ELSEVIER

Journal of Financial Economics 61 (2001) 77–106

JOURNAL OF Financial ECONOMICS

www.elsevier.com/locate/econbase

Short-sellers, fundamental analysis, and stock returns☆

Patricia M. Dechow[a,*], Amy P. Hutton[b], Lisa Meulbroek[b], Richard G. Sloan[a]

[a] *University of Michigan Business School, Ann Arbor, MI 48109, USA*
[b] *Harvard Business School, Harvard University, Boston, MA 02163, USA*

Received 19 August 1998; received in revised form 26 June 2000

Abstract

Firms with low ratios of fundamentals (such as earning and book values) to market values are known to have systematically lower future stock returns. We document that short-sellers position themselves in the stock of such firms, and then cover their positions as the ratios mean-revert. We also show that short-sellers refine their trading strategies to minimize transactions costs and maximize their investment returns. Our evidence is consistent with short-sellers using information in these ratios to take positions in stocks with lower expected future returns.

JEL classification: G12; G14; M41

Keywords: Short-sellers; Fundamental analysis; Trading strategies

☆This paper has benefited from the comments of seminar participants at the Australian Graduate School of Management, the American Accounting Association 1999 Annual Meetings, Cornell University, Louisiana State University, Harvard Business School, University of North Carolina, University of Southern California, University of Texas at Austin, and Northwestern University. We are also grateful for the comments from the editor, Bill Schwert, and the referee (Ken French).

*Corresponding author. Tel.: +1-734-764-3191; fax: +1-734-936-8716.

E-mail address: dechow@umich.edu (P.M. Dechow).

0304-405X/01/$ - see front matter
PII: S0304-405X(01)00056-3

1. Introduction

Conventional wisdom characterizes short-sellers as sophisticated investors who incur relatively large transactions costs attempting to short-sell and subsequently repurchase temporarily overpriced securities.[1] Asquith and Meulbroek (1996) provide evidence that short-sellers, as a group, successfully identify securities that subsequently underperform the market. In this paper, we identify the characteristics of the securities targeted by short-sellers. Specifically, we examine whether short-sellers target stocks of firms that are priced high relative to fundamentals such as earnings and book values.

A large body of evidence demonstrates that ratios of measures of fundamental value to market value systematically predict future stock returns. These ratios compare estimates of "intrinsic" values based on accounting data to observed market prices. They range from simple ratios such as earnings-to-price and book-to-market (e.g., Fama and French, 1995; Lakonishok et al., 1994) to ratios based on more sophisticated valuation models such as Ohlson (1995) (e.g., Frankel and Lee, 1998; Dechow et al., 1999). Given the well-documented predictive ability of these ratios with respect to future stock returns, they provide a natural starting point for investigating the trading strategies of short-sellers.

We document a strong relation between the trading strategies of short-sellers and ratios of fundamentals to market prices. Our tests indicate that short-sellers target securities that have low fundamental-to-price ratios and then they unwind their positions as these ratios revert to normal levels. We also show that short-sellers refine their trading strategies in three ways in order to maximize their investment returns. First, short-sellers avoid securities for which the transactions costs of short-selling are high. Second, short-sellers supplement their trading strategies by using information beyond that in fundamental-to-price ratios that has predictive ability with respect to future returns. Third, we show that short-sellers avoid shorting securities with low fundamental-to-price ratios when the low ratios are attributable to temporarily low fundamentals. In other words, short-sellers act as if they are able to discriminate between low ratios that are due to temporarily low fundamentals and low ratios that are attributable to temporarily high prices.

A straightforward interpretation of our results is that low fundamental-to-price ratios are associated with temporary overpricing that is actively exploited by short-sellers. This interpretation is consistent with the Lakonishok et al. (1994) hypothesis that "naïve" investors tend to be overoptimistic about the future prospects of stocks with low fundamental-to-price ratios. Under this interpretation, our evidence suggests that short-sellers are sophisticated

[1] See, for example, *Business Week*, August 5, 1996, pp. 63–68, *Fortune*, November 9, 1998 p. 272, and *Forbes*, December 28, 1998, pp. 101–103.

investors who play an important role in keeping the price of stocks in line with fundamentals. An alternative interpretation of our results is that low fundamental-to-price ratios are associated with unique risk characteristics. This interpretation is consistent with the Fama and French (1992) hypothesis that stocks with low fundamental-to-price ratios have low sensitivity to the "book-to-market" risk factor. Under this interpretation, short-sellers achieve superior returns by short-selling low-risk stocks. These superior returns are compensation for the increased exposure to the book-to-market risk factor. In an attempt to discriminate between these competing interpretations, we conducted a telephone survey of major global short-selling hedge funds. The fund managers all endorsed the first interpretation provided above, i.e., they short-sell stocks they perceive to be overpriced. However, it is also possible that short-sellers inadvertently load up on the risk factor conjectured by the second interpretation above.

The paper proceeds in four sections. The next section develops our predictions. Section 3 describes our research design, Section 4 presents the results, and Section 5 concludes.

2. Empirical predictions

We begin in Section 2.1 by describing the institutional features of short-selling and identifying the objectives, risks, and costs of short-selling. Section 2.2 then describes several established techniques for predicting future stock returns by comparing ratios of fundamental measures of value to market prices. These sections provide the underpinnings for our empirical predictions, which are presented in Section 2.3. In Section 2.4 we discuss the possible confounding effects of any unidentified risk factors on the interpretation of our results.

2.1. Institutional details on short-selling

A short sale is a sale of a stock that one does not already own, but has borrowed from a brokerage house, a large institutional investor, or another broker-dealer. The short-seller establishes the position by selling the borrowed stock, and closes the position by buying the stock back at a later time, using the purchased shares to extinguish the initial loan of the stock. By selling short, an investor can profit from a decrease in the stock price. The risk-return profile for a short position is very different from that of a long position. A short-seller's maximum gain is the sale price of the stock (if the stock price falls to zero), while the loss is potentially unlimited (if the stock price rises). Because of the high risk associated with short-selling, and because of its putative potential for manipulating stock prices, short-selling is heavily regulated in U.S. stock

markets and is not allowed in many foreign stock markets. Many institutional investors are prohibited from short-selling, or restricted in the size of their short positions relative to the overall size of their portfolios. Asquith and Meulbroek (1996) provide an extensive review of the institutional aspects of short-selling. Here we provide only a brief summary of the process in the United States.

Regulation in the United States has developed from beliefs that short-sellers can cause stock prices to spiral downward. The ensuing regulations act to increase the cost of short-selling. The U.S. Securities and Exchange Commission requires short-sellers to sell only on a "plus tick" or a "zero plus tick," that is, when the stock price has increased. The proceeds from a short sale are not available to the short-seller. Instead, the proceeds are escrowed as collateral for the owner of the borrowed shares. Typically, the short-seller receives interest on the proceeds, but the rate received (the "rebate") is below the market rate. The difference is the compensation to the lender of the stock. Thus, short-sellers cannot directly use the proceeds from short sales to reinvest or to hedge their short position. Regulation T, set by the Federal Reserve, requires short-sellers of stocks to deposit additional collateral of 50% of the market value of the shorted shares. The short-seller can use either long positions in other securities or interest-bearing Treasury securities to meet this additional margin requirement, mitigating the cost of maintaining this additional collateral (any dividends or interest earned on securities in the collateral margin account accrue to the short-seller). If the price of the shorted stock rises, increasing the liability of the short-seller, additional collateral funds are generally required. The tax treatment of short positions contributes to the high cost of short-selling. All profits from a short sale are taxed at the short-term capital gains rate, no matter how long the short position is open. Finally, the short-seller is required to reimburse the stock lender for any dividends or other distributions paid to the shareholders of the shorted stock while the short position is open. Because the ex-dividend stock price of the shorted stock is generally higher than the pre-dividend stock price less the amount of the dividend (e.g., Frank and Jagannathan, 1998), dividend reimbursement represents a real cost to the short-seller (in addition to inconvenience and transactions costs).

