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We find a positive association between short-selling and accruals during 1988-2003. Short arbitrage occurs primarily among firms in the top accrual decile, and firms with sufficiently high supply of loanable shares (proxied by institutional holdings). Consistent with limits to short arbitrage, there is an asymmetry between the up- and down- sides of the accrual anomaly. Asymmetry is only present on NASDAQ, and is significantly stronger among firms with low institutional holdings, low liquidity (turnover and size), and high residual volatility. Thus, there is short arbitrage of the accrual anomaly, but short sale constraints limit its effectiveness.

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

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1. Introduction

Recently market upheavals have led to increased scrutiny and regulation of short-selling. Opponents argue that market manipulation by short sellers distorts prices. Concerns about this possibility motivated the U.S. Securities and Exchange Commission to make short selling harder by banning certain methods of doing so for a selected list of firms.[1] On the other hand, defenders of short selling argue that short-sellers help prevent firms from becoming highly overvalued (a situation which can result in market crashes).

We test here whether short-arbitrageurs respond to firm overvaluation, and whether they succeed in correcting it, by measuring the effect on short selling of a proxy for market misvaluation, accruals. We further test whether constraints on short arbitrage exacerbate the accrual anomaly.

Accounting adjustments to earnings, as reflected in a firm's operating accruals, are strong and robust negative predictors of future abnormal stock returns.[2] Indeed, Fama and French (2007) identify the accrual anomaly as among the most pervasive and robust of the well-known financial anomalies. Several authors suggest that the accrual anomaly derives from investor naiveté (e.g., Sloan 1996). Under this hypothesis, high accruals cause overvaluation, and subsequent low abnormal returns when this overvaluation is corrected. Indeed, market inefficiency is the predominant interpretation of the accrual anomaly.[3] Two natural questions

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[1] These changes were motivated by recent upheavals in mortgage markets, which have led to dramatic drops in the stock prices of private Government Sponsored Enterprises (Fannie Mae and Freddie Mac) as well as those of important financial firms (K. Scannell and J. Strasburg, *Wall Street Journal*, p. A1, July 16, 2008).

[2] Operating accruals (Sloan 1996) are negative predictors of future returns, as are various accrual components (e.g. operating, investing, and financing accruals; Richardson, Sloan, Soliman, and Tuna 2005), and more inclusive variables that contain accruals (Fairfield, Whisenant, and Yohn 2003; Hirshleifer, Hou, Teoh, and Zhang 2004).

[3] 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). 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

raised by this evidence are whether arbitrageurs recognize the anomaly and trade to profit from it; 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 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 short arbitrage can explain why several stock return anomalies are stronger on the short side (predictable negative returns) than on the long side (predictable positive returns).[4] We therefore argue that asymmetry in return predictability (defined as a difference in the absolute values of top decile and bottom decile returns) is an indicator of the relative effectiveness of short versus long arbitrage.

Thus, this paper has two main goals: to test whether investors engage in short arbitrage of the accrual anomaly, and to use asymmetry in return predictability to test whether short arbitrage activity succeeds in constraining mispricing. In addition, we test reasonable predictions about the comparative statics of short arbitrage: whether firm and market characteristics that proxy for mispricing pressure and costs of or barriers to short selling affect the extent of short arbitrage and the degree of return asymmetry in the predicted fashion.

If sophisticated investors engage in short arbitrage of overpriced stocks, then their trades should increase short interest when forecasting variables such as accruals predict lower returns, i.e., when accruals are high. Furthermore, if short arbitrage operates effectively, we expect to see

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use of information contained in accruals (Bradshaw, Richardson, and Sloan 2001). Polk and Sapienza (2009) use an accruals-based variable as a proxy for mispricing to test its effects on corporate investment.

[4] 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. Using several kinds of tests, Bris, Goetzmann, and Zhu (2007) find that downward price discovery is inhibited in countries where short sales are not allowed or not practiced, and that prices incorporated negative information faster in five countries after they removed short sale restrictions. Greenwood (2009) finds that special selling restrictions in Japan associated with stock splits lead to very high returns that reverse when the restrictions are relaxed.

a relatively low asymmetry in the magnitude of abnormal returns between the downside of the anomaly (e.g., when accruals are high) and the upside of the anomaly (when accruals are low), as compared to a market where short arbitrage is much more constrained than long arbitrage.

A recent set of papers suggest a rich array of determinants of short selling, including size, share turnover, book-to-market, residual standard deviation, and institutional ownership (Asquith, Pathak, and Ritter 2005, Nagel 2005, D'Avolio 2002). The motivation for these variables is discussed in Section 2. To provide sharper tests of the determinants and effects of short arbitrage, we exploit these variables either as controls or as parameters to vary for comparative statics tests. Ali and Trombley (2006) further verify the importance of several of these variables as determinants of short selling.

Past literature has provided little evidence that investors use short sales to arbitrage the accrual anomaly. 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). Richardson (2003) suggests that short sellers may be ignoring valuable information. For a sample of 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). A sample that is post-selected based on later events can provide insight about whether short sellers use accrual information to predict future events, but does not provide a test (nor do the authors claim it tests) of whether short sellers arbitrage the accrual anomaly.

There are several other key differences between our tests and those in past research. We systematically examine arbitrage of the accrual anomalies in a general sample that includes both NASDAQ and NYSE firms and a 16-year (1988-2003) time period instead of the 6 to 9-year time periods and/or post-selected samples of exceptional firms used in other recent work. It is useful to include smaller NASDAQ firms which are informationally more opaque, since this is where we expect to see more mispricing and higher costs of short arbitrage. Furthermore, we find that the spread in accruals between the top and bottom accrual deciles among NASDAQ firms is more than 110% higher than among NYSE firms. This suggests a much greater range of investor misperceptions on NASDAQ. It is informative to include a longer time period that includes not only the great bull market of the 1990's, but the high-tech stock market crash of 2000-2002 and the earlier (late 1980s) recession. In contrast with other recent work, we include an extensive set of test controls. This is crucial for testing whether there is short arbitrage of the accrual anomaly, as contrasted with short selling in response to other known determinants of short interest, or short arbitrage against some other anomaly variable such as book-to-market or momentum that happens to be correlated with accruals.

