Do Arbitrageurs Amplify Economic Shocks?

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Abstract: We examine whether arbitrageurs amplify fundamental shocks in the context of short arbitrage in equity markets. The ability of arbitrageurs to hold on to short positions depends on asset values: shorts are often reduced following good news about a stock. As a result, the prices of highly shorted stocks are excessively sensitive to economic shocks. Using monthly short interest data and exploiting differences in short selling regulations across stock exchanges to instrument for the amount of shorting in a stock, we find the following. (1) The price of a highly shorted stock is more sensitive to earnings news than a stock with little short interest. (2) Short interest changes around announcements (proxied by share turnover) are more sensitive to earnings surprises for highly shorted stocks. (3) For highly shorted stocks, returns to shorting are higher following better earnings news. (4) These differential sensitivities are driven by very good earnings news as opposed to very bad earnings news. These findings point to the importance of limited arbitrage in affecting asset price dynamics and the potentially destabilizing role of speculators.

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I. Introduction

In this paper, we examine whether arbitrageurs amplify exogenous economic shocks in asset markets. This issue is related to a large literature dating back to Friedman (1953) on the role of speculators in affecting asset price dynamics. A number of theories indicate that asset prices are excessively sensitive to economic news when arbitrage is limited in various ways by leverage constraints or agency problems arising from delegated money management.[1] For example, suppose hedge funds subject to leverage constraints have positions in a stock and there is a negative earnings surprise about the stock causing the price to fall. They are forced to cut back on their positions and the stock price will move more with the news than an otherwise similar stock without any hedge funds. The key amplifying mechanism is that the ability of arbitrageurs to maintain their positions is tied to asset values, which imparts an upward tilt to asset demand schedules.[2] There is relatively little evidence on whether fundamental shocks are amplified by such speculative activity, but, in light of recent financial crises and the growing importance of hedge funds to the economy, an understanding of the effects of speculators on asset price dynamics has never been more important from both academic and public policy perspectives.

We tackle this issue in the context of short arbitrage in equity markets. There are several reasons for why short selling in equity markets is an ideal setting to study this issue. First, we can measure the magnitude of arbitrage activity (on the short side) in different stocks. There are plentiful panel data on the magnitude of short selling and most of it is undertaken by professional speculators such as hedge funds as opposed to retail investors. This stands in contrast to the

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[1] This list is by no means exhaustive. Examples include Delong, Shleifer, Summers and Waldmann (1990), Shleifer and Vishny (1997), Kyle and Xiong (2001), and Gromb and Vayanos (2002).

[2] This leverage mechanism has been pointed out in a number of other settings including stocks (Garbade (1982)), corporate asset sales (Shleifer and Vishny (1992)), land (Kashyap, Scharfstein and Weil (1990)), Kiyotaki and Moore (1997)) and housing (Stein (1995)).

difficulty of measuring levered long speculative positions in equities. Second, in practice, the ability of arbitrageurs to hold on to short positions depends on asset values: shorts are often reduced (increased) following good (bad) news about a stock for a variety of reasons. Most notably, short sales tend to be highly levered transactions that require having enough funds in the margin account. Third, there is substantial anecdotal evidence in support of this amplification mechanism in the context of short arbitrage. The financial press often speaks of "short covering" (the cutting down of short positions through the purchase of shares) causing excess volatility in markets. A famous case in point is the internet stock eBay which reported significantly better earnings than expected in the summer of 2005. Its stock price soared the same day. The press pointed to short covering as a likely source of the price movement (see Nassar (2005)).

We begin by developing a simple three date model of asset price dynamics in which arbitrageurs have a profitable opportunity to short an over-priced stock subject to positive sentiment. The key ingredient is that the ability of arbitrageurs to hold on to short positions depends on asset values (i.e. the past performance of these positions). There is also an earnings announcement which may affect the sentiment in the stock. The sensitivity of the stock price to earnings news is simply the regression coefficient of the stock return around the earnings announcement date on the earnings surprise (or the difference between the earnings and the consensus forecast scaled by previous earnings). The main prediction we derive is that this earnings sensitivity is higher for a stock with positive short selling (i.e. arbitrage presence) than for a stock with no short selling (i.e. no arbitrageurs). Using observed leverage ratios for short sell trades in particular and hedge funds more generally as well as observed levels of short interest, calibration exercises indicate that the sensitivity of price to earnings news for highly shorted stocks should be around 3 to 4 times larger than that of other stocks.

Using monthly data on short sales in U.S. equities from the period of 1990 to 2003, we test this prediction by running a pooled regression of cumulative abnormal returns around (quarterly) earnings announcement dates (from 5 days before to one day after) on a dummy variable for an above-the-median earnings surprise (defined as above the median for that quarter), a dummy variable for whether a stock is highly shorted before the earnings date (defined as a short ratio, short interest to shares outstanding, in the top decile for that quarter), and the highly shorted dummy interacted with the above-the-median earnings surprise dummy. The coefficient for the interaction then tells us the difference in the sensitivity of stock price to news between highly shorted stocks and stocks with little short interest. We focus on highly shorted stocks because stocks may have a small amount of short interest due to hedging trades. Only those with substantial short ratios are likely subject to genuine valuation motivated arbitrage activity. There are a number of other measurement issues which we can control for using firm characteristics.

But the most important worry from our perspective is the potential endogeneity of short interest. Arbitrageurs may want to avoid shorting stocks whose price is very sensitive to news because these stocks pose more fundamental risk.[3] Alternatively, the highly shorted stocks may be much more in the media spotlight and hence their stock returns maybe more sensitive to earnings surprises. The estimation bias using ordinary least squares (OLS) can go either way. Fortunately, in these regressions, we can exploit differences in short selling regulations across stock exchanges to instrument for the amount of shorting in a stock. For reasons which we detail below, short selling regulations are much more lax for stocks listed on NASDAQ than on the NYSE. Indeed, we find that short interest ratios are substantially higher for NASDAQ stocks all

[3] For example, suppose some stocks have more investors who sleep through the news, so that price reacts less to earnings news. All else equal, these stocks are less risky to short for arbitrageurs and hence they are more likely to attract short interest.

else equal. We use this regulatory difference to instrument for short interest. The exclusion restriction that allows this instrument to identify the causal effect of differentials in shorting on the price sensitivity of stocks to earnings shocks is that the price sensitivity of NASDAQ stocks to earnings news is different than NYSE stocks (conditional on observable stock characteristics) only because of this difference in shorting propensity across exchanges and not for any other unobservable reason. This instrument is also useful for dealing with potential measurement error in the short interest ratio which may bias against finding our effect.

Using this instrument for short interest, we find that the price of a highly shorted stock is more sensitive to earnings news than a stock with little shorting. For stocks with little short interest, above-the-median earnings surprises lead to a higher cumulative abnormal return of about 2.03 percentage points. In contrast, for highly shorted stocks, the comparable figure is around 8.5 percentage points depending on the controls used. This difference (about four-and-a-half times as big) is economically and statistically significant and roughly in line with our calibration results. As we detail below, this relationship is also robust to a variety of different specifications such as different sub-periods and ways of measuring abnormal returns and earnings surprises.

We next test a key auxiliary prediction, which is that the change in the short interest ratio of a stock should be negatively correlated with the earnings surprise (i.e. a positive earnings surprise should lead to a fall in this ratio). In other words, we are verifying the key mechanism behind the amplification effect. Ideally, we want to measure the sensitivity of changes in daily short interest to unexpected earnings announcements. Unfortunately, we can only observe short interest at a monthly frequency (during the middle of months whereas earnings announcements tend to occur at the end of months). Such monthly changes are too coarse to pick up the short covering effect around earnings dates. Therefore, we use a stock's turnover as a proxy for changes in short interest. The prediction is that turnover is more sensitive to unexpected earnings for highly shorted stocks than other stocks.