The standard stock-lending practice is that the loan must be repaid on demand. This practice exposes short-sellers to the risk of being "squeezed." A short squeeze occurs when the lender of the borrowed shares wants to sell the stock. If the short-seller is unable to find an alternative lender, the short-seller must repurchase the shares in the open market to repay the loan and close the position. To avoid this risk, a short-seller can borrow on a term basis for an additional fee, but most short-sellers seem to prefer the risk of a squeeze to the cost of a term loan, and term loans are rare. To help short-sellers assess the probability of a squeeze, the broker will sometimes reveal the identity of the

lender of the shorted stock. Generally, a short squeeze is less likely for more liquid securities, such as large market-capitalization stocks with high institutional ownership, since it is easier for brokers to find alternative lenders of such stocks in the event that the original lender demands the return of the borrowed shares.[2]

Short-selling is therefore riskier and more expensive than establishing a long position. Because short sales are more costly than long transactions, Diamond and Verrechia (1987) suggest that short-sellers will not trade unless they expect the price to fall enough to compensate them for the additional costs and risks of shorting. Short-sellers, they propose, are therefore more likely to be better informed than are investors with long positions. A short sale is the most direct way for an investor to bet that a stock's price will decrease.[3] Of course, short sales occur for a myriad of reasons, only one of which is a belief by the short-seller that the stock is overvalued relative to its fundamentals. In a merger situation, investors often simultaneously go long in the target firm's stock and short in the acquiring firm's stock. In "pairs trading" investors hedge themselves by shorting a security whose return is highly correlated with the return of another security they have purchased (e.g., selling Dell short and purchasing Gateway). Another reason for short-selling is to arbitrage a price differential between the stock and debt convertible into the stock. These other reasons for short-selling are not motivated by the expectation of a price decline. Thus, to the extent that short-selling is attributable to these other activities, they add noise to our empirical tests.

Early research on short interests by Figlewski (1981), Woolridge and Dickinson (1994), Brent, Morse, and Stice (1990), and Figlewski and Webb (1993) fails to document a strong relation between short interest and excess returns. However, Asquith and Meulbroek point out that the power of the tests in these studies is weak, since their sample selections are not based on the magnitude of the short interests. As documented by Asquith and Meulbroek, many firms have very small short positions (less than 0.5%). These small short positions are likely to represent hedge positions, rather than a systematic attempt to exploit perceived overpricing. By focusing on a sample of firm-years with large short interests (e.g., firm-years with short positions greater than 2.5% of shares outstanding), Asquith and Meulbroek document a strong and

[2] An extreme example of a short squeeze is the case of Amazon.com. In June 1998, the number of shorted Amazon shares neared its entire float. The firm then announced a stock split, and the stock price rose significantly, with demand coming from both long investors *and* short-sellers who were squeezed due to the lack of shares to borrow. Fears of a short squeeze have been cited as an important reason why many short-sellers avoid heavily shorting "overpriced" Internet stocks (see St. Louis Post-Dispatch, July 19, 1998, p. E3).

[3] Asquith and Meulbroek (1996) point out that although the option market may seem a less costly way to achieve the same goal, many hedge-fund managers and other practitioners state that the option market is even more expensive, particularly for hard-to-borrow stocks.

consistent relation between short interests and excess returns. They document that stocks with high levels of short interest perform significantly more poorly than comparable stocks without short positions.

2.2. Ratios of fundamentals to market prices

Basu (1983), Lakonishok et al. (1994), and Sloan (1996) show that various measures of cash flows scaled by price are positively related to future stock returns. Basu (1983) and Fama and French (1992) show that earnings-to-price ratios are positively related to future returns. Stattman (1980), Rosenberg et al. (1985), and Fama and French (1992) show that book-to-market ratios are positively related to future returns. Considerable prior research has investigated each of these ratios, and their predictive ability with respect to future returns is well documented, so we do not describe them in detail. However, research on the more sophisticated value-to-market measure is less well known and is discussed below.

In a dividend-discounting framework, firm value can be expressed as the sum of the book value of common equity plus the present value of future abnormal earnings (see Edwards and Bell, 1961; Ohlson, 1995):

$$P_t = b_t + \sum_{\tau=1}^{\infty} \frac{E_t[x^a_{t+\tau}]}{(1+r)^{\tau}},$$

where

b_t = book value of common equity at time t
$x^a_{t+\tau}$, = $\text{Earnings}_{t+\tau} - rb_{t+\tau-1}$
r = cost of equity capital.

Following Ohlson (1995), Dechow et al. (1999) model abnormal earnings as a simple autoregressive process:

$$x^a_{t+1} = \omega\, x^a_t + \varepsilon_{t+1}.$$

Intrinsic value can then be expressed as

$$P_t = b_t + \alpha x^a_t$$

with

$$\alpha = \frac{\omega}{1+r-\omega},$$

where ω measures the persistence of abnormal earnings. This valuation model combines information in both earnings and book value. A persistence parameter of $\omega = 1$ implies a pure earnings model, while a persistence parameter of $\omega = 0$ implies a pure book value model. Empirically, Dechow et al. (1999) show that the average persistence parameter is around 0.6. They

demonstrate that the ratio of intrinsic value to market value computed using $\omega = 0.6$ is more highly associated with future returns than the earnings-to-price and book-to-market ratios. We employ their procedure in computing our value-to-market ratio.

2.3. Empirical predictions

The focus of this paper is on determining whether short-sellers exploit the predictable returns associated with the valuation ratios identified above. Prior research has shown that high cash-flow-to-price, earnings-to-price, book-to-market, and value-to-market firms earn higher one-year-ahead returns than do firms with low values for these ratios. So long as sophisticated investors do not perceive stocks with relatively high fundamentals to be riskier, we expect them to take advantage of these predictable returns. That is, we expect sophisticated investors to buy stocks for which the predictable returns are the highest (where cash-flow-to-price, earnings-to-price, book-to-market and value-to-market are *high*) and (short) sell stocks for which the predictable returns are the lowest (where cash-flow-to-price, earnings-to-price, book-to-market, and value-to-market are *low*). It is difficult to identify which long-positioned investors are sophisticated. However, as argued above, short-sellers represent sophisticated investors who claim to specialize in selling overpriced stocks.

Our primary empirical prediction is that short interests will be relatively high in firm-years with relatively low values of cash-flow-to-price, earnings-to-price, book-to-market, and value-to-market ratios. We also predict that short-sellers will subsequently cover their positions as the predictable returns are realized and stock prices fall back in line with fundamentals. Finally, we investigate whether the magnitudes of short positions are influenced by differences in the relative transactions costs associated with shorting different securities. Such evidence would suggest that the effectiveness of short-selling as a mechanism for enhancing market efficiency is limited by the high transactions costs associated with short-selling.

2.4. Risk and fundamental-to-price ratios

Our results and their interpretation will be confounded if fundamental-to-price ratios capture risk factors unknown to us, that are responsible for the lower returns of low fundamental-to-price stocks (Fama and French, 1992). If these ratios do indeed capture risk factors, then there are two additional interpretations of our results:

1. Short-sellers have unique preferences for the risk factors, which motivates their trading behavior with respect to low fundamental-to-price stocks; and

2. Short-sellers think that they are profiting from short-selling overpriced securities, but they are inadvertently loading up on the unidentified risk factors.

