Investor short-termism and asset pricing

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Abstract

This paper proposes an empirical approach to quantify short-term trading and examines its impact on the market's pricing of firm fundamentals. Short-term trading has become the dominant force in the U.S. capital market, accounting for about 78% of total dollar trading volume and bringing total share turnover to over 100% per quarter in recent years. In contrast, quarterly institutional turnover has been remarkably stable over time, averaging about 20% over the past 25 years. More important, we find that a reasonable level of short-term trading helps to make the market more efficient, but excessive short-term trading in the capital market could have some negative effects on market efficiency. Short-term trading could hinder the market's ability to incorporate information about firm fundamentals into asset prices, a result consistent with the theoretical prediction by Froot, Scharfstein, and Stein (1992). Stock prices tend to overreact to fundamentals news when short-term trading is at a high volume. In subsequent periods, the incremental price changes associated with excessive short-term trading are almost entirely reversed.

Keywords: Short-term investors, trading volume, stock return, price discovery.

JEL: G10, G11, G12, G14, G23, M40, M41

1. Introduction

In this paper, we examine the impact of short-term trading on the market's incorporation of news about firm fundamentals into stock prices. Short-term trading refers to all short-term trading activities by hedge funds and traditional institutional traders not associated with quarterly changes in institutional 13f holdings.[1] The motivation for this study is twofold. First, owing to the rising popularity of hedge funds and proprietary trading, short-term trading has become a dominant driver of trading volume in the U.S. capital market over the past 15 years. Second, short-term trading strategies are often agnostic to a stock's price level and have no intrinsic interest in the fate of companies, giving a firm's fundamentals, such as earnings and cash flows, a less important role than purely statistical return correlations in these trading strategies. A key objective of the financial reporting system is to provide a firm's fundamental information to the capital markets (e.g., Verrecchia 2001; the mission statement of Financial Accounting Standards Board). When investors trade stocks on the basis of information about firm fundamentals, in equilibrium stock prices converge to their fundamental values (Ball and Brown 1968; Kothari 2001; Lee 2001). However, when most trades are based on statistical and often short-lived correlations in stock returns and investors do not hold stocks for investment purposes, the presence of efficient pricing becomes more questionable.

Both intuition and theory suggest that short-term traders can either improve or hinder market efficiency. On one hand, short-term traders can identify temporary deviations of stock prices from firm fundamentals, and their trading helps to arbitrage away transitory price

[1] Much of short-term trading is high-frequency trading. Some contemporaneous papers (e.g., Brogaard 2011) examine the effect of high-frequency trading using the Nasdaq high frequency data that cover 120 stocks from 2008 to 2009. The Nasdaq high frequency data are not suitable for this study at least for two reasons. First, there is little variation in high-frequency trading on these 120 large-cap stocks during the 2008-2009 period, compared to huge variations in short-term trading as illustrated in Figure 2. Second, the 2008-2009 period covers essentially the financial crisis, which introduces many confounding effects. The market reaction to fundamental news is likely to be different during the financial crisis relative to other periods.

distortions. On the other hand, theoretical models (Froot, Scharfstein, and Stein 1992) suggest that a market with more short-horizon traders performs less efficiently than one with long-term investors, possibly because short-horizon traders may choose to study information unrelated to firm fundamentals. Vives (1995) suggests that short-horizon traders reduce price informativeness with concentrated arrival of information, which is likely to be the case for earnings news such as earnings announcements. Yet, to date, little empirical research has investigated how short-term trading affects asset prices. In this paper, we quantify short-term trading using publicly available databases (CRSP and 13f) and investigate its impact on the market's pricing of firm fundamentals.

We use a large sample of firms from the Center for Research in Security Prices (CRSP) and the Thomson Reuters Institutional Holdings databases during 1985–2009. We find that institutional turnover was remarkably stable (around 20% per quarter) throughout the 1985–2009 sample period, even though institutional holdings steadily increased from 40% in 1985 to over 60% in 2009.[2] From 1985 to 1994, stock turnover was also very stable—around 17% per quarter, a number close to the average institutional turnover over the same time period. However, quarterly stock turnover increased dramatically after 1995, climbing to over 100% by 2009. The drastic divergence of stock turnover from the turnover of institutional holdings coincides with the emergence and rising popularity of short-term trading by hedge funds and proprietary trading desks. We estimate that short-term trading was responsible for about 78% of the dollar trading volume in 2009, even after conservatively assuming that it was zero prior to 1995. This surge in short-term trading naturally raises concerns regarding its beneficial or harmful effects for U.S. capital markets.

[2] Aggregate institutional turnover (about 80% per year) can be viewed as the weighted average of turnovers between active and passive institutional investors. Active traditional institutions often have an annual turnover budget ranging from 100% to 150%, whereas passive investors typically have extremely low turnovers (5-10% per year).

