OWNERSHIP STRUCTURE, EXPECTATIONS, AND SHORT SALES ON THE NASDAQ

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Abstract

We estimate expected short interest for Nasdaq stocks. Extending prior work, our research is among the first to investigate the impact of ownership structure on short-selling activity. We find that short interest is negatively related to institutional ownership and positively related to inside ownership; stocks with greater liquidity and smaller relative spreads are more heavily shorted. We also develop a measure of the unanticipated level of short selling; relative to the reported amount of short interest, this unexpected level of short selling seems at first to better represent the opinions of informed investors engaging in costly short-selling activities. However, the power of the unanticipated level of short-selling factor is displaced when we make allowances for traditional market, firm-size, and momentum variables. (JEL G12, G14)

Introduction

Thomas (2006) affirms the struggle of financial researchers as they consider short sales. Confronting institutional and statistical issues, a new short sales literature has evolved in the past few years; we seek to temper the struggle with a set of related examinations that extend this research. First, we examine the impact of ownership structure on the level of short interest and find it significantly related to short-selling activity. Second, we extend our ownership measures and discover that while short selling is negatively related to institutional ownership, it is positively related to inside ownership; this latter relationship is not an artifact of the non-monotonic relationship between ownership concentration and firm value documented by Morck et al. (1988). Third, we find that short sellers are more active in stocks with greater liquidity and smaller relative bid-ask spreads. Finally, we measure expected short interest and demonstrate that our measure of the unanticipated level of short interest seems to provide greater explanatory power for future returns than do the raw measures of short sales; however, this greater power is displaced when we adopt selected firm size and momentum variables as additional explanatory factors.

In advancing our understanding of short selling, we connect two lines of research. First, the literature provides evidence of negative long-run underperformance for stocks experiencing high short interest [see Asquith and Meulbroek (1995), DeChow et al. (2001), and Desai et al. (2002)]. These authors suggest that high short-interest levels often reflect the negative opinions of informed investors. Another group examines factors that influence the amount of short-sales activity. They reach several conclusions: the level of institutional ownership can constrain the ability to borrow shares [see D'Avolio (2002), Jones and Lamont (2002), and Geczy et al. (2002)], short sellers prefer liquid stock with high ratios of market to fundamental values [see DeChow et al. (2001)], and, finally, stocks with exchange-traded options attract greater levels of short interest [see Figlewski and Webb (1993)].

We measure expected short interest in a manner that frames the influence of ownership structure and other factors simultaneously. We incorporate new measures that are among the first to consider the effect of inside ownership on short interest. Given that many factors likely

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influence the level of short selling, it is difficult to interpret the signal provided by the informed investors that frequently engage in this activity. Towards examining this signal, we also measure whether the unexpected level of short interest provides greater predictive ability for subsequent stock returns than the absolute measures of short sales.

We provide several insights into the factors influencing the amount of short-selling activity. First, we document a negative relation between short interest and institutional ownership. On the surface, this finding seems to contradict recent research showing that institutional investors are the dominant participants in the market for lending shares for short selling [see D'Avolio (2002), Jones and Lamont (2002), and Geczy et al. (2002)]. However, stocks that are unavailable for borrowing tend to have small market capitalizations, and for stocks with large market values, the ability to borrow shares from institutions does not appear to be a significant constraint; this echoes recent findings by Asquith et al. (2005). Our analysis of large Nasdaq stocks is consistent with sophisticated short sellers being less active in stocks disproportionately purchased by institutional investors, shown by Wermers (2000) and Pinnuck (2003) to demonstrate superior stock-selection ability.

Second, we discover a positive relation between inside ownership and short interest. By taking larger positions in firms with higher agency costs from entrenchment, short sellers may act to profit from a depreciative effect on corporate performance of excessive inside ownership. This new finding implies that short sellers may be using inside ownership data in their short-selling decisions, or that the factors upon which short sales choices are made are themselves tied into inside ownership levels. The inside ownership findings are not an artifact of the non-monotonic relationships between ownership concentration levels and firm value as portrayed by Morck et al. (1988). The average inside ownership levels of our sample imply such a relationship, but such is not the case.

Third, short-selling activity is lower in stocks with higher bid-ask spreads and other proxies for transaction costs. Short sellers exhibit a preference for firms with multiple market makers; these informed investors may find it more profitable to conduct their activities across several dealers. We affirm that stock liquidity is significantly associated with short selling; the less liquid stocks, with fewer market makers and lower trading volume and larger bid-ask spreads, are typically less heavily shorted. Stocks with higher transaction costs are less likely to be sold short.

Fourth, we complete our examinations with an estimation of expected short interest and use the difference between observed short interests and our estimates to represent the level of unanticipated short selling. Regression analyses initially suggest that this unexpected short interest has greater predictive power for short-run returns than the unadjusted level of short sales. However, upon further study and with the inclusion of controls for size, value versus growth and momentum, the significance of our proxy for unanticipated short selling is largely diminished, relative to the raw measure of the short-interest ratio itself. Echoing the seminal findings of Figlewski (1981), most firms with higher short-interest ratios underperform those with lower ratios.