In an attempt to discriminate between these alternative interpretations, we surveyed the world's ten largest short-selling hedge funds. (The rankings are from Managed Accounts Report, Inc. as of February 1999). One of the ten funds chose not to participate, but the nine respondents confirmed the conventional wisdom that their primary objective is to profit from short-selling temporarily overpriced stocks (survey results available upon request). They argued against the first risk factor interpretation described above. Of course, it is still possible that they inadvertently load up on risk in line with the second interpretation described above. Nevertheless, it is informative that sophisticated investors reject the risk factor interpretation. The fact that these sophisticated investors "vote with their feet" by shorting millions of dollars based on their belief that low fundamental-to-value ratios are associated with temporary mispricing provides additional credence to the mispricing interpretation.

3. Sample formation and variable measurement

In Section 3.1 we discuss the data sources and sample selection. In Section 3.2 we discuss our variable measurement.

3.1. Data sources and sample selection

We require the following information to test our predictions: financial statement data, stock returns, institutional holdings data, and short interest data. Annual financial statement data are obtained from COMPUSTAT. Monthly stock returns are obtained from the Center for Research in Security Prices (CRSP). We obtain institutional data from Spectrum's quarterly tapes. Short interest data are extracted from Asquith and Meulbroek's database of monthly short interests. This database includes all New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) firms and covers the time period 1976–1993. The original data sources for the Asquith and Meulbroek database are the Standard and Poor's *Daily Stock Price Record* and *Quarterly History Tape* for the years 1976–1990 and the exchanges (NYSE and AMEX) for the years 1990–1993.

Given the limits of the short interest database, our analysis is restricted to NYSE and AMEX firms in the years 1976–1993. Use of financial statement and stock return data eliminates firm-years not appearing on COMPUSTAT or CRSP. Tests using the Spectrum data are restricted to the years 1983–1993.

3.2. Variable measurement

The short interest variable used in our analysis is the percent of outstanding shares shorted. This is equal to the number of common shares shorted divided by the total number of common shares outstanding. We measure short positions three months after the end of the fiscal year from which we extract the financial data to compute our fundamental-to-price ratios. This provides us with reasonable assurance that the financial data would have been available to short-sellers. The return cumulation period also begins three months after the fiscal year-end. We use buy-and-hold one-year-ahead stock returns (including dividends). We measure abnormal returns by adjusting each firm's return by the equal-weighted return for all NYSE and AMEX stocks over the same time period. Note that this measure of abnormal returns makes no adjustment for differences in risk across firms, and so potentially biases our results in favor of mispricing. However, previous research has established that the predictable returns associated with the fundamental-to-price ratios are robust with respect to a variety of techniques for adjusting returns, and so we employ this relatively straightforward adjustment method. Asquith and Meulbroek (1996) also establish that the negative relation between excess returns and short positions is robust to a variety of techniques for calculating excess returns.

We examine two measures of institutional holdings at the fiscal year-end: the percent of outstanding shares held by institutions and the number of institutions investing in the common stock of the firm. We also calculate dividend yields as cash dividends paid per share (Compustat item 21) divided by stock price. Finally, we construct the four fundamental-to-price ratios described in Section 2.2. Similar to prior research, we exclude observations when the numerator is negative and winsorize the most extreme 1% of our observations. We measure the earnings-to-price ratio as operating income after depreciation generated from year $t-1$ to t (Compustat item 178) divided by the product of common shares outstanding (Compustat item 25) and the firm's fiscal year-end price (Compustat item 199). We measure the cash-flow-to-price ratio as cash flow generated from year $t-1$ to t divided by the product of common shares outstanding and the fiscal year-end price. Following Sloan (1996), cash flows are measured as earnings minus accruals, with earnings measured as described above and accruals measured as follows:

$$\text{Accruals}_t = (\Delta CA_t - \Delta Cash_t) - (\Delta CL_t - \Delta STD_t - \Delta TP)_t - Dep_t,$$

where

ΔCA_t = change in current assets (Compustat item 4)
ΔCL_t = change in current liabilities (Compustat item 5)
$\Delta Cash_t$ = change in cash and cash equivalents (Compustat item 1)
ΔSTD_t = change in debt included in current liabilities (Compustat item 34)
ΔTP_t = change in income tax payable (Compustat item 71) and

Dep_t = depreciation and amortization expense (Compustat item 14).

We measure the book-to-market ratio as the book value of common equity (Compustat item 60) divided by the product of common shares outstanding and the fiscal year-end price. We measure the value-to-market ratio at t as

$$\frac{\text{Book value of common equity}_t + \alpha_1\,[\text{Abnormal earnings}_t]}{\text{Common shares outstanding}_t \times \text{Price}_t}$$

and

Abnormal earnings$_t$ = Earnings$_t$ (Compustat item 18) − (Book value of common equity$_{t-1}$ × r), and

$$\alpha_1 = \frac{\omega}{1 + r - \omega},$$

where ω is the persistence factor of abnormal earnings and r, the discount rate, is set equal to the long-run average return on equity of 12%. Following Dechow et al. (1999), we measure the persistence factor ω for firm i in year t by performing the following pooled cross-sectional/time-series regression using all firm-years with available data in all prior years up to year t:

$$\text{Abnormal earnings}_{i,t-1} = \alpha_0 + \omega\ (\text{Abnormal earnings}_{i,t-2}) + \varepsilon_{i,t-1}.$$

In 1983, we use all firm-years prior to 1983, and in 1984 we use all firm-years prior to 1984, etc. We do not use information about abnormal earnings in year t since firms have different financial year-ends, and so not all information would necessarily be available for calculating ω. For more details on this model see Ohlson (1995) and Dechow et al. (1999).

4. Results

Section 4.1 provides the results of our basic analysis of the relation between short interests, fundamental-to-price ratios, and future stock returns. Section 4.2 presents additional results that provide further insights into the determinants of short interest.

4.1. Short positions and the fundamental-to-price ratios

Asquith and Meulbroek (1996) report that while most firms have less than 0.5% of their outstanding shares shorted, a few firms have very large short positions (more than 5% of outstanding shares are shorted). The distribution of short positions is very similar for our sample of 34,037 firm-years. No short positions are observed for 12,445 firm-years, or 36.6% of the observations. Approximately 46% of our firm-year observations have very small short

positions (more than zero but no more than 0.5%). However, the distribution is highly skewed, with fewer than 2% of firm-years having over 5% of their outstanding shares shorted. Fig. 1 provides a calendar time plot of short positions. The average short interest has increased over time. Part of this increase is likely to be due to the deregulation of the capital market and the growth in hedge funds. Similar time trends are also observed in our fundamental-to-price ratios. Our empirical tests take into account the effect of this serial correlation on coefficient estimates.

Panel A of Table 1 provides evidence on the relation between short positions and future returns. We sort firm-years into six categories based on the magnitude of the short position in the stock. Note that the number of observations varies across the categories, ranging from 12,445 in the category with no short positions to 564 in the category with over 5% of the outstanding shares shorted. For each category, we sort firm-years by calendar year and calculate the mean one-year-ahead abnormal return for each calendar year. The average of the 18 calendar-year mean abnormal returns are reported in Panel A. Consistent with Asquith and Meulbroek (1996) we document a negative relation between the level of short interest and future stock returns. Future abnormal returns decline monotonically with the level of short interest. For firms with no short positions, the average one-year-ahead abnormal return is 2.3%, while for firms with over 5% shorted, the average abnormal return falls to −18.1%.[4] For each of the categories with short positions, the average abnormal return is significantly lower than the average abnormal return for the firm-years with no short positions.[5]

In the tests that follow, we classify firms with over 0.5% of outstanding shares shorted as firms with "high short" positions, while the remaining firms are classified as "low short" positions. We focus on "high shorts" (as opposed to nonzero shorts) to increase the power of our tests. Large short positions are more likely to represent a consensus among short-sellers that a stock is

[4] The time-series mean abnormal return for all firms with over 0.5% shorted is −3.5% with a standard error of 0.009 (significant at the 0.001 level using a two-tailed test). The time-series mean abnormal return for firms with over 0.5% shorted but less than 5% shorted is −2.4% with a standard error of 0.012 (significant at the 0.06 level using a two-tailed test). Thus, firms that we classify as having "high short" positions have significantly negative abnormal returns.

