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ACCRUAL-BASED RETURN ANOMALIES?

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Key Words: Accruals, NOA, anomalies, arbitrage, short sales, market efficiency

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1. Introduction

Past and present accounting adjustments to earnings, as reflected in a firm's operating accruals and its level of net operating assets (NOA), are strong and robust negative predictors of future abnormal stock returns.[1] Indeed, Fama and French (2006) identify the accrual anomaly as among the most pervasive and robust of the well-known financial anomalies. Several authors (e.g., Sloan 1996, Teoh, Welch and Wong 1998ab, and Hirshleifer, Hou, Teoh and Zhang 2004) suggest that the accrual or NOA anomalies derive from investor naiveté. Under this hypothesis, high accruals and high NOA are associated with market overvaluation, and subsequently with low abnormal returns when this overvaluation is corrected. Indeed, market inefficiency is the predominant interpretation of the empirical evidence on the accrual anomaly and the NOA ('balance-sheet-bloat') anomaly.[2] Two natural questions raised by this evidence are whether arbitrageurs recognize these anomalies and trade to profit from them; and the extent to which arbitrage activity reduces mispricing.

Short interest, the amount of short selling in a stock, provides a revealing window into the determinants of arbitrage activity and about the extent to which arbitrage succeeds in eliminating mispricing. Since it is harder or more costly to sell a stock short than to go long, arbitrageurs can more easily exploit underpricing than overpricing. Thus, constraints on arbitrage offer a possible explanation for why several stock return anomalies are stronger on the short side

[1] Operating accruals (Sloan 1996) and the change in net operating assets (Fairfield, Whisenant, and Yohn 2003) are negative predictors of future returns, as are various accrual components (e.g. operating, investing, and financing accruals; Richardson, Sloan, Soliman, and Tuna 2005). Hirshleifer, Hou, Teoh, and Zhang (2004) report that the level of net operating assets is a negative predictor of returns after controlling for other return predictors including the latest change in NOA. They propose that the level of NOA is a measure of 'balance sheet bloat,' the degree to which accounting reports incite investors with limited attention to be overoptimistic about the firm. The NOA, or 'sustainability effect,' is a highly significant predictor of returns up to a 3 year forecasting horizon.

[2] The abovementioned studies document abnormal returns after controlling for standard benchmarks, which suggests that these effects do not derive from rational risk premia. Hirshleifer, Hou, and Teoh (2007) provide evidence that the accrual anomaly is not captured by a rational multifactor pricing model in which factors are built based upon the return-predicting characteristic (accruals or NOA). Furthermore, operating accruals are positively associated with overoptimism in analysts' forecasts of future earnings (Teoh and Wong 2002), and auditors also do not make full use of information contained in accruals (Bradshaw, Richardson, and Sloan 2001).

(predictable negative returns) than on the long side (predictable positive returns).[3] Thus, asymmetry in return predictability provides information about the relative effectiveness of short versus long arbitrage.

This paper tests whether investors engage in short arbitrage of accounting-related return anomalies, and whether such activity constrains mispricing. In addition, by examining the effects of firm and market characteristics on short interest, we investigate how the information environment, the degree of investor sophistication, and the tightness of short sale constraints affect the amount of short arbitrage activity and its effectiveness in correcting misvaluation.

If sophisticated investors engage in short arbitrage of overpriced stocks, then their trades should increase short interest when forecasting variables such as accruals or NOA predict lower returns, i.e., when these variables are high. Furthermore, if short arbitrage operates effectively, we expect to see a relatively small asymmetry between the negative abnormal returns on the downside of the anomaly (e.g., when accruals or NOA are high) and on the upside of the anomaly (when these forecasters are low), as compared to a market where short arbitrage is much more constrained than long arbitrage. Thus, in addition to investigating the extent and determinants of short arbitrage activity, we investigate the determinants of the relative effectiveness of long versus short arbitrage, as measured by return asymmetry.

To isolate short arbitrage and its effects on returns more sharply, we exploit the insights provided by a recent set of papers about the determinants of short selling and the ease of short arbitrage. This research suggests a rich array of control variables, including size, volume, book-to-market, residual standard deviation, and institutional ownership. Short interest can be influenced by differences in liquidity across stocks; size and volume help capture such

[3] Examples include post-earnings announcement drift (Bernard and Thomas 1989), momentum (Hong, Lim, and Stein 2000), and the sustainability or Net Operating Assets effect (Hirshleifer, Hou, Teoh and Zhang 2004). Ali and Trombley (2006) examine the effect of short sale constraints on asymmetry in the momentum anomaly.

differences. Greater investor disagreement about a stock should also be associated with higher short interest (see, e.g., D'Avolio 2002); residual standard deviation, and (to the extent that there is more disagreement about growth than mature firms) book-to-market help capture differences in investor disagreement. Since institutional owners provide the main loan supply of stock, the level of institutional ownership is a proxy for the supply of loanable shares (Asquith, Pathak, and Ritter 2005, Nagel 2005). Ali and Trombley (2006) further verify the importance and reliability of some of the controls we use for studies of short arbitrage and its effects.

The trading environment of a stock—NYSE versus NASDAQ—is correlated with constraints on short selling. NYSE firms tend to be much larger, more liquid, and less volatile than NASDAQ firms, and have greater institutional following, which increases the supply of loanable shares for short-selling. Furthermore, we expect the trading environment to provide useful information about the quality of the firm's information environment. There is on average less timely news arrival about NASDAQ than NYSE firms. NYSE firms tend to be followed by more analysts, and have price discovery through a different exchange trading process. The poorer information environment for NASDAQ firms leaves greater room for investor disagreement and misperceptions.

A poor information environment creates greater scope for mispricing, and hence greater need for arbitrage, including short arbitrage. Higher costs or risks of arbitrage also contribute to mispricing. Both forces—stronger investor misperceptions, and greater costs of arbitrage—suggest that return anomalies will tend to be stronger among NASDAQ than among NYSE firms. Furthermore, if the small and risky firms on NASDAQ tend to be harder and riskier to sell short, downside anomalies should be especially strong on NASDAQ. This implies greater return asymmetry between the short-side and the long-side of anomalies among NASDAQ than among

NYSE firms.

Whether the amount of short arbitrage on NASDAQ is greater or less than on NYSE therefore depends upon a balance of two effects—stronger misperceptions on NASDAQ, creating a need for arbitrage, but tighter short-sale constraints on smaller and less liquid firms. Evidence about the extent of short arbitrage on the two exchanges therefore provides information about differences in investor misperceptions across the two exchanges.

Some recent research has begun to take advantage of the information in short interest to provide insight into the arbitrage of accounting-related anomalies. There is evidence that short sellers take advantage of overpricing as measured by high fundamental-to-price ratios, such as cash-flow-to-price, earnings-to-price and book-to-price (Dechow et al., 2001). Dechow et al. (2001) also report that firms with large short positions tend to have high institutional ownership, consistent with a greater supply of loanable shares or else with institutions being more willing to sell short.

However, conclusions as to whether investors use short sales to arbitrage the accrual or related anomalies have been surprisingly mixed. Short sellers do not seem to arbitrage the overvaluation of firms associated with high operating accruals during the 1990-98 period among U.S. (non-NASDAQ) exchange-traded stocks (Richardson 2003).[4] Richardson (2003) suggests that short sellers may be ignoring valuable information. There is also evidence that among firms that engaged in fraudulent or erroneous reporting leading to restatements during the 1997-2002 period, prior short selling was related to accruals (Desai, Krishnamurthy, and Venkataraman 2006).

This paper builds upon previous work by examining the arbitrage of anomalies relating to

[4] This is the case even using a measure that combines accruals with a proxy for investment expenditures. This variable is much like the change in NOA (see Fairfield, Whisenant, and Yohn 2003 and Richardson, Sloan, Soliman, and Tuna 2004).

operating accruals and NOA using a general sample of NASDAQ as well as NYSE firms, using a 16-year (1988-2003) time period instead of the 7 to 9-year time periods of other recent papers, and by including an extensive set of test controls. Extending the time period is informative, because the Richardson (2003) study includes the great bull market of the 1990's, but not the high-tech stock market crash of 2000-2002 or the earlier (late 1980s) recession. Furthermore, the inclusion of a more complete set of test and control variables for other determinants of short interest also turns out to make a critical difference for several conclusions. In addition, we examine the relationships of the ease of short arbitrage with mean abnormal returns and return asymmetry. This allows us to evaluate the *effectiveness* of short arbitrage.

In order to control for the effect of risk or of misvaluation deriving from other sources, in measuring abnormal returns we apply a standard approach, the characteristics adjustment method of Daniel, Grinblatt, Titman and Wermers (1997). Using our longer sample period inclusive of the tech sector decline, in univariate tests we find a relatively modest degree of evidence of higher short-selling of high-accrual NYSE firms (significant at the 10% level). Thus, using a longer time period than the tests of Richardson (2003), we find that even the univariate NYSE evidence suggests a difference in short interest between firms with low versus high accruals.

In a multivariate test that includes the relevant controls, even on NYSE there is a strongly significant positive relationship between accruals and short interest. Thus, investors seem to engage in arbitrage of the overvaluation of high-accruals firms by selling them short. In other words, even in the NYSE subsample where the pressure toward mispricing is presumably weaker, sophisticated arbitrage of the accrual anomaly leaves tracks in the data.

For NASDAQ firms, both univariate and multivariate tests indicate a significant positive relation between short interest and accruals. The mean short interest in the highest accrual decile is over 40% higher than the mean short interest of the lowest accrual decile.