Short Selling, Stock Returns, and Factors Affecting the Expected Level of Short Sales

The value and interpretation of short sales data partially depends on the reason for the short sale. Short selling is normally pursed to: (1) profit from a stock price decline, (2) postpone taxation and lock in a gain on a stock (known as shorting against the box), or (3) reduce portfolio exposure or variance through hedging or arbitrage activities.[1] In circumstances where short sales

[1]Shorting against the box, considered by Tucker and Watson (1999), is a practice virtually eliminated by the Taxpayer Relief Act of 1997. Short-selling activity is frequently associated, as well, with merger activity. Geczy et al. (2002) report the increased costliness of this strategy when the acquirer's stock is not widely available to borrowers.

are prompted by uninformed strategies, as with objectives (2) and (3), high short interest is less likely to be followed by the underperformance occurring with informed short selling.[2]

A number of theoretical models imply that restrictions on short sales affect security prices. These costly restrictions include uptick rules, the availability of stock to sell short, dividend obligations on shorted stock, institutional restraints on short selling for some mutual funds and corporate employees, and short squeezes where shorted stock must be returned to lenders. Miller (1977) shows that optimistic investors can bid up stock prices to an inefficient level when these short-selling constraints prevent a better-informed group of investors from delivering their adverse opinions to the market.

Diamond and Verrecchia (1987) develop a model that assumes rational investors incorporate short-sale constraints into their expectations. While asset prices in this framework are not biased upward, the speed of price adjustment is reduced, and higher unanticipated short interest is a negative signal for stocks. Similarly, Duffie et al. (2002) find that lending fees for stocks loaned to short sellers can push equity prices higher in an environment with limited short selling than in one with no short selling; recent work by Haruvy and Noussair (2006) affirms that a market is more complete when short selling is less constrained .

While some empirical studies show that the relation between short interest and future stock returns is non-negative [see Woolridge and Dickinson (1994)], more recent research finds long-run underperformance for stocks experiencing high short interest. Senchack and Starks (1993), Asquith and Meulbroek (1995), and DeChow et al. (2001) find that NYSE and Amex stocks with high short interest have lower stock returns. Farinella et al. (2001) and Desai et al. (2002) document similar results for Nasdaq stocks, and these findings are robust to controls for size, book-to-market, momentum, and market factors.

The negative relation between short interest and subsequent returns is consistent with informed investors initiating costly short sales. However, the level of short interest itself is sensitive to a variety of firm characteristics that obfuscate its interpretation.

Institutional Ownership

One of the factors that can constrain short selling is the ability to borrow shares. The largest lenders are custody banks, which act as agents for institutional owners. D'Avolio (2002) finds that institutional ownership, concentrated in large stocks, explains approximately 55% of the cross-sectional variation in loan supply. Jones and Lamont (2002) analyze the market for borrowing stock from 1926 to 1933 through the loan rate, which is the compensation to the lender in a short sale. Stocks that first appear in their database are assumed to have high shorting demand, and these securities experience low future returns. By examining data from a prominent lender of equities, Geczy et al. (2002) investigate three types of stocks that are particularly vulnerable to costly constraints on short sales: IPOs, merging stocks, and growth stocks. The authors find that borrowing costs are small relative to profits from shorting these stocks, which are commonly thought to be overpriced.

To provide further insight into the impact of institutional ownership on short sales, Nagel (2005) examines the relation between the book-to-market ratios and returns on stocks with low institutional ownership. The returns of growth stocks decline with institutional ownership; this is consistent with these stocks being overpriced due to the inability to borrow shares to short. He argues that the book-to-market effect is closely related to short-sales constraints rather than the exposure of these stocks to risk factors.

Using data on mutual fund holdings from 1979 to 1998, Chen et al. (2002) consider how the number of owners of a particular stock impacts its returns. In the presence of restrictions on short sales, low market breadth implies that the opinions of some investors are not reflected in the stock

[2]Informed short selling is done by investors who have special information that indicates a stock's price exceeds its fundamental value.

price. They document the underperformance of stocks with declining breadth that they suggest reflects the greater difficulty in implementing short sales. In their theoretical discourse, Hong and Stein (2003) show how short-selling constraints can inhibit stock prices from reflecting the opinions of all investors. Such information is more likely to be "flushed out through the trading process" in a falling, versus stable or rising, market.

If institutional ownership affects firm performance, then it should influence the level of short selling. McConnell and Servaes (1990) document a positive relation between Tobin's Q and institutional ownership. The authors argue that this finding is consistent with these investors providing valuable monitoring at a low cost. As this efficient monitoring may result in greater future earnings, a high Tobin's Q does not necessarily signal an overvalued stock. Han and Suk (1998) address this issue by examining the contemporaneous relation between stock returns and ownership structure. Their study concludes that higher institutional ownership is associated with higher stock returns.

Inside Ownership

Morck et al. (1988), McConnell and Servaes (1990), and Han and Suk (1998) find that corporate valuations peak at high levels of inside ownership. The complex relation between insiders and valuation is related to the following factors: the convergence of interests between shareholders and managers as inside ownership increases, the entrenchment of management with higher ownership, and the connection between stock remuneration and firm performance. Since inside ownership impacts stock prices, this factor likely affects the level of short sales.

The amount of inside ownership may also affect the observed level of short-selling activity by influencing the availability of shares for borrowing. Publicly-traded companies have formal insider trading policies that often prohibit insiders from holding shares in margin accounts.[3] Such policies not only prevent insiders from having to unexpectedly sell their stock due to a margin call, but also take these shares out of the pool of available shares for borrowing. Thus, the cost of borrowing stock may increase with inside ownership.

Insiders that hedge their ownership positions may indirectly affect the level of short interest. Bettis et al. (2001) find that insiders often use derivatives such as collars and swaps to hedge on average 25% of their stock exposure. The institutions (often commercial banks) that facilitate these transactions may hedge their positions by shorting stock.