[5] For each of the short interest portfolios, for each calendar year, we subtract the mean abnormal return on the no-short portfolio from the mean abnormal return on the short interest portfolio. We then determine whether the 18 resulting hedge portfolio returns are significant using the time-series standard errors of the hedge portfolio returns. The significance levels for each category are less than 0.06 using a two-tailed test. We also investigate the robustness of these results by computing the standard errors of portfolio returns, weighting each observation by the square root of the reciprocal of the number of observations in the portfolio. This procedure controls for any heteroskedasticity introduced by changing numbers of portfolio observations over calendar time. However, because the number of observations is relatively constant over time, it has little discernible effect on the standard errors.

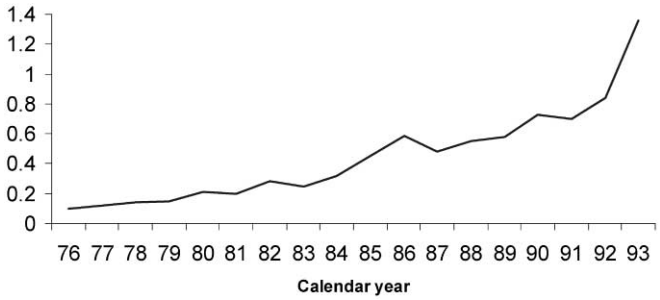

Fig. 1. Average percent of outstanding shares shorted three months after the fiscal year-end. Sample consists of 34,037 firm-year observations over the sample period 1975–1993 with data available on both the number of shares shorted and the variables required to compute the fundamental-to-price ratios.

overpriced (consistent with the return results in Panel A of Table 1). This 0.5% cutoff is arbitrary however, and so we test the sensitivity of our results to this cutoff. The tenor of our results is unchanged when we use 1% or 2.5% cutoffs.

Panel B of Table 1 reports the relation between the four fundamental-to-price ratios and future abnormal stock returns. Firm-year observations are assigned to ten portfolios based on the relative magnitude of their ratios. The ranking procedure is carried out separately for each ratio and each calendar year. We then pool the observations across calendar years such that portfolio 1 contains the lowest values of each of the ratios and portfolio 10 contains the highest values of each ratio across the sample period. Recall that prior research has documented a positive relation between one-year-ahead abnormal returns and each of the four ratios. Panel B indicates that we can replicate prior findings for our sample of firm-years. For cash-flow-to-price, the abnormal returns vary from −6.1% in portfolio 1 to 9.9% in portfolio 10. For earnings-to-price, the abnormal returns are slightly smaller, varying from −3.1% in portfolio 1 to 10.4% in portfolio 10. For book-to-market, the abnormal returns are −2.7% in portfolio 1 and 9.6% in portfolio 10. Finally, for our value-to-market ratio, the abnormal returns, range from −2.5% in portfolio 1 to 10.1% in portfolio 10. While we refer to these returns as abnormal returns, they might reflect our mis-measurement of the normal returns associated with omitted risk factors. Either way, our primary hypothesis is that short-sellers will take positions in low-ratio stocks in order to take advantage of the lower returns.

Panel B of Table 1 also reports the proportion of the observations in each portfolio with over 0.5% of outstanding shares shorted (classified as "Prop. of high shorts"). The results indicate that short positions are consistently highest in portfolios 1 and 2 for all four ratios (where the fundamental-to-price ratios and future abnormal returns are low). Also, in the case of the book-to-market and value-to-market ratios, there is a fairly steady decline in short positions as

the ratios increase. Thus, short-sellers clearly focus more heavily on stocks with low ratios of fundamentals to value. At the same time, short sales are also present even in stocks with the highest ratios of fundamentals to value. This could reflect the influence of the other reasons for short-selling that we identify in Section 2.1. Alternatively, it could reflect limitations of our measures of fundamental value to accurately capture "intrinsic" value. For example, our measures of fundamental value ignore future growth opportunities, which are clearly important determinants of firm value.

Table 2 provides chi-square tests of whether portfolio 1 has a significantly greater proportion of "high shorts" than the other portfolios for each of our four fundamental-to-price ratios. The rows split the sample into "low short" and "high short" observations. The columns rank on the magnitude of the valuation ratios. "Low" contains observations from portfolio 1, "medium" contains observations from portfolios 2 through 9, and "high" contains observations from portfolio 10. If "high shorts" are randomly distributed across the portfolios, we would expect 10% of the high shorts in "Low", 80% in "Medium" and 10% in "High."[6] The results indicate that across the fundamental-to-price ratios, 12.7 to 15.2% of the high-short firm-years fall into the lowest fundamental-to-price portfolio. For each ratio, the chi-square test rejects the null of independence at the 0.001 level. Similar results are obtained when we use 1% and 2.5% cutoffs for low versus high short positions. It is also noteworthy that high short positions are more frequent for the book-to-market and value-to-market ratios (15.2% and 14.8%, respectively) than for the cash-to-price and the earnings-to-price ratios (13.4% and 12.7%, respectively). In the next section, we investigate a potential explanation for this result. Overall, the results in Tables 1 and 2 confirm our primary hypothesis that short-sellers tend to target stocks with low fundamental-to-price ratios.

4.2. Additional tests of the determinants of short positions

The results in Tables 1 and 2 indicate that there is an economically and statistically significant concentration of short positions in firms with low fundamental-to-price ratios. However, these results also indicate that not all stocks with low fundamental-to-price ratios are heavily shorted. In this section we focus on providing additional insights into why some of these stocks are not heavily shorted. We hypothesize that there are two reasons why short-sellers choose *not* to short-sell stock with a low fundamental-to-price ratio:

(1) The transactions costs of short-selling the stock are high; and

[6] Note that Table 2 reports the relative proportion of total outstanding "high shorts" allocated to the low, medium, and high groups, respectively. In contrast, Table 1 reports the absolute proportion of "high shorts" within each portfolio (rather than the relative proportion). This is why the percentages reported in Tables 1 and 2 do not match.

Table 1
The relation between short positions, fundamental-to-price ratios, and one-year-ahead abnormal stock returns.[a]

Panel A: The relation between the proportion of shares shorted and future abnormal returns

	"Low shorts"		"High shorts"			
	No short positions	Between 0% and $\frac{1}{2}$%	Between $\frac{1}{2}$% to $1\frac{1}{2}$%	Between $1\frac{1}{2}$% to $2\frac{1}{2}$%	Between $2\frac{1}{2}$% to 5%	Over 5% shorted
Average short positions (%)	0.00	0.14	0.85	1.92	3.43	8.47
Average abnormal return	0.023	−0.005	−0.016	−0.042	−0.046	−0.181
Std error of abnormal returns	0.008	0.006	0.012	0.025	0.029	0.037
Observations	12,445	15,632	3,672	944	780	564
Overall average abnormal return	Low shorts:	0.007	High shorts:		−0.035	

Panel B: Abnormal returns and short positions for portfolios formed on fundamental-to-price ratios

	Low fundamental-to-price									High fundamental-to-price
Portfolio number	1	2	3	4	5	6	7	8	9	10
Cash-flow-to-price	0.044	0.098	0.137	0.174	0.213	0.257	0.310	0.376	0.484	0.792
Abnormal return	−0.061	−0.042	−0.018	−0.018	0.011	0.019	0.041	0.031	0.055	0.099
Prop. of high shorts	0.235	0.199	0.175	0.161	0.138	0.156	0.177	0.179	0.170	0.164
Earnings-to-price	0.047	0.094	0.124	0.149	0.175	0.200	0.233	0.273	0.339	0.541
Abnormal return	−0.031	−0.029	−0.008	−0.010	0.014	0.006	0.043	0.039	0.061	0.104
Prop. of high shorts	0.230	0.225	0.181	0.169	0.151	0.141	0.151	0.164	0.162	0.166