There are also differences across exchange in the success of arbitrage of the accrual anomaly. We find that the hedge returns from the accrual anomaly (long on low-accrual firms, short on high-accrual firms) are much larger among NASDAQ than among NYSE firms. This effect comes mainly from the fact that the returns earned by high-accrual NASDAQ firms are even lower than the low returns earned by high-accruals NYSE firms. A long position in the top accrual decile among NASDAQ firms on average earns –80 basis points per month (t = –7.62), whereas for the top NYSE accrual decile the loss is only –25 basis points per month (t = –2.37).

Furthermore, on NASDAQ accrual-strategy profits are highly asymmetric, with no significant long-side gains from holding firms in the lowest accrual decile, as contrasted with strong short-side profits. In contrast, on NYSE profits are basically symmetric between going long on low accrual firms, and going short on high accrual firms. These findings of strong abnormal return asymmetry on NASDAQ but not NYSE suggest that short arbitrage is especially costly, difficult, or risky among NASDAQ firms.

There are a number of possible reasons for return asymmetry, so it is important to test whether the identified asymmetry is actually related to constraints on short-selling. To do so, we sort the pooled sample of firms (both NYSE and NASDAQ) by their institutional holdings (a proxy for the amount of loanable shares). We find significantly positive return asymmetry in the accrual anomaly only within the decile with lowest institutional ownership—the decile in which shares are hardest to sell short.

Furthermore, the spread in accruals between the top and bottom accrual deciles among NASDAQ firms is more than 110% higher than among NYSE firms. To the extent that extreme accruals are misvalued, this suggests much greater investor misperceptions on NASDAQ, and therefore much greater incentive for sophisticated investors to sell short NASDAQ firms than NYSE firms.

These findings suggest that limited information, limited liquidity, and more extreme accruals contribute to greater misvaluation among NASDAQ firms, and that nevertheless this greater misvaluation induces greater short-selling; that this NASDAQ short-selling is severely constrained by such considerations as risk and illiquidity, and especially the supply of loanable shares; and that constraints on short-selling prevent the downside anomaly from being arbitraged away as much for NASDAQ firms as with NYSE firms.

Turning to NOA, in univariate analysis, there is no significant relation between the level of NOA and short-interest among either NYSE or NASDAQ firms. This is surprising, since we verify that the NOA or 'balance sheet bloat' effect is even stronger than the accrual anomaly. In a test that includes NYSE and NASDAQ firms from 1988-2002, we confirm that the hedge returns (low minus high) associated with the NOA anomaly are large (1.45% per month, t = 11.37).

However, it is crucial in testing for short arbitrage of an anomaly to include controls, since the anomaly variable (NOA, in this case) is likely to be correlated with other predictors of abnormal returns (such as accruals, book-to-market, and momentum) that investors might be arbitraging. In multivariate tests that include appropriate controls, we find economically and statistically significant short arbitrage of the NOA anomaly. This arbitrage activity is primarily concentrated on NASDAQ. We argue that this is because the profit opportunities available from arbitraging the NOA anomaly are much stronger on NASDAQ than on NYSE.

There is a hint of asymmetry (not statistically significant) between the long- and short-side returns from an NOA-based strategy on NYSE, and that this asymmetry is somewhat larger, on NASDAQ than on NYSE. However, a test using institutional holdings as a proxy for the supply of loanable shares strongly suggests that constraints on short-selling are *not* the source of return asymmetry for NOA. Specifically, NOA asymmetry is not concentrated in the lowest institutional ownership decile (the firms that are hardest to sell short).

2. Information Environments, Investor Misperceptions, and Short Sale Constraints of NASDAQ and NYSE Firms

In order to sell short, investors must borrow shares from an investor who owns them and is willing to lend. The short seller typically leave cash collateral with the lender. In addition to the collateral, equal to 102% of the market value of the borrowed shares, Federal Reserve Regulation T requires short sellers to post an additional 50% in margin when the lender is a U.S. broker-dealer. The lender pays the short seller interest, the rebate rate, on the collateral. The spread between the rebate rate and the market interest rate on cash funds, often referred to as the loan fee, is a direct cost to the short seller.

D’Avolio (2002) documents that 9% of stocks have loan fees above 1% per annum, among which about 1% have negative rebate rates. He also finds that the probability of being “special” (stocks with high loan fees) decreases with size and institutional ownership, and disagreement among investors seem to predict specialness.

Under current regulations, lenders maintain the right to recall a loan at any time. The recalled borrower can either “cover” the short by buying back the shares and returning them to the lender, or to reestablish the short at a higher loan fee. A “short squeeze” occurs when increasingly optimistic investors compete with recalled borrowers to buy shares being sold by lenders. These involuntary closeouts of short trades just when their expected profits are nominally at their highest are a source of risk for short sellers. D'Avolio (2002) document that in an average month of his sample, 2% (61) of the stocks on loan are recalled. Conditional on having been recalled, the mean time before the short can be reestablished with the lender is 23 trading days.

For several reasons, we expect greater pressure toward mispricing among NASDAQ than among NYSE firms. Since credible public information tends to be scarcer for NASDAQ than NYSE firms, beliefs are likely to be more biased (in either optimistic or pessimistic directions) among NASDAQ firms. Moreover, as compared to NYSE firms, NASDAQ firms tend to be held more by individuals rather than institutions. If individual investors tend to be less sophisticated than institutional investors, then the scope for investor misperceptions will tend to be greater among NASDAQ firms. In addition, as we document, NASDAQ firms tend to have greater variance in the accrual and NOA variables that potentially drive unsophisticated perceptions.

Furthermore, the constraints, costs, and risks of arbitrage are likely to be higher among NASDAQ stocks than among NYSE stocks owing to greater volatility and lower liquidity. Some of the constraints impinge especially on short arbitrage rather than just arbitrage in general. The presence of institutional shareholders, who tend to be more willing to loan shares, should tend to increase the supply of shares and the effectiveness of arbitrage (Asquith, Pathak, and Ritter 2005, Nagel 2005). The lower institutional shareholdings of NASDAQ firms make it harder to obtain shares to borrow for purposes of short selling. In addition, the risk of a short squeeze is greater in illiquid stocks and in stocks where there are few potential lenders of shares. This problem is exacerbated by the higher volatility of NASDAQ firms. The relative scarcity of institutional holders of NASDAQ firms also shrinks the pool of sophisticated institutional investors analyzing these stocks and potentially arbitraging away mispricing.

A potentially opposing effect is that regulatory restrictions on short selling are stricter on NYSE than on NASDAQ. This suggests that after controlling for other characteristics of NYSE and NASDAQ firms, NASDAQ firms should be easier to sell short (Fishman, Hong, and Kubik 2006). However, the dominant effect on ease of short-selling is likely to come from the very large differences between the kinds of firms that trade on NYSE versus NASDAQ - that NASDAQ firms are smaller, less liquid, more volatile, and have lower institutional holdings.

If there is lower investor sophistication among NASDAQ than NYSE firms, and higher costs of arbitrage, then we expect greater misvaluation in general, and therefore stronger return-forecasting anomalies. Furthermore, since short arbitrage is more tightly constrained than long arbitrage and this difference is especially strong among NASDAQ firms, there should be greater asymmetry between the strength of return anomalies on the upside (exploitable by taking long positions) than on the downside (exploitable by short selling) among NASDAQ firms as compared with NYSE firms.

Short arbitrage of overpriced stocks can be viewed as a response by sophisticated investors to overoptimistic beliefs of naive investors.[5] As discussed in the introduction, whether the extent of short arbitrage activity is greater on NASDAQ than on NYSE depends upon a balance of effects: greater investor misperceptions on NASDAQ, encouraging greater short arbitrage against the overpricing of firms with high accruals or NOA, versus a likelihood of

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[5]Consistent with short interest at least to some extent representing sophisticated arbitrage of mispricing, for both NYSE and NASDAQ stocks, short interest is a negative predictor of subsequent abnormal returns (Asquith and Meulbroek 1996, Desai, Ramesh, Thiagarajan, and Balachandran 2002). Asquith, Pathak, and Ritter (2005) report that these effects are present only with equally-weighted portfolios. This implies that the effects are strongest for small firms, which suggests that it may be especially informative to investigate short-selling and arbitrage using NASDAQ firms. Lamont and Thaler (2003) document that very high costs of short-selling are associated with extreme price discrepancies between tech firms involved in equity carve-outs and their parent firms. Ofek, Richardson and Whitelaw (2004) report that costs of short-selling are associated with failures of arbitrage between the stock market and options markets, and that stronger constraints on short-selling are associated with negative subsequent abnormal returns. Jones and Lamont (2002) find that during 1926-1933, stocks that were expensive to short tended to have high valuations and low subsequent returns, consistent with overvaluation. In a study of a more recent time period that disentangles the supply and demand for short-selling, Cohen, Diether, and Malloy (2007) document that higher demand for short selling is associated with stock price declines in the subsequent month.

stronger constraints on arbitrage among NASDAQ firms. Quantitatively, we document that the accrual and NOA return anomalies are stronger on NASDAQ than on NYSE, especially on the downside, which creates a stronger motive for short arbitrage. On the other hand, NYSE firms tend to have higher institutional holdings and greater liquidity, which makes short selling less costly. There is therefore a balance of possible effects, so we test empirically to see which dominates.

3. Data Description

3.1 Sample Characteristics and Variable Measurement

<u>Sample Characteristics</u>

We obtain monthly short interest data from NASDAQ for the period from June 1988 to December 2003, and from NYSE for the period from January 1988 to June 2002.[6] NASDAQ defines short selling as the selling of a security which the seller does not own, or any sale which is completed by the delivery of a security borrowed by the seller. Therefore, short sellers assume the risk that they may be forced to buy back the stock at a higher price than the price at which they sold short.