Financial Ratios

Lakonishok et al. (1994) and Fama and French (1995) find that financial ratios predict future stock returns. Through an examination of monthly short interest figures, Dechow et al. (2001) test whether short sellers use this information in selecting stocks. They consider financial ratios such as cash-flow-to-price, earnings-to-price, book-to-market, and value-to-market. Changes in short interest indicate that short sellers consider fundamental analysis when initiating positions, and tend to cover their short sales when these ratios return to regular levels. Short sellers avoid companies that have temporarily low accounting figures and instead concentrate on firms that have high market prices.

Stock Liquidity and other Factors Influencing Short Sales and Subsequent Returns

Several studies find that short sellers pursue strategies involving more liquid stocks with lower transactions costs. Dechow et al. (2001) reach this conclusion using the market value,

[3] As an example, the 2003 Insider Trading Policy for Cinergy Corporation reads as follows: "directors, officers and employees, and their Related Persons may not hold Company Securities in margin accounts. Investing in Company Securities provides an opportunity to share in the future growth of the Company. Investment in the Company and sharing in the growth of the Company, however, does not mean short-range speculation based on fluctuations in the market. Such activities may put the personal gain of the director, officer or employee in conflict with the best interests of the Company and its security holders."

institutional holdings, number of institutional owners, and dividend yield as proxies for such costs. Kadiyala and Vetsuypens (2002) find that short interest responds positively to the improved liquidity associated with stock splits. The relatively liquid stocks will trade at a premium and have lower future returns. Empirical studies by Brennan and Subrahmanyam (1996) and Brennan et al. (1998) illustrate this relationship. Baker and Stein (2004) extend this research through a model that incorporates short-sales constraints and a class of investors that underreact to information in order flow. In such an environment, high levels of liquidity reflect positive sentiment by irrational investors and overvalued stocks. Work by Duarte et al. (2006) portrays the unattractiveness of short selling less liquid stocks, though they confess that "low observed short interest level[s]" cannot be "fully explained by the liquidity events" (such as short squeezes) confronted in some short sales. They underscore the costliness of using options to hedge short-selling losses.

A variety of other factors affect the level of short interest in a particular stock, and one of the most important is the existence of exchange-traded options on the stock. Figlewski and Webb (1993) find increased short-selling activity for optionable stocks, and this is attributed to the options reducing the effect of short-sale constraints. Danielson and Sorescu (2001) affirm these results and document a connection between the price effect of option introductions and short-interest changes. Evans et al. (2002) find that options on hard-to-borrow stocks trade for parity as option market-makers extract profits from their unique ability to sell short without borrowing stock.

Also likely to influence the amount of short interest is the presence of convertible securities; the importance of convertibles in the short sales story is highlighted by Asquith et al. (2005), where stocks with convertibles are found to more likely have a 'high level" of short interest than a "random" stock. Hedge funds can sell short the underlying stock, thereby neutralizing the impact on the convertible of movements in the stock, and generate a cash flow from the convertible's coupon or dividend. As well, hedging models often suggest short selling when a convertible is closer to being "in the money." Likewise, Howe et al. (1998) document arbitrage opportunities - buying the convertible preferred and simultaneously selling the underlying common - for market-makers at the time of and subsequent to the announcement of conversion-forcing calls of convertible preferred stocks.

The amount of short interest may also be impacted by the divergence of investors' views on future corporate performance. When there are constraints on short sales, Boehme et al. (2006) affirm that stock prices will reflect the optimistic views of investors who purchase the stock but not opinions of the relatively pessimistic who avoid costly short selling. Using the dispersion in analysts' earnings forecasts to proxy for differences of opinion, Diether et al. (2002) find that stocks with controversial prospects underperform those with the least amount of forecast diversion.

Data and Methodology

We assemble a sample consisting of the largest 200 firms on the Nasdaq. These firms are used because of their greater data availability. Size is measured as the market capitalization at the end of each year. Our sample period is from July 1991 to December 1998. It changes at the beginning of each year to reflect the new year-end market capitalizations. The sample is restricted to stocks with available CRSP, Compustat, Standard & Poors, and Compaq Disclosure data. Securities that are delisted (due to acquisition, for example) are dropped from our analysis when removed from the Nasdaq. Securities that continue to be listed after acquisition activity are retained in the study.

Our analysis focuses on the short-selling activity in our sample, and this data is drawn from a comprehensive report of all monthly short selling on the Nasdaq.[4] Short-selling activity is

[4]The report is prepared by the Historical Research Department at the NASD. This data avoids the potential sample selection bias of short-selling studies restricted to information published in the financial press. Short sales data availability