Book-to-market	0.245	0.416	0.548	0.669	0.785	0.904	1.043	1.220	1.505	2.292
Abnormal return	−0.027	−0.010	0.001	0.011	−0.002	0.010	0.013	0.054	0.079	0.096
Prop. of high shorts	0.259	0.219	0.175	0.175	0.171	0.165	0.156	0.133	0.121	0.108
Value-to-market	0.249	0.406	0.538	0.652	0.759	0.873	0.995	1.140	1.362	2.006
Abnormal return	−0.025	−0.017	0.001	−0.006	0.005	0.011	0.021	0.042	0.064	0.101
Prop. of high shorts	0.256	0.228	0.197	0.169	0.174	0.161	0.154	0.147	0.126	0.110

[a] Portfolios are formed for the fundamental-to-price ratios by ranking firm-year observations into ten equal-sized portfolios. All ratios are calculated using fiscal year-end data. Abnormal returns are equal-weighted average returns calculated by cumulating returns over the one-year period beginning three months after the fiscal year-end and subtracting the corresponding one-year equal-weighted return for all NYSE and AMEX stocks. Cash-flow-to-price is cash flows for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Earnings-to-price is earnings for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Book-to-market is the book value of common equity at the end of the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Value-to-market is measured as the book value of common equity at the end of the fiscal year plus the product of α_1 and abnormal earnings, all divided by the product of the number of shares outstanding and price at the fiscal year-end. Short positions, the number of common shares shorted divided by the total number of common shares outstanding, are measured three months after the fiscal year-end. % of high shorts is the percentage of short positions in each portfolio that are greater than 0.5%. The number of observations for the fundamental-to-price ratios are 24,913 for cash-flow-to-price, 30,125 for earnings-to-price, 33,878 for book-to-market, and 33,724 for value-to-market.

Average abnormal return is calculated as the average of the 18 calendar-year mean abnormal returns for each category. Standard errors are determined based on the 18 calendar-year mean abnormal returns. The sample period is from 1975 to 1993. The abnormal returns for each category with short positions are significantly different from the category with no short positions at the 5% level using a two-tailed test.

Table 2
Chi-square tests of the association between short positions and the fundamental-to-price ratios. Observations are ranked based on the magnitude of their fundamental-to-price ratios. "Low" consists of observations in portfolio 1 from Table 1 (the lowest 10%); "Medium" consists of observations in portfolios 2 through 9; "High" consists of observations in portfolio 10 (the highest 10%).[a]

Portfolios (from Table 1)		1 "Low"	2 through 9 "Medium"	10 "High"	Total
Expected percentage		10	80	10	100
Panel A: Cash-flow-to-price					
Low short	Observations	1,901	16,561	2,078	20,540
	Percentage	9.26	80.63	10.12	100
High short	Observations	584	3,382	407	4,373
	Percentage	13.35	77.34	9.31	100
				Chi-square statistic	67.99
Panel B: Earnings-to-price					
Low short	Observations	2,348	20,251	2,383	24,982
	Percentage	9.40	81.06	9.54	100
High short	Observations	654	3,868	621	5,143
	Percentage	12.72	75.21	12.07	100
				Chi-square statistic	92.86
Panel C: Book-to-market					
Low short	Observations	2,480	22,537	2,914	27,931
	Percentage	8.88	80.69	10.43	100
High short	Observations	901	4,579	467	5,947
	Percentage	15.15	77.00	7.85	100
				Chi-square statistic	234.28
Panel D: Value-to-market					
Low short	Observations	2,488	22,386	2,929	27,803
	Percentage	8.95	80.52	10.53	100
High short	Observations	876	4,609	436	5,921
	Percentage	14.79	77.84	7.36	100
				Chi-square statistic	220.81

[a]The fundamental-to-price ratios are cash-flow-to-price, earnings-to-price, book-to-market, and value-to-market. Short positions are measured three months after the fiscal year-end. "High short" consists of all firm-year observations with over 0.5% of the outstanding shares shorted, and "Low short" consists of all remaining firm-year observations. Cash-flow-to-price is cash flows for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Earnings-to-price is earnings for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Book-to-market is the book value of common equity at the end of the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Value-to-market is measured as the book value of common equity at the end of the fiscal year plus the product of α_1 and abnormal earnings, all divided by the product of the number of shares outstanding and price at the fiscal year-end. The sample period is from 1975 to 1993.

(2) Short-sellers have additional information indicating that the stock is not overpriced.

In this section, we provide the results of tests of these two hypotheses.

The discussion in Section 2.1 indicates that the transactions costs of short-selling are lower for larger, more liquid stocks. Transactions costs are also lower in stocks with significant institutional ownership, since shares of these stock are easier to borrow and less likely to be subject to a short squeeze. Finally, transactions costs are expected to be higher for firms paying dividends because stock prices tend to fall by less than the amount of the dividend the short-seller is required to reimburse. Panel A of Table 3 presents the means, standard errors of the means, and medians for market value, institutional holdings, number of institutions, and dividend yield across the high and low short groups. For each calendar year, we calculate the mean and median of each variable. We report the mean of the 11 calendar-year means and the median of the 11 calendar-year medians. We test whether the means of the low and high shorts differ by subtracting the calendar-year means of the low shorts from those of the high shorts. All differences are statistically significant at the 1% level using a two-tailed test. The results indicate that all variables examined in Table 3 differ across the high and low short groups in the manner predicted by the transactions costs hypothesis. Firms with high short positions tend to be larger, have greater institutional ownership, and pay lower dividends.

Panel B of Table 3 tests the transactions costs hypothesis using a multivariate regression framework in order to control for potential correlated omitted variables. The dependent variable, "high short," is an indicator variable that takes the value of one in observations with short positions greater than 0.5% of shares outstanding and zero otherwise. We drop the "number of institutions" variable from this analysis because it is designed to capture the same underlying construct as the "institutional holdings" variable. The tenor of the regression results is unchanged when the log of the number of institutional investors is used instead of the percentage of outstanding shares held by institutional investors. We also include an indicator variable that takes on a value of one if the observation has a low fundamental-to-price ratio (i.e., in the lowest decile) and zero otherwise, in order to demonstrate that the transactions costs variables do not subsume the predictive ability of the fundamental-to-price ratios. This possibility is particularly evident in the case of the dividend yield variable. Recall that dividend yield is the ratio of dividends to price, and dividends generally correlate positively with other fundamentals. This provides the following regression specification:

$$\begin{aligned}\text{High short} = {} & \beta_0 + \beta_1 \text{Low fundamental ratio} + \beta_2 \text{Log(market value)} \\ & + \beta_3 \text{Institutional holding} + \beta_4 \text{Dividend yield}.\end{aligned}$$

Table 3
Analysis of the relation between short positions and firm characteristics affecting the transactions costs of short-selling. In Panel A, "High shorts" consist of all firm-year observations with more than 0.5% of their outstanding shares shorted, and "Low shorts" consist of all remaining firm-year observations. In Panel B, "High short" is an indicator variable equal to one for firms with more than 0.5% of their outstanding shares shorted, and zero otherwise.[a]

	Short position (%)	Market value	Institutional holdings (%)	Number of institutions	Dividend yield	Total number of observations across 11 calendar years
Panel A						
Mean						
Low shorts	0.098	1,191.4	0.234	47.7	0.032	15,334
High shorts	2.238	1,572.0	0.326	85.4	0.025	4,809
Standard error of the mean						
Low shorts	0.005	130.3	0.008	2.8	0.003	
High shorts	0.140	129.7	0.020	6.1	0.003	
Median						
Low shorts	0.027	142.4	0.178	15.8	0.019	15,334
High shorts	1.158	463.4	0.338	51.9	0.015	4,809