The data description from NASDAQ indicates the following. Member firms are required to report their short positions monthly to the NASDR TS-Customer Advocacy & Quality Management Department. Short positions in all accounts in shares, warrants, units, ADRs, and convertible preferred stocks resulting from short sales have to be reported. NASDAQ then compiles the short position for each NASDAQ security from the reports they receive.

The short positions reported are as of settlement on the 15th of each month, or the preceding business day if the 15th is not a business day. The reports must be filed by the second

[6] NASDAQ indicates that the February and July 1990 data are missing from their database.

business day after the reporting settlement date. Since it takes 3 (or 5 for earlier periods) business days to settle trades, the short interest number includes short sales that occurred 3 (or 5) business days prior to the 15th. NASDAQ publishes the short interest data on the 8th business day after the reporting settlement date. The short selling data from the NYSE is also as of settlement on the 15th of the month.

Monthly stock returns are obtained from CRSP. The sample is first selected by merging the monthly CRSP stock returns file with the monthly short interest file according to the stock ticker and calendar month. If a match is found, the sample is then matched with the annual financial statement data file from Compustat, allowing for a four-month lag between the fiscal year end and the month when the short position is reported.[7] We end up with a maximum of 56,527 firm-year observations for the NASDAQ sample and 26,600 firm-year observations for the NYSE sample. The different test methods impose further varying restrictions on sample size depending on accounting variables needed.

Variable Measurement

To assist in comparing short positions across time and firms, following Asquith et al. (2005), we calculate short interest as the short position reported by the NYSE or NASDAQ in the fifth month after the fiscal year end divided by the number of shares outstanding as reported on CRSP for the same month.[8] The four-month gap between the fiscal year end and the short

[7] We also eliminated ADR observations because some of the short interest positions listed on the data file exceeded the total number of shares outstanding in CRSP.

[8] NASDAQ indicates that the monthly short interest information includes the adjustment for stock splits. The adjustment to the short interest for stocks that split on or before the reporting settlement date will automatically be reflected in the most current reporting period. However, for stock splits that occur after the settlement date, the adjustment will be reflected in the following reporting period. We scale short interest by the share outstanding in the same month from the CRSP tape. This may introduce error if the split occurs after the settlement date because the short interest data will be based on the pre-split shares, whereas CRSP may reflect the post-split shares outstanding.

position is to ensure that the short–sellers have the accounting information available to them prior to taking short positions. [9]

Prior research has recommended measuring operating accruals from the Statement of Cash Flows over measuring them from the Balance Sheet (Collins and Hribar 2002). Because our short interest data begins in 1988, we are able to use the Statement of Cash Flows to calculate operating accruals as:

Operating Accruals = (Earnings – CFO) /Average Total Assets

Following Hirshleifer, Hou, Teoh, and Zhang (2004), the other potential trading screen accounting variables are calculated as follows.

Net Operating Assets (NOA)

= [*Operating Assets (OA) – Operating Liabilities (OL)*] */ Average Total Assets,*

where OA = total assets (item 6) – cash and short investment (item 1), and OL = total assets – debt included in current liabilities (item 34) – long term debt (item 9) – minority interests (item 38) – preferred stocks (item 130) – common equity (item 60).

To examine whether short–sellers exploit predictable returns associated with a particular trading strategy, we first rank firms each fiscal year by the trading screen (Operating Accruals or NOA) and then assign them in equal numbers into ten portfolios. High decile portfolios contain firms with the highest accounting screen and Low portfolios contain firms with the lowest accounting screen.

[9] We also calculated short interest in two alternative ways. (1) We used only short positions that exceed a cutoff of 0.5% of shares outstanding as in Dechow et al (2001). Dechow et al argue that large short positions are more likely to represent a consensus among short-sellers that a stock is overpriced based on the trading strategy screen, whereas low short positions may reflect short-selling behavior based on other considerations (e.g. risk hedging). (2) For each firm-fiscal year, we average the monthly short positions from month five through 17 after the fiscal year instead of using the month five short position only. The results are generally similar and so are not reported.

Table 1 reports the variable statistics for the pooled sample and for the NYSE and NASDAQ subsamples. On average, NASDAQ firms have more negative operating accruals and lower NOA than NYSE firms. The means and medians of these variables are similar in magnitude to those reported in prior literature.

Short selling of NYSE firms is higher than that of NASDAQ firms by both mean and median measures. This may reflect that, in general, the shares of NYSE firms are easier, cheaper, and less risky to borrow and sell short than those of NASDAQ firms. Compared to NYSE firms, NASDAQ firms in our sample have much smaller market capitalizations, and have higher growth as measured by book-to-market (the mean difference in BTM is significant using a *t* test but the median difference is not significant in a Wilcoxon test). Trading volumes and institutional holdings are also lower for NASDAQ than NYSE firms, and residual standard deviation is higher for NASDAQ than NYSE firms. Therefore, the average NASDAQ firm is less liquid, and hence harder to sell short, than NYSE firms.

4. The Accrual and NOA Anomalies: Existence and Asymmetry

Before testing directly whether short-sellers trade to exploit the accrual and NOA anomalies, it is important first to verify whether these anomalies are present during our sample period. Also, examination of the return evidence provides a different and revealing window into the efficacy of short arbitrage. If short arbitrage is much less effective than long arbitrage, we expect an asymmetry between the predictability of returns on the up and down sides. In other words, we expect the negative mean abnormal returns after accruals or NOA is high to be much larger in absolute value than the positive mean abnormal returns after accruals or NOA is low. In contrast, if short arbitrage is engaged in just as readily as long arbitrage, we expect these anomalies to be symmetric. Subsection 4.1 examines the existence and asymmetry of the accrual anomaly, and Subsection 4.2 examines the NOA anomaly.

4.1 Existence and Asymmetry of the Accrual Anomaly

We first describe the ability of accruals to predict returns, and the degree to which this predictive power is asymmetric with respect to positive versus negative accruals. In Table 2, firms are ranked each month for the full sample, NYSE subsample, or NASDAQ subsample respectively based upon their operating accruals and then sorted into ten deciles. Equal-weighted monthly abnormal returns in each decile are computed using the characteristic-based portfolio matching procedure used in Daniel, Grinblatt, Titman, and Wermers (1997) to control for size, book-to-market, and 12-month stock return momentum.

In the Daniel et al (1997) procedure, to form benchmark portfolios all observations are first sorted each month into size quintiles, and then within each size quintile further sorted into book-to-market quintiles. Stocks are then further sorted within each of these 25 groups into quintiles based on the firms past 12-month returns, skipping the most recent month. Stocks are weighted equally within each of these 125 groups. To form a size, book-to-market, and momentum-hedged return for any stock, we subtract the return of the equal-weighted benchmark portfolio to which that stock belongs from the return of the stock. The hedge portfolio consists of a long position in the lowest ranked portfolio and an offsetting short position in the highest ranked portfolio. All *t*-statistics reported are based on the time series of monthly mean portfolio returns.

Table 2 indicates that the hedge returns from taking long positions in low-accrual firms and a short position in high-accrual firms are substantial and significant in the full sample, and much larger among NASDAQ firms than among NYSE firms. For the sample period 1988-2002, the monthly return spread between Low and High accrual deciles in the full sample is 105 basis points per month (t = 5.57), which is actually stronger than both the spread on the NYSE of 57 basis points per month (t = 3.55), and on NASDAQ of 99 basis points per month (t = 4.65).[10,11] Thus the mean abnormal hedge returns among NASDAQ firms is more than 70% larger than the return spread among NYSE firms. The larger NASDAQ return spread suggests a stronger incentive for investors to identify and sell short high-accrual firms on NASDAQ than on NYSE.

Earlier research has suggested that trading profits are quite different in the 1999 onwards period with the NASDAQ boom and crash, so we also examine the return spreads from 1988-1998 and 1999-2002 subperiods (results not reported in Table 2). Similar return spreads are observed in the period 1988-1998, suggesting that the effect is not driven by the post-crash years. The effect is weaker for NYSE firms during 1999-2002, and is very strong for NASDAQ firms during 1999-2002.

On NASDAQ there are no significant long-side profits from holding the lowest accruals portfolio. The difference in the hedge returns on NASDAQ versus NYSE derives mainly from the much more negative returns earned by NASDAQ firms in the highest accrual decile than NYSE firms in the highest accrual decile. For the entire sample period 1988-2002, a long position in the highest accrual decile among NASDAQ firms on average loses 80 basis points per month (t = –7.62), whereas for NYSE firms the loss is less than half as large, –25 basis points per month (t = –2.37).

It is not surprising that abnormal profits from the accrual strategy are larger among

[10] Looking across accrual deciles, the pattern is not perfectly monotonic, but the trend in returns is clearly declining as Accruals increases.
[11] A pooled hedge return can be stronger than the hedge return in either of its subsamples. For example, this can occur if NYSE firms help the pooled sample achieve high returns in the low accrual decile, whereas NASDAQ firms help the pooled sample achieve low returns in the high accrual decile.

NASDAQ firms than among NYSE firms since, as shown in Table 4, the dispersion of accruals is greater among NASDAQ firms. Panel D of Table 4 shows that mean accruals are twice as negative for the lowest NASDAQ decile as for the lowest NYSE decile, and 2.4 times larger for the highest NASDAQ decile than the highest NYSE decile. This results in significantly larger High-Low interdecile spread in accruals on NASDAQ than on NYSE. Thus, the evidence in Table 2 does not provide any indication that there is a greater sensitivity of misvaluation to accruals on NASDAQ than on NYSE. In this sense the accrual anomaly seems to be about equally strong on the two trading venues, a conclusion borne out in unreported multivariate return regressions.