Perhaps most importantly, we exploit proxies for market liquidity and the ease of borrowing the stock to test the comparative statics of short arbitrage. We test whether greater ease of short-selling encourages greater short arbitrage. We also test whether greater ease and lower risk of undertaking short arbitrage strategies makes it more effective, in the sense of reducing the asymmetry between the upside versus the downside of the accrual anomaly.

It is important to perform comparative statics tests to verify whether the link between accruals and short-interest is causal, rather than a consequence of model misspecification such as a correlated omitted variable. Our comparative statics tests are also crucial for assessing whether any measured return asymmetry is caused by constraints on short arbitrage rather than other causes.

In sharp contrast with previous findings, we find strong evidence of short arbitrage of the accrual anomaly. In univariate tests we find that high-accrual firms have higher short interest. Evidence of short arbitrage activity is mainly confined to the top accruals decile. The effect is stronger among NASDAQ firms, for which the mean short interest in the highest accrual decile is over 40% higher than the mean short interest of the lowest accrual decile. But even among NYSE firms (which more closely match the Richardson (2003) sample) there is some evidence of higher short-selling of high-accrual firms (significant at the 10% level). Furthermore, we find that firms that move into the top accrual decile experience increases in short interest relative to the preceding year.

However, it is crucial in testing for short arbitrage of an anomaly to include controls, since the anomaly variable (accruals) is likely to be correlated with other predictors of abnormal returns (such as book-to-market, and momentum) that investors might be arbitraging, and other determinants of short interest such as size, share turnover, and institutional ownership. One way to control for firm fixed effects is to perform an analysis in changes. We find that when firms move into the top accrual decile from one year to the next, there is a significant increase in short interest relative to the preceding year (even among NYSE firms). More importantly, in multivariate tests that include appropriate controls, we find a significant positive relationship between accruals and short interest. Furthermore, we document a significant positive interaction effect between accruals and institutional holdings, suggesting that when shares are easier to borrow, there is more short arbitrage of the accrual anomaly.

We also test the *effectiveness* of short arbitrage in attenuating the short side of the accrual anomaly. Return asymmetry in the accrual anomaly can arise from the extent of constraints on short-selling and with mispricing pressure. Previous literature suggests that institutions are the main lenders of stock for short selling, so that institutional ownership is a key measure of the ease of borrowing stock. We find a significant negative relationship between abnormal return asymmetry and institutional ownership (a proxy for the amount of loanable shares), after controlling for proxies for liquidity (which affects the ease of short-selling and the risk of short squeezes), residual volatility (which makes short-selling riskier), and mispricing pressure (which can overwhelm the arbitrage capital of investors who are willing to sell short).

The liquidity tests provide further confirmation that greater ease of short arbitrage reduces asymmetry. We find that liquidity as proxied by Size and Turnover is negatively related to return asymmetry. The standard deviation of market model residuals (STDRES), as a proxy for disagreement and risk, can capture the degree to which the capital of short arbitrageurs can be overwhelmed by mispricing pressure. Consistent with this hypothesis, we find that higher STDRES is also associated with greater return asymmetry.

There is also much greater hedge returns and asymmetry of returns from the accrual anomaly among NASDAQ than NYSE firms. The greater hedge returns on NASDAQ come mainly from much greater abnormal returns from shorting high-accrual NASDAQ firms (80 basis points per month, $t = 7.62$) than from shorting high-accrual NYSE firms (25 basis points per month, $t = 2.37$). On NASDAQ accrual-strategy abnormal profits are highly asymmetric, with no significant long-side gains from holding firms in the lowest accrual decile. In contrast, on NYSE profits are basically symmetric between the long and short sides. These findings suggest that on average short arbitrage may be more costly, difficult, or risky among NASDAQ firms than among NYSE firms.

Overall, our findings on differences across exchanges suggest that limited information, limited liquidity, and more extreme accruals contribute to greater misvaluation among NASDAQ firms, that this greater misvaluation induces greater short-selling of overpriced firms, but that such short arbitrage is severely constrained by risk, illiquidity, and especially the supply of loanable shares, so that the downside anomaly remains stronger among NASDAQ firms.

There has been other recent research that takes 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-market (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.

This paper differs from Dechow et al. (2001) in several ways. Our paper tests for short arbitrage of the accrual anomaly, which is predominantly viewed in the literature as a market inefficiency. In contrast, there is a great deal of controversy over whether the value effect (e.g., the book-to-market anomaly) reflects mispricing or rational risk premia.[5] So in our paper it is relatively clear-cut that the short interest tests are actually about the arbitrage of mispricing. Our paper includes a rich set of further control variables (including book-to-market) suggested by recent literature on short interest and on the predictability of returns, which helps ensure that the short-selling patterns we identify relationship are coming from short arbitrage of the accrual anomaly rather than an accidental correlation. We go further to identify whether the correlation between the anomaly variable (accruals in our case) with short interest come from a causal relationship, by testing whether the relation is stronger in firms for which it is easier to borrow stock (as proxied by institutional holdings). Finally, we test the effectiveness of short arbitrage

[5] As documented by Fama and French (1993), there is comovement associated with portfolios formed based upon book-to-market. The 3-factor model explains much of the ability of book-to-market to predict the cross-section of returns. This is consistent with a rational factor pricing model, although there has been further debate associated with more stringent tests (Daniel and Titman 1996) and with the attempt to link the book-to-market characteristic to economic fundamentals (Griffin and Lemmon 2002).

by examining how constraints on arbitrage and the intensity of mispricing pressure affect the asymmetry of abnormal returns. To our knowledge, our study is the first to perform such a test.

2. Information Environments, Investor Misperceptions, and Short Sale Constraints

Short arbitrage of overpriced stocks can be viewed as a response by sophisticated investors to overoptimistic beliefs of naive investors.[6] In order to sell short, an investor must borrow shares from an investor who owns them and is willing to lend. The short seller typically leaves 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.

[6]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, Diether, Lee, and Werner 2009a). 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.

