock selection ability. The Finnish Armed Forces administers an intelligence test (120 questions covering verbal, math, and logical reasoning) to recruits around the time of induction into mandatory military duty (generally at the age of 19 or 20). The scores range from 1 to 9, and GKL define a low-IQ investor as one with a FAF score from 1 to 4 and a high-IQ investor as one with a FAF score of 9. Based on these definitions, 24% of their sample are low-IQ investors, while 8% are high-IQ investors. The spread in portfolio returns earned by low- versus high-IQ investors is

2.2% per year and is marginally significant. However, an analysis of the returns following purchases provides convincing statistical evidence that high-IQ investors make better trades than low-IQ investors. GKL also document high-IQ investors have better trade execution, though they do not measure the net portfolio returns of high-IQ investors, so it is difficult to know whether high-IQ investors would beat an appropriate benchmark after a reasonable accounting for transaction costs.

Ivkovic, Sialm, and Weisbenner (2008) argue that informed individual investors would tend to concentrate their portfolios in the stocks for which they hold an informational advantage. Using the LDB dataset, they document that investors with concentrated portfolios (with only one or two stocks) outperform diversified portfolios (with three or more stocks) by 16bps per month. This “concentration” effect is more pronounced for local stock and non-S&P 500 stocks.

Finally, Barber and Odean (2001) compare the performance of men and women using data from the LDB dataset. Unlike the studies on cross-sectional performance discussed above, this study focuses on the net returns (i.e. returns net of spreads and commissions) of men and women. The study is motivated by the two observations: (1) men tend to be more prone to overconfidence than women in areas culturally perceived to be in the male domain (Deaux and Farris, 1977), and (2) models that assume that investors are overconfident tend to predict investors will trade excessively and to their detriment. When combined, these observations predict that men will trade more than women and that excessive trading will hurt their performance. Consistent with these predictions, Barber and Odean (2001) document that men trade more than women; the annual turnover rates of men are about 80%, while those of women are 50%. The excessive trading of men leads to poor returns. While both men and women earn poor returns, men perform worse. Virtually all of the gender-based difference in performance can be traced to the fact that men tend to trade more aggressively than women. Neither men nor women appear to have stock selection ability (i.e. the gross returns earned on their trades are similar), so men’s tendency to trade aggressively and the resulting trading costs drag down men’s returns. Dorn and Huberman (2005) find that men with accounts at a German online brokerage trade more actively than women, but gender effects are reduced if one accounts for differences in self-reported risk aversion. Choi, Laibson, and Metrick (2002), Agnew, Balduzzi, and Sundén (2003), and Mitchell et al. (2006), all report that while trading levels are low in 401(k) plans, men trade more actively than women. In contrast to the US and German and 401(k) plan evidence, Feng and Seasholes (2008) find no significant turnover or performance differences in the accounts of men and women in China.

A careful reading of the research on cross-sectional variation in performance yields three general conclusions. First, there is strong evidence of cross-sectional variation in trading skill. Second, security selection skill among individuals is rare (i.e. confined to a relatively small group of stocks or individuals). Third, even the best stock pickers have trouble covering transaction costs.

## 2. WHY DO INDIVIDUAL INVESTORS UNDERPERFORM?

The majority of the empirical evidence indicates that individual investors, in aggregate, earn poor long-run returns and would be better off had they invested in a low-cost index fund. This evidence of poor performance is particularly compelling when we include transaction costs (e.g. commissions, bid-ask spreads, market impact, and transaction taxes). While transaction costs are an important component of the shortfall, a second component is the poor security selection ability of individual investors documented in many studies that we reviewed in the prior section. These observations lead one to wonder why investors trade so much and to their detriment.

### 2.1 Asymmetric Information

One possibility is that individual investors realize that they are at an informational disadvantage when trading and only do so for non-speculative reasons including liquidity needs, rebalancing, and taxes. Investors may need to purchase stocks to save, or sell stocks to consume. At times, investors may need to rebalance their portfolios to manage risk-return tradeoffs. Occasionally, investors will want to harvest tax losses to minimize their tax bill. When faced with these liquidity, rebalancing, or tax management needs, retail investors are forced to trade with others who might be better informed. It is, however, difficult to reconcile non-speculative trading needs with the annual turnover rates of 250% for the 20% most active investors in the LDB dataset (Barber and Odean, 2000), annual turnover of 300% in Taiwan (Barber et al., 2009), or annual turnover of 500% in China (Gao, 2002). Furthermore, investors who do have unusual non-speculative needs to trade could dramatically lower their asymmetric information and transaction costs by investing in low cost, no load mutual funds.

Why do so many investors self-manage portfolios when they could earn better returns with lower risk in low-cost mutual funds, such as index funds? And why do investors with portfolios of individual equities trade actively when doing so lowers their expected returns? We turn to possible behavioral explanations.

### 2.2 Overconfidence

Overconfidence can explain the relatively high turnover rates and poor performance of individual investors. A rich literature in psychology documents that people generally are overconfident (for an overview of this literature see Moore and Healy, 2008, and citations in Odean, 1999). One variety of overconfidence is a belief that one knows more than one actually does, which is sometimes labeled “miscalibration” or “overprecision”. In a classic illustration of this type of overconfidence, subjects are presented a series of 10 difficult questions (e.g. “What is the length of the Nile river?”). They are then asked to provide a low and high guess such that the correct answer is between the low and high guess with a probability of 90%. The well-calibrated subject would, on average, provide

intervals that contain the correct answer nine out of 10 times. Typically, subjects provide intervals that contain far fewer correct answers (Alpert and Raiffa, 1982). A second variety of overconfidence is a belief that one is better than the median person, which has been (mis)labeled the “better-than-average” effect. For example, when asked about their own driving ability relative to the population of drivers, most people rank themselves above the driver of median ability (Svenson, 1981). Related to, but distinct from, the better-than-average effect is the tendency to overestimate one’s actual ability. For example, a student might think his score on a test is 80% when he actually scored 65% (and the average score was 90%). (See Moore and Healy, 2008, for discussion.)

Several papers have developed theoretical models based on the observation that investors are overconfident (Benos, 1998; Caballe and Sakovics, 2003; Daniel, Hirshleifer, and Subrahmanyam, 1998; Gervais and Odean, 2001; Hong, Scheinkman, and Xiong, 2006; Kyle and Wang, 1997; Odean, 1998; Peng and Xiong, 2006; Scheinkman and Xiong, 2003; and Wang, 2001). Generally, these models assume investors suffer from the miscalibration type of overconfidence. For example, one can extend the classic models of Kyle (1985), Grossman and Stiglitz (1980), or Diamond and Vercchia (1981) by assuming some investors are miscalibrated (or overconfident) about the precision of their information (see Odean, 1999). In these three settings, the overconfidence models generally predict that investors will trade too much and to their detriment.