Returning to Table 2, the bottom row labeled **–(H+L)** is the mean return on a portfolio that is short on both the highest and lowest characteristic deciles. This is a measure of the asymmetry between upside and downside profits from the hedge strategy. A larger absolute value of the abnormal returns of the high portfolio (H) compared to those of the low portfolio (L) will increase –(H + L). The asymmetry is significant and substantial in the full sample (43 basis points per month, $t = 2.26$); the negative mean abnormal return of –74 basis points per month in the highest accrual decile is more than twice as large in absolute value as the positive mean return of 31 basis points per month among firms in the lowest accrual decile. However, this asymmetry comes mainly from the significant and large effect on NASDAQ (61 basis points per month, $t = 2.86$). The asymmetry is completely insignificant on NYSE. The negative mean abnormal return of –80 basis points in the highest accrual decile on NASDAQ is more than four times as large in absolute value as the positive mean return of 19 basis points firms in the lowest accrual decile. These findings suggest that short-selling constraints make short arbitrage of the accrual anomaly less effective on NASDAQ than on the NYSE.

As discussed in the introduction, greater institutional shareholding should encourage short arbitrage, because institutional investors are more likely to lend shares for short-selling. Greater ease of short arbitrage should, in equilibrium, reduce the return asymmetry associated with an anomaly. Table 3 examines the asymmetry of the accrual and NOA anomalies among firms sorted into deciles according to institutional shareholdings (InstHold). Panel A indicates that there is significant return asymmetry only in the lowest InstHold decile (– (H + L) = 78 basis points per month, t = 2.05); the next largest asymmetry is insignificant and less than half as large (38 basis points per month). This evidence suggests (with substantial economic magnitude, but somewhat marginal statistical significance) that short arbitrage of the accrual anomaly is more limited among firms with low institutional holdings.

4.2 Existence and Asymmetry of the NOA Anomaly

We now describe the ability of NOA to predict returns, and the degree of asymmetry of the NOA anomaly for our sample period, which extends the period considered in Hirshleifer et al. (2004). Table 2 indicates that the NOA hedge abnormal returns in the full sample are a substantial 1.36% per month (t = 8.89), with profits achievable on both the long and short side of the strategy. The hedge returns are almost four times as large on NASDAQ (1.74% per month, t = 9.05) as on NYSE (0.45% per month, t = 3.01). For NASDAQ but not NYSE, the lowest decile of NOA yields highly significantly positive abnormal returns, suggesting that even a pure long-side arbitrage is potentially profitable.

To see if the higher abnormal profit from the NOA strategy among NASDAQ firms comes from greater sensitivity of misvaluation to NOA on NASDAQ, we must consider the alternative possibility that the high returns achievable on NASDAQ are explained by greater dispersion of NOA across NASDAQ firms. Panel D of Table 5 shows that dispersion is higher on NASDAQ, but that the difference is very modest: the mean interdecile NOA spread is 0.99 on NASDAQ as compared with 0.94 on NYSE. This difference is statistically significant (t = 2.49), but only about 5%. Given the strong return differentials in Table 2, it seems that future abnormal returns are far more sensitive to misvaluation on NASDAQ than on NYSE. This contrasts with the finding for the accrual anomaly that (after accounting for differences in dispersion of accruals) the sensitivity is about equally strong on the two trading venues.

The finding that the NOA anomaly is stronger on NASDAQ than on NYSE suggests either that the pressure toward mispricing is greater on NASDAQ, presumably because information and investor sophistication is more limited (and because of greater variability in NOA on NASDAQ), or that arbitrage is less effective owing to lack of liquidity. Greater misvaluation of NOA on NASDAQ should increase the incentive for short as well as long arbitrage.

The negative mean abnormal return in the highest decile associated with shorting high NOA firms is larger in absolute value than the positive mean return of firms in the lowest NOA decile. Return asymmetry, as measured (see the definition above in Subsection 4.1) by the bottom row of Table 2, **–(H+L)**, is reasonably large and significant in the pooled sample (0.36%, t = 2.37). The point estimate for the asymmetry is non-negligible but statistically insignificant on NYSE (0.27% per month, t = 1.83), but the asymmetry is significant and large on NASDAQ (0.52% per month, t = 2.71). These findings suggest either that short-selling constraints make short arbitrage less effective than long arbitrage on NASDAQ, or alternatively that there are other sources of asymmetry, e.g., behavioral biases of investors being asymmetric with respect to high versus low NOA.

It is therefore important to test whether the asymmetry of the NOA anomaly is driven by constraints on short arbitrage. In Table 3, Panel B, we examine how asymmetry changes as a function of institutional shareholdings, a proxy for the supply of loanable shares (Asquith, Pathak, and Ritter 2005; Nagel 2005). In contrast with the evidence for the accrual anomaly, there is relatively little pattern across deciles in the asymmetry of the NOA anomaly, with asymmetry fluctuating non-monotonically, with a low of –1 basis points per month in decile 6, and a high of 50 basis points per month in deciles 1 and 4 (significant in decile 4, t = 2.29). This evidence does not give any clear indication of a systematic difference in the degree of short arbitrage across institutional ownership deciles. In other words, there is not obvious evidence that greater ease of short arbitrage helps attenuate the downside of the anomaly relative to the upside. This raises a question of whether short sellers were even aware of and interested in arbitraging the NOA anomaly during this sample period.

5. The Relationship Between Short Interest, Accruals and NOA: Univariate Tests

Evidence from short interest provides further insight into the nature of short arbitrage. An anomaly that is strong on the down- as well as the upside should be the target of strong short arbitrage, unless even sophisticated investors have failed to recognize the anomaly, or barriers to borrowing stock in order to sell short are severe. Strong short arbitrage, i.e., a strong relation between the return predictor and short interest, suggests that some investors are highly aware of the anomaly, and are profiting thereby to the extent that the supply of loanable shares permits.

We first examine short arbitrage of the accrual anomaly (Subsection 5.1), and then short arbitrage of the NOA anomaly (Subsection 5.2). Subsection 5.3 discusses the interpretation of the univariate results given the possibility of other influences on accruals and NOA, and the fact that accruals and NOA themselves are correlated.

5.1 Short Arbitrage of the Accrual Anomaly

As discussed in the introduction, for the 1990-98 period past research has not detected a statistically significant univariate correlation among NYSE firms between short interest and the level of operating accruals (Richardson 2003). Given the relatively short time period of this finding, it is important to test this using our 1988 to 2003 sample that includes the stock market and high-tech sector bust as well as the preceding market boom. Table 4 Panel A reports mean short positions for the pooled sample. Table 4 Panel B reports mean short positions for NYSE firms from 1988 to 2002, and Panel C reports mean short positions for NASDAQ firms from 1988 to 2003.[12]

For convenient comparison with previous research, we begin with the analysis by trading venue in Panels B and C. In our longer sample period, Panel B provides some indication that investors do engage in short arbitrage of the accrual anomaly among NYSE firms. The difference in short interest between the highest and lowest accrual deciles is 0.40, which is non-negligible, and has a *t*-statistic of 1.80, which is significant at the 10% level.[13] As we will discuss below, more powerful multivariate tests more strongly confirm short arbitrage even among NYSE firms.

Panel C shows that in the 1988-2003 period, the univariate results for NASDAQ firms are stronger. The mean short interest in the highest accrual decile is 1.79, which is over 40%

[12] The sample periods are the maximum for which we have short interest data from the exchanges. The qualitative results are similar for median changes.
[13] The point estimates are non-monotonic, with short interest higher in the lowest accrual decile than in decile 9. However, the difference between the two is not statistically significant.

higher than the mean short interest of the lowest accrual decile, 1.26. Thus, the difference of 0.53, which is significant at the 5% level (*t* = 2.40), is economically substantial. Investors seem to be actively engaged in the arbitrage of overvalued, high-accruals firms through short-selling. We have also examined NASDAQ findings during the 1990-1998 period (not reported in tables); during this period the effect is even more strongly significant (H – L = 0.61, *t* = 3.23).

Returning to Panel A, we see that in the pooled sample, short interest is increasing with accruals. The mean short interest in the highest accrual decile is 1.86, whereas in the lowest accrual decile mean short interest is only 1.37. The difference of 0.49 is significant at the 5% level (*t* = 2.27), and is quantitatively substantial relative to the levels of short interest in the different deciles. In other words, variation in accruals has a substantial effect on mean short interest. The findings of Panel B and C indicate that this effect in the overall sample comes more from NASDAQ than from NYSE firms.

Why is short arbitrage of the accrual anomaly stronger for NASDAQ than for NYSE? The evidence from Table 2 that the accrual anomaly is much stronger on NASDAQ than on NYSE suggests a simple reason, that misperceptions on the part of naïve investors are stronger on NASDAQ. Such misperceptions, by creating greater pressure for mispricing, should increase the incentive of sophisticated investors to engage in arbitrage activity.

One source of the greater mispricing on NASDAQ is that accruals have much higher dispersion on NASDAQ than on NYSE. Table 4 Panel D shows that the bottom decile of accruals on NASDAQ has a significantly lower (more negative) level of mean accruals than the corresponding decile on NYSE (difference –0.21, *t* = –7.85). Similarly, the top decile of accruals on NASDAQ has a significantly higher level of mean accruals than the corresponding decile on NYSE (difference 0.12, *t* = 11.38). Thus, the High minus Low decile spread in mean accruals is much larger on NASDAQ than on NYSE (difference in differences of 0.34, t = 16.45).