Using either the OLS or IV approach, we find results consistent with our model, though the results are larger using IV. Using the IV estimates, we find that for stocks with little short interest, unexpectedly big earnings news (defined as the absolute value of the earnings surprise being above the median for that quarter) has a negligible effect on share turnover. For highly shorted stocks, the comparable figure is around 1.4 percentage points. This is also an economically and statistically significant difference and is consistent with our model.[4]

Moreover, the premise of the amplification mechanism is that arbitrageurs are forced to get out of short positions that are profitable (perhaps because sentiment rises even more after good news or the good earnings news is transitory). We verify this premise by looking at the profitability of short positions the week following above-the-median earnings surprise, using either the OLS or IV approach; though again, the IV estimates are larger. We find that for stocks that are un-shorted, above-the-median earnings surprises predict subsequent positive excess returns (from 2 days after to 7 days after the announcement) to holding the stock. This is consistent with the well documented post earnings announcement drift (see, e.g., Bernard and Thomas (1989, 1990)). However, for highly shorted stocks, there are actually negative excess returns following above-the-median earnings surprises. In other words, short positions are somewhat more profitable after good earnings news for these stocks. This difference is economically and statistically significant: the magnitudes are substantial, between -1.5 to -4 percentage points depending on the regression specification. This post announcement return

[4] These findings control for level differences in turnover between highly-shorted stocks and other stocks. Consistent with our model, highly-shorted stocks have higher turnover than other stocks. However, this could also be consistent with other asset pricing models without our effects (see, e.g., Scheinkman and Xiong (2003)).

finding strongly supports the short-covering mechanism as the basis of the above price sensitivity and turnover findings.

According to the model, these differential sensitivities are symmetric with regard to very good versus very bad earnings surprises because we assume that shorts are reduced following good and increased following bad news. But if the cutting back effect dominates, then we should see these differential sensitivities being largely driven by very good news as opposed to very bad news. And importantly, anecdotal evidence suggests that this is likely to be the case. To check this, we divide earnings surprises in terciles (high, middle and low earnings surprise groups per quarter) and create two dummy variables: a high earnings surprise (top tercile) dummy and a low earnings surprise (low tercile) dummy. We then re-run the above IV regressions using these two dummies instead of the above-the-median earnings surprise dummy. We find that the differential sensitivities documented above are largely driven by the comparison of the high tercile (very good earnings news) group to the medium tercile group. This asymmetry in differential sensitivities with respect to news also strongly cuts against alternative interpretations of our findings not based on short covering.

Our contribution is to show that arbitrageurs amplify exogenous fundamental shocks because their ability to hold on to positions depends on asset values. We are agnostic as to the cause of why short arbitrageurs, for instance, cut their positions following good news. We have naturally framed this short covering in terms of leverage, risk management or more general agency issues. But it could very well be due to other factors such as behavioral biases which lead arbitrageurs to cut their losses.

There is a growing literature testing the implications of limits to arbitrage models. Most closely related to ours is Savor and Gamboa-Cavazos (2005), who find that short sellers cover their positions after suffering losses and increase them after experiencing gains (measured using past returns), that this relationship is very strong for positions established due to perceived overvaluation and that expected returns do not explain the documented short seller behavior. Similarly, Lamont and Stein (2004) document a negative correlation between past index returns and the aggregate short interest ratio. The main innovation of our paper relative to these and other empirical papers in the literature more generally is that we show that arbitrage activity directly influences asset prices through at least one channel: the amplification of fundamental shocks.[5] The important point is that this paper is a first in directly showing the economic mechanism that leads to destabilizing speculation in asset markets.

Our paper is also closely related to empirical papers looking at the relationship between leverage and asset prices. Most notably, Lamont and Stein (1999) test a similar hypothesis as ours but in the context of the housing market. Their principal finding is that in cities where a greater fraction of homeowners are highly leveraged, house prices react more sensitively to city-specific shocks such as changes in per capita income. In contrast to their very interesting paper, our setting provides a tighter test of the amplification-of-fundamental-shocks hypothesis for a few of reasons. First, we have a strong instrument for short interest in contrast to their weaker instrument for homeownership leverage. Second, the horizon in which earnings shocks affect stock prices is a bit more straightforward than when per capita income shocks affect housing prices; i.e. we can do an event study around earnings announcements. And third, we can test auxiliary implications to gauge the reasonableness of our empirical findings and model.

[5] Again, this list is by no means exhaustive. Other recent examples related to testing limits of arbitrage models include Brunnermeier and Nagel (2004) who examine the holdings of certain hedge funds during the Internet bubble and Gabaix, Krishnamurthy and Vigneron (2005) who argue that prices of mortgage-backed securities are determined by specialized arbitrageurs.

Our paper proceeds as follows. We present a simple model to derive the main predictions in section II. The data is presented in section III and the empirical findings in section IV. We conclude in section V. All proofs are in the Appendix.

II. Model

There is a single asset (the stock) available in unit net supply. There are three dates, numbered 0, 1, and 2. At date 2, the asset is liquidated with payoff v, which may take on the value $\bar{v}$ or $\underline{v}$ with equal chance. At date 1, the value of v is announced to all. We denote the price at time t by p_t.

There are two sets of agents in the economy: noise traders and risk neutral rational speculators (e.g. hedge funds). The noise traders over-estimate the fundamental payoff by an amount $S > 0$ at time 0. This sentiment (optimism) may widen or narrow to $S(v)$ at time 1 (depending on the nature of the earnings announcement) and disappears completely by time 2. More formally, we assume that aggregate noise trader demands time 0 and 1 are given by (in share terms)

$$Q_0^N = \frac{E_0[v]+S}{p_0} = \frac{\frac{1}{2}\bar{v}+\frac{1}{2}\underline{v}+S}{p_0} \tag{1}$$

and

$$Q_1^N = \frac{E_1[v]+S(v)}{p_1} = \frac{v+S(v)}{p_1} \tag{2}$$

respectively.

Arbitrageurs undertake short positions to partially counteract the noise traders, but we assume their resources in the two periods, given by F_0 and $F_1(v)$, are insufficient to bring prices to fundamental value. For simplicity, initial aggregate speculator demand is given by

$$Q_0^S = -\frac{F_0}{p_0} \tag{3}$$

where $F_0 < S$. (In the Appendix, we solve the more general model in which arbitrageurs can determine how much of their resources ($D_0 \leq F_0$) to invest at time 0. The remainder is invested in cash and yields a zero net return as a safeguard against running out of funds at time 1.) At time 1, all uncertainty has been resolved and speculators take the maximum possible short position, yielding a demand of

$$Q_1^S = -\frac{F_1}{p_1} \tag{4}$$

provided $F_1(v) \leq S(v)$. Due to the unit net supply assumption, the short demand of speculators in this model is also the short ratio, or the ratio of shares shorted to total shares outstanding.

We also make the following assumption regarding the time evolution of the arbitrageurs' resources

$$F_1(v) = F_0 + aF_0\left(1 - \frac{p_1(v)}{p_0}\right), \tag{5}$$

where $a > 1$. If the arbitrageurs do not short at time 0, then $F_1(v) = F_0$. But since they are assumed to short an amount F_0, their capital at time 1 depends on the return of shorting, $\left(1 - \frac{p_1(v)}{p_0}\right)$, between time 0 and 1. How sensitive their resources are at time 1 to asset values or past returns (i.e. their ability to hold on to shorts) is given by the parameter a. We are agnostic as to the source of why $a > 1$. Most naturally, it reflects the fact that short sellers tend to be levered. Also plausibly, it may be an internal risk management control or imposed on the speculators by outside investors, (see, e.g., Shleifer and Vishny (1997)). For instance, one interpretation is that there are loss-limits at the position level or related value-at-risk (VAR) considerations and when a short position suffers a loss, the position is dramatically cut back. (Plentiful anecdotal evidence (cited in the Introduction) seems to bear this assumption out.)

We now solve for the asset prices. Date 2 represents the long-run in which price reverts to fundamental value, i.e. by no arbitrage, $p_2 = v$. Since aggregate demand in each period must equal the unit supply, i.e.

$$Q_t^S + Q_t^N = 1, \tag{6}$$

price at time 0 is

$$p_0 = \frac{1}{2}\bar{v} + \frac{1}{2}\underline{v} + S - F_0 . \tag{7}$$

Equating supply and demand at time 1 and then substituting from equation (5), we get

$$p_1(v) = \frac{v + S(v) - F_0(1+a)}{1 - a\dfrac{F_0}{p_0}} \quad . \tag{8}$$

Finally, we introduce an important variable for our empirical work. This variable, the the sensitivity of stock price to earnings news (or often called the earnings response coefficient) denoted by β, is:

$$\beta(v) = \frac{\dfrac{\Delta p}{p_0}}{\dfrac{\Delta v}{p_0}} = \frac{p_1 - p_0}{v - E[v]} \tag{9}$$

The earnings response coefficient is the percent change in price divided by the percent change in the value of the stock (scaled by price). It represents the responsiveness of price to innovations in fundamental value. Higher values of β denote higher sensitivity of prices to news. Alternatively, we can also scale the earnings innovations by the expectation of earnings. The theoretical results are similar and so we stay with the definition in equation (9) since it is the one most often used in papers that measure the sensitivity of price to earnings news.