A number of empirical facts line up reasonably well with the predictions of these theoretical models. Investors who trade the most perform the worst (Barber and Odean, 2000). Men, who are more prone to be overconfident than women, trade more and perform worse than women (Barber and Odean, 2001).

Empirical work has attempted to tease out the type of overconfidence, miscalibration or better-than-average, that is linked to excessive trading. Combining survey evidence with trades and positions for 1,345 German investors, Dorn et al. (2005) document that investors who think themselves more knowledgeable than average churn their portfolios more. Similarly, Glaser and Weber (2007) use survey evidence and trading records for 215 German investors to document a link between the “better-than-average” type of overconfidence and trading activity. Using a five-question version of the calibration experiment described earlier, Glaser and Weber find no reliable link between the miscalibration type of overconfidence and trading activity. (While this is a provocative nonresult, using a five- or 10-question survey to measure miscalibration strikes us as a very noisy measure that would yield low power to reject the null hypothesis that miscalibration and trading activity are unrelated.) Finally, Grinblatt and Keloharju (2009) find that Finnish investors with an inflated sense of their own abilities tend to trade more; we elaborate on this finding in more detail in the next section.

Closely related to the notion of overconfidence are self-assessments of competence, which are studied by Graham, Harvey, and Huang (2009). They argue that “people are more willing to bet on their own judgments when they feel skillful or knowledgeable”.



To test this conjecture, they use survey responses from 475 US investors to study the impact of self-assessed competence on trading. Competence is based on the answer to the following question “How comfortable do you feel about your ability to understand investment products, alternatives, and opportunities?” Subjects responded on a five-point scale ranging from “1-very uncomfortable” to “5-very comfortable”. Graham et al. document a strong link between self-assessed competence and the propensity to trade. They measure the better-than-average effect by taking the difference between the answers to questions about an investor’s expected return on their own portfolio and the expected return on the market. They find weak evidence that this measure of overconfidence is linked to trading activity.

In summary, a fair amount of evidence indicates that the better-than-average and overestimation varieties of overconfidence are correlated with higher levels of trading by investors. While the evidence that miscalibration is linked to trading is weaker, we suspect this weak link might be partially explained by the current inability to measure miscalibration well.

### 2.3 Sensation Seeking

A noncompeting explanation for the excessive trading of individual investors is the simple observation that trading is entertainment and appeals to people who enjoy sensation seeking activities such as gambling. Using the Finnish dataset, Grinblatt and Keloharju (GK, 2009) analyze both sensation seeking and overconfidence as mechanisms that lead to trading. They use traffic tickets as a proxy for sensation seeking and argue that those who speed are more likely to be sensation seekers. To measure overconfidence, GK use data from tests administered to men entering the Finnish Armed Forces that measure the candidates’ actual ability (i.e. test outcomes) and perceived ability (i.e. self-assessments). GK use the measure of perceived ability that is orthogonal to actual ability as a measure of overconfidence. Using these instruments, GK document that both sensation seeking and overconfidence affect trading, though the tenor of their results depend a bit on whether one focuses on the decision to trade, the number of trades, or portfolio turnover as the dependent variable of interest.

Dorn and Sengmueller (2009) match survey responses to trading records for 1,000 investors at a German discount broker. Investors are asked whether they agree or disagree (on a five-point scale) with the following four statements: (1) I enjoy investing, (2) I enjoy risky propositions, (3) Games are only fun when money is involved, and (4) In gambling, the fascination increases with the size of the bet. Investors who agree with these statements tend to trade more. Investors who report enjoying investing (question 1) or gambling (questions 2–4) trade at twice the rate of other investors.

Trading competes with other activities for the attention of sensation-seeking investors. Thus, we would expect trading to wane when there are a number of thrilling activities at their disposal. There is some suggestive evidence that this is the case. Dorn, Dorn, and Sengmueller (2007) analyze the trading response of individual investors to

multistate lottery jackpots in the US. Using small trades in the TAQ dataset to identify individual investors during the period 1998–2004, they document that a one standard deviation increase in multistate lottery jackpots (i.e. Powerball and Mega Millions) is associated with a 1% reduction in small trader participation (the fraction of trading volume contributed by trades of less than \$5000); this effect is most pronounced for lottery-like stocks (e.g. low-prices stocks with high past volatility and skewness). Similarly, Barber et al. (2009) find that trading in Taiwan dropped by about 25% when a legal lottery was introduced on the island in April 2002. As in Dorn, Dorn, and Sengmueller (2007), Gao and Lin (2011) further explore this substitution effect by analyzing the volume of individual investor trading in Taiwan around lotteries with unusually large jackpots. They document trading by individual investors declines during periods with unusually large lottery jackpots; moreover, the effects are greatest in stocks with high levels of individual investors participation and skewed returns.

In related papers, Kumar (2009b) and Mitton and Vorkink (2007) hypothesize that retail investors have a taste for stocks with lottery-like payoffs. Note that this is distinct from the sensation-seeking (or entertainment) hypothesis discussed above. Sensation-seeking investors will trade to entertain themselves but might hold well-diversified portfolios and eschew lottery-like stocks. Investors with a preference for skewness will hold lottery-like stocks but might refrain from trading. Thus, preferences for skewness may lead to under-diversification but has no immediate implications for trading. We elaborate on these findings later when we discuss the literature on diversification.

## 2.4 Familiarity

There is debate about whether individual investors possess an informational advantage about companies that are close to where they live or in their industry of employment. Some scholars argue that individual investors are better informed about the prospects of such companies and that this information advantage leads to superior investment performance. Others argue individuals overinvest in these stocks because they are familiar to them, leading to under-diversification and average or even below-par returns. In this section, we discuss the evidence on performance. In section 6, we discuss the implications for diversification.

Massa and Simonov (2006) analyze portfolio holdings of Swedish investors and document that investors tilt their portfolio toward stocks that are most closely related to them, either professionally (e.g. a financial professional investing in a finance stock) or geographically (e.g. a Seattle investor investing in a Seattle stock). They argue that this familiarity-based investing allows investors to earn higher returns because of the information advantage conferred by familiarity. Similarly, Ivkovic and Weisbenner (2005) use the LDB dataset to document individual investors tend to overweight local stocks and argue the returns on local stocks are strong. Seasholes and Zhu (2010) argue that this result is not robust and leans on faulty statistical methodologies. After considering a battery of tests using the same dataset as Ivkovic and Weisbenner (2005), they conclude that

individual investors do not earn superior returns on local stocks. Døskeland and Hvide (2011) document that, after excluding own-company stock holdings, individual investors in Norway overweight stocks in the industry in which they are employed despite the diversification disadvantages of doing so and earn negative abnormal returns on the stocks they buy in their industry of employment.