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: lower availability of credible public information, smaller relatively holdings by institutional (presumably more sophisticated) investors, possible lower quality of earnings, and greater variability in the accrual variable that drives mispricing. The constraints, costs, and risks of arbitrage (and especially short arbitrage) are likely to be higher among NASDAQ stocks than among NYSE stocks owing to greater volatility and lower liquidity, lower institutional holdings (and therefore fewer shares available for borrowing, Asquith, Pathak, and Ritter 2005, Nagel 2005), and greater risk of a short squeeze.[7]

We expect short arbitrage to be more active when there is an ample supply of loanable shares. Several authors document that institutional owners provide the main loan supply of stock, and consequently, the level of institutional ownership is a key proxy for ease of short selling (Asquith, Pathak, and Ritter 2005, Nagel 2005). Furthermore, we expect liquidity, as proxied by

[7] 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 large differences between the kinds of firms that trade on the different trading venues.

size and share turnover, to encourage short-selling by reducing the risk of short squeezes.

We expect greater investor disagreement about a stock to be associated with higher short interest (see, e.g., D'Avolio 2002), regardless of whether there is short arbitrage of the accrual anomaly; we use residual standard deviation, and book-to-market (since there is likely to be more disagreement about growth firms than mature firms) to control for differences in investor disagreement.

Institutional holdings, liquidity variables, and residual standard deviation, also provide means of testing comparative statics effects on the *effectiveness* of short arbitrage. Since institutional investors in a stock provide the supply of loanable shares, we expect high institutional holdings to be associated with lower return asymmetry. Since high liquidity reduces the risk of short squeezes, we also expect high Turnover and Size to be associated with lower return asymmetry.

With respect to residual standard deviation, in general we expect stronger mispricing pressure can temporarily overwhelm the capital of arbitrageurs. This will especially be the case when arbitrage is riskier. The set of investors willing to engage in short selling is relatively limited, so that it is easier to overwhelm short arbitrage capital than long capital. Residual standard deviation proxies for investor disagreement, which in turn may be associated with market misperceptions. Residual standard deviation is also a proxy for risk of arbitrage. For both reasons, we predict high residual standard deviation to be associated with greater asymmetry in the accrual anomaly.

3. Data Description

3.1 Sample Characteristics and Variable Measurement

Sample Characteristics

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.[8] 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.

NASDAQ indicates that member firms are required to report their short positions in all accounts in shares, warrants, units, ADRs, and convertible preferred stocks resulting. 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 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.[9] We end up with a maximum of 56,527 firm-year observations for the NASDAQ sample and 26,600 firm-year observations for

[8] NASDAQ indicates that the February and July 1990 data are missing from their database.
[9] 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.

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, Pathak, and Ritter (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.[10] The four-month gap between the fiscal year end and the short position is to ensure that the short–sellers have the accounting information available to them prior to taking short positions. [11]

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:

$$\textit{Operating Accruals} = (\textit{Earnings} - \textit{CFO}) / \textit{Average Total Assets}$$

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) and then assign them in equal numbers into ten portfolios. High decile portfolios contain firms

[10] 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.
[11] 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.

with the highest accounting screen and Low portfolios contain firms with the lowest accounting screen.

Table 1 reports the variable statistics for the pooled sample and for the NYSE and NASDAQ subsamples. The mean (median) short interest (SI) in the pooled sample is 1.37% (0.25%). The mean (median) level of Accruals in the pooled sample is 0.06 (0.04). On average, NASDAQ firms have more negative operating accruals than NYSE firms. The means and medians 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.[12]

4. The Accrual Anomaly: Existence and Asymmetry

Before testing directly whether short-sellers trade to exploit the accrual anomaly, it is important first to verify whether it is present during our sample period. Furthermore, we perform return tests of 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 are high to be much larger in absolute value than the positive mean abnormal returns after accruals are low. To provide a sharper test, we then examine how return asymmetry varies with a proxy for the ease of borrowing shares for short-selling.

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[12] This may reflect that, in general, the shares of NYSE firms are easier and less risky to sell short than those of NASDAQ firms. Compared to NYSE firms, NASDAQ firms in our sample have smaller market capitalizations and 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). Although NASDAQ firms have a higher monthly share turnover ratio (possibly due to individual investors having a greater desire to speculate in small stocks), their monthly trading volume (not reported) is lower. Institutional holdings are also lower for NASDAQ than NYSE firms, and residual standard deviation is higher for NASDAQ than NYSE firms. However, caution is needed in interpreting the univariate results because several correlated variables change simultaneously when we compare across exchanges.

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.[13] 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 ($t = 5.57$). This is actually stronger than both the spread on the NYSE of 57

[13] We provide results separated by exchange to capture several possible effects, and for comparison with past work that has sometimes focused on specific exchanges. If there is lower investor sophistication among NASDAQ than NYSE firms, and higher costs of arbitrage, then we expect greater misvaluation, and therefore stronger return anomalies. Furthermore, since short arbitrage is more constrained than long arbitrage and this difference is especially strong among NASDAQ firms, there should be greater asymmetry between the upside of return anomalies (exploitable by taking long positions) and the downside (exploitable by short selling) among NASDAQ firms.

basis points per month ($t = 3.55$), and on NASDAQ of 99 basis points per month ($t = 4.65$).[14,15] 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 high-tech boom and crash, so we also examine the return spreads from 1988-1998 and 1999-2002 sub-periods (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 NASDAQ firms than among NYSE firms since, as shown in Table 4, the dispersion of accruals is greater among NASDAQ firms. Panel B 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

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[14] Looking across accrual deciles, the pattern is not perfectly monotonic, but the trend in returns is clearly declining as Accruals increases.

[15] 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.

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 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.

However, short sale constraints are not the only possible source of return asymmetry. To identify the source more sharply, we examine the relation of asymmetry to constraints on short selling. As discussed in the introduction, past research has shown that greater institutional shareholding encourages short selling, because institutional investors are more likely to lend shares. Greater ease of short arbitrage should, in equilibrium, reduce the return asymmetry associated with an anomaly.

Table 3 examines the determinants of the abnormal return asymmetry in the accrual anomaly. Each month, firms are first sorted into decile portfolios according to the value of Accruals in the previous fiscal year. We then separately rank the firms within the highest accrual decile (denoted by H) and the lowest accrual decile (denoted by L) according to the level of institutional ownership. We then form 2-firm portfolios by selecting one firm from the highest accrual decile (denote it H) and the other firm from the lowest accrual decile (denote it L), matching by their institutional ownership ranks within their Accrual decile portfolios. Abnormal Return Asymmetry is defined as the difference between the monthly abnormal return of shorting H and that of longing L.[16] We then examine how it is associated with institutional ownership and other possible constraints on short selling.