The following three propositions are the key predictions of the model that we test. For all three propositions, we are assuming there is not enough capital to bring prices close to fundamental value.

Proposition 1: *The sensitivity of stock price to earnings news is greater for shorted stocks than for un-shorted stocks.*

The key amplifying mechanism is that the ability of arbitrageurs to maintain their positions is tied to asset values. The effect is similar to that of leverage constraints for long positions. We will make use of the following rearrangement of terms in (9):

$$\beta(v) = k\left(1 + \frac{S(v) - S}{v - E[v]}\right), \tag{10}$$

where $k = \left(1 - a\frac{F_0}{p_0}\right)^{-1} \geq 1$. Notice that $k = 1$ for stocks with zero initial short interest. Hence, all else equal, the earnings-response-coefficient of a shorted stock should be larger than that of an un-shorted stock by a factor of k. In our empirical work, we define a shorted stock as stocks in the top 10% of the short ratio distribution. For this sub-group, the mean short ratio is about 26%, i.e. $\frac{F_0}{p_0} = 0.26$ Moreover, the leverage ratio of short sales for individual investors can be as high as two and we know that many hedge funds also have leverage ratios of around two to three, i.e. a is between 2 to 3. These magnitudes then suggest that k is reasonably between 2 to 4. Hence, we expect the earnings-response-coefficient of highly shorted stocks in our sample to be around two to four times bigger than that of other stocks.

An important proviso on this analysis is that we only observe short interest at a monthly frequency. Other papers looking at daily short interest find that the amount of shorting on a daily basis can be much higher: sometimes a couple of times higher than found in monthly figures (see, e.g., Diether, Lee and Werner (2005)). What apparently happens is that there are a lot of higher-frequency shorting strategies that revert rather quickly; i.e. within a week or two, short positions are closed. So the 26% figure for the mean short ratio of stocks in the top 10% of the short ratio distribution is likely to be a lower bound. As such, the difference in the magnitude of the earnings-response-coefficient between highly- and un-shorted stocks can easily be as big as a factor of five. Ideally, we want to work with daily short ratios but this mandated data from SEC is only available for about one year and only available for a subset of stocks, which makes implementing our analyses infeasible. Moreover, this database is limited in that it only tracks initiations in short positions and not the covering of them. This note also leads us to our next set of empirical analysis.

The second proposition is a key auxiliary prediction of the model: the change in the short interest ratio of a stock should be negatively correlated with the earnings surprise (i.e. a positive earnings surprise should lead to a drop in the short ratio). Unfortunately, our monthly short interest data is too coarse to capture this short covering effect around earnings announcements, particularly in light of the findings in Diether, Lee and Werner (2005). Due to the inability to measure daily short covering, we show that this short covering effect translates into turnover being more sensitive to unexpected earnings for highly shorted stocks than un-shorted stocks.

Proposition 2*: For shorted stocks, the change in short ratio is inversely related to the earnings surprise. Share turnover around earnings announcements is more sensitive to (the absolute value) unexpected earnings for highly shorted stocks than for un-shorted stocks.*

It is the latter implication of this proposition that we focus on in our empirical work. Note that for un-shorted stocks, there is no turnover since we only have noise traders and no arbitrageurs. Hence, we are unable to make magnitude comparisons as we did for the stock return results. We can only test that turnover is more sensitive to unexpected earnings news for shorted stocks.

Finally, the premise of the amplification mechanism is that arbitrageurs are forced to get out of profitable short positions. Proposition 3 formalizes this premise by allowing sentiment to rise even after good news so that the short position remains profitable. This is a modeling device meant to capture the fact that short positions may be fundamentally profitable but arbitrageurs may have difficulty hanging on to short positions if their ability to do so depends on asset values. In a more dynamic set-up with multiple earnings dates, we could also accomplish the same result by introducing transitory earnings shocks.

Proposition 3: *If sentiment increases proportionally with unexpected earnings news, then for highly shorted stocks, the expected return to shorting is higher after a good earnings surprise.*

We test Proposition 3 by comparing subsequent stock returns after earnings announcements for highly shorted stocks to un-shorted stocks.

According to the model, these differential sensitivities are symmetric with regard to very good versus very bad earnings surprises because we assume that shorts are reduced following good and increased following bad news. But anecdotal evidence suggests that the cutting back of shorts following bad news is more likely than the increase in shorts following good news. If this is the case, then Proposition 4 below holds.

Proposition 4: *If shorts are often reduced (but less likely to increased) following good (bad) news about a stock, then the above differential sensitivities should be largely driven by very good news as opposed to very bad news.*

III. Data

Our data on monthly short interest, available for the period of 1990 to 2003, are obtained from Bloomberg. We use short interest to construct short ratios for each month. Each month's short interest data represents positions that closed on the first business day on or after the 15th of the month. Hence we approximate the short ratio by dividing total short interest positions by shares outstanding (from CRSP) on or closest to the 12th day of each month. We define HISR as a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise. We focus on highly shorted stocks because previous studies find stocks may have a small amount of short interest due to hedging trades (see, e.g., Chen, Hong and Stein (2001), Asquith, Pathak and Ritter (2006)). In other words, these studies find that for the vast majority of stocks, there are very little valuation-motivated shorts at any point in time. Hence, only stocks with substantial short ratios are likely subject to genuine valuation motivated arbitrage activity. The 10% cut-off is chosen because among this sub-group, there is a relatively high short ratio (about 26%). (Our results are robust to using other cut-offs such as the top quintile but they are naturally smaller since there is dramatically less shorting as one moves down the short ratio distribution.)

We combine these data with information from three other databases. First, quarterly earnings consensus estimates and actual initial (i.e. unadjusted) releases are collected from the I/B/E/S summary files. In practice, researchers have a few different ways of calculating unexpected earnings (*UE*). *UE* is the difference between the actual quarterly earnings according to I/B/E/S and the consensus forecast provided by I/B/E/S in the last month before the announcement date scaled by either past price, previous earnings or the consensus forecast (see, e.g., Conrad, Cornell and Landsman (2002), Kothari (2001)). Researchers differ in the choice of how to scale *UE*. Typically, they scale by either past price or previous earnings and less frequently by the consensus forecast. Our results are fairly similar across these different measures. So we follow convention and scale *UE* by past price and present in the robustness section the results when *UE* is scaled by previous earnings and the consensus forecast. We will actually work with the following transformation of *UE*: *HIUE* is a dummy equal to one if the unexpected earning is above the median in the quarter and zero otherwise.

Second, data on daily holding period returns, prices, trading volume and shares outstanding are obtained from the Center for Research in Securities Prices (CRSP). Using these data, we calculate cumulative abnormal returns around earnings announcement dates as follows. Each stock is assigned to a size-valuation category by assigning them each year first to size deciles based on their market capitalization at the start of the year and then to valuation deciles based on the ratio of market capitalization to last year's book equity. In this way we create one hundred different size-valuation categories. We use the entire sample to calculate the loadings of these one hundred portfolios using the Sharpe (1964) CAPM and the Fama and French (1993) three-factor model.

In addition to a simple return net of the risk-free, we then calculate daily abnormal returns for each stock using one of these two models. For each year, each stock inherits the loadings of its size-valuation category (determined at the beginning of the year) with which its abnormal return is calculated. Abnormal returns are then cumulated from five trading days before until one day after the earnings release date (*CAR*). We also calculate cumulative post-announcement returns (*POSTCAR*) using days +2 to +7 relative to earnings release. We have worked with various permutations of the timing in calculating these event day returns and the results are all similar. We use the two definitions here since they are again standards in event studies. Using the CRSP database, we also calculate daily share turnover (using trading volume and shares outstanding) and then take the average of daily share turnover from day -5 to day +1 surrounding the earnings announcement (*AVGTURN*). The timing is set to match that of the *CAR*.

Third, the following annual accounting variables are obtained from the CRSP/COMPUSTAT merged Industrial Annual data file: book equity (data item 60), convertible securities (data item 39), earnings per share (data item 57) and fiscal-year-end closing price (data item 199). The price-to-earnings valuation ratio is calculated as the lagged price as of 21 days before earnings release divided by the previous year's annual EPS. We have also performed (but do not report for brevity) a number of other robustness checks using the following different valuation ratios. We calculate the following alternative P/E ratios for robustness checks: previous year's fiscal-year-end closing price in the numerator and current release of earnings from I/B/E/S in the denominator. The other valuation ratios used for further robustness checks are market-to-book, market-to-assets and market-to-sales, all generated similarly using 21 day lagged prices and previous year's accounting numbers.