In summary, the performance implication of investing in geographically or occupationally familiar stocks is the subject of ongoing debate. However, investors overweight these stocks in their equity portfolios, which has potentially important implications for diversification, a subject we return to later in this review.

### 3. THE DISPOSITION EFFECT: SELLING WINNERS AND HOLDING LOSERS

Individual investors have a strong preference for selling stocks that have increased in value since bought (winners) relative to stocks that have decreased in value since bought (losers). Shefrin and Statman (1985) labeled this behavior the “disposition effect”—investors are disposed to sell winners and hold losers. In this section, we begin by illustrating the basic effect. We then survey the empirical and experimental work documenting the disposition effect, which we summarize in Table 2. We close by discussing possible explanations for the disposition effect.

#### 3.1 The Evidence

The disposition effect is a remarkably consistent and robust phenomenon. Before diving into the literature on this topic, we illustrate the basic effect using data from the LDB dataset and the Finnish dataset from 1995 to 2008. (The analysis of the Finnish dataset was provided to us by Noah Stoffman.) Specifically, we estimate models of the form

$$h(t, x(t)) = h_0(t) \exp(\beta_1 x_1 + \dots + \beta_p x_p),$$

where  $h(t, x(t))$  is the hazard rate at time  $t$  conditional on a set of  $p$  observed predictors as of period  $t$  (denoted  $x(t)$ ). The baseline hazard rate,  $h_0(t)$ , is the hazard rate when all predictors take on a value of zero. The  $\beta$  coefficients are estimated from the data. The hazard rate is the probability density function of the hazard event at time  $t$  conditional on survival to time  $t$  (i.e. not observing the hazard event prior to  $t$ ).

In our analyses, the hazard event is the sale of a stock, and time is measured in days subsequent to the original purchase. The hazard rate for a particular stock being sold by a particular investor is conditional on the covariates for that stock and investor at time  $t$ .

For each  $k$ th covariate, we report estimates of the hazard ratio assuming a one-unit increase in the covariate:

$$\exp(\beta_k) = \frac{h_0(t) \exp(\beta_1 x_1 - \dots - \beta_k (x_k - 1) - \dots - \beta_p x_p)}{h_0(t) \exp(\beta_1 x_1 + \dots + \beta_k x_k + \dots + \beta_p x_p)}.$$

**Table 2** Summary of articles on the disposition effect

Article	Dataset	Main Finding
Barber et al. (2007)	Taiwan Stock Exchange 1995–1999	The disposition effect is present for individual and institutional investors (mutual funds, corporations, dealers, and foreigners). Individuals have the strongest disposition effect.
Brown et al. (2006)	Australian Stock Exchange 1995–2000	The disposition effect is present for individual and institutional investors in the Australian IPO market, though traders making large trades are less prone to the disposition effect.
Calvet, Campbell, and Sodini (2009)	Statistics Sweden 1992–2002	Provides a comprehensive analysis of motivation for portfolio rebalancing.
Feng and Seasholes (2005)	Chinese Broker 2005–2006	Less sophisticated households are more likely to sell winners and hold losers. Trading experience and investor sophistication ameliorate the disposition effect.
Dhar and Zhu (2006)	US Discount Broker 1991–1996	Among individual investors, the disposition effect is weaker among the wealthy and those employed as professionals.
Frazzini (2006)	Thomson Financial CDA/Spectrum Mutual Funds database 1980–2002	Mutual funds sell equities held for a gain at a higher rate than those held for a loss, and this tendency is stronger following years of poor fund performance.
Grimblatt and Keloharju (2001a)	Finland Stock Exchange 1995–1996	Individual investors sell winners and hold losers.
Heath et al. (1999)	Employee Stock Options at Seven US Companies 1985–1994	Employee stock options are more likely to be exercised when the stock is trading above its prior-year high.
Odean (1998)	US Discount Broker 1987–1993	Individual investors sell winners and hold losers.
Shapira and Venezia (2001)	Israeli Broker 1994	Both professionally managed accounts and self-managed accounts display a disposition effect. The effect is most pronounced for self-managed accounts.
Weber and Camerer (1998)	Experimental Market	Subjects participating in an experimental stock market are more likely to sell winners rather than losers. The disposition effect is mitigated when investors are forced to sell all positions and then repurchase.

Note that the hazard ratio,  $\exp(\beta_k)$ , is the ratio of hazard rates for two stocks with the same covariates, except that  $x_k$  is one unit larger for the stock whose hazard rate is given in the numerator. Thus, if  $x_k$  is a dummy variable, the hazard ratio is the ratio of the hazard when the dummy variable takes on a value of 1 to the hazard when its value is 0 and all other covariates are the same.

The Cox model makes no assumptions about how the baseline hazard rate changes over time and does not estimate the baseline hazard rate. The model does assume that hazard ratios do not change with time. For example, the model makes no assumptions about how the unconditional rate of selling stocks changes from day 50 to day 100, but the model does assume that if a winner is sold at a 20% higher rate than a loser on day 50, then the winner will also be sold at a 20% higher rate than a loser on day 100.

To analyze how the magnitude of the return since a stock was purchased affects the hazard rate of selling the stock, we create dummy variables for 4% wide return categories. These return categories are:

$$r \leq -42\%, -42\% < r \leq -38\%, \dots, -2\% < r \leq 2\%, \dots, 58\% < r \leq 62\%, 62\% < r.$$