A final observation about Table 4 is that short interest is to a substantial extent concentrated in the top accrual decile (Decile 10). In the pooled analysis and in the NASDAQ subsample, a substantial fairly large fraction of the High Minus Low difference in short interest would still be present even if we compare Decile 10 with Decile 9 instead of with Decile 1. (For the NYSE subsample, the 10 – 9 decile difference is actually larger than the 10 – 1 difference.) This concentration of short interest makes sense if there are fixed costs of short arbitrage activity, such as the costs of identifying appropriate positions to take. In such a situation arbitrageurs will focus the most attention on the most overpriced stocks.

5.2 Short Arbitrage of the NOA Anomaly

In contrast, Table 5 indicates that in the pooled sample, the univariate tests shows little sign during our 1988-2003 sample period that short sellers were exploiting the NOA anomaly. The difference in short interest between the High- and Low- NOA portfolios is just 0.19, (t = 0.93).

Table 5 Panel B shows that among NYSE firms, there is no sign of short arbitrage of the NOA anomaly. There is even some hint (interdecile difference –0.31, t = –1.89) of a reverse arbitrage effect (though this is not borne out in multivariate tests). Table 5 Panel C shows only a weak hint among NASDAQ firms during 1988-2003 that short sellers exploited the NOA anomaly. The difference in short interest between the High- and Low- NOA portfolios is just 0.27 (t = 1.20). Overall, the univariate tests provide little sign of short arbitrage on either NYSE or NASDAQ.

Since the NOA or 'balance sheet bloat' anomaly is more recently documented than the accrual anomaly, a possible explanation for that lack of short arbitrage based upon NOA is that as of 2002 or 2003 even sophisticated investors were generally not aware of such opportunities. However, before drawing such a conclusion, it is important to keep in mind the limitations of univariate tests, that they fail to control for other determinants of short interest. We therefore defer discussion of the economic meaning of these findings to Section 6.

5.3 Discussion: Alternative Test Methods

As discussed earlier, short interest is likely to be influenced by variables other than accruals and NOA, such as the degree of disagreement and the extent of institutional ownership, both of which are likely to vary across industries. To the extent that these other influences are fixed over time, an analysis in changes can filter out such extraneous effects, potentially reducing the noise of the test. In unreported tests, we find evidence that increases in accruals and even NOA are associated with increases in short interest.

A possible disadvantage of an analysis in changes is that some of the cross-sectional differences in short-interest are due to cross-sectional differences in accruals or NOA, the effects we would like to detect. Furthermore, while an analysis in changes filters out extraneous fixed effects, it does not deal with interfering effects that shift over time. Although there is a degree of stability to cross-firm or cross-industry variations in variables such as institutional ownership and residual volatility, these variables and other possible influences are likely to vary over time.

In particular, a general challenge for tests of short arbitrage of an anomaly is that the return-forecasting variable may be correlated with other forecasters of returns. For example, if accruals are correlated with past return momentum or with book-to-market, and if there is short arbitrage of the momentum anomaly or the value effect, then to verify short arbitrage of the accrual anomaly we need to control for past return momentum and for book-to-market. There is indeed evidence that short-interest is correlated with firms' book-to-market ratios, suggesting that there is short-arbitrage of the 'value' (book-to-market) effect (Dechow et al 2001). If accruals are correlated with book-to-market, then any relation between short-interest and accruals could be a consequence of short arbitrage of the value effect rather than of the accrual anomaly. Since firm valuations (book-to-market ratios) fluctuate stochastically over time, performing a test in differences does not fully address this issue.

In consequence, in Section 6 we perform multivariate tests which explicitly control both for other determinants of short interest, and for other known predictors of stock returns. This allows us to verify whether the apparent arbitrage of the accrual anomaly found in our univariate tests (both in levels and changes) are actually due to arbitrageurs trading in response to accruals.

6. Short Arbitrage of the Accrual and NOA Anomalies: Multivariate Tests

Multivariate testing of whether there is short arbitrage of the accrual and NOA anomalies is important for two reasons. The first is that there are several determinants of short interest in general which need not derive from arbitrage of these anomalies. The second is that accruals and NOA are correlated with each other, and with other return predictors. In consequence, short arbitrage of one anomaly (e.g., momentum) could induce a correlation between short interest and other return predictors (e.g., accruals or NOA), even if no investor is basing a decision to go short on this other predictor.

To control for other general determinants of short interest, we include in our regressions measures of institutional ownership, residual return volatility, book-to-market, and size. When institutional ownership is high, the stock is easier to borrow for purposes of short-selling

(Asquith, Pathak, and Ritter 2005, Nagel 2005), so we control for institutional ownership (IO). Higher liquidity also tends to make a stock easier to sell short, so we control for firm size (LnSize) and volume (LnVolume). High residual volatility makes short arbitrage riskier, so we include a residual volatility measure (StdRes) as a control (see Pontiff 1996, Duan, Hu, and McClean 2006).

A general propensity toward disagreement is another source of demand for shares to sell short (D'Avolio 2002). If high accruals happen to be associated with firms that have greater disagreement, this would induce an association between accruals and short interest even if no investors were selling short based upon the level of accruals. We therefore control for some general proxies for investor disagreement. High residual volatility may allow greater room for disagreement among investors, which provides a distinct interpretation of the residual volatility control. In addition, we include book-to-market (LnBTM), which is an inverse proxy for disagreement if there is more disagreement about growth (low book-to-market) firms than about mature firms.

We also include a control for the trading venue, using a dummy variable NYSE which is equal to 1 if the firm is NYSE-traded and 0 if it is a NASDAQ firm. Our proxies for liquidity and propensity to disagreement are imperfect, and the trading venue can offer additional relevant information. For example, the kind of company that is able to qualify for, and chooses to be traded upon, the NYSE may have greater liquidity and a more transparent information environment; NYSE trading itself affects liquidity. We also examine the interaction of the NYSE dummy with accruals and NOA.

In addition to including the NYSE dummy as a main effect, we allow for interactions of NYSE with Accruals and NOA. Similarly, we allow for interactions of Accruals and NOA with

STDRES and InstHold. Intuitively, for a given strength of the anomaly, short interest may be more sensitive to accruals or NOA for a stock that is easier to short sell.

The book-to-market and size variables are useful as controls for a second reason, their documented ability to predict future returns. Since momentum is a strong stock return predictor, we also include a momentum variable, measured as the compounded past returns from months –12 to –2 relative to the short interest position month. We also perform tests that include both accruals and NOA to determine whether investors are engaging in short arbitrage of each anomaly per se.

We saw in Section 5.1 that there was a nonlinear relationship in which short interest was concentrated especially in the top accrual decile, and that conceptually this makes sense because when there are fixed costs of short arbitrage, it is most profitable to focus on the most overvalued firms. To capture the nonlinear relationship between short arbitrage, in our multivariate tests we use dummy variables that are equal to one when the firm's Accruals or NOA are in the top decile, and zero otherwise.

Table 6 describes multivariate regressions of short interest on either HighAccrual, HighNOA, or both, as well as year fixed effects, the six control variables discussed above, a dummy variable for NYSE, and interaction variables between NYSE and the six control variables. These interaction variables allow for the possibility that the effects of the controls on short interest differ across trading venues. To test for significance, *t*-statistics are calculated based on clustered robust standard errors which adjust for within-cluster autocorrelations clustered by firm (Petersen 2007).[14]

Table 6 provides strong evidence of short arbitrage of the accrual anomaly after

[14] As an alternative test, we also applied estimator of Thompson (2006), which allows for clustering by both firm and year (serial correlation and cross-correlation). The results were similar. We also performed tests that omit penny stocks (those with price less than $5). The results were qualitatively similar.

controlling for other anomalies and determinants of short interest. Model 1 includes accruals but not NOA. The coefficient on HighAccrual is 0.578 (t = 7.33). The coefficient on HighAccrual*NYSE is 0.425 (t = 2.11); this indicates that the evidence of short arbitrage of the accrual anomaly is even stronger on NYSE than on NASDAQ. The evidence on the NYSE of short arbitrage of the accrual anomaly is therefore stronger in the multivariate than the marginal evidence from the univariate test, indicating that it is important to control for other determinants of short interest.

It might seem surprising that the multivariate relation between short interest and accruals is not stronger on NASDAQ than on the NYSE, given that in the univariate tests, the spread in mean short interest across accrual deciles was larger and more significant on NASDAQ. However, as discussed earlier, accruals have much a greater dispersion on NASDAQ than on NYSE (Table 4 Panel D). So even if the slope relation between short interest and accruals were slightly weaker on NASDAQ, the much greater variation in accruals on NASDAQ would induce a larger variation in short interest across accrual deciles on NASDAQ than on NYSE.

When HighNOA and HighNOA* NYSE are added to the regression (Model 3), the coefficient on HighAccrual remains almost identical and with similar statistical significance as in Model 1. Thus, there is no indication that the correlation between short interest and accruals derives from NOA. This evidence is consistent with short sellers arbitraging the accrual anomaly itself.

There is also evidence that short sellers arbitrage the NOA anomaly. Model 2 examines the relationship between short interest and NOA, without controlling for Accruals. The coefficient on HighNOA is 0.383 (t = 5.17).[15] The coefficient on the interaction term HighNOA*NYSE is –0.291 (t = –2.46), which is of the opposite sign, indicating that the relation between short interest and NOA on the NYSE is weaker, and an F-test shows that the effect of NOA on short-interest is insignificant on the NYSE. Since NOA contains current period accruals, it is important to control for accruals as well. In Model 3, which adds HighAccrual to the regression, the coefficient on HighNOA declines modestly to 0.331 (t = 4.36), and the NYSE interaction term is again negative (–0.266, t = –2.26). Again, an F-test shows that the effect of NOA on short-interest is insignificant on the NYSE. Thus, in contrast with the strength of the accruals findings on both exchanges, short arbitrage activity of the NOA anomaly seems to be concentrated mainly on NASDAQ.[16]

To assess the quantitative importance of short arbitrage of the accrual anomaly, from Table 6 Model 3 we calculate that holding constant other variables (firm size, trading volume, book-to-market, residual volatility, institutional ownership, return momentum, and NOA), on average the effect of a firm being inside rather than outside the top accrual decile increases short interest increases by 1.005% (among NYSE firms) and 0.551% (among NASDAQ firms). To provide some benchmarks for comparison, the mean (median) short interest in the sample is 1.37% (0.25%), with a standard deviation of 3.34%. Thus, the effect of accruals on short interest is economically important.