The sample includes stocks that are listed on the NYSE or NASDAQ, and they are in the top three quintiles of the market cap distribution of our sample (to help make the NASDAQ stocks comparable to the NYSE stocks). Observations are dropped if the dependent variable is missing or the controls are missing. The summary statistics for these variables are presented in Table 1. The key statistic to keep an eye on is that the mean of the short ratio distribution is about 4.97% and its standard deviation is 13.47%. For stocks in the top 10% of the short ratio distribution, the mean is 26% as we mentioned earlier. The statistics for the other variables are similar to those reported in other papers.

IV. Empirical Findings

A. Sensitivity of Price to Earnings News

We begin by testing Proposition 1. We want to measure how the sensitivity of price to earnings news varies by whether a stock is actively shorted or not. We first measure the overall effect of unexpected earnings shocks on returns, i.e. the price to earnings sensitivity for the typical firm in our sample. This will provide us with a benchmark. To this end, we estimate the following specification:

$$\begin{aligned} CAR_{i,t} = \alpha + \beta_1 HIUE_{i,t} + \beta_2 HISR_{i,t} + SIZE\ dummies_{i,t} + P/E\ dummies_{i,t} \\ + IO\ dummies_{i,t} + DISAGREEMENT\ dummies_{i,t} \\ + CONVDEBT\ dummies_{i,t} + INDUSTRY\ dummies_{i} \\ + YEAR\ dummies_{t} + \varepsilon_{i,t} \end{aligned} \tag{11}$$

The left-hand side (LHS) variable is *CAR* (cumulative abnormal return from day -5 to +1). The right-hand side (RHS) variable of interest is *HIUE* (a dummy equal to one if the earnings surprise is above the median in the quarter and zero otherwise). The other RHS variables include HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (the dispersion in analyst forecasts (calculated as in Diether, Malloy and Scherbina (2002)) divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. We will explain the rationales behind each of these control variables as we build on this specification to test our predictions below.

The result for this specification is reported in column 1 of Table 2. As expected, the coefficient on unexpected earnings is positive and statistically different than zero. The coefficient implies that having high or above median unexpected earnings is associated with a 2.83 percentage point increase in the return of the stock (*CAR*). This is about 40% of a standard deviation of *CAR*. This numbers is in line with other studies of the sensitivity of stock price to earnings surprises mentioned earlier.

We then estimate the following model, which is the same as the previous one, except for the addition of the interaction of *HIUE* and *HISR*:

$$\begin{aligned} CAR_{i,t} = {} & \alpha + \beta_1 HIUE_{i,t} + \beta_2 HISR_{i,t} + \beta_3 HIUE_{i,t} \times HISR_{i,t} + SIZE\ dummies_{i,t} \\ & + P/E\ dummies_{i,t} + DISAGREEMENT\ dummies_{i,t} + IO\ dummies_{i,t} \\ & + CONVDEBT\ dummies_{i,t} + INDUSTRY\ dummies_{i} + YEAR\ dummies_{t} + \varepsilon_{i,t} \end{aligned} \quad . \qquad (12)$$

The coefficient of interest is β_3, which measures the differential sensitivity of high short ratio stocks to unexpected earnings shocks than other stocks. The result is reported in column 2 of Table 2. In column 2, the estimates show that the sensitivity to high unexpected earnings shocks is greater for high short ratio stocks. β_1 suggests that for a low short ratio stock, a high *UE* shock is associated with a 2.78 percentage point increase in *CAR*. Importantly, β_3 is 0.40 and marginally statistically significant with a t-statistic of 1.64. There are a couple ways to think about the size of β_3. First, β_3 suggests that the sensitivity of high short ratio stocks to unexpected earnings is about 0.40/2.78 = 14% greater than for low short ratio stocks. Another way of saying that is that for a high *UE*, the increase in *CAR* is 0.40 percentage points more for a high short ratio stock than a low short ratio stock.

Our worry is that that this differential in sensitivity between shorted and un-shorted stocks might be due to other factors. For instance, shorted firms might be bigger firms and bigger firms' prices have higher sensitivities to earnings news than smaller firms. To this end, we estimate a third specification, which is similar to the second except that we interact the unexpected earnings measure with the other controls (firm size, price-to-earnings, disagreement, institutional ownership, and convertible debt). The specification is given by:

$$
\begin{aligned}
CAR5_{i,t} = {} & \alpha + \beta_1 HIUE_{i,t} + \beta_2 HISR_{i,t} + \beta_3 HIUE_{i,t} \times HISR_{i,t} + SIZE\ dummies_{i,t} \\
& + SIZE\ dummies_{i,t} \times HIUE_{i,t} + P/E\ dummies_{i,t} + P/E\ dummies_{i,t} \times HIUE_{i,t} \\
& + DISAGREEMENT\ dummies + DISAGREEMENT\ dummies \times HIUE_{i,t} \\
& + IO\ dummies_{i,t} + IO\ dummies_{i,t} \times HIUE_{i,t} \\
& + CONVDEBT\ dummies_{i,t} + CONVDEBT\ dummies_{i,t} \times HIUE_{i,t} \\
& + INDUSTRY\ dummies_i + YEAR\ dummies_t + \varepsilon_{i,t}
\end{aligned} \quad . \qquad (13)
$$

Again, the coefficient of interest is β_3, which measures the differential sensitivity of high short ratio shocks to unexpected earnings shocks than other stocks. Note that we cannot obtain an estimate of β_1 in this specification (because of all of the other interactions with *HIUE*). In addition to size by *HIUE* interactions, we also include price-to-earnings by *HIUE* interactions because the price of high price-to-earnings stocks are likely to have a different sensitivity to earnings news than low ones. Similarly, we also add in interactions of *HIUE* and DISAGREEMENT because highly shorted stocks may simply have more analyst dispersion and the price of high divergence of opinion stocks may react more to news. The logic for institutional ownership is similar. As for convertible debt, short interest might be driven by hedging trades associated with the purchase of convertible securities. Because we want to as precisely measure short interest related to speculative trades as possible, we include convertible debt by *HIUE* interactions.

The results from this estimation are presented in column 3. β_3 is about the same as in column 2. For this value, high *UE* is associated with a 0.49 percentage point greater increase in *CAR* than a low short ratio stock (about 18% greater in magnitude when compared to the baseline result of 2.78 percentage points for low short ratio stocks in column 2). The good news here is that adding these additional controls for firm characteristics makes our results stronger (the t-statistic is 1.90). This partly alleviates concerns that our results are driven by omitted firm characteristics. Again, this difference is statistically significant but is only somewhat larger economically than the result obtained from the previous specification.

As we alluded to in the introduction, the most important worry from our perspective is the endogeneity of short interest. The bias to the OLS results can go either way. On the one hand, arbitrageurs may want to avoid shorting stocks whose price is very sensitive to news because these stocks have more fundamental risk. In this scenario, the OLS result is biased downward. Alternatively, the highly shorted stocks may be much more in the media spotlight and hence their *CAR*s maybe more sensitive to *UE*. Under this scenario, the OLS result is biased upward. The calibration exercise suggests that we should find that this sensitivity differs by around 3 to 4 times. The estimates from Table 2 imply only around a 14% to 18% difference, suggesting that perhaps our OLS results are downward biased.

Fortunately, we can exploit differences in short selling regulations across stock exchanges to instrument for the amount of shorting in a stock. Short selling regulations are much more lax for stocks listed on NASDAQ than on the NYSE. Before 1994, there were not even any short selling regulations for NASDAQ stocks. It is generally thought that NASDAQ introduced some degree of regulation to compete with NYSE for firm listings because companies typically do not like to have their stocks shorted. The two exchanges also use somewhat different price tests (NYSE uses the tick test which is generally thought to be more stringent than the bid test used by NASDAQ).

This price-test difference aside, the NASDAQ regulations that were introduced and those currently in use are substantially weaker than those of the NYSE. First, NASDAQ exempts its market-makers from short selling regulations. Second, trades originating from Electronic Communications Networks (ECNs) are also exempt. This means that 30% of NASDAQ short sale trades are not even subject to a bid test, whereas all NYSE trades are subject to a tick test (see, e.g., Jickling (2005), O'Hara and Angstadt (2004)).