Panel B

High short $= \beta_0 + \beta_1$Low fundamental ratio $+ \beta_2$Log(market value) $+ \beta_3$Institutional holdings $+ \beta_4$Dividend yield $+ \varepsilon$

	β_0	β_1	β_2	β_3	β_4	Average adj R^2(%)
Predicted sign	?	+	+	+	−	
Cash-flow-to-price						
Mean estimate	−0.017	0.068[c]	0.040[b]	0.210[c]	−1.095[d]	6.71
Std error	0.015	0.021	0.004	0.081	0.512	

Earnings-to-price						
Mean estimate	−0.016	0.043[b]	0.040[b]	0.197[c]	−0.993	6.81
Std error	0.012	0.013	0.004	0.077	0.546	
Book-to-market						
Mean estimate	0.017[d]	0.083[c]	0.036[b]	0.208[c]	−1.005	6.89
Std error	0.009	0.035	0.003	0.087	0.583	
Value-to-market						
Mean estimate	−0.007	0.130[d]	0.039[b]	0.209[c]	−0.973	7.34
Std error	0.012	0.037	0.004	0.082	0.581	

[a] Short positions, the number of common shares shorted divided by the total number of common shares outstanding, are measured three months after the fiscal year-end. Cash-flow-to-price is cash flows for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Earnings-to-price is earnings for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Book-to-market is the book value of common equity at the end of the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Value-to-market is measured as the book value of common equity at the end of the fiscal year plus the product of α_1 and abnormal earnings, all divided by the product of the number of shares outstanding and price at the fiscal year-end. Market value is the product of the number of shares outstanding and the market price measured at fiscal year-end (in millions). Institutional holdings (%) is the total number of shares held by institutions divided by the number of shares outstanding measured at the fiscal year-end. Number of institutions is the number of institutions holding shares in the firm at the fiscal year-end. Dividend yield is total dividends paid during the fiscal year divided by price at the end of the fiscal year. Low fundamental ratio is an indicator variable equal to one for observations in the lowest decile of the fundamental-to-price ratio (portfolio 1 in Table 1), and zero otherwise.

In Panel A, the reported means (medians) are based on calendar-year means (medians). Differences in means between the high short and low short groups are calculated for each variable for each calendar year. For all variables, the differences in means are significantly different from zero at 1% level or better using a two-tailed test.

In Panel B, a separate cross-sectional regression is estimated for each calendar year and the coefficients' standard errors are calculated from the annual coefficient estimates using the estimator proposed by Newey and West (1987). The total number of observations used in the regressions are as follows: for cash-flow-to-price, 14,414; earnings-to-price, 17,163; book-to-market, 19,950; and value-to-market, 19,831. The sample period is from 1975 to 1993.

[b] The mean coefficient estimate is significantly different from zero at the 1% level using a two-tailed test.

[c] The mean coefficient estimate is significantly different from zero at the 5% level using a two-tailed test.

[d] The mean coefficient estimate is significantly different from zero at the 10% level using a two-tailed test.

We perform Fama-MacBeth cross-sectional regressions. Each calendar year we estimate a separate cross-sectional regression and the coefficients' standard errors are calculated from the annual coefficient estimates. Inspection of the time-series behavior of the coefficient estimates provides some evidence of autocorrelation. The autocorrelation is generally positive and is particularly prevalent at the first lag, but negligible beyond the third lag. Accordingly, we compute our standard errors using the estimator proposed by Newey and West (1987) with three lags. We also use this Newey and West estimator to compute the standard errors of the Fama-MacBeth coefficients in all of the remaining regressions in the paper.

The results in Panel B of Table 3 generally confirm the univariate analysis. Each of the transactions cost variables bears the hypothesized sign and, with the exception of the dividend yield variable, they are statistically significant. The dividend yield variable is insignificant in all but the cash-flow-to-price regression. Dividends and measures of intrinsic value are highly correlated, and the resulting multicollinearity renders the dividend yield variable insignificant. As a result, it is difficult for us to know if the negative coefficient on dividend yield is attributable to the higher transactions costs associated with shorting high yield stocks, or if high yields are capturing higher fundamental-to-price ratios. The low fundamental ratio variables load with positive and statistically significant coefficients in all four regressions, reinforcing our primary hypothesis that stocks with low ratios have higher short positions. Note that this relation holds true even after controlling for dividend yield and the other transactions costs variables, so it is not the case that the fundamental-to-price ratios are simply proxying for the transactions costs of short-selling. Overall, the results in Table 3 confirm that short-sellers load up on stocks with low fundamental-to-price ratios, but simultaneously avoid stocks with high transactions costs.

The second reason that short-sellers might choose not to take a position in a stock with a low fundamental-to-price ratio is that they have additional information indicating that the security is not likely to experience a price decline. While stocks with low fundamental-to-price ratios experience lower stock returns on average, it is certainly not the case that each low-ratio stock underperforms. In fact, some of the lowest fundamental-to-price stocks, such as Cisco Systems, have performed consistently well for extended periods of time. In addition, firms can report temporarily low ratios due to temporarily low fundamentals rather than to temporarily high prices. For example, cash flows are frequently temporarily low due to nonrecurring items.[7] It is possible

[7] Cash flows are frequently low due to investments in working capital and one-off restructuring activities, such as severance payments. Earnings are also frequently temporarily low due to one-off charges such as write-offs, restructuring charges, and losses on the sale of investments. Book values are less frequently temporarily low, but occasionally this occurs for firms in highly cyclical industries. Thus we expect that temporarily low fundamentals will not be as pervasive for the book-to-market ratio.

that short-sellers are able to use additional information to identify stocks with temporarily low fundamentals and avoid shorting them. If short-sellers are successful in avoiding such stocks, then we expect that stocks with *both* low fundamental-to-price ratios *and* high short positions will experience relatively lower returns than stocks with low fundamental-to-price ratios but with low short positions.

We formally investigate this possibility in Table 4. Four variables are reported for each fundamental-to-price ratio: (i) the fundamental-to-price ratio in the portfolio formation year (labeled "current value of ratio"), (ii) the fundamental-to-price ratio one year later (labeled "future value of ratio"), (iii) the change in the fundamental over the year, and (iv) the change in price over the year. We deflate the change in the fundamental by the price at the beginning of the year. We use abnormal returns as the measure of the change in price over the year. Recall that portfolio 1 contains firms with low fundamental-to-price ratios that tend to increase as the ratios mean-revert. These ratios can mean-revert through either increasing fundamentals or declining stock prices. We predict that short-sellers will select the firms in portfolio 1 that are more likely to have declining stock prices as opposed to increasing fundamentals. In other words, short-sellers are able to distinguish between firms for which a low ratio is due to temporary overpricing versus temporarily low fundamentals.

Portfolio 10 is included in Table 4 for comparative purposes. Recall that portfolio 10 consists of firms with high fundamental-to-price ratios (that tend to decline over time). This portfolio consists of firms that earn positive expected returns. However, the results in Table 1 indicate that short-sellers also target some of these high-ratio firms. We predict that short-sellers will select firms within portfolio 10 that are less likely to earn positive expected returns. In other words, short-sellers avoid firms for which a high ratio is due to temporary underpricing versus temporarily high fundamentals.