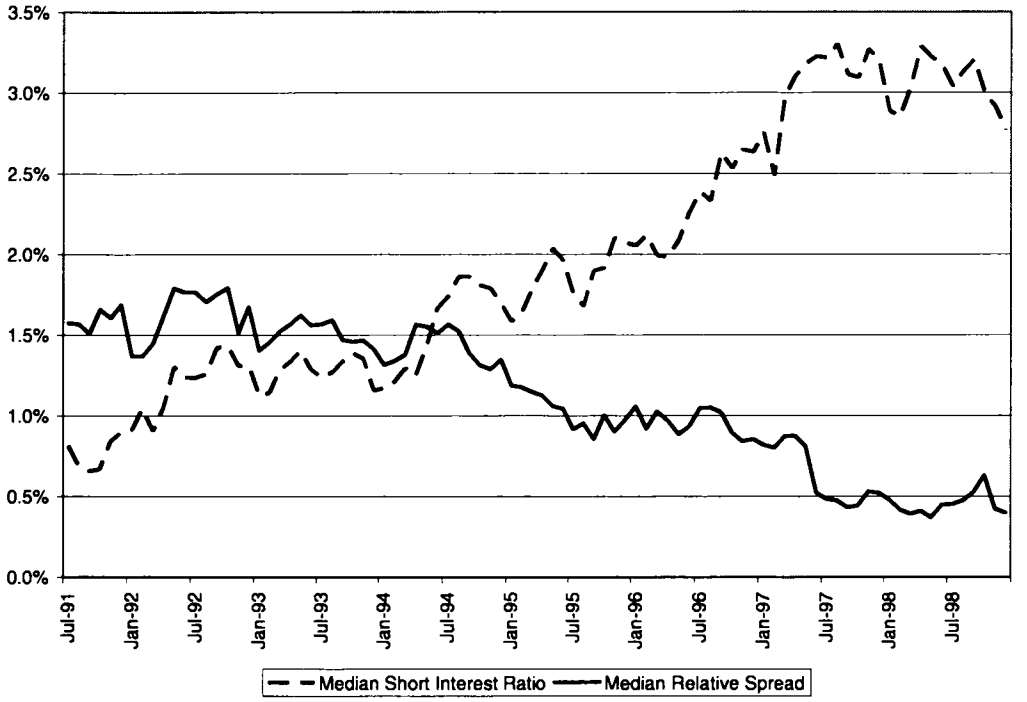
measured using the short-interest ratio, which is a firm's reported short interest divided by its shares outstanding. Statistics on the cross-sectional variation in the short-interest ratio for our sample are given in Table 1. The mean, median, 25th percentile, and 75th percentile of the short-interest ratio are provided for each year; the data are positively skewed.

Table 1: Short-Interest Ratio

Year	25th Percentile	Median	Mean	75th Percentile
1991	0.19%	0.76%	2.23%	2.59%
1992	0.34%	1.18%	3.06%	3.62%
1993	0.40%	1.29%	3.22%	3.84%
1994	0.50%	1.54%	3.22%	4.17%
1995	0.76%	1.85%	3.50%	4.28%
1996	1.02%	2.32%	3.67%	4.45%
1997	1.56%	3.10%	4.56%	5.79%
1998	1.45%	3.05%	4.31%	5.55%

Note: The short-interest ratio is the number of shorted shares divided by the number of shares outstanding, as reported by the NASD. The sample consists of the 200 Nasdaq stocks with the largest market values at the end of the prior year. Data is examined for the period from July of 1991 through December of 1998.

FIGURE 1: Median Short-Interest Ratios and Relative Spreads



Note: This figure shows the median short-interest ratios and relative bid-ask spreads for the 200 largest Nasdaq firms from July of 1991 through December of 1998. The short-interest ratio is the number of total shares short in a given month divided by the total shares outstanding. The relative spread is the difference between the bid and ask quotes at the end of the day divided by the closing price for a stock.

constrains much research, as underscored by Boehme et al. (2006), as they note the greater access to shorting data in the 1920's than today.

Table 1 reveals that short-selling in our sample grows over time. Average short interest ratios and bid-ask spreads, a proxy for the costliness of short selling, are illustrated for the sample period in Figure 1. This graph reveals that short-selling activity increases as one of the costs of short selling falls. Figure 1 illustrates one motivation behind our study, to discover how differing short-selling costs affect the level of short interest, and how to interpret the short-selling activity as a signal of future returns. The mean (median) short interest ratio increases from 2.23% (0.76%) at the beginning of our sample period to 4.31% (3.05%) in 1998. The median short interest ratio increases for every year during our sample period except 1998.

Table 2A provides summary statistics. Using data on short sales provided by Nasdaq, the mean (median) short interest ratio over our sample period is 3.55% (1.93%). We gather data from the Center for Research in Security Prices (CRSP) on stock prices, trading volume, spreads, and market makers. The mean share price is $33.48, and daily trading volume averages 780,967 shares. The mean (median) market capitalization of the companies in our sample is $2.68 billion ($1.07 billion). Bid-ask spread data shows absolute spreads that average around $0.37 or 1.3% of the typical firm's stock price (shown as the relative spread). The mean standard deviation of returns, which is calculated using daily data from 25 days to five days before the monthly release of short interest data, is 2.98%. On average, 25 market makers facilitate the trading in each stock in our sample.

Table 2A: Summary Statistics

	Mean	Median
Short-interest ratio	3.55%	1.93%
Closing price	$33.48	$29.84
Number of trades per day	556.65	188.60
Volume	780,967	321,063
Market capitalization (thousands)	$2,681,409	$1,072,967
End-of-day spread	0.37	0.30
Relative spread	1.30%	1.08%
Standard deviation of returns	2.98%	2.72%
Number of market makers	24.59	21.80
Number of analysts	10.82	9.00
Median analyst forecast of long-term growth	22.41%	20.40%
Standard deviation of analysts' forecasts	5.08%	3.60%
Price-to-book ratio	7.88	4.49
Price-to-earnings ratio	30.96	16.43
Dividend-to-price ratio	0.04%	0.00%
Institutional ownership	51.63%	53.11%
Inside ownership	19.33%	11.56%
Months with listed options	81.26%	
Months with convertible bond conversion	0.04%	

Note: This table provides summary statistics on the 200 largest Nasdaq firms from July of 1991 to December of 1998. The short-interest ratio is the number of shorted shares divided by the number of shares outstanding, as reported by the NASD. Stock price, trading activity, market capitalization, spread measures and standard deviation of returns – calculated over the days (-25, -5) before the monthly release of short interest data – are gathered from the CRSP files, as is the number of market makers. The relative spread is the closing bid-ask spread divided by the closing stock price. Analyst data is provided by I/B/E/S. Price-to-book, price-to-earnings ratios and dividend measures are constructed using CRSP data and accounting information from Compustat. Annual ownership data is provided by Compaq Disclosure. Standard and Poor's Stock Guides provided option and convertible data for the firms in the sample. Only the means are provided for the firm characteristics in the last two rows since these are dummy variables.