Therefore, we expect to find that short interest ratios are substantially higher for NASDAQ stocks all else equal. In particular, we see whether that being a NASDAQ stock increases the likelihood that the stock is in the top 10% of the short ratio distribution using the following regression:

$$\begin{aligned} HISR_{i,t} = \alpha + \beta_1 NASDAQ_{i,t} &+ SIZE\ dummies_{i,t} + P/E\ dummies_{i,t} \\ &+ DISAGREEMENT\ dummies_{i,t} + IO\ dummies_{i,t} \\ &+ CONVDEBT\ dummies_{i,t} + INDUSTRY\ dummies_{i} \\ &+ YEAR\ dummies_{t} + \varepsilon_{i,t} \end{aligned} \quad . \qquad (14)$$

The coefficient of interest is β_1, which measures how being a NASDAQ stock affects the probability that the stock is in the top 10% of the short ratio distribution. (We have also run this as a probit or logit and obtained similar results). The result is presented in Table 3; being a NASDAQ stock increases the probability that a stock is in the top 10% of the short ratio distribution by about 8.8 percentage points. The t-statistic of the coefficient is 6.38.

We use this regulatory difference to instrument for short interest. The exclusion restriction that allows this instrument to identify the causal effect of differentials in shorting on the price sensitivity of stocks to earnings shocks is that the price sensitivity of NASDAQ stocks to earnings news is different than NYSE stocks (conditional on observable stock characteristics) only because of this difference in shorting propensity across exchanges and not for any other unobservable reason.

In Table 4 we present the 2SLS or instrumental variables (IV) estimates. Column 1 is the IV version of equation 1. Our instrument is an indicator that the stock is traded on NASDAQ. Mechanically, the IV procedure works like this. First, we take the fitted values of *HISR* from equation (14) above (the first stage) and substitute those fitted values into equation (11) instead of *HISR* and run the ordinary least squares (OLS) (the second stage).[6] β_1 is now the causal effect of *HISR* on CAR (if the assumption that NASDAQ is a good instrument holds).

Column 2 is the IV version of equation 2. Notice that we now have two endogenous variables on the RHS of the specification: *HISR* as before and the *HISR*×*HIUE* variable. To estimate equation (12) using IV we now need at least two instruments for the two endogenous regressors. We again use the NASDAQ indicator and also the NASDAQ indicator interacted with the *HIUE* indicator.

Mechanically, the IV procedure for equation (12) works like this. There are two first stage equations; we must obtain fitted values of both endogenous regressors. The two first stages are:

$$\begin{aligned} HISR_{i,t} = {} & \alpha + \beta_1 NASDAQ_{i,t} + \beta_2 NASDAQ_{i,t} \times HIUE_{i,t} + \beta_3 HIUE_{i,t} + SIZE\ dummies_{i,t} \\ & + P/E\ dummies_{i,t} + DISAGREEMENT\ \ dummies_{i,t} + IO\ dummies_{i,t} \\ & + CONVDEBT\ dummies_{i,t} + INDUSTRY\ dummies_{i} + YEAR\ dummies_{t} + \varepsilon_{i,t} \end{aligned} \quad , \tag{15}$$

and

$$\begin{aligned} HISR_{i,t} \times HIUE_{i,t} = {} & \alpha + \beta_1 NASDAQ_{i,t} + \beta_2 NASDAQ_{i,t} \times HIUE_{i,t} + \beta_3 HIUE_{i,t} \\ & + SIZE\ dummies_{i,t} + P/E\ dummies_{i,t} + DISAGREEMENT\ \ dummies_{i,t} \\ & + IO\ dummies_{i,t} + CONVDEBT\ dummies_{i,t} + INDUSTRY\ dummies_{i} \\ & + YEAR\ dummies_{t} + \varepsilon_{i,t} \end{aligned} \quad . \tag{16}$$

We take the fitted values of these two regressions and substitute them for *HISR* and *HISR*×*HIUE* in equation (12). This is the second stage; running OLS will give the correct coefficients.

[6] Of course, the standard errors of the second stage are adjusted to account for the first stage estimation.

Column 3 is the same, but like before we also interact *HIUE* with other controls (and again cannot estimate a level effect of *HIUE*).

In column 1 of Table 4, the coefficient on *HIUE* is positive and statistically significant. The magnitude suggests that high *UE* is associated with a 2.82 percentage point increase in *CAR* (again about 40% of a SD of *CAR*). In column 2, the coefficient on β_1 is positive and statistically significant, suggesting high *UE* is associated with a 2.03 percentage point increase in *CAR* for low short ratio stocks. β_3 is positive (6.85 percentage points) and significant. So the total price sensitivity to earnings news for highly shorted stocks is 8.88 percentage points. One way to think about the size of β_3 is that it implies that the effect of high *UE* on *CAR* is about 4.4 times larger for high short ratio stocks than low short ratio stocks (8.88 compared to 2.03). Or the extra sensitivity of highly shorted stocks to high *UE* is 6.85 percentage points (about 97% of a SD of *CAR*). Using the coefficient in column 3, the extra sensitivity of high short ratio stocks to high *UE* is only slightly smaller. This again assures us that our results are quite robust to different specifications. Importantly, recall that the calibration exercise in the model part of the paper indicates that we expect the sensitivity to earnings news of highly shorted stocks to be about 3-4 times bigger than un-shorted stocks. As such, the magnitudes of the IV estimates are very much in the same ball park as those obtained from our calibration exercise. This confirmation provides added comfort that our findings are robust and economically sensible.

B. Sensitivity of Turnover to Earnings News

We now test Proposition 2. We want to measure how the sensitivity of turnover to earnings news varies by whether a stock is actively shorted or not. Our analysis proceeds in a manner similar to that of Tables 2 and 4. The results are presented in Table 5. It is the equivalent of Tables 2 and 4 except that the LHS variable is *AVGTURN*, the average (from day -5 to 1 around the earnings announcement) turnover of the stock minus the average turnover of the stocks in the exchange the stock is part of during the quarter of the observation, and *HIUE* is replaced by *HIABSUE* (a dummy for absolute earnings surprise above the median in that quarter). The reason we use *HIABSUE* instead of *HIUE* is that either good or bad earnings news will lead to turnover according to our model.

Columns 1 through 3 of Table 5 show the OLS results (analogs to Table 2). Column 1 shows that high absolute *UE* increases turnover by about 0.093 percentage points (about 13% of a SD of turnover). Column 2 shows that this sensitivity is greater for highly shorted stocks. For low short ratio stocks, the sensitivity of UE to HIABSUE is 0.084 percentage points. In contrast, the extra sensitivity for highly shorted stocks is 0.121 percentage points. The results using the more elaborate specification given in column 3 are similar (0.118 compared to 0.121 percentage points).

Because the same endogeneity critique applies to these *AVGTURN* regressions as the *CAR* regressions, columns 4 through 6 show the IV results. Column 4 shows that high absolute *UE* increases turnover by about 0.155 percentage points (about 21% of a SD of turnover). Column 5 compares the sensitivities of low short ratio to high short ratio stocks. Having high absolute *UE* and being low short ratio increases turnover by 0.047; i.e., there is no effect for low short ratio stocks. In contrast, the coefficient in front of the interaction term suggests that among high short ratio stocks, high absolute UE increases turnover by about 1.4 percentage points. In other words, all of the effect is for high short ratio stocks. The results in column 6 are similar. These results are all economically and marginally statistically significant (t-statistics of 1.66 to 1.8). In our model, all trading comes from the short covering effect since we only have arbitrageurs and noise traders. As such, our model would indeed predict that all of the effects related to turnover and earnings news should come from only high short ratio stocks. Of course, in reality, there are many different factors driving trading volume which we do not model. Nonetheless, it is interesting to note that the strength of the empirical findings is not out of line with the spirit of our model.

Importantly, note that these findings control for level differences in turnover between highly shorted stocks and other stocks. Consistent with our model, highly shorted stocks (*HISR*) have higher turnover than other stocks. However, this could also be consistent with other asset pricing models without our effects. So, our findings are not driven by these level differences. Rather, we are measuring differences in sensitivities to earnings surprises.

C. Subsequent Stock Returns and Earnings News

We now test Proposition 3. We want to measure how returns after the earnings announcement date differ between highly shorted stocks and un-shorted stocks. In essence, we want to verify that if the CAR results are due to the short covering mechanism we propose, then we should see negative drift in returns after the earnings announcement. Our analysis proceeds in a manner similar to that of Tables 2 and 4. The results are presented in Table 6. In other words, Table 6 is the equivalent of Tables 2 and 4 except that the LHS variable is *POSTCAR* (from 2 days after to 7 days after the announcement) instead *CAR*.

Columns 1 through 3 show the OLS results. Column 1 suggests that high *UE* raises *POSTCAR* by about 0.5 percentage points (about 9% of a SD). This is consistent with the well documented post earnings announcement drift (see, e.g., Bernard and Thomas (1989, 1990)). Column 2 shows that there is a negative effect of high *UE* on *POSTCAR* for highly shorted stocks relative to low short ratio stocks. β_1 (0.56 percentage points) and β_3 (-0.63 percentage points) are the same magnitude and opposite sign, suggesting that all of the effect of *UE* on *POSTCAR* is for low short ratio stocks. Column 3 is similar. Hence, for highly shorted stocks, there are actually negative excess returns following above-the-median earnings surprises. In other words, short positions are somewhat more profitable after good earnings news for these stocks.