The relationship between institutional ownership (IO) and the ease of short selling is likely to be nonlinear. Once the number of shares available for borrowing reaches a sufficient level, IO is likely to be less of a binding constraint for short selling. We allow for non-linearity in alternative ways. In Model 1, a log transformation of IO is used, while in Models 2 and 3, a dummy variable (LowIO) is constructed based upon whether institutional ownership exceeds 5% (Model 2) or the firm-month falls within the lowest IO decile (Model 3).

For all three model specifications, we find low institutional ownership is strongly associated with greater abnormal return asymmetry, after controlling for liquidity measures

[16] A different possible definition of asymmetry would be the difference in differences between H – M (where M is the return on the middle two deciles) and M – L. Since (M – L) – (H – M) = – (H + L) + 2M, this definition is very similar to our – (H + L) measure. Since we expect the effect of short selling or short selling constraints to be primarily on the H portfolio, the – (H + L) measure seems more parsimonious.

(Size, Turnover) that may be related to the ease of short-selling, firm growth/valuation (BTM), and the standard deviation of market model residuals (STDRES), a measure of potential investor disagreement. The results are statistically significant, and of substantial economic magnitude. Specifically, Model 2 shows that when institutional ownership falls from above 5% to below 5%, there is on average a 2.2% per month (26.4% annualized) increase in abnormal return asymmetry. This evidence indicates that short arbitrage of the accrual anomaly is more limited among firms with low institutional holdings.

We also expect liquidity and investor disagreement to affect the effectiveness of short arbitrage. *Ceteris paribus*, illiquid firms (those with small size and low share turnover) have higher risk of short squeezes, which discourages short arbitrage and consequently should lead to greater return asymmetry. We find strong empirical support for this prediction: both Size and Turnover are significantly negatively associated with return asymmetry. For example, in Model 2, the coefficients on lnSize and Turnover are –0.0051 (t = –3.06) and –0.1104 (t = –8.44), respectively. Since the interquartile range (IQR) is 2.28 for lnSize and 0.02 for Turnover, these estimates show that as lnSize (Turnover) increases from the 25th percentile to the 75th percentile, there is on average a 1.16% (2.22%) per month decrease in abnormal return asymmetry. This evidence highlights the importance of liquidity in improving the effectiveness of short arbitrage.

Furthermore, we hypothesize that firms with higher residual volatility (STDRES) are riskier to arbitrage, and that greater investor disagreement (also proxied by STDRES) tend to be have stronger mispricing pressure, which can exhaust the market's capacity for short-arbitrage. For both reasons, we predict STDRES to be associated with abnormal return asymmetry in the accrual anomaly. Consistent with this prediction, we find the coefficient on STDRES is significantly positive in all three models (in Model 2, for example, b = 0.3858, t = 2.89). With an interquartile range of 0.024, this estimate implies an average increase of 0.93% (11.16% annualized) in abnormal return asymmetry when residual volatility increases from the 25th percentile to the 75th percentile. Similarly, we find that book-to-market ratio (BTM) is negatively associated with abnormal return asymmetry (b = –0.0049, t = –1.69 in Model 2), possibly because investors are likely to have more disagreement about growth firms than mature firms.

5. The Relationship Between Short Interest and Accruals: 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). Subsection 5.2 discusses how the availability of loanable shares affects the extent of short arbitrage. Subsection 5.3 examines the relation of changes in Accrual to changes in short interest.

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 NYSE firms from 1988 to 2002, for NASDAQ firms from 1988 to 2003 and for the pooled sample.[17]

For convenient comparison with previous research, we begin with the analysis by trading venue. In our longer sample period, there is 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.[18] As we will discuss below, more powerful multivariate tests more strongly confirm short arbitrage even among NYSE firms.

Panel A also 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% 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.

Returning to 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 above 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?

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[17] The sample periods are the maximum for which we have short interest data from the exchanges. The qualitative results are similar for median changes.
[18] 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.

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.

Specifically, on NASDAQ accruals have much higher dispersion on NASDAQ than on NYSE. Table 4 Panel B 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).

If there are fixed costs of short arbitrage strategies, such as the costs of identifying appropriate positions to take, then we expect short interest to be concentrated among the most overpriced stocks. Consistent with this, in Table 4 short interest is substantially concentrated in the top accrual decile (Decile 10). In the pooled analysis and in the NASDAQ subsample, a 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 comparing Decile 10 with Decile 1. (For the NYSE subsample, the 10 – 9 decile difference is actually larger than the 10 – 1 difference, though not significantly so.)

5.2 The Effect of Institutional Holdings on Short Arbitrage of the Accrual Anomaly

As discussed earlier, institutional holdings is a key indicator of the supply of loanable shares. We therefore expect stronger short arbitrage of the accrual anomaly among firms with high institutional holdings. The multivariate analysis of Section 6 explicitly tests for this possibility. But even without including a full set of controls, we can see some signs of this effect.

Table 5 shows that among firms in the lowest institutional ownership decile, the mean difference in short interest between the highest Accrual decile portfolio and the lowest Accrual decile portfolio is an insignificant –0.010 (t = –0.92), whereas in the highest institutional ownership decile the mean difference in short interest between the highest Accrual decile portfolio and the lowest Accrual decile portfolio is a substantial 1.976 (t = 5.79). The difference in differences between the highest and lowest institutional ownership deciles is also a large and significant 1.986 (t = 6.12).

The differences in short interest between the highest versus lowest accrual decile portfolios across high versus low institutional holding are very highly significant. These findings suggest that it is important in multivariate tests of short arbitrage to allow for an interaction of accruals with institutional holdings.

5.3 The Effect of Changes in Accruals

As discussed earlier, short interest is likely to be influenced by variables other than accruals, 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. Table 6 provides evidence that increases over time in accruals are associated with increases in short interest.