Turning to NOA, all else equal, moving from outside the top NOA decile into the top NOA decile is associated with an average increase of 0.331% in short interest for NASDAQ firms. The effect is a more modest 0.065% for NYSE firms.

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[15] When we use continuous measures of accruals and NOA instead of the HighAccrual and HighNOA indicator variables, the evidence of short arbitrage of the accrual anomaly remains strong, but the evidence for NOA becomes much weaker.

[16] Fishman, Hong, and Kubik (2006) discuss features of the trading institutions on the different exchanges which, ceteris paribus, make short-selling easier on NASDAQ than on NYSE.

A natural question is why short-arbitrage on the NOA anomaly, but not the accrual anomaly, is so much more active on NASDAQ than on NYSE. Table 2 provides a clear answer. The hedge return profits available from both the accrual anomaly and the NOA anomaly are stronger on NASDAQ than on NYSE. But the difference is far stronger for NOA than for accruals. The NOA hedge profits are lower than the accrual anomaly on NYSE (45 basis points per month < 57 basis points per month), whereas NOA hedge profits are much stronger than accrual anomaly profits on NASDAQ (174 basis points per month > 99 basis points per month). The accrual anomaly profits are (0.0099/0.0057) – 1 = 74% greater on NASDAQ than on NYSE, whereas the NOA anomaly profits are (0.0174/0.0045) – 1 = 287% greater on NASDAQ than on NYSE. Thus, the incentives for short arbitrage of the NOA anomaly are much stronger on NASDAQ than on NYSE.

Putting together the findings of Sections 4, 5, and 6, our results suggest that for NOA, investor naiveté creates a much stronger pressure for mispricing on NASDAQ than on NYSE. For the accrual anomaly, the fact that the larger firms on NYSE tend to face less severe constraints on short-selling causes short arbitrage to be stronger on NYSE. But for the NOA anomaly, the mispricing pressure on NASDAQ seems to be so much stronger that short arbitrage is higher on NASDAQ. A possible reason for the greater strength of the mispricing pressure on NASDAQ is that these are smaller firms about which less information tends to be available. Since the NOA anomaly is more recently documented than the accrual anomaly and is less well-known, it is plausible that it will be especially pronounced among sets of firms for which poorer information is available.

7. Conclusion

This paper tests the extent to which short-sellers arbitrage the accrual and NOA anomalies. We expect the pressure for mispricing to be greater on NASDAQ than on NYSE, because of the greater uncertainty, greater presence of individual investors, and lower availability of information about NASDAQ firms. More generally, we expect greater pressure for mispricing, which should encourage short arbitrage, among smaller and less familiar firms. On the other hand, NASDAQ firms, or more generally smaller, lower-profile firms, may also experience higher severity of constraints on short-selling that deter short arbitrage, owing to less availability of loanable shares, lower liquidity, and greater disagreement among investors about firm prospects. The balance of these two forces affects the amount of short arbitrage between the two trading venues.

In either case, owing to both greater mispricing pressure and the greater costs and constraints to short-selling on NASDAQ, we expect stronger downside anomalies on NASDAQ than on NYSE. Since long arbitrage of an upside anomaly does not suffer from all the costs and constraints associated with short arbitrage, we also expect greater asymmetry between upside anomalies and downside anomalies on NASDAQ than on NYSE. More generally, we expect the degree of asymmetry and the extent of short arbitrage of anomalies to be related to proxies for mispricing pressure, and proxies for the severity of short sales constraints.

We confirm the accrual anomaly in our sample. Potentially consistent with the idea that NASDAQ firms tend to be harder to sell short (smaller, more volatile, lower supply of loanable shares), we find that the accrual anomaly is asymmetrically stronger on the downside on NASDAQ but not on NYSE. Furthermore, the accrual anomaly is asymmetric only for firms in the lowest decile of institutional holdings—the firms with the lowest supply of loanable shares for short-selling.

Richardson (2003) provides evidence from univariate tests indicating no statistically significant short arbitrage of the operating accrual anomaly among NYSE firms during the 1990-98. We show that over a more extended sample period that includes the high-tech sector bust as well as the preceding boom there is some evidence of short arbitrage of the accrual anomaly even in univariate tests on NYSE. Furthermore, recent research (D'Avolio 2002, Asquith, Pathak, and Ritter 2005, and Nagel 2005) suggests the use of a number of controls for the determinants of short interest, including size, volume, book-to-market, residual standard deviation, and institutional ownership. It is also desirable to control for other known return predictors, such as 12-month return momentum, to evaluate the *incremental* short-selling activity specifically associated with the accrual anomaly. In multivariate tests that include these controls, there is highly significant evidence of short-arbitrage of the accrual anomaly even on the NYSE.

In both univariate and multivariate tests, we find intense short-selling of high-accruals NASDAQ firms. A possible explanation for the greater amount of short arbitrage of the accrual anomaly among NASDAQ firms is that there are greater extremes of misvaluation on NASDAQ. Consistent with this possibility, we document that there is relatively large variation in accruals across NASDAQ firms; the spread between the top and bottom deciles in the level of accruals among NASDAQ firms is much greater than among NYSE firms. This suggests that the mispricing pressure associated with accruals is more severe in NASDAQ firms than in NYSE firms, and that this increases the incentive to engage in short-selling of overvalued NASDAQ firms. Nevertheless, our return evidence suggests that constraints or costs of short-selling (such as limited supply of loanable shares, risk, and illiquidity) are strong enough on NASDAQ to limit arbitrage, creating significant return asymmetry.

Consistent with past literature, the NOA, or balance sheet bloat anomaly is strong. We find that the asymmetry between long- and short-side returns from an NOA-based strategy is even larger on NASDAQ than on NYSE. This finding suggests that mispricing pressure on NASDAQ is intense, and that short arbitrage is imperfect, especially on NASDAQ.

In multivariate tests that include controls for other return predictors, we find economically and statistically significant short arbitrage of the NOA anomaly as well. This arbitrage activity is primarily concentrated on NASDAQ. We argue that this is because the profit opportunities available from arbitraging the NOA anomaly are much stronger on NASDAQ than on NYSE.

Overall, the evidence in this paper paints a picture in which short selling has only a degree of success in eliminating downside return anomalies. For the accrual and NOA anomalies, consistent with greater investor misperceptions inducing greater mispricing pressure among NASDAQ firms, we find that NASDAQ firms experience larger hedge returns than NYSE firms. For the accrual anomaly there is also greater asymmetry between upside and downside return predictability on NASDAQ than on NYSE, but for NOA the asymmetry is similar on the two exchanges. Short arbitrage of the accrual anomaly is greater on NYSE, whereas for the NOA anomaly (which is much stronger among NASDAQ firms) short arbitrage is greater on NASDAQ.

As a policy matter, our findings suggest that trading venues or regulatory policies that allow short selling to be cheaper and less risky can improve market efficiency. The recent relaxation by the Security and Exchange Commission of the “uptick rule” restricting short sales is a possible example (Diether, Lee, and Werner forthcoming, and Jakab 2007). Such improvements may potentially help protect investors from the hazards of trading overpriced stocks.

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Table 1
Description of Sample Statistics

Variable	Pooled Sample		NYSE Sample		NASDAQ Sample		Test for Difference (NYSE – NASDAQ)	
	Mean	Median	Mean	Median	Mean	Median	*t*-statistic	Wilcoxon *Z*
SI (%)	1.37	0.25	**1.63**	**0.54**	1.25	0.15	14.65	54.90
Accruals	–0.06	–0.04	**–0.05**	**–0.04**	–0.06	–0.05	16.32	6.22
NOA	0.56	0.61	**0.63**	**0.67**	0.52	0.56	52.55	49.83
Size ($m)	1,730	127	**4,284**	**794**	526	59	39.99	162.20
BTM	0.64	0.53	**0.56**	0.54	0.67	0.53	–4.93	0.87
Volume	222,343	31,095	**271,212**	**54,928**	199,347	23,813	7.81	50.90
STDRES	0.04	0.03	**0.02**	**0.02**	0.05	0.04	–142.28	–134.54
InstHold (%)	33.22	29.30	**46.97**	**48.66**	26.19	19.95	107.98	100.93
Momentum	0.13	0.03	**0.11**	**0.07**	0.15	0.00	-6.89	16.27
Sample Size	83,127		26,600		56,527			
Period	01/1988 – 12/2003		01/1988 – 06/2002		06/1988 – 12/2003			

Notes:

SI denotes Short Interest level, calculated as the short position four months after the fiscal year end (as reported on NASDAQ or NYSE monthly short interest files) divided by the number of shares outstanding in the same month as reported by CRSP, then multiply by 100 to express as a percentage.

Accruals are calculated as the difference between earnings before extraordinary items (item 123) and cash flows from operations (item 308) as reported on the statement of cash flows. This variable is scaled by average total assets.