Columns 4 through 6 show the IV results. Again in column 4, high *UE* increases *POSTCAR* by about 0.5 percentage points. In column 5, β_3 (-2.32 percentage points) is about three times as large in magnitude as β_1 (0.75 percentage points), suggesting that the overall effect of high *UE* for a highly shorted stock on *POSTCAR* is negative. More specifically, the overall effect for *HISR* and *HIUE* stocks is -1.57 percentage points (about 32% of a standard deviation of *POSTCAR*) and is statistically significant. The negative effect of β_3 is larger in column 6 with the more elaborate specification (now -4.77 percentage points) and also very significant.

Importantly, note that the economic magnitudes are in line with the CAR results. Notice that the IV estimates from the CAR results in Table 4 suggests that HIUE increased CAR by around an extra 6.8 percentage points for highly short stocks. To the extent that this 6.8 percentage points is an overreaction due to forced liquidations by arbitrageurs, we expect mean reversion in the subsequent days of a magnitude that is below that of this 6.8 percentage points figure. The POSTCAR numbers of -1.57 and -4.77 percentage points are in line with the CAR results. Hence, we conclude that the findings strongly support our Proposition 3.

D. Asymmetries in Differential Sensitivities: Very Good versus Very Bad News

We now test Proposition 4. If, as anecdotal evidence suggest, the cutting back of shorts following bad news is more likely than the increase in short following good news, then the above differential sensitivities should be largely driven by very good news as opposed to very bad news. To test this, we divide earnings surprises into terciles (high, middle and low earnings surprise groups per quarter) and create two dummy variables: a high earnings surprise (top tercile) dummy and a low earnings surprise (low tercile) dummy. We then re-run the above IV regressions using these two dummies instead of the above-median earnings surprise dummy. The OLS specification is given by:

$$\begin{aligned} CAR_{i,t} = {} & \alpha + \beta_1 HI3UE_{i,t} + LOW3UE_{i,t} + \beta_2 HISR_{i,t} + \beta_3 HI3UE_{i,t} \times HISR_{i,t} \\ & + \beta_4 LOW3UE_{i,t} \times HISR_{i,t} + SIZE\ dummies_{i,t} + P/E\ dummies_{i,t} \\ & + DISAGREEMENT\ dummies_{i,t} + IO\ dummies_{i,t} \\ & + CONVDEBT\ dummies_{i,t} + INDUSTRY\ dummies_i + YEAR\ dummies_t + \varepsilon_{i,t} \end{aligned} \tag{17}$$

Where *HI3UE* is a dummy for being in the top tercile of the unexpected earnings distribution of the quarter, *LOW3UE* is a dummy for being in the bottom tercile of the unexpected earnings distribution of the quarter and the other variables are defined as above. For the IV, there are now three endogenous variables: *HISR*, *HI3UE*HISR* and *LOW3UE*HISR*. The three instruments are: *NASDAQ*, *HI3UE*NASDAQ* and *LOW3UE*NASDAQ*.

The results of the IV regressions are reported in Table 7. We find that the differential sensitivities documented above are largely driven by the comparison of the high tercile (very good earnings news) group to the medium tercile group. The first column presents the CAR results. Notice that being in the highest tercile of UE and being highly shorted increases CAR by 14.24 percentage points in contrast to the -6.98 percentage points that comes with being in the lowest tercile of UE and being highly shorted. So the effect from the short covering is much bigger than the effect of an increase in shorts arising from having more capital with a more profitable short position as a result of a negative earnings surprise. Importantly, we see a similar asymmetry in the turnover results: almost all of the turnover effect is coming from very good news (1.569) in contrast very bad news (0.028). Finally, the POSTCAR results are similar to the CAR results in that the effect is much bigger for very good news (-4.80 percentage points) than very bad news (1.85 percentage points but statistically insignificant). These asymmetries in differential sensitivities with respect to news also strongly cuts against alternative interpretations of our findings no based on short covering.

E. Robustness Checks

In this section, we present a number of robustness checks. Table 8 takes the column 2 *CAR* regressions (Tables 2 and 4) and splits them into two time periods: 1990-1996 and 1997-2003. The OLS and IV results are similar for both time periods. Table 9 presents the *CAR* and *POSTCAR* regressions using the CAPM and returns net of the risk-free instead of the three-factor adjusted returns we use previously. There is no important difference between the results using these different adjustments. Tables 10 and 11 present our key findings in which we scale the earnings surprise by past price and consensus forecast instead of previous earnings. Table 12 reports the OLS estimates using stock fixed effects. The rationale for using stock fixed effects is that we worry about unobserved heterogeneity and if we also worried that our instrumental variables assumption is not reasonable. Fortunately, the results are all consistent with those reported earlier. These robustness checks increase our confidence in concluding that the bulk of the findings support our model.

V. Conclusion

We develop a simple model to examine whether arbitrageurs amplify fundamental shocks in the context of short arbitrage in equity markets. The key amplifying mechanism is that the ability of arbitrageurs to hold on to short positions depends on asset values: shorts are often cut (increased) following good (bad) news about a stock. As a result, the prices of highly shorted stocks are excessively sensitive to fundamental shocks.

Consistent with this model, we find that, controlling for a host of other stock characteristics, the price of a highly shorted stock is more sensitive to earnings news than a stock with little short interest. In these regressions, we exploit differences in short selling regulations across stock exchanges to instrument for the amount of shorting in a stock. Moreover, using daily share turnover as a proxy for short covering, we document that short interest changes in the predicted direction in response to earnings news. For highly shorted stocks, returns to shorting are actually somewhat higher following good earnings news. Finally, these differential sensitivities are driven by very good earnings news as opposed to very bad earnings news. These findings are broadly consistent with theories which emphasize the limits of arbitrage in affecting asset price dynamics.

As we suggested in the introduction, understanding the potentially destabilizing effects of speculators on asset markets is of paramount importance in light of the rise of hedge funds in the last decade. There are a number of avenues for further research to clarify the various channels through which speculators might destabilize markets. Along the same lines as this paper, when better daily data on short trades becomes available, we can more directly verify the short covering effect around earnings announcements as opposed to simply using share turnover. We can also use options data as opposed to short interest data to measure levered long or short positions in stocks and perform a similar set of analyses as in this paper. We plan to pursue these avenues in future research.

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Appendix

In this appendix we relax our earlier assumption that speculators put all their resources, F_0, at risk in the stock market immediately, and instead assume that they choose some amount, $D_0 \le F_0$ to put at risk (the remainder is invested in cash and yields a zero net return). The speculators may want to put some money aside in case the stock becomes an even better short trade after the earnings announcement. To complete the model, we set up the speculators' incentives and solve their optimization problem. We set the problem up in terms of speculators maximizing wealth at the liquidation date. Since speculators are fully invested at time 1, profits from time 0 to 1 are already factored into this maximization. Hence speculators maximize the expectation of $R(D_0) = F_1(D_0)\left(2 - \frac{v}{p_1(D_0)}\right)$ with respect to D_0:

$$\max_{D_0} E[R] = \max_{D_0} \frac{1}{2} F_1(\bar{v})\left(2 - \frac{\bar{v}}{p_1(\bar{v})}\right) + \frac{1}{2} F_1(\underline{v})\left(2 - \frac{\underline{v}}{p_1(\underline{v})}\right) \tag{A1}$$

Taking the first derivative with respect to D_0 above and substituting F_1 from (5) gives us the following FOC:

$$\frac{1}{2}\left(1 - \frac{p_1(\bar{v})}{p_0}\right)\left(2 - \frac{\bar{v}}{p_1(\bar{v})}\right) + \frac{1}{2}\left(1 - \frac{p_1(\underline{v})}{p_0}\right)\left(2 - \frac{\underline{v}}{p_1(\underline{v})}\right) \ge 0 \tag{A2}$$

If the FOC is strictly greater than 0 then $D_0 = F_0$. For $D_0 < F_0$ to be optimal the FOC must be equal to 0. Each term in (A2) represents the incremental gross return following either a positive or a negative fundamental value announcement, accounting for the returns accumulated at both period 1 and period 2. The optimization condition (A2) and the price equations define the equilibrium of this model.