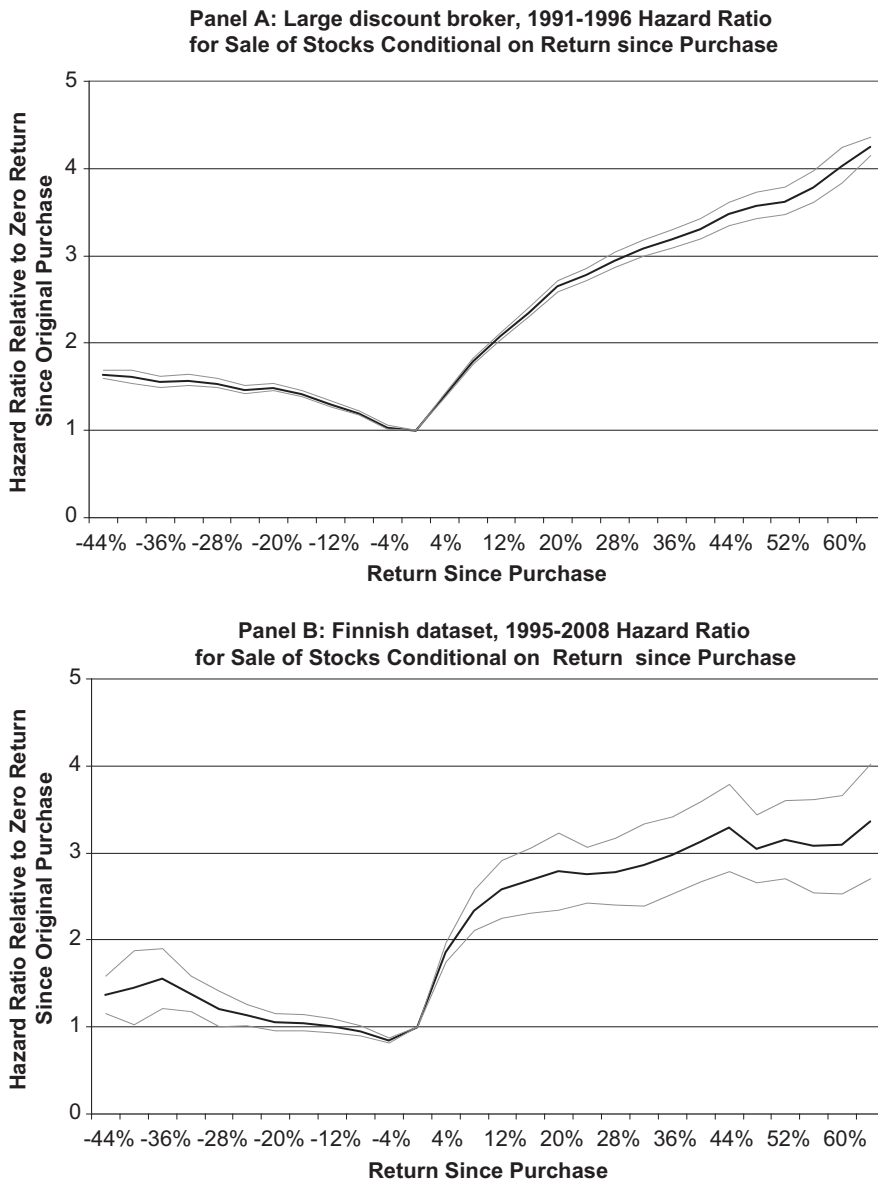
For example, we create a dummy variable that is one if the return at the time of the sale is greater than  $-2\%$  and less than or equal to  $2\%$ . These covariates are time varying since the return since purchase can change daily.

For the LDB dataset, we estimate one model for the full sample period (1991–1996) and base confidence intervals on the estimated standard errors for the single model. For the Finnish dataset, separate models are estimated for each sample year (1995–2008) and then the results are averaged across years. Confidence intervals are based on the time-series standard errors of coefficient estimates (i.e. an adaptation of the Fama–Macbeth approach to calculating standard errors that assumes serial independence in the estimated coefficients).<sup>4</sup>

In Figure 1, Panel A, we plot the hazard ratio for selling ( $y$  axis) for various levels of return since the stock was purchased ( $x$  axis) using data from the large discount brokerage covering the period 1991–1996. In Panel B, results using the Finnish data are plotted. The general patterns of the hazard ratios are remarkably consistent.

Consider the large discount broker (Panel A). The default hazard rate is the omitted return category that includes returns of  $-2\%$  to  $2\%$ . The tendency to sell a stock increases dramatically as returns increase. For example, the hazard rate for selling stocks up between 18–22% since purchased is 2.65 times greater than the hazard rate for selling stocks that have experienced returns between  $-2\%$  and  $2\%$ . Negative returns since a stock was purchased also increase the hazard rate of selling, but not as dramatically as positive returns. For example, the hazard rate for selling stocks up 18–22% since

<sup>4</sup> Since the Cox models are computationally intense with time-varying covariates (i.e., returns since purchase) and many households, estimating one model for the full 1995–2008 sample period is computationally challenging.



**Figure 1** The disposition effect. Grey lines represent 95% confidence intervals on estimated hazard ratios.

purchased is 1.77 times greater than the hazard rate for selling stocks down 18–22% since purchased. The results are qualitatively similar for the Finnish data.

A number of studies—both experimental and empirical—confirm the presence of the disposition effect. [Weber and Camerer \(1998\)](#) provide early experimental support

for the disposition effect. In their experiment, subjects observe price changes on six stocks (stocks A–G) over 14 periods. The probability that a stock will increase in value varies across stocks, but not rounds. Subjects know the distribution of these probabilities, but do not know which stock has the highest probability of increasing in price. A rational Bayesian would conclude that the stock with the most price increases has the greatest chance of being the stock with a high probability of further increasing in value, so the disposition effect (selling winners, holding losers) is clearly counterproductive in this setting. Nonetheless, subjects sell winners at a 50% higher rate than losers; 60% of sales are winners, while 40% of sales are losers.

Odean (1998) examines trading records for 10,000 accounts at a large US discount brokerage for the period 1987–1993. In brief, Odean compares the rate at which investors sell winners (realized gains) and losers (realized losses) and compares the realization of gains and losses to the opportunities to sell winners and losers. He finds that, relative to opportunities, investors realize their gains at about a 50% higher rate than their losses and that this difference is not explained by informed trading, a rational belief in mean reversion, transactions costs, or rebalancing. (See Calvet, Campbell, and Sodini, 2009, for a comprehensive analysis of the rebalancing of household portfolios.)

Grinblatt and Keloharju (2001a) examine the disposition effect using the trading records for virtually all Finnish investors during 1995 and 1996. Controlling for a wide variety of factors, they find that investors have a tendency to hold onto losers. Relative to a stock with a capital gain, a stock with a capital loss of up to 30% is 21% less likely to be sold; a stock with a capital loss in excess of 30% is 32% less likely to be sold. Furthermore, stocks with high past returns or trading near their monthly high are more likely to be sold.

Heath, Huddart, and Lang (1999) find that employee stock options are more likely to be exercised when the stock is trading above its previous year's high and that exercise is positively related to stock returns during the previous month and negatively related to returns over longer horizons.

Kaustia (2004) tracks trading volume following IPOs and finds that IPOs that opened below their offer price experience significantly more trading volume when they trade above rather than below the offer price. Brown et al. (2006) analyze records for Australian investors who subscribed to IPOs between 1995 and 2000 and find that the disposition effect "... is pervasive across investor classes".