We first discuss the results for the lowest cash-flow-to-price ratio (portfolio 1) firms. Table 4 indicates that at the time of portfolio formation, firms with high and low short positions have identical mean cash-flow-to-price ratios of 0.042. One year later, these ratios have reverted to 0.181 and 0.139, respectively. We next investigate whether this mean reversion is due to increasing fundamentals or declining prices. The results indicate that firms with low short positions have significantly larger increases in fundamentals relative to firms with high short positions (0.095 versus 0.054). A difference-in-means test for the change in fundamentals is significant at the 1% level. This is consistent with short-sellers identifying and avoiding firms with low ratios that are attributable to temporarily low cash flows. Finally, the results indicate that firms with low short positions have significantly smaller reductions in prices relative to firms with high short positions (-5.9% versus -16.6%). A difference-in-means test for the change in prices

Table 4
Tests investigating the ability of short-sellers to target firms with fundamental-to-price ratios that mean-revert through changing fundamentals versus changing prices.[a]

Portfolio	Short position	Current value of ratio		Future value of ratio		Change in fundamental		Change in price	
		Mean	Std. error	Mean	Std. error	Mean	Std. error	Mean	Std. error
		CF_t/P_t		CF_{t+1}/P_{t+1}		$\Delta CF_{t+1,t}/P_t$		Abnormal return	
1	Low short	0.042	0.003	0.181	0.007	0.095	0.010	−0.059	0.015
	High short	0.042	0.003	0.139	0.012	0.054	0.007	−0.166	0.022
	P-value	0.981		0.009		0.004		0.000	
10	Low short	0.782	0.021	0.521	0.020	−0.251	0.020	0.057	0.015
	High short	0.790	0.026	0.525	0.029	−0.237	0.032	−0.013	0.034
	P-value	0.767		0.849		0.710		0.080	
		E_t/P_t		E_{t+1}/P_{t+1}		$\Delta E_{t+1,t}/P_t$		Abnormal return	
1	Low short	0.044	0.005	0.095	0.007	0.017	0.005	−0.060	0.015
	High short	0.045	0.005	0.089	0.007	0.021	0.007	−0.118	0.026
	P-value	0.786		0.607		0.614		0.046	
10	Low short	0.548	0.025	0.461	0.022	−0.016	0.016	0.064	0.014
	High short	0.593	0.024	0.508	0.023	0.009	0.026	−0.027	0.025
	P-value	0.202		0.157		0.420		0.006	
		B_t/M_t		B_{t+1}/M_{t+1}		$\Delta B_{t+1,t}/M_t$		Abnormal return	
1	Low short	0.234	0.018	0.313	0.019	0.074	0.006	−0.070	0.027
	High short	0.225	0.016	0.311	0.020	0.091	0.006	−0.111	0.021
	P-value	0.763		0.968		0.081		0.273	

10	Low short	2.350	0.115	2.018	0.100	−0.082	0.025	0.012	0.018
	High short	2.460	0.124	2.068	0.129	−0.135	0.040	−0.061	0.036
	P-value	0.518		0.763		0.296		0.102	
		Value_t/M_t		$\text{Value}_{t+1}/M_{t+1}$		$\Delta\text{Value}_{t+1,t}/M_t$		Abnormal return	
1	Low short	0.176	0.024	0.382	0.018	0.179	0.011	−0.101	0.020
	High short	0.176	0.023	0.345	0.021	0.144	0.010	−0.158	0.017
	P-value	0.950		0.234		0.026		0.046	
10	Low short	2.003	0.097	1.651	0.091	−0.030	0.027	0.038	0.014
	High short	2.059	0.113	1.569	0.085	−0.051	0.043	−0.032	0.038
	P-value	0.663		0.595		0.733		0.112	

[a] "High shorts" consist of all firm-year observations with more than 0.5% of their outstanding shares shorted, and "Low shorts" consists of all remaining firm-year observations. Short positions, the number of common shares shorted divided by the total number of common shares outstanding, are measured three months after the fiscal year-end. Portfolio 1 consists of all firm-years in the lowest decile and portfolio 10 consists of firms in the highest decile of fundamental-to-price ratios (see Table 1). The fundamental price ratios are cash-flow-to-price (CF_t/P_t), earnings-to-price (E_t/P_t), book-to-market (B_t/M_t), and value to market (Value_t/M_t). The mean value in the year of portfolio formation is provided in column 3 followed by the mean of the ratio in the following year (column 5). The mean change in the fundamental ratio scaled by the current year's price is provided in column 7 and the mean change in price is provided in column 9. Change in price is the annual change in the denominator of the fundamental-to-price ratio. The change in price is calculated equivalently to the measure of abnormal returns, where abnormal returns are calculated by cumulating returns over the one-year period beginning three months after the fiscal year-end and subtracting the corresponding one-year equal-weighted return for all NYSE and AMEX stocks. Calendar-year means are first calculated for each of the 18 years in our sample. Reported means are the means of the 18 calendar-year means. Standard errors and *P*-values are based on the 18 calendar-year means. Reported *P*-values are for *t*-tests of differences in means. The sample period is from 1975 to 1993.

is significant at the 1% level. This is consistent with short-sellers identifying and targeting firms with low ratios that are attributable to temporarily high stock prices. Overall, these results confirm that short-sellers are able to distinguish between firms for which a low cash-flow-to-price ratio is due to temporarily low fundamentals versus temporarily high prices, and modify their strategy accordingly.

For comparative purposes, Table 4 also reports the cash-flow-to-price ratios for portfolio 10. Recall that this portfolio of firms has positive expected stock returns. If short-sellers choose to position themselves in firms in this portfolio, then they must use information other than the cash-flow-to-price ratio to select which securities will have poor future stock price performance. The results indicate that firms with low short positions have significantly larger price increases relative to firms with high short positions (5.7% versus −1.3%). Thus, short-sellers are able to identify a subsample of the high cash-flow-to-price ratio firms that have poor stock price performance.

Table 4 goes on to provide a similar analysis of each of the other three fundamental-to-price ratios. In each case, we see that short-sellers are able to identify which of the low fundamental-to-price ratio stocks are more likely to have larger future stock price declines. Further, the differences are statistically significant at the 5% level or better for all but the book-to-market ratio. However, for ratios other than cash-flow-to-price, we see less evidence that short-sellers are able to identify which of the low-ratio firms have temporarily low fundamentals. This is consistent with the established fact that cash flows consist of more transitory components than other fundamentals (Dechow, 1994). Finally, we see that short-sellers are able to identify which of the high fundamental-to-price ratios are less likely to have stock price increases, though the differences are only statistically significant for the earnings-to-price ratio.

In summary, the evidence in Table 4 indicates that short-sellers use information in addition to that in simple fundamental-to-price ratios to predict future stock returns. This evidence helps explain why short-sellers do not target all firms with low fundamental-to-price ratios and why they sometimes target firms with high fundamental-to-price ratios. We also find that short-sellers' ability to supplement a simple fundamental-to-price strategy is greatest in the case of the cash-flow-to-price strategy, where they are able to screen out low-ratio firms with temporarily low fundamentals. This result helps explain why we see relatively fewer "high short" observations in the low cash-flow-to-price portfolio in Table 2.