We will make use of the following rearrangement of terms for the earnings-response-coefficient for the proofs below

$$\beta(v) = k\left(1 + \frac{S(v) - S - (F_0 - D_0)}{v - E[v]}\right), \tag{A3}$$

where $k = \left(1 - a\frac{D_0}{p_0}\right)^{-1} \ge 1$ and $k > 1$ for stocks with nonzero initial short ratio $\frac{D_0}{p_0} > 0$. All the propositions below assume that there is not enough capital to bring prices close to fundamental value.

Proof of Proposition 1: Note that the definition for β can be written as

$$\beta(v) = \frac{p_1 - p_0}{v - E[v]} \tag{A4}$$

We will assume that sentiment S and $S(v)$ are raised uniformly for the shorted stock (for which $0 < D_0 < D^*$, where D^* is defined below) over the un-shorted stock ($D_0 = 0$) so that $S(v) - S$ does not change.

In order for the proposition to hold, speculators must be subject to capital constraints, i.e. $a > 0$. When $a = 0$, the initial decision regarding D_0 is made independently of the wealth maximization problem of period 1. Hence D_0 will be chosen equal to F_0 in order to maximize period 1 profits. Along with the fact that $k = \left(1 - a\frac{D_0}{p_0}\right)^{-1} = 1$, this implies that (A3) for $a = 0$ can be simplified to

$$\beta(v) = \left(1 + \frac{S(v) - S}{v - E[v]}\right). \tag{A5}$$

Since $S(v) - S$, and v are the same for the shorted and un-shorted stock, all terms in (A5) are equal, and so the betas are equal.

Now return to the case of $a > 0$. First, we demonstrate that the partial derivative of β with respect to D_0 at the point $D_0 = F_0 = 0$ is greater than zero. Hence β is increasing for small D_0. From (A3), β consists of the product of two positive terms, k and $\left(1 + \frac{S(v) - S - (F_0 - D_0)}{v - E[v]}\right)$. It is straightforward to show that $\frac{\partial k}{\partial D_0} > 0$ at $D_0 = 0$. To prove that $\frac{\partial \beta}{\partial D_0} > 0$, it is only necessary to show that the derivative of the second term is nonnegative. Since the first order condition is continuous in D_0 and is positive for $D_0 = 0$, it must be the case that $D_0 = F_0$ even for small $D_0 > 0$. Hence $\frac{\partial F_0}{\partial D_0} = 1$, and the derivative of the second term is zero.

So far we have shown that β is larger for positive short interest stocks so long as D_0 is small. Since $\frac{\partial k}{\partial D_0}$ is always positive, changes in the sign of $\frac{\partial}{\partial D_0}\beta$ must come from changes in $\frac{\partial F_0}{\partial D_0}$. From the first order condition, we notice that as D_0 and F_0 increase, there will eventually come a point where $\frac{\partial F_0}{\partial D_0} < 1$, and at this point $\frac{\partial}{\partial D_0}\beta$ decreases and may eventually turn negative (we will see momentarily that it must turn negative). From all the equations involved, notice that this is the only possible source of change in the sign of $\frac{\partial}{\partial D_0}\beta$. Finally, consider what happens for very large D_0 and F_0. In such a case, price equals fundamental value and $\beta = 1$. Hence there must exist D^*, and so too F^*, such that the proposition holds whenever initial capital is below F^*.

Proof of Proposition 2: Intuitively, a positive (negative) earnings shock and resultant increase (decrease) in price cuts into (adds to) the speculator's selling power, implying a lower (higher) short ratio in the following period. A speculator subject to collateral constraints and/or performance based fund flow would also lose (gain) some collateral, inducing him to reduce (expand) his short position further. Now examine this statement algebraically. The initial short ratio is $\frac{D_0}{p_0}$ and the post-announcement short ratio is $\frac{F_1}{p_1}$. Consider the effect of positive news, $v - E[v] > 0$. The change in price, $p_1 - p_0$, is $v + S(v) - F_1 - (E[v] + S - D_0)$. This expression is the sum of the change in fundamental value, $v - E[v]$, and the change in unarbitraged sentiment, $S(v) - F_1 - (S - D_0)$. So long as the positive earnings news does not perversely cause the un-arbitraged sentiment to decrease, both terms are positive and the change in price is proportional to the earnings surprise. Now provided there is not enough capital to bring prices close to fundamental value in the sense of Proposition 1, D_0 is near F_0 , and $F_1 < D_0$. Therefore the short ratio changes inversely with the earnings surprise.

To show the statement regarding share turnover, note that the only traders in our model are noise traders and speculators. Hence aggregate share turnover is proportional to the (absolute value of) change in demand of either type of trader. As we've seen above, the speculator's demand is equal to the current short ratio, so turnover is exactly equal to the (absolute) change in short ratio.

Proof of Proposition 3: The expected return to shorting in our model is the ratio of price to fundamental value. Before and after a positive earnings surprise, this ratio is $\frac{p_0}{E[v]}$ and $\frac{p_1(\bar{v})}{\bar{v}}$, respectively. Of course, for $\bar{v} = E[v]$ (i.e. no earnings news), the expected return to shorting does not change. Hence our proposition is equivalent to $\frac{dp_1(\bar{v})}{d\bar{v}} > 1$. Our assumption that sentiment increases proportionally with unexpected earnings news is interpreted as $S'(\bar{v}) > 0$. From (8), $\frac{dp_1(\bar{v})}{d\bar{v}} = k(1 + S'(v))$. To prove the proposition, note that $k > 1$ for highly shorted stocks.

Table 1: Summary Statistics				
	Mean	25th percentile	Median	75th percentile
	(1)	(2)	(3)	(4)
Short Ratio (% of shares outstanding)	4.97 [13.47]	.84	1.96	4.59
AVGTURN (mean turnover (%) from day -5 to +1)	.76 [.73]	.25	.48	.98
CAR (cumulative abnormal return (%) from day -5 to +1)	.73 [7.05]	-3.26	.49	4.64
POSTCAR (cumulative abnormal return from day +2 to +7)	.27 [4.92]	-2.68	.15	3.11
Unexpected Earnings (as a % of previous price)	.01 [.44]	-.02	.01	.07
Unexpected Earnings (as a % of previous earnings)	.15 [50.26]	-.34	.32	1.67
Unexpected Earnings (as a % the consensus forecast)	2.54 [91.15]	-2.38	2.08	9.09
Market Capitalization (millions of dollars)	6420 [22951]	652	1404	3957
Price/Earnings	38.5 [155.5]	14.7	20.3	30.9
Analyst Disagreement	.11 [.38]	.02	.04	.09
Institutional Ownership (% of shares outstanding)	61.1 [20.1]	48.2	62.8	75.5
Convertible Debt (millions of dollars)	50.7 [203.2]	0	0	0

This table presents the summary statistics of the sample used in the regression estimations. The sample includes all stocks in the top three quintiles of the market capitalization distribution of the sample that are traded either on NASDAQ or the NYSE from 1990-2003. Standard deviations are in brackets. All continuous variables used in the regression specifications (AVGTURN, CAR and POSTCAR) are winsorized at the 5th and 95th percentile within the observations of each quarter. There are 43,954 observations.

Table 2: OLS Estimates of the Sensitivity of Stock Returns to Unexpected Earnings			
	(1)	(2)	(3)
Indicator for High Unexpected Earnings (HIUE)	2.83 (.07)	2.78 (.08)	
Indicator for High Short Ratio (HISR)	.90 (.13)	.69 (.19)	.66 (.20)
High Unexpected Earnings $\times$ High Short Ratio (HIUExHISR)		.40 (.25)	.49 (.26)

The dependent variable is CAR. The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 3: The Effect of being Traded on NASDAQ on the Probability of Having a High Short Ratio	
Indicator for NASDAQ traded stock	.088 (.014)

The dependent variable is HISR. The independent variables include NSADAQ (a dummy equal to one if the stock is listed on NASDAQ and zero otherwise), HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 4: IV Estimates of the Sensitivity of Stock Returns to Unexpected Earnings			
	(1)	(2)	(3)
Indicator for High Unexpected Earnings (HIUE)	2.82 (.08)	2.03 (.21)	
Indicator for High Short Ratio (HISR)	2.62 (1.33)	-.85 (1.56)	-.49 (1.79)
High Unexpected Earnings $\times$ High Short Ratio (HIUExHISR)		6.85 (1.80)	6.51 (2.58)

The dependent variable is CAR. The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 5: OLS and IV Estimates of the Sensitivity of Turnover to Unexpected Earnings