The disposition effect has been documented for individual investors in several countries, for some groups of professional investors, and for different types of assets. Shapira and Venezia (2001) analyze the trading of 4,330 investors with accounts at an Israeli brokerage in 1994. About 60% of these accounts are professionally managed, while for other accounts, investors make independent decisions. They measure the duration of round-trip trades conditional on whether the stock was sold for a gain or loss. A tendency to sell winners and hold losers would, *ceteris paribus*, yield shorter

holding periods for winners vs. losers. Both professionally managed accounts and independent accounts exhibit the disposition effect (the holding periods for winners is roughly half that of losers), though the effect is somewhat stronger for independent accounts.

Feng and Seasholes (2005) use hazard rate models to estimate the magnitude of the disposition effect for 1,511 Chinese investors using trades data from a Chinese broker in 2000. These Chinese investors are 32% less likely to realize a loss. Chen et al. (2007) analyze almost 50,000 Chinese investors using data from a Chinese brokerage firm over the period 1998–2002. Using methods similar to those in Odean (1998), Chen et al. document that Chinese investors are 67% more likely to sell a winner than a loser. For a small subsample of 212 institutional investors who trade through this broker, Chen et al. document a much weaker disposition effect as institutions are only 15% more likely to see a winner. Choe and Eom (2009) find a disposition effect for investors in Korean stock index futures; the effect is strongest for individual investors.

Compelling evidence beyond Chen et al. (2007) and Choe and Eom (2009) suggests that institutions suffer from the disposition effect, albeit to a lesser extent than individual investors. Frazzini (2006) estimates, from 1980 to 2002, the rates at which US mutual funds realize gains and losses in their equity holdings relative to how many positions they hold for a gain or a loss. For all funds, gains are realized at a rate 21% higher than losses; for funds in the previous year's bottom performance quintile, gains are realized at a rate 72% higher than losses. Barber et al. (2007) analyze trading records for all investors at the Taiwan Stock Exchange from 1995 to 1999 to compare the disposition effect of individual and various categories of institutional investors. They find a strong disposition effect for individual investors, who are nearly four times as likely to sell a winner rather than a loser. Corporate investors and dealers also are disposed to selling winners (though the effect is much weaker than that observed for individuals), but neither Taiwan mutual funds nor foreign investors in Taiwan are disposed to selling winners.

Consistent with this investment behavior being a mistake that has its origins in cognitive ability or financial literacy, the disposition effect is most pronounced for financially unsophisticated investors. For example, the disposition effect tends to be stronger for individual rather than institutional investors (Brown et al., 2006; Chen et al., 2007; Choe and Eom, 2009; and Barber et al., 2007). Dhar and Zhu (2006) use the LDB dataset to document that wealthier and professionally-occupied investors are less likely to sell winners and more likely to sell losers. Calvet, Campbell, and Sodini (2009) document a similar result among Swedish investors. Finally, in the LDB data, investors who place more trades on the same day are less likely to exhibit the disposition effect (Kumar and Lim, 2008) and the disposition effect is greatest for hard-to-value stocks (Kumar, 2009a).

There is also intriguing evidence that investors learn to avoid the disposition effect over time. Among the Chinese individual investors they study, Feng and Seasholes



(2005) document that the disposition effect dissipates with trading experience (time since first trade) and various measures of financial sophistication measured early in a trader's history. Seru, Shumway, and Stoffman (2010) examine trading records for individual investors in Finland from 1995 to 2003. They find that the disposition effect declines with experience when experience is measured in number of trades. The drop in the disposition effect is much less when trading experience is measured in years.

The research discussed above presents a remarkably clear portrait of a prototypical individual investor who sells his winners and holds his losers. This behavior is broadly categorized as an investment mistake because it is tax inefficient.<sup>5</sup> Thus, while taxes clearly affect the trading of individual investors, they cannot explain the disposition effect. Investors' 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, though not necessarily at a constant rate. Constantinides (1984) shows that when there are transactions costs, and no distinction is made between the short-term and long-term tax rates, investors should increase their tax-loss selling gradually from January to December.<sup>6</sup> Australia has a June tax year end, so the Constantinides model would predict accelerated selling in June for Australia, a prediction confirmed by Brown et al. (2006).

Barber and Odean (2004) document the disposition effect for taxable and tax-deferred accounts for the LDB dataset and for a dataset of trading and position records from January 1998 to June 1999 for 418,332 households with accounts at a large US full-service brokerage. They find that at both the discount and full-service brokers, the disposition effect is reversed in December in taxable, but not tax-deferred, accounts. Using a Cox proportional hazard rate model and the US discount brokerage data, Ivkovich, Poterba, and Weisbenner (2005) document that: "Investors are more likely to realize losses in taxable accounts than in tax-deferred accounts, not just in December, but throughout the year."

### 3.2 Why Do Investors Prefer to Sell Winners?

While the tendency of investors to sell winners more readily than losers is empirically robust, recent research focuses on why investors behave this way. Shefrin and Statman (1985) attribute the disposition effect to a combination of prospect theory, regret aversion, mental accounting, and self-control issues. Prospect theory was developed from a series of experiments in which Kahneman and Tversky (1979) ask students to choose

<sup>5</sup> In addition, selling winners rather losers arguably leaves individual investors missing out on some returns that might be earned because of momentum effects (Jegadeesh and Titman, 1991).

<sup>6</sup> Dyl (1977), Lakonishok and Smidt (1986), and Badrinath and Lewellen (1991) report evidence that investors do sell more losing investments near the end of the year.

between hypothetical outcomes such as: “Which of the following would you prefer? A: A 50% chance to win 1000, and 50% chance to win nothing; B: 450 for sure.” It is not obvious exactly how such choices translate into the realm of investing. Shefrin and Statman assume that, due to mental accounting (Thaler, 1985), most investors will segregate gambles and thus tend to evaluate performance at the level of individual securities (e.g. stocks) rather portfolios.

What is less clear is what happens when investors apply prospect theory preferences to stock investments. Barberis and Xiong (2009) model the trading behavior of an investor with prospect theory preferences. They find that, if performance is evaluated annually, prospect theory preferences do not necessarily lead to a tendency to realize gains more readily than losses and can even have the opposite effect. Hens and Vlcek’s (2011) model questions whether investors with prospect theory preferences would even buy stocks in the first place. Henderson (2012) develops an optimal stopping model based on prospect theory preferences and finds investors are more likely to realize gains than losses. Kaustia (2010b) finds that prospect theory can lead to holding onto both losers and winners. Yao and Li (2011) model a market in which investors with prospect theory preferences interact with investors with constant relative risk aversion (CRRA) and find that this interaction commonly generates a negative-feedback trading tendency, which favors the disposition effect and contrarian behavior, for prospect theory investors.