In the pooled sample, a move into the highest Accruals decile relative to the preceding year is associated with an average increase in short interest of 0.5082. This change in short interest is significantly different from zero (t = 6.88). It is possible that cross-decile shifts in Accruals are associated with shifts in other determinants of short interest. To control for this possibility, we use as a benchmark for comparison the mean change in short interest in response to cross-decile shifts among Accruals deciles 1 through 9 (10 being the highest decile)..A Satterthwaite two-sample test of mean difference (assuming unequal variance) indicates that a move into the highest Accruals decile is associated with a significantly higher short interest increase than in the benchmark case (difference = 0.3154, t = 5.09).

Furthermore, the effect of accruals changes is very different among firms with high institutional holdings (easier short-selling) and low institutional holdings. Within the bottom two IO deciles, moving into the top Accruals decile has no significant effect on short interest. In sharp contrast, in the top two IO deciles, moving into the highest Accruals decile has a strong and highly significant positive effect on short interest of 1.4067 (t = 4.35) for decile 9, and 1.4688 (t = 4.90) for decile 10. The effect on short interest of a move within Accruals deciles 1 through 9 is much smaller, so that the difference in the effect on short interest of a move into the top Accruals decile versus the benchmark is also strong and significant 1.1993 (t = 5.69) for IO decile 9, and 0.9477 (t = 3.48) for IO decile 10.[19]

Figure 1 illustrates changes of short interest position around the time of a move into the highest Accruals decile. Consistent with the findings of Table 6, on average there is an increase in short interest when the firm-year moves into the highest Accruals decile. Among firms with high institutional holdings (IO deciles 9 and 10), we observe notable jumps in short interest from year –1 to year 0, in contrast to the nearly flat lines for firms with low institutional holdings (IO deciles 1 and 2). Moreover, Figure 1 shows that a move out of the highest Accruals decile is associated with decreases in short interest only for firms among the highest IO decile.

[19] The tests that split by IO have the additional data requirement that IO observations be available.

6. Short Arbitrage of the Accrual Anomaly: Multivariate Tests

A 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, the effects we would like to detect. More importantly, a univariate analysis only filters out extraneous fixed effects, not time-varying ones.

Multivariate testing of whether there is short arbitrage of the accrual anomaly 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 reason is that the accruals variable is correlated with other return predictors. In consequence, short arbitrage of one anomaly (e.g., momentum, or book-to-market) could induce a correlation between short interest and accruals, even if no investor is basing a decision to go short accruals. Thus, to verify short arbitrage of the accrual anomaly we need to control for other return predictors. For example, 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).

We therefore 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) is actually due to arbitrageurs trading in response to accruals.

To control for other general determinants of short interest, we include in our regressions measures of institutional ownership, residual return volatility, book-to-market, size, share turnover ratio and a dummy variable for trading venue. 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 holdings (IO). Higher liquidity also tends to make a stock easier to sell short, so we control for firm size (LnSize) and monthly share turnover ratio (Turnover). 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 2009, Mashruwala, Rajgopal, and Shevlin 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 (BTM), 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, Fishman, Hong, and Kubik (2007) discuss features of the trading institutions on the different exchanges which, *ceteris paribus*, make short-selling easier on NASDAQ than on NYSE. On the other hand, 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. Furthermore, NYSE trading itself affects liquidity.

When shares are easy to borrow, it becomes easier to engage in short arbitrage against high accruals. Past literature has identified institutional holdings as a key indicator of the availability of shares for borrowing. We therefore predict that high institutional holdings should be associated with stronger short arbitrage. To test this prediction, we include interactions of IO with Accrual (in addition to including IO as a main effect).

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 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. (We also saw evidence in Subsection 5.4 that moving into the top accrual decile was associated with an increase in short interest.) To capture the nonlinear nature of short arbitrage, in our multivariate tests we use dummy variables that are equal to one when the firm's accruals are in the top decile, and zero otherwise.

Table 7 describes multivariate regressions of short interest on HighAccrual, as well as year fixed effects, the six control variables discussed above, and the interaction of HighAccrual with institutional ownership variables. The non-linear effect of institutional ownership on the ease of short selling is allowed for in alternative specifications as in Table 3. To test for significance, *t*-statistics are calculated based on clustered robust standard errors which adjust for within-cluster autocorrelations clustered by firm (Petersen 2009).[20]

Table 7 provides strong evidence of short arbitrage of the accrual anomaly, and of stronger short arbitrage activity when more shares are available to borrow. These tests control for other anomalies and determinants of short interest. Model 1 includes HighAccrual but not the interaction term. HighAccrual has a highly significant positive coefficient, which indicates that it is incrementally associated with greater short interest.

Model 2 shows that the effect of HighAccrual on short interest is significantly greater when shares are more easily borrowed, as proxied by institutional shareholding. The coefficient on HighAccrual is an insignificant –0.0046 (t = –0.05), suggesting that when institutional ownership is as low as 1% (lnIO = 0), there is no evidence of short sellers exploiting the accrual anomaly. However, the coefficient on HighAccrual*lnIO is a highly significant 0.2891 (t = 7.08), implying that as the constraint on loanable shares is relaxed, there is a significant increase in short selling targeting toward high accrual firms.[21]

Models 3 and 4 generate similar findings. Short arbitrage of the accrual anomaly is extremely strong among firms with high institutional holdings, but the effect is significantly weaker when institutional ownership drops below 5%, or when the firm-month is in the lowest IO decile. The greater strength of the evidence of short arbitrage of the accrual anomaly in the multivariate tests indicates that it is important to control for other determinants of short interest.

To assess the quantitative importance of short arbitrage of the accrual anomaly, we perform calculations based upon Model 1. We calculate that holding constant other variables (firm size, share turnover, book-to-market, residual volatility, institutional ownership, and return

[20] 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.
[21] The results are qualitatively the same if we add an interactive control variable HighAccrual*lnSize to isolate the incremental effect of institutional ownership.

momentum), on average the effect of a firm being inside rather than outside the top accrual decile increases short interest increases by 0.76%. 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.

As a further sensitivity analysis, in Table 8 we regress the change in short interest on the change in HighAccrual, and the changes in each of the controls.[22] Change in HighAccrual remains a significant incremental predictor of changes in short interest. This evidence indicates that the evidence of short arbitrage of the accrual anomaly that we have identified is not just cross-sectional; it is present even in a pure time series test.