Table 2B: Correlation Analysis

	Relative Spread	Short Interest Ratio
Short interest ratio	-0.167***	
Relative spread		-0.167***
Share price	-0.352***	0.036***
Market value	-0.284***	-0.088***
Volume	-0.374***	0.120***
Number of analysts	-0.452***	0.005
Median analyst forecast of long-term growth	-0.096***	0.353***
Standard deviation of analysts' forecasts	-0.050***	0.198***
Standard deviation of returns	0.102***	0.248***
Long-run prior return	-0.300***	-0.155***
Dividend-to-price ratio	0.075***	-0.131***
Price-to-earnings ratio	-0.058***	0.201***
Price-to-book ratio	-0.099***	0.124***
Listed options	-0.069***	0.092***
Number of market makers	-0.420***	0.179***
Percent institutional ownership	-0.308***	0.051***
Percent insider ownership	0.179***	-0.019***
Convertible bond conversion	-0.034***	0.031

Note: This table provides a correlation analysis for selected features of the 200 largest Nasdaq firms from July of 1991 to December of 1998. Mean correlation coefficients are reported, and these statistics are calculated over the 90 months in our sample. The relative spread is the closing bid-ask spread divided by the closing stock price. The short-interest ratio is the number of shorted shares divided by the number of shares outstanding, as reported by the NASD. Stock price, trading activity, market capitalization, spread measures and standard deviation of returns – calculated over the days (-25, -5) before the monthly release of short interest data – are gathered from the CRSP files, as is the number of market makers. Analyst data is provided by I/B/E/S. Long run prior returns are the cumulative returns for the sample stocks over the 180 days prior to reporting short interest. Price-to-earnings and price-to-book ratios are constructed using CRSP data and accounting information from Compustat. Annual ownership data is provided by Compaq Disclosure. Standard and Poor's Stock Guides provided option and convertible data for the firms in the sample. The middle (final) column provides Pearson correlation coefficients between the relative bid-ask spread (short-interest ratio) and firm characteristics. While correlation coefficients are estimated monthly, only the mean correlations are reported. The mean is calculated for the 90 months in our sample period. Significance level 1% (***), 5% (**), and 10% (*).

Analyst data used in our research is provided by the Institutional Brokers Estimate System (I/B/E/S). The average company in our sample has 11 analysts following its stock. The median analyst estimate of the long-term growth rate for earnings averages 22.41% and has a standard deviation of 5.08%. The price-to-book and price-to-earnings ratios are constructed using CRSP data and accounting information from Compustat.[5] The average company in our sample trades for over seven times its book value and around 31 times its most recent earnings. We also calculate the dividend yield for our sample. Most companies do not pay a dividend, and the mean ratio of dividend to price is 0.04%.

Annual ownership data is provided by Compaq Disclosure. For the 200 largest Nasdaq firms, the average institutional and inside ownership are 51.63% and 19.33%, respectively. Using the monthly Standard & Poor's Stock Guides, we determine which of the stocks in our sample have exchange-traded options. Over 81% of the monthly observations in our sample are for stocks with listed options. The final row in Table 2A contains the percentage of monthly observations that occur immediately before a conversion of a convertible bond. This information is gathered by using the Standard & Poor's Bond Guide to get a list of convertible bonds that had "privileges

[5]The most extreme one percent of our observations of the price-to-book and price-to-earnings ratios are Winsorized to reduce the influence of outliers. This approach follows the methodology of Dechow et al. (2001).

changing and/or expiring."[6]

Correlation data are provided in Table 2B. These correlation coefficients, between the selected explanatory factors, the relative spread and the short interest ratio, provide insights into variables contributing to the costliness of short selling, and the level of short sales. The insignificant correlations between the convertible bond conversion factor and the short interest ratio derive largely from the low number of conversions in our sample. Other signs and significances of the variables are generally as expected.

We use this sample to consider several related hypotheses and extend earlier short sales studies with factors unreported in those examinations. One such variable is inside ownership, and our first hypothesis is stated as follows:

H1: The short interest ratios are unrelated to the level of inside ownership.

If we find a positive relationship, the data will be consistent with short sellers implementing strategies to profit from the entrenchment of management. However, if inside ownership is negatively related with short interest, then the dominant role that these owners have on short-selling activity may be through constraining the supply of shortable shares. The second hypothesis examined in our study also investigates the impact of ownership.

H2: The short interest ratios are unrelated to the level of institutional ownership.

D'Avolio (2002), Jones and Lamont (2002), and Geczy et al. (2002) investigate the market for borrowing shares and find that low institutional ownership inhibits short selling. While this implies a positive relation between short interest and institutional ownership, other research suggests a negative correlation. Wermers (2000) and Pinnuck (2003) document the ability of mutual fund managers to pick stocks that outperform. If short sellers are sophisticated investors, they will be less inclined to short stocks favored by those with such selective ability. Dechow et al. (2001) investigate this with a regression analysis using a binary dependent variable. The authors find that the probability of observing high short interest (greater that 0.5% of outstanding shares) is greater with more institutional ownership. However, as a substantial number of stocks have little short interest (46% in the study by Dechow et al.), a more precise description of the correlation between institutional ownership and short interest is unavailable.