	OLS				IV		
	(1)	(2)	(3)		(4)	(5)	(6)
Indicator for High Absolute Unexpected Earnings (HIABSUE)	.093 (.009)	.084 (.009)			.155 (.018)	.047 (.057)	
Indicator for High Short Ratio (HISR)	.544 (.027)	.518 (.029)	.519 (.029)		2.505 (.417)	2.285 (.383)	2.307 (.385)
High Absolute Unexpected Earnings×High Short Ratio (HIABSUE)		.121 (.045)	.118 (.045)			1.403 (.809)	1.327 (.799)

The dependent variable is AVGTURN. The independent variables include HIABSUE (a dummy equal to one if the stock's absolute earnings surprise is above the median for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 6: OLS and IV Estimates of the Effect of Unexpected Earnings on Subsequent Stock Returns

	OLS				IV		
	(1)	(2)	(3)		(4)	(5)	(6)
Indicator for High Unexpected Earnings (HIUE)	.49 (.05)	.56 (.05)			.49 (.05)	.75 (.13)	
Indicator for High Short Ratio (HISR)	-.01 (.09)	.32 (.13)	.34 (.13)		-.69 (.89)	.48 (1.03)	1.82 (1.24)
High Unexpected Earnings×High Short Ratio (HIUExHISR)		-.63 (.18)	-.67 (.19)			-2.32 (1.12)	-4.77 (1.77)

The dependent variable is POSTCAR. The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 7: IV Estimates of Differential Sensitivities, Very Good versus Very Bad News

	CAR	AVGTURN	POSTCAR
	(1)	(2)	(3)
Indicator for Highest Tercile Unexpected Earnings (HI3UE)	.78 (.39)	-.003 (.061)	.90 (.21)
Indicator for Lowest Tercile Unexpected Earnings (LOW3UE)	-1.69 (.26)	.096 (.039)	-.38 (.17)
Indicator for High Short Ratio (HISR)	1.65 (1.31)	2.258 (.372)	-.17 (.87)
Highest Tercile Unexpected Earnings$\times$High Short Ratio (HI3UExHISR)	14.24 (4.26)	1.569 (.699)	-4.80 (2.18)
Lowest Tercile Unexpected Earnings$\times$High Short Ratio (LOW3UExHISR)	-6.98 (3.02)	.028 (.431)	1.85 (1.91)

The dependent variable is CAR in columns (1). The dependent variable is AVGTURN in columns (2), and the dependent variable is POSTCAR in columns (3). The independent variables include HI3UE (a dummy equal to one if the stock's earnings surprise is in the highest tercile for the quarter of the observation and zero otherwise), LOW3UE (a dummy equal to one if the stock's earnings surprise is in the lowest tercile for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level), YEAR dummies and stock fixed effects. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 8: OLS and IV Estimates of the Sensitivity of of Stock Returns to Unexpected Earnings by Time Period				
	1990-1996		1997-2003	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Indicator for High Unexpected Earnings (HIUE)	2.59 (.10)	1.75 (.29)	2.92 (.12)	2.24 (.26)
Indicator for High Short Ratio (HISR)	.56 (.25)	-.74 (1.96)	.83 (.30)	-1.49 (2.16)
High Unexpected Earnings $\times$ High Short Ratio (HIUExHISR)	.36 (.32)	6.64 (2.33)	.61 (.41)	7.30 (2.57)

The dependent variable is CAR. The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 9: OLS and IV Estimates of the Effect of Unexpected Earnings on Stock Returns, Alternate Benchmarks

Panel A: CAR

	CAPM			Net Risk-Free	
	OLS	IV		OLS	IV
	(1)	(2)		(3)	(4)
Indicator for High Unexpected Earnings	2.76 (.08)	2.03 (.21)		2.80 (.08)	1.95 (.22)
Indicator for High Short Ratio	.67 (.19)	-1.03 (1.56)		.67 (.20)	-2.44 (1.65)
High Unexpected Earnings×High Short Ratio	.42 (.25)	6.78 (1.79)		.41 (.26)	7.72 (1.85)

Panel B: POSTCAR

	CAPM			Net Risk-Free	
	OLS	IV		OLS	IV
	(1)	(2)		(3)	(4)
Indicator for High Unexpected Earnings	.56 (.05)	.79 (.13)		.60 (.06)	.88 (.14)
Indicator for High Short Ratio	.31 (.13)	.64 (1.02)		.36 (.14)	1.84 (1.09)
High Unexpected Earnings×High Short Ratio	-.61 (.18)	-2.57 (1.13)		-.56 (.19)	-2.95 (1.18)

The dependent variable in Panel A is CAR. The dependent variable in Panel B is POSTCAR. The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 10: Unexpected Earnings Scaled by the Past Earnings

	CAR			AVGTURN			POSTCAR	
	OLS	IV		OLS	IV		OLS	IV
	(1)	(2)		(3)	(4)		(5)	(6)
Indicator for High Unexpected Earnings (HIUE) (except for AVGTURN where it is HIABSUE)	2.78 (.08)	2.12 (.21)		.106 (.009)	-.003 (.038)		.57 (.05)	.67 (.13)
Indicator for High Short Ratio (HISR)	.64 (.19)	-1.49 (1.66)		.521 (.031)	1.791 (.345)		.26 (.13)	-.03 (1.06)
High Unexpected Earnings $\times$ High Short Ratio (except for AVGTURN where it is HIABSUExHISR)	.46 (.24)	6.09 (1.82)		.086 (.036)	2.002 (.453)		-.51 (.18)	-1.36 (1.09)

The dependent variable is CAR in columns (1) and (2). The dependent variable is AVGTURN in columns (3) and (4), and the dependent variable is POSTCAR in columns (5) and (6). The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HIABSUE (a dummy equal to one if the stock's absolute earnings surprise is above the median for the quarter of the observation and zero otherwise), (HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 11: Unexpected Earnings Scaled by the Consensus Forecast

	CAR			AVGTURN			POSTCAR	
	OLS	IV		OLS	IV		OLS	IV
	(1)	(2)		(3)	(4)		(5)	(6)
Indicator for High Unexpected Earnings (HIUE) (except for AVGTURN where it is HIABSUE)	2.68 (.08)	2.00 (.20)		.098 (.009)	.023 (.035)		.60 (.05)	.68 (.12)
Indicator for High Short Ratio (HISR)	.32 (.20)	-2.69 (1.91)		.517 (.030)	2.262 (.450)		.24 (.14)	-.14 (1.21)
High Unexpected Earnings×High Short Ratio (HIUExHISR) (except for AVGTURN where it is HIABSUExHISR)	.75 (.25)	6.74 (1.90)		.043 (.031)	.352 (.296)		-.47 (.17)	-1.06 (1.12)

The dependent variable is CAR in columns (1) and (2). The dependent variable is AVGTURN in columns (3) and (4), and the dependent variable is POSTCAR in columns (5) and (6). The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HIABSUE (a dummy equal to one if the stock's absolute earnings surprise is above the median for the quarter of the observation and zero otherwise), (HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level) and YEAR dummies. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.

Table 12: OLS Estimates Including Stock Fixed Effects

	CAR	AVGTURN	POSTCAR
	(1)	(2)	(3)
Indicator for High Unexpected Earnings (HIUE) (except for AVGTURN where it is HIABSUE)	2.83 (.08)	.068 (.006)	.60 (.06)
Indicator for High Short Ratio (HISR)	.31 (.23)	.232 (.017)	.19 (.15)
High Unexpected Earnings$\times$High Short Ratio (HIUExHISR) (except for AVGTURN where it is HIABSUExHISR)	.48 (.26)	.072 (.029)	-.62 (.19)

The dependent variable is CAR in columns (1). The dependent variable is AVGTURN in columns (2), and the dependent variable is POSTCAR in columns (3). The independent variables include HIUE (a dummy equal to one if the stock's earnings surprise is above the median for the quarter of the observation and zero otherwise), HIABSUE (a dummy equal to one if the stock's absolute earnings surprise is above the median for the quarter of the observation and zero otherwise), (HISR (a dummy equal to one if the stock is in the top 10% of the short ratio distribution for the quarter of the observation and zero otherwise), SIZE (market cap divided into 25 dummies by quarter), P/E (price-to-earnings divided into 25 dummies by quarter), DISAGREEMENT (analyst disagreement divided into 25 dummies by quarter), IO (institutional ownership divided into 25 dummies by quarter), CONVDEBT (convertible debt divided into 25 dummies by quarter), INDUSTRY dummies (SIC at the 2 digit level), YEAR dummies and stock fixed effects. The standard errors are adjusted by allowing for the errors to be correlated across observations of the same stock; i.e. the standard errors are clustered by stock.