Barberis and Xiong (2009, 2012) argue that investors gain utility from realizing gains and dub this behavior “realization utility”. They show that, if gains and losses are evaluated when they are realized, a disposition effect obtains. In ongoing work using brain imaging (fMRI) while subjects are making buying and selling decisions in an experimental market, Frydman et al. (2011) present intriguing results that are consistent with the notion that investors get a burst of utility when they sell a winner.

Summers and Duxbury (2007) examine the role of emotions in creating the disposition effect. They find no disposition effect in experimental markets when subjects do not actively choose the stocks in their portfolios; if subjects do not feel responsible for decisions leading to gains and losses, they no longer sell winners more readily than losers. This suggests that the emotions of regret and its positive counterpart—referred to by some authors as rejoicing and by others as pride—contribute to the disposition effect. Muermann and Volkman (2006) develop a model of the disposition effect in which investors respond to anticipated regret and pride. Strahilevitz, Odean, and Barber (2011) document that individual investors are more likely to repurchase a stock that they have previously sold if the price has dropped since the previous transaction. They attribute this behavior to the emotions of regret when one repurchases at a higher price than one sold at and rejoicing when one repurchases at a lower price. Consistent with this emotional story, Weber and Welfens (2011) confirm in experiments that subjects exhibit this behavior only when they were responsible for the original sale, suggesting

that investors refrain from repurchasing stocks at a higher price than their previous sale price to avoid regret.

#### 4. REINFORCEMENT LEARNING

The simplest form of learning may be to repeat behaviors that previously coincided with pleasure and avoid those that coincided with pain. Several studies suggest that individual investors engage in such simple reinforcement learning. [Choi et al. \(2009\)](#) document that investors overextrapolate from their personal experience when making savings decisions; investors whose 401(k) accounts have experienced greater returns or lower variance increase their saving rates. [Strahilevitz, Odean, and Barber \(2011\)](#) find that investors are more likely to repurchase a stock that they previously sold for a profit than one previously sold for a loss. [Huang \(2010\)](#) demonstrates that investors, particularly unsophisticated investors, are more likely to buy a stock in an industry if their previous investments in this industry have earned a higher return than the market. [De, Gondhi, and Pochiraju \(2010\)](#) show that individual investors trade more actively when their most recent trades are successful. [Kaustia and Knupfer \(2008\)](#) document that investors are more likely to subscribe to initial public offerings (IPOs) if their personal experience with IPO investments has been profitable. [Malmendier and Nagel \(2011\)](#) establish that investor age cohorts who have experienced high stock market returns throughout their lives are less risk averse and more likely to invest in stocks.

#### 5. ATTENTION: CHASING THE ACTION

Individuals have a limited amount of attention that they can devote to investing. Attention can affect the trading behavior of investors in two distinct ways. On one hand, directing too little attention to important information can result in a delayed reaction to important information. On the other hand, devoting too much attention to (perhaps stale or irrelevant) information can lead to an overreaction.

Recent research provides some support for the notion that distracted investors miss important information. [Hirshleifer, Lim, and Teoh \(2009\)](#) find that the market reaction to an earnings surprise is smaller and post-earnings announcement drift is greater for firms that announce earnings on days that many other firms announce earnings; they argue that this is because more firms are competing for investors' attention. Similarly, [Dellavigna and Pollet \(2009\)](#) document the market reaction to Friday earnings announcements is muted and the drift is greater; they argue investors are distracted on Fridays and are unable to fully process Friday announcements. However, [Hirshleifer et al. \(2008\)](#) are unable to link post-earnings announcement drift to the trades of individual investors in the LDB dataset, who tend to be net buyers subsequent to both positive and negative extreme earnings surprises.

Barber and Odean (2008) argue that attention greatly influences individual investor purchase decisions. Investors face a huge search problem when choosing stocks to buy. Rather than searching systematically, many investors may consider only stocks that first catch their attention (e.g. stocks that are in the news, or stocks with large price moves). This will lead individual investors to buy attention-grabbing stocks heavily. Since most individual investors own only a small number of stocks and only sell stocks that they own, selling poses less of a search problem and is less sensitive to attention effects. Using abnormal trading volume, the previous day's return, and news coverage as proxies for attention, Barber and Odean find that individual investors in the LDB and FSB datasets execute proportionately more buy orders for more attention-grabbing stocks.

Examining transaction records for 6,459,723 accounts trading on the Shanghai Stock Exchange, Seasholes and Wu (2007) document positive buy-sell imbalances for individual investors when stocks hit upper price limits. They argue that hitting an upper price limit is an attention-grabbing event and find that imbalances are most positive when few other stocks hit upper price limits on the same day. Even investors who have never previously owned a stock are more likely to buy when stocks hit these limits. Seasholes and Wu also find that other (rational) investors systematically profit at the expense of the attention driven individual investors.

Engelberg and Parsons (2011) find that individual investors are more likely to trade an S&P 500 index stock subsequent to an earnings announcement if that announcement was covered in the investor's local newspaper. Both buying and selling increase, though buying somewhat more than selling. Engelberg, Sasseville, and Williams (2011) look at overnight market reaction to buy and sell recommendations on the television show *Mad Money*. They find that the market reaction is greater following recommendations made when viewership—based on Nielson ratings—is higher. Furthermore, consistent with Barber and Odean's hypothesis that attention matters more for buying than selling, they find that: "While first-time buy recommendations have a large overnight return of 2.4%, first-time sell recommendations have overnight returns that are smaller in magnitude (-0.29%)."

Da, Engelberg, and Gao (2011) use Google search frequency as a measure of investor attention to analyze whether investor attention can cause price pressure effects as described in Barber and Odean (2008). Using data from 2004 to 2008, they document that increases in search frequency predict higher returns in the ensuing two weeks and an eventual reversal within the year.

## 6. FAILURE TO DIVERSIFY

Risk-averse investors should hold a diversified portfolio to minimize the impact of idiosyncratic risk on their investment outcomes. A fair bit of evidence suggests that many investors fail to effectively diversify idiosyncratic risk.