Thus far, our evidence indicates that short-sellers target firms with low fundamental-to-price ratios and poor future stock price performance. However, we have provided no direct evidence that short-sellers move in and out of securities to take advantage of the predictable stock return behavior associated with fundamental-to-price ratios. In Table 5, we provide direct

evidence that short-sellers move into securities for which these ratios decline and move out of securities to cover and profit from their positions as the ratios increase. This is accomplished by estimating a regression of the change in short interest on the change in the fundamental-to-price ratio, where changes are measured over annual intervals and the regression is estimated separately for each calendar year. If short-sellers cover their positions as the fundamental-to-price ratios revert to more normal levels, then we should observe a negative relation between the respective changes. As in Table 4, we also decompose the change in the fundamental-to-price ratio into the change that is attributable to changing fundamentals versus changing prices. To the extent that short-sellers open and cover their positions in response to predictable price changes, we should observe a positive coefficient on the "change in price" variable. To the extent that short-sellers positions respond to temporary fluctuations in fundamentals, we should see a negative coefficient on the "change in fundamental" variable.[8]

For each of the four alternative measures of fundamentals, Table 5 reports summary statistics for two Fama-MacBeth regressions. The first regression is the simple change specification and the second regression incorporates the decomposition of the change in the fundamental-to-price ratio into the change in the fundamental and the change in price. The first regression reveals that there is a negative and statistically significant relation for three of the four ratios. The relation only lacks statistical significance for the earnings-to-price ratio. Thus, the results generally confirm our primary hypothesis that short-sellers' positions track changes in fundamental-to-price ratios. The second regression reveals a very strong positive relation between changes in short positions and changes in prices. This result indicates that short-sellers take positions in stocks experiencing price runups and then cover their positions as prices decline. The relation between short positions and changes in fundamentals (changes in the numerator) is again mixed. For the cash-flow-to-price and earnings-to-price ratios, the relation is weak and statistically insignificant. This is consistent with short-sellers identifying temporary fluctuations in these ratios, and not engaging in short-selling activity around changes in the fundamental-to-price ratios that are driven by temporary fluctuations in the fundamentals. In contrast, for the book-to-market and value-to-price ratios, there is a strong negative relation between changes in fundamentals and changes in short positions. These results are consistent with short-sellers being able to identify transitory components in cash flows and

[8] For example, a low cash-to-price ratio can revert to normal levels through an increase in the numerator (increasing future cash flows) or a decrease in the denominator (decreasing future prices). If short-sellers can distinguish between mean reversion due to increasing cash flows rather than decreasing prices, we would only expect them to take positions in low-ratio firms in which decreasing future prices are expected. This will lead to an insignificant coefficient on the change in cash flows and a significantly positive coefficient on the change in price.

Table 5
Tests of the explanatory power of changing fundamental-to-price ratios and their components with respect to changes in short interest.[a]

Change in short interest = $\beta_0 + \beta_1$Change in fundamental-to-price ratio + β_2Change in fundamental + β_3Change in price

		β_0	β_1	β_2	β_3	Average
Predicted sign		?	−	−	+	adj R^2(%)
Cash-flow-to-price						
Reg 1	Mean estimate	0.0226[b]	−0.0420[b]			0.09
	Std error	0.0044	0.0115			
Reg 2	Mean estimate	0.0233[b]		−0.0028	0.0967[b]	1.43
	Std error	0.0038		0.0185	0.0179	
Earnings-to-price						
Reg 1	Mean estimate	0.0276[b]	−0.0554			0.12
	Std error	0.0061	0.0517			
Reg 2	Mean estimate	0.0264[b]		0.0278	0.1017[b]	1.75
	Std error	0.0042		0.0344	0.0178	
Book-to-market						
Reg 1	Mean estimate	0.0218[b]	−0.0580[b]			0.50
	Std error	0.0036	0.0139			
Reg 2	Mean estimate	0.0278[b]		−0.0492[b]	0.1125[b]	1.82
	Std error	0.0030		0.0109	0.0184	

Value-to-market						
Reg 1	Mean estimate	0.0225[b]	−0.0528[b]			0.39
	Std error	0.0038	0.0121			
Reg 2	Mean estimate	0.0280[b]		−0.0453[b]	0.1167[b]	1.80
	Std error	0.0030		0.0071	0.0176	

[a] Change in short interest is equal to the annual change in short positions measured three months after the fiscal year-end. Short position, calculated as the number of common shares shorted divided by the total number of common shares outstanding, is measured three months after the fiscal year-end. Change in fundamental-to-price ratio is the annual change in the fundamental-to-price ratio. Change in fundamental is the annual change in the numerator of the fundamental-to-price ratio. Change in price is the annual change in the denominator of the fundamental-to-price ratio. This is calculated equivalently to the measure of abnormal returns, where abnormal returns are calculated by cumulating returns over the one-year period beginning three months after the fiscal year-end and subtracting the corresponding one-year equal-weighted return for all NYSE and AMEX stocks. The fundamental-to-price ratios are calculated as follows. Cash-flow-to-price is cash flows for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Earnings-to-price is earnings for the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Book-to-market is the book value of common equity at the end of the fiscal year divided by the product of the number of shares outstanding and price at the fiscal year-end. Value-to-market is measured as the book value of common equity at the end of the fiscal year plus the product of α_1 and abnormal earnings, all divided by the product of the number of shares outstanding and price at the fiscal year-end. For each calendar year, a separate cross-sectional regression is estimated and the coefficients' standard errors are calculated from the annual coefficient estimates using the estimator proposed by Newey and West (1987). The total number of observations used in the regressions are as follows: for cash-flow-to-price, 20,397; earnings-to-price, 25,179; book-to-market, 29,709; and value-to-market, 29,531. The sample period is from 1975 to 1993.

[b] The mean coefficient estimate is significantly different from zero at the 1% level using a two-tailed test.

earnings but not in book value and intrinsic value. The results help explain why we see relatively fewer "high short" observations in the low cash-flow-to-price and earnings-to-price portfolios in Table 2. It appears that short-sellers are able to attribute some of the low ratios to temporarily low fundamentals rather than temporarily high prices, and so avoid shorting such stocks.

5. Conclusion

In this study, we provide evidence that short-sellers position themselves in stocks with low fundamental-to-price ratios. We analyze four ratios of fundamental-to-price: cash-flow-to-price, earnings-to-price, book-to-market, and value-to-market. Prior research has already established that these ratios have predictive ability with respect to the cross-section of future stock returns. The contribution of this study is to demonstrate that short-sellers act as if they use these ratios to identify overpriced stocks, and then cover their positions as prices decline to bring the stocks' values back in line with the fundamentals.

In addition to showing that short-sellers use the information in fundamental-to-price ratios, we also show that short-sellers further refine their investment strategies. First, we show that short-sellers concentrate on shorting stocks for which the transactions costs associated with short-selling are relatively low. Second, we show that short-sellers are able to distinguish between firms for which the low fundamental-to-price ratios are driven by temporarily high stock prices and firms with temporarily low fundamentals. Finally, we show that short-sellers supplement information in the low fundamental-to-price ratios with additional information that predicts future stock returns.

Our findings have implications for the debate concerning the source of the predictable stock returns associated with fundamental-to-price ratios. The leading explanations for these predictable returns are unidentified risk factors (Fama and French, 1992), research design flaws (Barber and Lyon, 1997; Kothari and Warner, 1997), and temporary mispricing (Lakonishok et al., 1994). We provide evidence that short-sellers actively exploit the predictable returns associated with these ratios. The temporary mispricing explanation is most consistent with our findings. Conventional wisdom, along with our survey of large hedge funds, suggests that one motivation for short-selling is to profit from stock price declines. Our results are consistent with short-sellers using the information in fundamental-to-price ratios to identify overpriced securities and profit from the subsequent price declines. Of the other two explanations, the research design flaws explanation is least consistent with our findings. If the predictable returns associated with low fundamental-to-price ratios stem from research design flaws, it is difficult to understand why short-sellers would systematically try and exploit these predictable returns. Finally, the uni-

dentified risk factors explanation, while more difficult to reconcile with our findings, cannot be ruled out. First, it is possible that short-sellers have unique risk preferences that lead them to actively trade in and out of short positions to maintain their preferred risk profile. However, we are unable to find any short-sellers who articulate their objectives in this way. Second, short-sellers might mistakenly attribute the lower returns associated with low fundamental-to-price stocks to temporary overpricing, when the lower returns are in fact due to unidentified risk factors. If this is the case, then our findings still provide a framework for understanding the behavior of short-sellers. Our findings also then suggest that even sophisticated investors, such as short-sellers, do not seem to understand the risk factors that have been so elusive to academics.

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