Taken together, the short-interest findings of Sections 4-6 indicate that, in contrast with some previous literature, there is short arbitrage of the accrual anomaly; and that this activity is much stronger among stocks that are easier to borrow, i.e., stocks which have high levels of institutional holdings.

7. Conclusion

There is an active policy debate about whether short selling is in large part a means of manipulating stock prices, or whether it has a valuable economic function. Proponents of mild regulation of short-selling argue that short arbitrage is crucial for preventing firms from becoming highly overvalued. In this paper, using accruals as a proxy for market misvaluation, we test whether there is short selling targeted at overvalued firms, and whether short arbitrage is effective in reducing overvaluation.

We therefore test whether short-sellers trade against the accrual anomaly, and whether

[22] We consider a specification without interaction terms, because the change in Accrual * IO from t to $t + 1$ includes levels, not just changes, in IO and Accrual. This would leave firm fixed effects in the regression, which defeats the purpose of running a regression in changes.

such short arbitrage is successful, or whether the anomaly is much stronger on the short side than on the long side. To establish causality, we perform further tests of the comparative statics of short arbitrage: the effect of several factors (such as the availability of loanable stock, liquidity, and investor disagreement) that affect the need for or the ease of short arbitrage on short arbitrage activity and on the degree of asymmetry in mispricing.

We confirm the accrual anomaly in our sample, with higher hedge returns for NASDAQ firms than for NYSE firms. Furthermore, consistent with strong limits to short arbitrage, there is asymmetry in the accrual anomaly. This asymmetry is greater for firms with low institutional holdings (for which shares are hard to borrow for short selling), for illiquid firms (for which shareholders are at greater risk for short squeezes), for firms with high residual volatility (which have higher disagreement and mispricing which potentially can overwhelm short arbitrage capital) and on NASDAQ rather than NYSE (probably because NASDAQ firms tend to be more prone to mispricing and harder to sell short). Specifically, 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.

Our tests of whether short arbitrageurs target high accrual firms provide a sharp contrast with some previous work finding no arbitrage of the accrual anomaly in a more restricted sample. Base on univariate tests, Richardson (2003) found no statistically significant short arbitrage of the operating accrual anomaly among NYSE firms. We show that over a more extended sample period that includes the high-tech sector bust as well as the boom that preceded it, there is evidence of short arbitrage of the accrual anomaly even in univariate tests for NYSE firms. Furthermore, from year to year when a firm moves into the top accrual decile, short interest on average increases by a highly significant and very substantial economic magnitude, and the mean increase is significant even among NYSE firms.

We use several controls for the determinants of short interest, including size, share turnover, book-to-market, residual standard deviation, and institutional ownership that recent research has suggested are important. It is also crucial 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.

As a further test for whether the relation between accruals and short selling is causal, we perform a comparative statics test by examining whether greater ease of borrowing stock affects the extent of short arbitrage. We document a strong interaction effect between accruals and institutional holdings; short arbitrage is much stronger in firms held heavily by institutions (for which shares are more available for borrowing).

We expect the pressure for mispricing to be greater on NASDAQ than on NYSE, but costs of short arbitrage also tend to be higher among NASDAQ firms. So it is not obvious whether which trading venue should have more short arbitrage activity. But owing to both greater mispricing pressure and the greater costs and constraints to short-selling among NASDAQ firms, we unambiguously expect stronger downside anomalies, and therefore greater return asymmetry on NASDAQ than on NYSE.

In both univariate and multivariate tests, we find that short-arbitrage targeted at high-accrual firms is stronger on NASDAQ than on NYSE. Consistent with greater extremes in the pressure toward misvaluation on NASDAQ, we find that there is a larger variation in accruals across NASDAQ firms than across NYSE firms. Despite the heavy short arbitrage activity on NASDAQ, the 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.

Overall, the evidence in this paper paints a picture in which short selling has only a degree of success in eliminating the downside of the accrual anomalies. There is strong evidence that short sellers bet against high accrual firms. But asymmetry in the accrual anomaly remains, and this asymmetry is greater for firms with low institutional holdings (for which shares are hard to borrow for short selling), for illiquid firms (for which shareholders are at greater risk for short squeezes), for firms with high residual volatility (whose greater risk and disagreement/mispricing pressure can potentially overwhelm short arbitrage capital), and on NASDAQ (which has less liquid firms and firms that are more prone to mispricing) rather than NYSE.

There is a general debate in the accounting and asset pricing literatures about whether anomalies represent market inefficiencies, rational risk premia, or some form of data snooping or measurement error. Our findings that there is short arbitrage of the accrual anomaly, but that this short arbitrage is not entirely effective, provides a new and distinct form of evidence that the accrual anomaly does indeed represent a market inefficiency.

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 relaxation by the Security and Exchange Commission of the “uptick rule” restricting short sales is a possible example (Diether, Lee, and Werner 2009b, and Jakab 2008). 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
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
Turnover	0.026	0.006	0.006	0.003	0.036	0.011	−18.51	−107.74
STDRES	0.04	0.03	0.02	0.02	0.05	0.04	−142.28	−134.54
IO (%)	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.

Size is market value of stockholders' 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**.

Turnover is monthly share turnover, calculated as monthly stock trading volume in millions of dollars divided by **Size**.

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.

IO 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 rank sum test of difference in medians.

Table 2

Average Monthly Abnormal Returns for Accruals Portfolios
One Year after Portfolio Formation

	Pooled	NYSE	NASDAQ
Lowest Accruals Decile	0.0031* (1.87)	0.0032*** (2.64)	0.0019 (1.03)
Highest Accruals Decile	–0.0074*** (–8.48)	–0.0025*** (–2.37)	–0.0080*** (–7.62)
Hedge Return **(*L* – *H*)**	0.0105*** (5.57)	0.0057*** (3.55)	0.0099*** (4.65)
Return Asymmetry **–(*H* + *L*)**	0.0043*** (2.26)	–0.0007 (–0.49)	0.0061*** (2.86)
Average Number of Stocks Per Month	430	158	272

Notes:

Table 1 notes define Accruals. Firms are first sorted into decile portfolios according to their values of Accruals. Decile portfolios are formed monthly based on Accruals 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 *t*-statistics reported in parentheses are calculated based on a time series of 180 monthly portfolio abnormal stock returns (Fama-MacBeth approach).