Investors who overinvest in the stock of their employer (company stock) are left exposed to the fortunes of that employer (idiosyncratic risk). Famously, Enron employees had 62% of their retirement plan assets invested in company stock at the end of 2000. By December 2001, the company had declared bankruptcy and its employees had lost both their jobs and a large fraction of their retirement income. Similar stories unfolded at Global Crossing, Lucent, Polaroid, and Kmart. [Poterba \(2003\)](#) analyzes the 20 largest defined contribution plans managed by corporations, and documents that 44% of plan assets are invested in company stock. [Mitchell and Utkus \(2003\)](#) estimate that five million Americans have over 60% of their plan assets invested in company stock. [Benartzi \(2001\)](#) documents that some of the allocation to company stock is discretionary on the part of employees. Moreover, this discretionary allocation is largest for companies with strong return performance over the prior 10 years, which is consistent with the general stock buying behavior of individual investors (see Section 7 and [Figure 2](#) below).

The proportion invested in company stock has declined over the past 10 years. According to the Employee Benefits Research Institute, in 1998 60% of recently hired employees invested in company stock. That figure dropped to 36% in 2009. Nonetheless, as of 2009, about 5% of participants had more than 80% of their account balances invested in company stock.

[Barber and Odean \(2000\)](#) document that, on average, investors in the LDB dataset hold only four stocks. [Goetzmann and Kumar \(2008\)](#) analyze the underdiversification of these investors in detail. They document that investors tend to hold portfolios that are highly volatile and consist of stocks that are more highly correlated than one would expect if stocks were chosen randomly. [Mitton and Vorkink \(2007\)](#) argue that this preference for small portfolios might be driven by a preference for skewness. In support of this hypothesis, they document that investors with small portfolios tend to have more highly skewed outcomes. Moreover, investors with small portfolios tend to pick stocks with above-average skewness (especially idiosyncratic skewness). In a related paper, [Kumar \(2009b\)](#) shows that individuals prefer stocks with high idiosyncratic volatility, high idiosyncratic skewness, or low stocks prices. He further shows that the same demographic characteristics that predict lottery participation (e.g. education, income, and religious affiliation) also predict the strength of lottery-like preferences in stocks. [Grinblatt and Keloharju \(2011\)](#) document that high-IQ Finnish investors are more likely to hold mutual funds and larger numbers of stocks.

Investors prefer local and familiar stocks. They avoid investment in foreign stocks, which arguably provide strong diversification benefits ([Cooper and Kaplanis, 1994](#); [French and Poterba, 1991](#); [Lewis, 1999](#); [Tesar and Werner, 1995](#)). The reticence to invest abroad is changing, but still persists. For example, [French \(2008\)](#) documents that the fraction of the aggregate US investor portfolio allocated to foreign stocks grew from

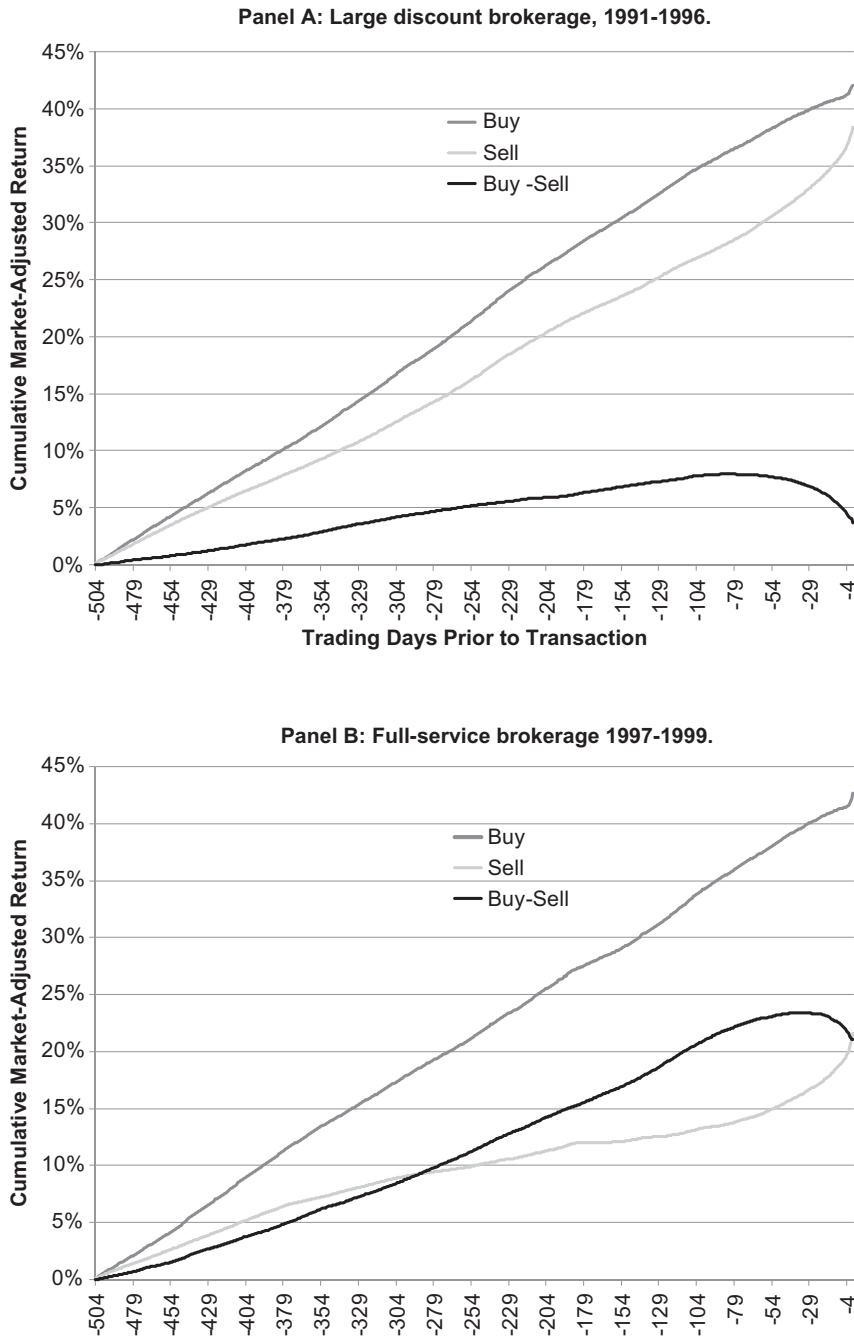


Figure 2 Cumulative abnormal returns prior to purchases and sales.

2% in 1980 to 8.5% in 1990 and 27.2% in 2007. Despite these trends, the home bias remains a strong phenomenon around the globe (Solnik and Zuo, 2011).