NOA denotes Net Operating Assets, calculated as Operating Assets (OA) minus Operating Liabilities (OL), where OA = total assets (item 6) – cash and short investment (item 1), and OL = total assets – debt included in current liabilities (item 34) – long term debt (item 9) – minority interests (item 38) – preferred stocks (item 130) – common equity (item 60). This variable is scaled by average total assets.

Size is market value of equity, calculated as the number of shares outstanding (item 25) multiplied by the fiscal year end price (item 199). The unit is millions of dollars.

BTM denotes Book-to-Market, calculated as the book value of common equity (item 60) divided by **Size**.

Volume is the average daily trading volume as reported on the monthly short interest reports of NASDAQ or NYSE.

STDRES is the standard deviation of the Market Model residuals for daily returns over a one-year window ending one month prior to the month of reported short position.

InstHold denotes Institutional Ownership, calculated as the total number of shares held by institutions divided by the total number of shares outstanding, then multiplied by 100 to express as a percentage.

Momentum is the compounded monthly return for the window (–12, –2) from the short position report month.

Satterthwaite *t*-statistics for the test of difference in means are reported assuming unequal variance. Wilcoxon *Z* statistics are reported for the test of difference in medians. Bolded numbers denote $p < 0.05$.

Table 2
Average Monthly Abnormal Returns for Accruals and NOA Decile Portfolios
One Year after Portfolio Formation

	Accruals			NOA		
Portfolio Ranking	Pooled	NYSE	NASDAQ	Pooled	NYSE	NASDAQ
Lowest	0.0031 (1.87)	**0.0032** (2.64)	0.0019 (1.03)	**0.0050** (4.32)	0.0009 (0.78)	**0.0061** (4.37)
2	**0.0024** (2.86)	0.0015 (1.79)	**0.0028** (2.33)	**0.0039** (5.07)	0.0012 (1.41)	**0.0045** (4.64)
3	**0.0025** (3.22)	0.0004 (0.58)	0.0018 (1.74)	**0.0033** (4.10)	0.0013 (1.69)	**0.0035** (3.79)
4	0.0006 (0.88)	0.0000 (0.02)	**0.0027** (2.14)	**0.0022** (2.98)	**0.0013** (1.99)	**0.0041** (4.40)
5	0.0010 (1.38)	**0.0014** (2.25)	0.0011 (1.02)	**0.0014** (2.02)	0.0012 (1.85)	0.0003 (0.26)
6	0.0005 (0.78)	0.0002 (0.30)	0.0015 (1.49)	0.0002 (0.24)	0.0011 (1.66)	0.0018 (1.79)
7	0.0004 (0.56)	0.0004 (0.50)	0.0006 (0.60)	–0.0006 (–0.88)	–0.0007 (–0.98)	–0.0010 (–1.03)
8	–0.0009 (–1.05)	**–0.0020** (–3.35)	–0.0006 (–0.53)	**–0.0020** (–3.11)	–0.0005 (–0.61)	**–0.0025** (–2.85)
9	**–0.0023** (–2.96)	**–0.0027** (–3.45)	**–0.0038** (–3.96)	**–0.0048** (–5.48)	**–0.0023** (–2.94)	**–0.0055** (–5.16)
Highest	**–0.0074** (–8.48)	**–0.0025** (–2.37)	**–0.0080** (–7.62)	**–0.0086** (–8.58)	**–0.0036** (–3.72)	**–0.0113** (–8.54)
***Hedge* (*L – H*)**	**0.0105** (5.57)	**0.0057** (3.55)	**0.0099** (4.65)	**0.0136** (8.89)	**0.0045** (3.01)	**0.0174** (9.05)
–(*H* + *L*)	**0.0043** (2.26)	–0.0007 (–0.49)	**0.0061** (2.86)	**0.0036** (2.37)	0.0027 (1.83)	**0.0052** (2.71)
Average Number of Stocks Per Month	430	158	272	499	176	323

Notes:

Table 1 notes define Accruals and NOA. Firms are first sorted into decile portfolios according to their values of Accruals or NOA. Decile portfolios are formed monthly based on Accruals or NOA of the previous fiscal year, with a minimum four-month lag between the fiscal year end and the portfolio formation month.

To facilitate comparison, the sample period is from 1988 to 2002 for all cases.

The monthly abnormal return for any individual stock is calculated by subtracting the equal-weighted return of a benchmark portfolio matched by size, book-to-market and momentum from the raw return of the stock. The equal-weighted abnormal return for each portfolio is then averaged across the decile. The hedge portfolio consists of a long position in the lowest ranked portfolio and an offsetting short position in the highest ranked portfolio.

The time series averages of the monthly portfolio returns are reported along with their *t*-statistics over the periods shown. The values reported in parentheses are *t*-statistics based on the time series of the monthly portfolio abnormal stock returns ($N = 180$). Bolded numbers denote $p < 0.05$.

Table 3
Distribution of Average Monthly Abnormal Return Asymmetry
Across Institutional Ownership (IO) Deciles

Panel A: Abnormal return asymmetry based on Accruals decile portfolios

	Lowest IO	2	3	4	5	6	7	8	9	Highest IO
Lowest Accruals	–0.0023 (–0.78)	0.0020 (0.76)	0.0007 (0.30)	–0.0005 (–0.02)	0.0012 (0.60)	0.0013 (0.59)	0.0015 (0.91)	**0.0033** (2.04)	**0.0038** (2.71)	0.0007 (0.61)
Highest Accruals	**–0.0055** (–2.30)	**–0.0058** (–2.96)	–0.0023 (–1.09)	–0.0027 (–1.50)	**–0.0041** (–2.68)	–0.0026 (–1.69)	**–0.0053** (–3.82)	**–0.0036** (–2.22)	–0.0020 (–1.61)	–0.0026 (–1.88)
– (H + L)	**0.0078** (2.05)	0.0038 (1.13)	0.0018 (0.53)	0.0032 (0.93)	0.0029 (1.14)	0.0013 (0.51)	0.0038 (1.72)	0.0003 (0.15)	–0.0018 (–0.95)	0.0019 (1.04)

Panel B: Abnormal return asymmetry based on NOA decile portfolios

	Lowest IO	2	3	4	5	6	7	8	9	Highest IO
Lowest NOA	0.0026 (1.11)	0.0035 (1.90)	**0.0061** (2.96)	**0.0033** (2.07)	0.0025 (1.74)	0.0018 (1.22)	**0.0039** (2.30)	**0.0045** (3.09)	0.0016 (1.18)	0.0015 (1.22)
Highest NOA	**–0.0076** (–2.48)	**–0.0047** (–2.59)	**–0.0047** (–2.97)	**–0.0083** (–5.57)	**–0.0035** (–2.30)	–0.0019 (–1.45)	**–0.0032** (–2.59)	**–0.0062** (–4.90)	**–0.0048** (–4.10)	**–0.0044** (–3.75)
– (H + L)	0.0050 (1.28)	0.0012 (0.47)	–0.0014 (–0.53)	**0.0050** (2.29)	0.0010 (0.48)	0.0001 (0.02)	–0.0007 (–0.30)	0.0017 (0.84)	0.0032 (1.77)	0.0029 (1.75)

Notes:

Table 1 notes define Accruals, NOA and InstHold. Table 2 notes define portfolio formation process and abnormal return calculation methods. The sample period is from June 1988 to December 2002.

The time series averages of the monthly portfolio abnormal returns are reported. The values reported in parentheses are t-statistics based on the time series of the monthly portfolio abnormal stock returns (N = 175). Bolded numbers denote $p < 0.05$.

Table 4
Univariate Analysis of Short Interest Positions across Accrual Portfolios

***Panel A**: Pooled Analysis of Short Interest Positions across **Accrual Portfolios** (1988-2003)*

Portfolio	Accruals	SI	NOA	lnSize	BTM	lnVolume	STDRES	InstHold	Momentum
Lowest	–0.37	1.37	0.45	3.55	0.33	10.22	0.06	21.76	–0.01
2	–0.15	1.32	0.56	4.37	0.69	10.18	0.05	30.89	0.10
9	0.04	1.51	0.60	4.64	0.63	10.12	0.04	33.04	0.15
Highest	0.17	1.86	0.63	4.12	0.57	10.18	0.04	25.83	0.20
H – L	**0.54** (24.69)	**0.49** (2.27)	**0.18** (8.28)	**0.56** (2.31)	**0.24** (2.73)	–0.03 (–0.11)	**–0.02** (–5.86)	**4.07** (2.33)	**0.21** (2.34)

***Panel B**: Analysis of **NYSE** Short Interest Positions across **Accrual Portfolios** (1988-2002)*

Portfolio	Accruals	SI	NOA	lnSize	BTM	lnVolume	STDRES	InstHold	Momentum
Lowest	–0.21	1.90	0.56	5.87	–0.11	10.62	0.03	42.32	0.04
2	–0.10	1.64	0.64	6.69	0.58	10.77	0.02	47.65	0.13
9	0.01	1.61	0.63	6.59	0.64	10.54	0.02	47.18	0.11
Highest	0.09	2.30	0.67	6.11	0.56	10.46	0.02	45.12	0.11
H – L	**0.30** (43.86)	0.40 (1.80)	**0.10** (7.28)	0.24 (1.19)	**0.67** (3.46)	–0.16 (–0.31)	**–0.01** (–3.86)	2.80 (1.34)	0.07 (1.61)

***Panel C**: Analysis of **NASDAQ** Short Interest Positions across **Accrual Portfolios** (1988-2003)*

Portfolio	Accruals	SI	NOA	lnSize	BTM	lnVolume	STDRES	InstHold	Momentum
Lowest	–0.43	1.26	0.43	3.14	0.46	10.16	0.07	17.14	–0.03
2	–0.17	1.18	0.53	3.67	0.74	9.98	0.05	23.74	0.12
9	0.06	1.41	0.59	3.99	0.63	10.00	0.04	26.74	0.18
Highest	0.20	1.79	0.62	3.82	0.55	10.15	0.05	21.88	0.23
H – L	**0.63** (22.72)	**0.53** (2.40)	**0.19** (8.02)	**0.68** (2.64)	0.09 (0.68)	–0.01 (–0.03)	**–0.02** (–6.84)	**4.74** (2.71)	**0.26** (2.58)

***Panel D**: Comparison of **Mean Accruals Spread** across NYSE and NASDAQ firm-years (1988-2002)*

	Lowest Decile	Highest Decile	Difference (H – L)
NYSE (1)	–0.21	0.09	0.30
NASDAQ (2)	–0.42	0.21	0.63
Difference (2) – (1)	**–0.21** (–7.85)	**0.12** (11.38)	**0.34** (16.45)

Notes:
Observations with missing Accruals are excluded. The pooled sample in Panel A has 73,014 firm-year observations. The sample size is 23,967 for Panel B, 49,047 for Panel C and 70,337 for Panel D. For each panel, observations are ranked annually and sorted into accruals deciles. Each year cross-sectional means of accruals are computed for each decile. The time series means and *t*-statistics are reported. See Table 1 notes for variable definitions. LnSize is the logarithm of Size. LnVolume is log (1 + Volume). Bolded numbers denote $p < 0.05$.