Another of the goals with this research is to examine the information content of short interest relative to the liquidity of the stock and its costliness to short. Some stocks are more costly to short, and face greater impediments to short selling than others. Such factors as the bid-ask spread and the number of market makers are proxies for this costliness in the trading a given stock. Previous studies of the determinants of short interest examine only indirect measures of liquidity. Thus, our third hypothesis is as follows:

H3: Short interest is unrelated to the bid-ask spread and the number of market makers.

We expect that the amount of short-selling activity is likely greater among more liquid stocks that are less costly to short. As investors are more willing to own a stock when its transaction costs are lower, the relatively liquid stocks will trade at a premium and have lower future returns. Furthermore, if short sellers tend to be well-informed investors, they may exhibit a preference for stocks with more market-makers; a greater number of such market makers allow sales to be disguised as they are executed among dispersed traders using different market makers.

Finally, and because short selling is a costly activity, we expect that the unanticipated amount

[6]Our entire sample contains only 30 convertible bond conversions, and this low number is inadequate for drawing meaningful statistical conclusions. This variable is not reported in the multivariate analysis, and the results are unaffected by the decision to exclude this factor.

of short interest provides a stronger signal regarding subsequent returns than the reported level of short interest standing alone. To address this question, we use the residuals from an equation estimating short interest to represent the unexpected level of short interest. Our fourth hypothesis is formulated in the following manner:

H4: The unexpected short interest does not have greater predictive power for future returns than the unadjusted level of short interest.

Extending earlier work, we also expect to find more short selling activity in stocks with options and greater divergences of analyst options.

Results

Cross-Sectional Analysis of Short Interest

To better understand the determinants of short interest, we investigate the relationships between sample firm characteristics and those firms' short-interest ratios. Logs of selected variables are provided to normalize the error terms. Traditional regression analysis is used to estimate the short-interest ratio.[7] This function generates the expected level of short interest that is used later in the study.

The coefficient estimates and p-values for the cross-sectional analysis of the short-interest ratio are shown in Table 3. The equations are estimated for each of the 90 months in our sample, and the mean coefficient estimates are reported. This approach is used because the bid-ask spreads are narrowing and short-interest levels are increasing over virtually the entire study period. Without this control for time, our examination would find misleading relationships between the explanatory factors and the dependent variable. Table 3 provides estimates for two functions. In Equation 1, the observations are limited to firms with data on multiple analyst earnings estimates from I/B/E/S. This restriction reduces the sample size by 8.2% in the average month, but it allows us to incorporate the standard deviation of analysts' forecasts in our analysis. Equation 2 is estimated for the entire sample.

As shown in both equations in Table 3, in tests of our first hypothesis, inside ownership is positively associated with the short-interest ratio.[8] Short sellers may become more active as managers are entrenched through greater ownership. Another plausible explanation suggests insiders may hedge their stock holdings. As inside holdings are sometimes offset by positions in collars, swaps, and other derivatives, with financial institutions that facilitate these transactions reducing their own risk by short selling stock, a positive relation between inside ownership and the short-interest ratio may arise. Our results do not indicate that corporate policies preventing insiders from holding shares in margin accounts exhibit significant pressure on the ability to borrow shares for short selling. Our analysis rejects H1, and it represents the first research to document the effect of inside ownership on short interest.

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[7]Suggested by several researchers, seemingly unrelated regression analyses were also conducted with all of this study's tests. The unreported SUR results are only modestly different than the OLS results reported here.

[8]As previous research finds that insider ownership has a nonmonotonic relation with measures of corporate performance, we investigate alternative approaches to incorporating insider ownership in our examinations. A piecewise linear regression using the same ownership breakpoints as Morck et al. (1988) and a separate formulation involving a squared term similar to McConnell and Servaes (1990) and Han and Suk (1998) do not produce consistent results with our tests; we provide no evidence of a nonlinear relation between short interest and insider ownership. For the sake of brevity, these results, which are consistent with our finding of a positive relation between short interest and insider ownership, are not reported.

Table 3: Cross-Sectional Analysis of the Short-Interest Ratio

	Equation 1		Equation 2	
	Mean Coefficient	P-value	Mean Coefficient	P-value
Intercept	-6.867	< 0.001	-4.915	0.001
Relative spread	-0.549	< 0.001	-0.540	< 0.001
Market value	-0.620	< 0.001	-0.745	< 0.001
Options	0.092	< 0.001	0.087	< 0.001
Market makers	0.340	< 0.001	0.281	< 0.001
Volume	0.338	< 0.001	0.510	< 0.001
Institutional ownership	-0.121	0.071	-0.102	0.095
Inside ownership	0.219	0.021	0.412	< 0.001
Long run prior return	-0.173	<0.001	-0.300	< 0.001
Dividend-to-price ratio	-35.540	0.001	-68.257	< 0.001
Price-to-earnings ratio	0.119	< 0.001	0.412	< 0.001
Price-to-book ratio	0.014	0.485	0.147	< 0.001
Median analyst forecast of long-term growth	0.999	< 0.001		
Standard deviation of analysts' forecasts	0.118	< 0.001		
R^2	.48		.44	

Note: This table provides the estimates from an OLS regression analysis of the short-interest ratio. The models are estimated for each month in the 90-month sample period. Mean coefficient estimates and p-values are reported for a test of the null hypothesis that the mean coefficient estimate is different than zero. The relative spread is the closing bid-ask spread divided by the closing stock price. Market value data, market maker information and trading volume are taken from the CRSP files, options data from the Standard and Poor's Stock Guides, and ownership measures from Compaq Disclosure. Long run prior returns are the cumulative returns for the sample stocks over the 180 days prior to reporting short interest. Dividend, price-to-earnings and price-to-book ratios are generated using CRSP data and accounting information from Compustat. Long-term growth and deviations of forecasted growth are taken from the I/B/E/S files. In Model 1, the number of observations is limited to firms with I/B/E/S data and multiple analysts to allow the calculation of the standard deviation of analysts' growth forecasts.