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Table 3

Multivariate Analysis of Abnormal Return Asymmetry

	Model 1	Model 2 IO < 5%	Model 3 lowest IO decile
lnIO	−0.0070***		
	(−5.01)		
LowIO		0.0219***	0.0191***
		(5.13)	(4.07)
lnSize	−0.0040**	−0.0051***	−0.0064***
	(−2.25)	(−3.06)	(−3.77)
Turnover	−1.1066***	−1.1104***	−1.0928***
	(−8.43)	(−8.44)	(−8.36)
STDRES	0.3431**	0.3858***	0.3972***
	(2.56)	(2.89)	(2.96)
BTM	−0.0051*	−0.0049*	−0.0060**
	(−1.72)	(−1.69)	(−2.08)
Constant	0.0179	0.0306**	0.0383***
	(1.16)	(2.09)	(2.64)
N	190	190	190
Adjusted R-squared	0.020	0.021	0.020

Notes: The dependent variable is Abnormal Return Asymmetry. 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. Each month, firms are first sorted into decile portfolios according to their values of Accruals in the previous fiscal year, then 2-firm portfolios are formed by selecting one firm from the highest accrual decile (denote it H) and the other firm from the lowest accrual decile (denote it L), matching by their relative rank order in institutional ownership within the monthly Accrual decile portfolio. Abnormal Return Asymmetry is measured as the difference between the monthly abnormal return of shorting H and that of longing L. IO is the average institutional ownership for the 2-firm portfolio in the month. lnIO is the log transformation of IO. In Model 2, LowIO is defined as a dummy variable taking value 1 if IO < 5%, 0 otherwise. In Model 3, LowIO is defined as a dummy variable taking value 1 if the 2-firm portfolio ranks among the lowest IO decile for the month, 0 otherwise. See Table 1 for control variable definitions. To mitigate the influence of the extreme values, all control variables are winsorized at top and bottom 1%. The results are qualitatively the same without winsorization. There are 65,179 portfolio-months in the sample (requiring non-missing institutional ownership data reduces the sample size), but the *t*-statistics reported in the bracket are computed based on Fama-MacBeth approach using a time series of 190 months.

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Table 4

Univariate Analysis of Short Interest Positions (SI) across Accruals Portfolios

Panel A: Average short interest positions across accruals deciles

	Low	2	9	High	High – Low (*t*-statistic)
Sorting on Accruals					
		Average Short Interest Positions			
Pooled Sample	1.37	1.32	1.51	1.86	0.49** (2.27)
NYSE	1.90	1.64	1.61	2.30	0.40 (1.80)*
NASDAQ	1.26	1.18	1.41	1.79	0.53** (2.40)

Panel B: Comparison of mean accruals spread across NYSE and NASDAQ (1988-2002)

	Low	High	High – Low
Sorting on Accruals			
	Average Accruals		
NYSE (1)	–0.21	0.09	0.30
NASDAQ (2)	–0.42	0.21	0.63
Difference: (2) – (1) (*t*-statistic)	–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.

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Table 5

Analysis of Short Interest Positions across Accruals and IO Deciles

	Highest Accruals decile portfolio	Other Accruals decile portfolio	Difference: Highest – Other
Lowest IO decile	0.608	0.618	–0.010
Highest IO decile	4.912	2.936	1.976***
Difference: High – Low	4.304***	2.318***	1.986***

Notes:
Table 1 notes define Accruals and IO. Table 2 notes define portfolio formation process. Satterthwaite *t*-tests of difference in means are performed assuming unequal variance.

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Table 6
Changes in Short Interest in Response to Changes in the Decile Rank of Accruals

	Pooled Sample	Lowest IO Decile	IO Decile 2	IO Decile 9	Highest IO Decile
Moving into the **highest** Accruals Decile	0.5082*** (6.88)	–0.0424 (–1.05)	0.0020 (0.01)	1.4067*** (4.35)	1.4688*** (4.90)
Cross-Decile Shifts within Accruals Deciles 1 through 9	0.1656	0.0292	–0.0352	0.2074	0.5211
Difference	0.3154*** (5.09)	–0.0716 (–0.44)	0.0372 (0.31)	1.1993*** (5.69)	0.9477*** (3.48)

Notes: Table 1 notes define Accruals and IO. Firms are ranked each year by Accruals and assigned in equal numbers into decile portfolios. Decile 10 contains firms with the highest Accruals. "Moving into the highest Accrual Decile" denotes that the firm's Accruals decile rank is 10 in the current year and less than 10 in the previous year. "Cross-Decile Shifts within Accruals Decile 1 through 9" denotes that the firm's Accruals decile rank changes from the previous year but remains less than 10 both before and after the change. The pooled sample does not require non-missing data on institutional ownership.

Mean changes in short interest position from year to year are reported. The *t*-statistics reported in the first row of the table tests the hypothesis that the mean change is different from zero. In the last row, the reported *t*-statistics are calculated based on a Satterthwaite two-sample test of mean differences assuming unequal variance.

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Table 7
Multivariate Analysis of Short Interest Levels

	Model 1	Model 2	Model 3 IO < 5%	Model 4 lowest IO decile
HighAccrual	0.7634*** (10.14)	–0.0046 (–0.05)	0.9204*** (10.36)	0.8464*** (10.25)
lnIO	0.2881*** (15.66)	0.2514*** (13.49)		
HighAccrual*lnIO		0.2891*** (7.08)		
LowIO			–0.5308*** (–9.26)	–0.5530*** (–8.83)
HighAccrual*LowIO			–0.8441*** (–7.14)	–0.7483*** (–5.33)
lnSize	0.4361*** (19.75)	0.4372*** (19.83)	0.4962*** (23.39)	0.5072*** (24.42)
Turnover	8.1861*** (15.14)	8.2060*** (15.19)	8.0682*** (14.90)	8.0780*** (14.89)
BTM	–0.3643*** (–8.89)	–0.3664*** (–8.95)	–0.3366*** (–8.19)	–0.3285*** (–8.07)
STDRES	17.2083*** (16.36)	16.9608*** (16.16)	14.9259*** (14.33)	14.5556*** (13.91)
Momentum	–0.0986*** (–3.75)	–0.0978*** (–3.72)	–0.0852*** (–3.22)	–0.0861*** (–3.25)
NYSE	–0.3145*** (–4.63)	–0.3051*** (–4.51)	–0.3144*** (–4.58)	–0.3166*** (–4.60)
Constant	–2.0869*** (–16.99)	–1.9744*** (–16.20)	–1.3880*** (–10.24)	–1.4582*** (–11.04)
N	52,580	52,580	52,580	52,580
Adjusted R^2	0.104	0.105	0.098	0.097
p-value of F-test: HighAccrual + HighAccrual*LowIO = 0			0.389	0.427