Table 5
Univariate Analysis of Short Interest Positions across NOA Portfolios

***Panel A**: Pooled Analysis of Short Interest Positions across **NOA** Portfolios (1988-2003)*

Portfolio	NOA	SI	Accruals	lnSize	BTM	lnVolume	STDRES	InstHold	Momentum
Lowest	0.01	1.30	–0.12	4.61	0.19	9.92	0.04	25.42	0.18
2	0.22	1.24	–0.09	4.67	0.59	9.97	0.04	28.25	0.17
9	0.84	1.28	–0.03	4.74	0.82	9.94	0.04	32.49	0.08
Highest	1.00	1.49	–0.02	4.76	0.78	10.03	0.03	31.67	0.09
H – L	**0.98** (63.47)	0.19 (0.93)	**0.10** (10.03)	0.15 (0.65)	**0.59** (4.16)	0.11 (0.38)	**–0.01** (–2.62)	**6.25** (3.23)	–0.09 (–1.27)

***Panel B**: Analysis of **NYSE** Short Interest Positions across **NOA** Portfolios (1988-2002)*

Portfolio	NOA	SI	Accruals	lnSize	BTM	lnVolume	STDRES	InstHold	Momentum
Lowest	0.07	1.72	–0.07	6.74	–0.27	10.35	0.03	42.50	0.12
2	0.36	1.73	–0.06	6.84	0.48	10.71	0.02	47.22	0.13
9	0.86	1.53	–0.04	6.30	0.77	10.37	0.02	43.04	0.07
Highest	1.01	1.41	–0.02	6.16	0.75	10.24	0.02	41.55	0.11
H – L	**0.94** (42.58)	–0.31 (–1.89)	**0.05** (6.35)	**–0.58** (–2.95)	**1.02** (3.45)	–0.11 (–0.24)	**–0.01** (–2.92)	–0.95 (–0.53)	–0.01 (–0.24)

***Panel C**: Analysis of **NASDAQ** Short Interest Positions across **NOA** Portfolios (1988-2003)*

Portfolio	NOA	SI	Accruals	lnSize	BTM	lnVolume	STDRES	InstHold	Momentum
Lowest	0.00	1.19	–0.13	4.12	0.34	9.88	0.04	21.25	0.22
2	0.19	1.11	–0.10	4.09	0.61	9.73	0.04	22.60	0.17
9	0.83	1.07	–0.03	3.88	0.83	9.64	0.04	25.95	0.10
Highest	0.99	1.46	–0.02	4.01	0.79	9.88	0.04	25.18	0.09
H – L	**0.99** (66.34)	0.27 (1.20)	**0.11** (9.07)	–0.11 (–0.48)	**0.45** (2.56)	–0.00 (–0.02)	–0.00 (–0.52)	3.93 (1.88)	–0.13 (–1.40)

***Panel D**: Comparison of **Mean NOA Spreads** across NYSE and NASDAQ firm-years (1988-2002)*

	Lowest Decile	Highest Decile	Difference (H – L)
NYSE (1)	0.07	1.01	0.94
NASDAQ (2)	0.01	1.00	0.99
Difference (2) – (1)	**–0.06** (–4.33)	–0.01 (–0.64)	**0.05** (2.49)

Notes:
Observations with missing NOA are excluded. The pooled sample in Panel A has 73,014 firm-year observations. The sample size is 26,520 for Panel B, 56,290 for Panel C and 79,763 for Panel D. For each panel, observations are ranked annually by calendar year and sorted into NOA deciles. Each year the cross-sectional means of NOA are computed for each decile. The time series means and *t*-statistics are reported in all panels. See Table 1 and Table 3 for variable definitions. Bolded numbers indicate $p < 0.05$.

Table 6
Multivariate Regression of Short Interest on Accounting Predictors

	Model 1	Model 2	Model 3
HighAccrual	**0.578**		**0.551**
	(7.33)		(7.04)
HighAccrual*NYSE	**0.425**		**0.454**
	(2.11)		(2.26)
HighNOA		**0.383**	**0.331**
		(5.17)	(4.36)
HighNOA*NYSE		**–0.291**	**–0.266**
		(–2.46)	(–2.26)
lnSize	**0.252**	**0.200**	**0.251**
	(8.43)	(7.63)	(8.41)
lnSize*NYSE	**–0.268**	**–0.189**	**–0.265**
	(–5.18)	(–3.86)	(–5.13)
lnVolume	**0.387**	**0.364**	**0.386**
	(20.02)	(20.96)	(19.99)
lnVolume*NYSE	**–0.114**	**–0.115**	**–0.114**
	(–3.43)	(–3.66)	(–3.45)
BTM	**–0.267**	**–0.303**	**–0.271**
	(–7.34)	(–8.80)	(–7.47)
BTM*NYSE	0.029	0.067	0.032
	(0.28)	(0.70)	(0.31)
STDRES	**12.552**	**12.327**	**12.926**
	(11.21)	(12.23)	(11.59)
STDRES*NYSE	**28.171**	**29.721**	**28.048**
	(7.31)	(7.87)	(7.19)
InstHold	**0.019**	**0.020**	**0.019**
	(9.83)	(11.58)	(9.92)
InstHold*NYSE	**–0.007**	**–0.009**	**–0.007**
	(–2.65)	(–3.50)	(–2.68)
Momentum	**–0.164**	**–0.154**	**–0.162**
	(–6.25)	(–6.13)	(–6.16)
Momentum*NYSE	0.106	**0.156**	0.104
	(1.34)	(1.99)	(1.31)
Intercept	**–4.586**	**–4.100**	**–4.629**
	(–26.38)	(–27.45)	(–26.61)
NYSE	**2.013**	**1.661**	**2.038**
	6.55	5.74	6.56
Sample Size	52,517	59,786	52,511
Adjusted R^2	0.147	0.139	0.147

Notes:

The dependent variable is short interest level (SI). Sample observations are ranked annually by calendar year and sorted into Accruals and NOA deciles respectively. HighAccrual is a dummy variable takes value 1 if the firm-year ranks among the highest Accruals decile, 0 otherwise. HighNOA is a dummy variable takes value 1 if the firm-year ranks among the highest NOA decile, 0 otherwise. NYSE is a dummy variable equal to 1 if the firm is listed on NYSE, 0 if listed on NASDAQ. Table 1 notes define all other variables. All independent variables are winsorized at top and bottom 1%. The results remain qualitatively the same without winsorization.

$$\begin{aligned}\text{Short Interest} = {} & b_0 + b_1\,\text{HighAccrual} + b_2\,\text{HighAccrual*NYSE} + b_3\,\text{HighNOA} + b_4\,\text{HighNOA*NYSE} \\ & + b_5\,\text{lnSize} + b_6\,\text{lnSize*NYSE} + b_7\,\text{lnVolume} + b_8\,\text{lnVolume*NYSE} \\ & + b_9\,\text{BTM} + b_{10}\,\text{BTM*NYSE} + b_{11}\,\text{STDRES} + b_{12}\,\text{STDRES* NYSE} \\ & + b_{13}\,\text{InstHold} + b_{14}\,\text{InstHold*NYSE} + b_{15}\,\text{Momentum} + b_{16}\,\text{Momentum*NYSE} \\ & + b_{17}\,\text{NYSE}\end{aligned}$$

For all models in Table 6, if applicable, b_1 denotes the regression coefficient of HighAccrual, b_2 denotes the regression coefficient of HighAccrual*NYSE, b_3 denotes the regression coefficient of HighNOA, b_4 denotes the regression coefficient of HighNOA*NYSE, and so on, as illustrated in the equation above.

In Model 1, the F test rejects H0: $b_1 + b_2 = 0$ ($p = 0.00$).
In Model 2, the F test fails to reject H0: $b_3 + b_4 = 0$ ($p = 0.31$).
In Model 3, the F test rejects H0: $b_1 + b_2 = 0$ ($p = 0.00$), but fails to reject H0: $b_3 + b_4 = 0$ ($p = 0.46$).

The reported *t*-statistics are computed based on clustered standard errors robust to heteroskedasticity and within-cluster residual autocorrelations (clustered by firm). Year fixed effects are controlled in all regressions. Bolded coefficients in all models denote statistical significance at the 5% level (two-tailed test).