Our second hypothesis states that short interest is unrelated to institutional ownership, and it is also rejected by the data in our study. Both equations in Table 3 show that higher institutional ownership results in lower short interest. On the surface, these results seem to contradict D'Avolio (2002) where he shows that institutional ownership explains a significant portion of the variability in loan supply.[9] However, the apparent inconsistency is likely a result of the characteristics of our sample, which consists of the largest Nasdaq stocks. D'Avolio finds 1,267 stocks that are unavailable for borrowing from a large institutional lending intermediary; 86% of these stocks are in the bottom size decile and 57% are priced under $5. The mean price of the stocks in our sample is $33.48 and the average institutional ownership is 51.63%. Thus, the stocks that are most difficult to borrow from institutions are typically not among the largest 200 firms on the Nasdaq.

Recent research on mutual funds finds that managers purchase stocks that have subsequent positive abnormal returns. Wermers (2000) estimates these abnormal returns are 1.3% per year before accounting for transactions costs. Pinnuck (2003) provides support for this conclusion. As

[9] We examine whether low institutional ownership constrains the loan supply for our sample by estimating a piecewise regression that includes two variables for institutional ownership. A breakpoint of 3% is used because it is close to the mean and median short interest ratio for our sample. The variable for institutional ownership less than 3% is not significant in either test, so the results are not reported.

at least some institutional investors have superior ability to pick stocks, short sellers may be less active in stocks with increasing institutional ownership and few constraints on borrowing. As well, institutional buyers may be less inclined to margin their stock, and this could reduce stock supplies for lending to short sellers as institutional ownership increases.

Our third hypothesis states that transaction costs and short interest are unrelated. For both equations, the mean coefficient for the bid-ask spread is negative and significant, and the estimated coefficients for the number of market makers and share volume are positive and significant. These results reject H3 and are consistent with the idea that transaction costs are important impediments to short selling.[10] This study is among the first to provide evidence that short sellers have a preference for stocks with more market makers.

Like transaction costs, dividends are an impediment to short selling. Table 3 shows that stocks paying dividends have lower short interest. When dividends are issued, stock prices typically fall by less than the dividend and this represents a cost to short selling, absent any allowance for the dividend payment itself. Available options are also associated with increased short interest ratios. Consistent with Figlewski and Webb (1993) and Danielson and Sorescu (2001), our analysis indicates that stocks with exchange-traded options have higher short interest.

Extending Dechow et al. (2001), we include the price-to-earnings ratio and the price-to-book ratio in our expressions. The mean coefficients for these variables are positive in both equations, and this result affirms the earlier research. As the coefficient for the prior return is negative, the data also suggest that short sellers take into account momentum, which is a pattern documented by Jegadeesh and Titman (1993).

The last variables in this portion of our examinations relate to analyst forecasts. Short interest has a positive relation with analysts' forecasts of long-term growth rates. Studies show earnings estimates are upwardly biased, and sophisticated short sellers may be attempting to profit from more naïve investors who accept them as credible. Also, short interest increases with the standard deviation of analysts' forecasts. This supports the theoretical research of Hong and Stein (2003) and the empirical analysis of stock returns performed by Diether et al. (2002).

Raw Measures of Short Selling, Unexpected Short Interest, and Subsequent Returns

Our final tests reveal the importance of short interest and unanticipated short interest in describing subsequent returns. The unanticipated short-interest ratios in Equations 1a-1c in Table 4 are the residuals from Equation 1 in Table 3; residuals from Equation 2 in Table 3 are employed in Equations 2a-2c. Panel A of Table 4 provides estimates of short-run returns on various combinations of the short-interest ratio, unanticipated short-interest ratio, the CRSP Equal-Weighted Index, and three Fama-French descriptive factors drawn from the Kenneth French Library; small-minus-big, high-minus-low and momentum variables are employed. The short-run return is calculated over the 20-day period following the release of short-interest data. The CRSP Index return is unsurprisingly positively related to all returns in all periods.

In Panel A, 20-day short-run returns have a negative relation with the short-interest ratio, and this affirms the results of previous studies. The reported level of short interest has a statistically significant relation with subsequent short-run returns even in the presence of the unanticipated short-interest variable. The unexpected component of aggregate short interest does not contain the more powerful signal about future stock returns that we expected. Equations 1b and 2b in Panel A of Table 4 suggest the unanticipated short interest ratio does have some explanatory power, independent of the raw short interest measure, but that the power of the unexpected levels of short selling is displaced when the absolute measures of short selling are included factors.

[10]We divided factors explaining short interest into three categories: cost/ease of short selling, information flow, and hedging/arbitrage activity. Factors related to the cost or ease of shorting stock explain a greater portion of the variability in short selling levels than do factors related to information flow. Factors related to hedging or arbitrage activities explain the smallest portion of short interest variation. To achieve brevity, the R^2s from these regressions are not reported.