Notes:

The dependent variable is short interest level (SI). Sample observations are ranked annually by calendar year and sorted into Accrual deciles. HighAccrual is a dummy variable takes value 1 if the firm-year ranks among the highest Accruals decile, 0 otherwise. lnIO is the log transformation of Institutional ownership (IO). In Model 3, LowIO is defined as a dummy variable taking value 1 if IO < 5%, 0 otherwise. In Model 4, LowIO is defined as a dummy variable taking value 1 if the 2-firm portfolio ranks among the lowest IO decile for the month, 0 otherwise. In Model 5, LowIO is defined as a dummy variable taking value 1 if the 2-firm portfolio ranks among the lowest IO quintile for the month, 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. The *t*-statistics reported in the parentheses are computed based on clustered standard errors robust to heteroskedasticity and within-cluster residual autocorrelations (cluster by firm). Year fixed effects are controlled in all regressions.

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Table 8
Multivariate Analysis of Short Interest Changes

Variable	Coefficient (t-statistic)
ΔHighAccrual	0.1222***
	(2.97)
ΔlnSize	0.5006***
	(13.16)
ΔTurnover	–0.1730
	(–0.84)
ΔBTM	0.0185
	(1.48)
ΔSTDRES	6.5813***
	(5.79)
ΔlnIO	0.1243***
	(3.13)
ΔMomentum	–0.0867***
	(–2.95)
Constant	0.1140*
	(1.95)
N	41,350
Adjusted R^2	0.012

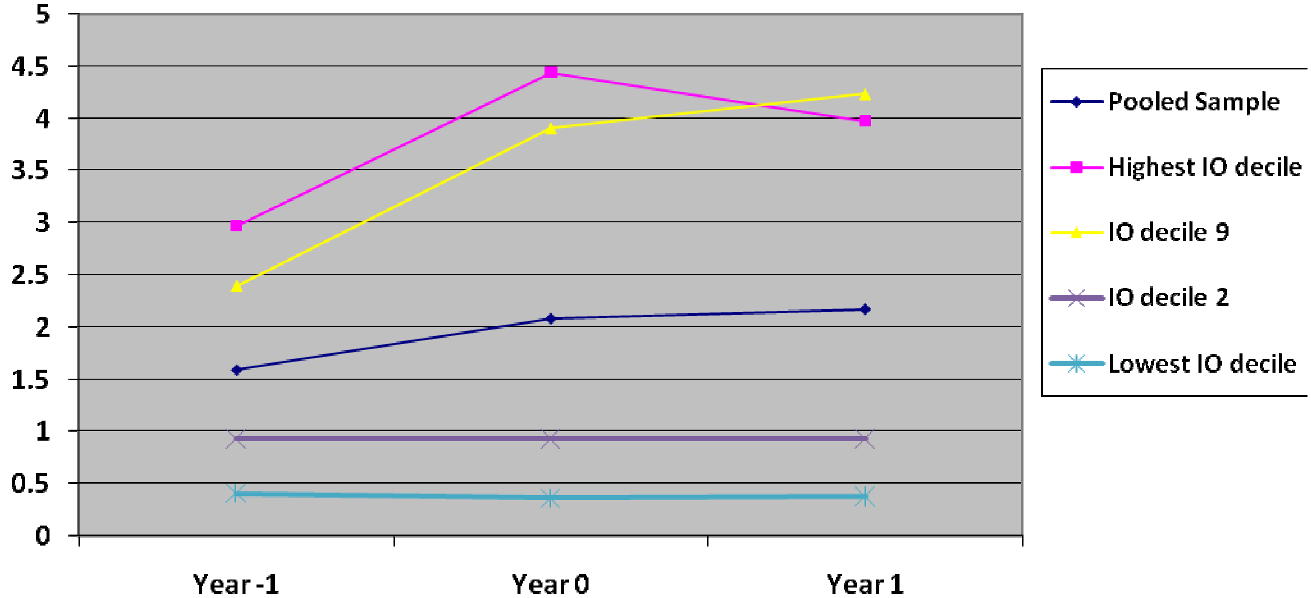
Notes: The dependent variable is the annual change in short interest level (ΔSI). ΔHighAccrual is the annual change in the HighAccrual dummy variable. For example, if the firm ranks among the highest accrual decile at $year_{t-1}$, but is no longer so at $year_t$, then ΔHighAccrual takes value –1 for $year_t$; if the firm does not rank among the highest accrual decile at $year_{t-1}$, but becomes so at $year_t$, then ΔHighAccrual takes value +1 for $year_t$; otherwise, ΔHighAccrual takes value 0. ΔlnSize, ΔTurnover, ΔBTM, ΔSTDRES, ΔlnIO and ΔMomentum are annual changes in lnSize, Turnover, BTM, STDRES, lnIO and Momentum, respectively.

The t-statistics reported in the parentheses are computed based on clustered standard errors robust to heteroskedasticity and within-cluster residual autocorrelations (cluster by fiscal year). The results are qualitatively the same if clustering by firm and controlling for fiscal year fixed effects.

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.

Figure 1

Changes in Short Interest
around the Time of a Move into the Highest Accruals Decile



Notes: The Y-axis denotes the mean change in short interest. Year 0 is the event time where the firm moves into the highest Accruals decile. The pooled sample does not require non-missing data on institutional ownership (see Table 1 for the definitions of IO, Accruals, and short interest).