Investors also prefer local stocks within their domestic portfolio. Huberman (2001) documents that investors are more likely to invest in a local rather than a distant phone company and attributes the preference to familiarity. Similarly, Finnish investors prefer to hold stocks close to where they live, that communicate in their native language, and that have a CEO of the same cultural background (Grinblatt and Keloharju, 2001b). Investors in the LDB dataset hold about 30% of their portfolio in stocks headquartered within a 240 mile radius of their home, while only 12% of firms are located within the same radius (Ivkovich and Weisbenner, 2005; Seasholes and Zhu, 2010). Similar results are found for China (Feng and Seasholes, 2004). Investing in stocks close to home is not a good diversification move for the same reasons that investing in company stock is problematic. Though arguably less severe than overinvesting in company stock, overinvesting in local stocks exposes investors to idiosyncratic local risk that also is likely correlated with their job prospects (i.e. the value of their human capital).<sup>7</sup>

To obtain an accurate picture of an investor's portfolio diversification, one needs to observe the total balance sheet of an investor. Most datasets do not afford this opportunity. A notable exception is the comprehensive dataset of asset holdings by Swedish households (Calvet, Campbell, and Sodini, 2007). The median household in Sweden holds a well-diversified portfolio with a Sharpe ratio equal to that of a global equity index. Calvet et al. define an investor's return loss as the difference between her mean return and the maximum achievable consistent with the standard deviation of her portfolio. This return loss is zero for the median household, but a sizable minority of households has economically large return losses. For example, 5% of investors have return losses on their portfolios of 5% per year or more. Matching Swedish online investors to individual tax records, Anderson (2008) finds that lower income, poorer, younger, and less well-educated investors invest a greater proportion of their wealth in individual stocks, hold more highly concentrated portfolios, trade more, and have worse trading performance.

In summary, some investors fail to take advantage of the full benefits of diversification. Under-diversified investors might overinvest in company stock, local stocks, familiar stocks, and domestic companies. Doing so may make them feel safe, but it leaves them exposed to increased volatility in their investment returns.

<sup>7</sup> As discussed earlier, Ivkovic and Weisbenner (2005) argue that investors earn strong returns from their local investments, while Seasholes and Zhu (2010) argue the returns to local investments are not unusual. Even if there is a return advantage for investing in local stocks, the advantage would need to be sufficiently large to cover transaction costs and the under-diversification that would result from a locally concentrated portfolio.

## 7. ARE INDIVIDUAL INVESTORS CONTRARIANS?

Are individual investors contrarians? Webster defines a contrarian as “a person who buys shares of stock when most other investors are selling and sells when they are buying”<sup>8</sup>. By this definition, it is institutions, not individuals, who almost certainly are contrarians since when institutions in aggregate are trading against individuals in aggregate, there will usually be a greater number of investors on individual investors’ side of the trade. The Oxford English Dictionary defines a contrarian as: “A person who (habitually) opposes or rejects prevailing opinion ... an investor who goes against the current consensus when trading, e.g. by buying shares in a company when their price is falling.”<sup>9</sup> This definition suggests that it is one’s beliefs that make one a contrarian. If investors’ beliefs can be inferred from their purchases, individual investors are not contrarians since they are far more likely to buy a stock when the price has been rising than when it has been falling.

Nevertheless, several authors characterize the trading behavior of individual investors as contrarian. Kaniel, Saar, and Titman (2008) argue that “there is widespread agreement in the literature that individuals tend to be contrarian ...”. Choe, Kho, and Stulz (1999) use data from the Korean stock exchange to examine the positive feedback trading of institutions during the Asian financial crisis and document that during this crisis individuals tend to be contrarian investors. Grinblatt and Kelharju (2000, 2001a) report similar contrarian behavior in Finland. (See also Jackson, 2003; Richards, 2005; and Griffin, Harris; and Topaloglu, 2003).

All of these papers label individual investors as contrarian based on the net buying (i.e. purchases minus sales) of individual investors in response to recent price changes. While the authors are accurate in their empirical observations, in our opinion, labeling individual investors contrarians mischaracterizes their beliefs. Barber, Odean, and Zhu (2009b) separately analyze the buying and selling of individual investors using the LDB and FSB datasets. They document that positive relation between the aggregate buying of individual investors and returns lagged up to 12 quarters for both datasets. However, a positive relation also exists between aggregate selling of individual investors and returns lagged up to 12 quarters (though these effects are somewhat weaker for the full-service broker).

In Figure 2, we provide a simple graphic representation of the prior returns of stocks bought and stocks sold using a standard event-time analysis. Specifically, we calculate the mean market-adjusted return on all purchases in event time, where day 0 is the day of the purchase. These means are cumulated beginning two years (504 trading days) prior to the purchase. There is an analogous calculation for sales. Panel A contains results for the LDB data, while Panel B contains results for the FSB data. It is clear

<sup>8</sup> Webster’s Third New International Dictionary, Unabridged, 1993, Merriam-Webster, Incorporated.

<sup>9</sup> Oxford English Dictionary, 2011, Oxford University Press.



from these graphs that investors both buy and sell stocks with strong past returns. For both the datasets, stocks bought, on average, outperform the market by 40 pps over two years prior to purchase. Stocks sold also outperform the market, but not by such a large margin. Over the previous four months at the discount and previous one month at the full-service brokerage, the stocks sold by investors outperform the market by more than stocks bought. This is consistent with the observation that individual investors are net sellers of stocks with strong performance over recent periods but net buyers of stocks with strong performance over longer periods. The tendency of investors both to buy and sell stocks with strong recent performance indicates that they use different thought processes when deciding what to buy versus what to sell.

We believe that buying is forward-looking and selling backward-looking. Investors buy stocks because of what they hope will happen and sell stocks because of what has already happened. When investors buy a stock (that they have not recently owned), they look to the past only to divine the future. Many investors employ the simple heuristic of assuming that the recent past is indicative of what is to come. Selling is different. When selling, investors are concerned about what a stock has done prior to the sale (and since being purchased). In most cases, this leads investors to sell winners and hold losers (i.e. the disposition effect), though, late in the tax year, investors tend to sell losers. It is unlikely that investors sell winners because they believe past winners are future losers; rather investors find it emotionally unpalatable to sell for a loss.

## 8. CONCLUSION

The investors who inhabit the real world and those who populate academic models are distant cousins. In theory, investors hold well-diversified portfolios and trade infrequently so as to minimize taxes and other investment costs. In practice, investors behave differently. They trade frequently and have perverse stock selection ability, incurring unnecessary investment costs and return losses. They tend to sell their winners and hold their losers, generating unnecessary tax liabilities. Many hold poorly diversified portfolios, resulting in unnecessarily high levels of diversifiable risk, and many are unduly influenced by media and past experience. Individual investors who ignore the prescriptive advice to buy and hold low-fee, well-diversified portfolios, generally do so to their detriment.

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