Table 4: Cross-Sectional Analysis of Returns Subsequent to Short-Interest Announcements

Panel A: Short-Run Returns

	Equation 1a	Equation 1b	Equation 1c	Equation 2a	Equation 2b	Equation 2c
Intercept	-0.016	-0.003	-0.015	-0.016	-0.003	-0.015
	<0.001	0.050	0.004	<0.001	0.027	0.004
Short-interest ratio	-0.003		-0.003	-0.003		-0.003
	<0.001		0.013	<0.001		0.015
Unanticipated		-0.004	-0.001		-0.004	-0.001
short-interest ratio		0.004	0.679		0.002	0.675
Market Return	1.071	1.067	1.071	1.071	1.067	1.070
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SMB	0.640	0.651	0.641	0.661	0.672	0.662
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HML	-0.770	-0.765	-0.770	-0.796	-0.790	-0.800
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Momentum	0.010	0.011	0.010	0.010	0.010	0.010
	0.002	0.001	0.002	0.002	<0.001	0.002
Adjusted R^2	18.4%	18.4%	18.4%	18.7%	18.6%	18.7%

Panel B: Long-Run Returns

	Equation 1a	Equation 1b	Equation 1c	Equation 2a	Equation 2b	Equation 2c
Intercept	-0.095	0.014	-0.093	-0.098	0.011	-0.121
	<0.001	0.044	<0.001	<0.001	0.121	<0.001
Short-interest ratio	-0.025		-0.025	-0.025		-0.031
	<0.001		<0.001	<0.001		<0.001
Unanticipated		-0.026	-0.001		-0.020	0.104
short-interest ratio		<0.001	0.841		<0.001	0.053
Market Return	0.724	0.653	0.722	0.727	0.655	0.743
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SMB	0.517	0.584	0.519	0.559	0.628	0.544
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HML	-0.526	-0.490	-0.525	-0.549	-0.506	-0.558
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Momentum	0.041	0.045	0.041	0.046	0.049	0.045
	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Adjusted R^2	4.3%	3.9%	4.3%	4.5%	4.0%	4.5%

Note: This table provides the coefficient estimates and p-values from an OLS regression of the returns for the short-run (20-day) and long-run (180-day) periods subsequent to the short-interest report date, in Panels A and B, respectively. The short-interest ratio is the number of shorted shares divided by the number of shares outstanding, as reported by the NASD. For Equations 1a-1c, the unanticipated short-interest ratio is the residual from Equation 1 in Table 3. For Equations 2a-2c, the unanticipated short-interest ratio is the residual from Equation 2 in Table 3. The market return is the CRSP equal-weighted index. Drawn from the Kenneth French Data Library (tuck.dartmouth.edu), SMB is the monthly benchmark measure of the relative performance of small versus big stocks; HML is the benchmark on the performance of value stocks relative to growth stocks; the momentum factor is a monthly measure of the returns on a given stock over time.

These results for the unanticipated short interest measure are broadly confirmed in Panel B of Table 4, where we consider 180-day long run returns subsequent to the release of short interest data; the unanticipated factor is modestly significant in Equation 2c of Panel B, but is still less significant than the short interest ratio. As we discover with the short-run returns, higher short

interest is typically followed by lower returns. Tests reveal that unexpected short interest provides a less significant signal of future returns than the simple short-interest measure. The evidence generally shows that the unadjusted short-interest ratio better explains, than the unanticipated component of short sales, subsequent returns. While excluding the Fama-French factors allows the unanticipated level of short selling to displace the raw measure in terms of statistical significance, the inclusion of those factors reveals that the first-observed dominance of the unanticipated short-selling factor is not robust.

Conclusions

We augment recent research on short selling. We examine the 200 largest Nasdaq stocks and find that the shorting activity in these stocks is negatively associated with institutional ownership and positively related with inside ownership; we discover that the unexpected level of short selling, as we measure it, is less meaningful in describing later returns than are simple measures of changing short selling activity. We confirm that the most costly stocks to short are the least likely to be shorted.

We interpret our analysis of ownership structure as evidence that short sellers exploit several relations between returns and inside and institutional ownership. The relation between inside ownership and short interest may reflect short sellers attempting to profit from the lower stock returns associated with management entrenchment. Another plausible explanation is that higher levels of short selling may result from insiders hedging their stock holdings.

Our findings are not an artifact of the non-monotonic relationships between firm values and ownership concentration described in earlier research; rather, we find average increases in short selling as inside ownership increases, independent of the relative concentration of ownership. As well, we find declinations in short selling as institutional ownership rises. This runs counter to some recent research, as institutions are arguably the largest source of stock for selling short. However, our selection of a sample of the largest firms on the Nasdaq, for whom institutional ownership is likely not a binding constraint on stock availability for selling short, may explain this result. As well, short sellers may be less active in stocks with higher institutional ownership, as those institutional investors have exhibited superior selective ability with stock investments. This may not be the case in studies of stocks outside the largest 200 firms on the Nasdaq, but is the case with our reported and unreported tests.

Finally, we develop a new measure of expected short interest and find that unanticipated changes in short-interest levels provide less predictive ability for subsequent stock returns than do the raw measures of short-selling activity. While the unanticipated measure seems at first to be more significant in a set of unreported tests, it is displaced by the absolute measure of short selling activity when we make allowances for traditional market, firm-size and momentum variables.

These findings suggest that firm characteristics and short selling costs obfuscate the interpretation of short interest levels. By documenting how these factors affect the actions of short sellers, our study helps us interpret the signal offered by these relatively sophisticated investors.

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