Our investigation reveals that a reasonable level of short-term trading helps to improve market efficiency, but excessive short-term trading could hinder the market's ability to incorporate news about a firm's fundamentals into asset prices, a result consistent with the prediction of Froot, Scharfstein, and Stein (1992). Using earnings surprises and analyst forecast revisions as proxies for news about firm fundamentals, we find that stock prices react more strongly to news about fundamentals when short-term trading is at a high volume. However, the incremental price reactions associated with such short-term trading are almost entirely reversed in the subsequent quarter. Taken together, the evidence suggests that excessive short-term trading exaggerates otherwise sound price reactions.

We conduct a variety of sensitivity checks and find that our results are robust to measurement errors and to alternative specifications. We also show that the recent surge in short-term trading is largely driven by hedge funds and other institutional traders rather than by individual investors.

This paper contributes to the accounting and finance literature in several important ways. First, this investigation provides an empirical method for estimating short-term trading volume for a large dataset and opens the area for future research. Although short-term trading is undocumented in SEC filings, our estimate suggests that it accounts for 78% of the total trading volume of 2009, in comparison to a much smaller fraction of trading volume filed in 13f filings by institutional investors. Our evidence raises the question that the dominance of short-term trading (78% in recent years) may not be optimal for the capital market. Second, we provide evidence that excessive short-term trading adversely affects the market's ability to incorporate information about firm fundamentals into asset prices. If our conclusion regarding short-term trading withstands further scrutiny, it has broad implications for the financial reporting system and for regulators. For example, regulators need to consider some disclosure of short-term trading, which may discourage certain trading behavior. Finally, this study shows that stock turnover increased dramatically over the past 15 years owing to the emergence and popularity of short-term trading. Such intertemporal structural changes in stock trading volume and price dynamics have implications for studies that assume volatility, trading volume, or price discovery to be stationary over time (no structural changes are allowed in the classic Fama-MacBeth approach).

The rest of the paper is structured as follows. Section 2 discusses the institutional background of short-term trading and reviews the prior literature. Section 3 describes the sample data and introduces the empirical approach used to estimate short-term trading. Section 4 presents the main results, Section 5 conducts robustness checks, and Section 6 concludes.

2. Background and prior literature

During the late 1980s and 1990s, traders across the world abandoned the traditional open-outcry system in favor of electronic trading desks as deregulation of the financial markets prompted a huge shift to screen-based trading. Since the mid 1990s, increased market liquidity and technological advances have created ideal conditions for the spread of automated trading. Short-term trading firms often deploy automated trading strategies across one or more asset classes that identify and profit from short-term price regularities. Short-term strategies try to earn small amounts of money on each trade, with the small profits from individual trades being amplified by high trading volume.[3]

Whether short-term trading acts to improve price discovery is not obvious. On one hand,

[3] The TABB Group, a consulting company in New York City, estimated that, as of 2009, high-frequency trading firms account for 73% of all U.S. equity trading volume. www.tabbgroup.com/PublicationDetail.aspx?PublicationID=505&MenuID=13&ParentMenuID=2&PageID=8.

short-term traders could spot temporary price distortion and their trading could directly eliminate price inefficiency. Additionally, short-term traders can bring liquidity to the market, as evidenced in increasing trading volume and narrower bid–ask spreads, and the increased liquidity may allow traditional institutional investors to more easily adjust their portfolios to reflect their fundamentals-based views on company performance. Thus, short-term trading may improve price discovery by helping to move the stock price toward its fundamental value. Prior studies examine the effect of trading on price discovery using institutional ownership data.[4] For example, Cohen, Gompers, and Vuolteenaho (2002) find that institutions buy shares from (sell shares to) individuals in response to positive (negative) cash-flow news, thus exploiting the underreaction phenomenon. Ke and Ramalingegowda (2005) show that transient institutional investors tend to exploit the post-earnings announcement drift.

On the other hand, short-term traders do not hold stocks for investment purposes and do not have any intrinsic interest in the fate of companies. Many short-term trading strategies are based solely on the statistical properties of short-term stock returns and order imbalance, and pay little attention to firm fundamentals. Theoretical models suggest that short-term traders could hurt market efficiency. For example, Froot, Scharfstein, and Stein (1992) show that short-horizon traders may put too much weight on short-term information and not enough on firm fundamentals, a practice making the market less efficient. Vives (1995) suggests that short-horizon traders may reduce price informativeness with concentrated arrival of information, which is likely to be the case around earnings news events. Additionally, Bushee (2001) finds that high levels of transient ownership are associated with an overweighting of near-term expected earnings.

This study examines whether short-term trading helps to improve the market

[4] As we show in the paper, short-term trading is not documented in the institutional holding database (13f filings).

incorporation of a firm's fundamentals news. Specifically, we consider two types of fundamentals news: earnings surprises and analysts' revision in their earnings forecasts. Prior literature shows that investors react positively to earnings news but that the reaction is incomplete, suggesting a stock price drift after the earnings news (Ball and Brown 1968; Bernard and Thomas 1990; Stickel 1991; Hand 1991; Chan et al. 1996; Zhang 2006). For example, Ball and Brown (1968) find that changes in annual earnings and stock returns are positively correlated and stock prices drift in the same direction as earnings news in subsequent years. Joy et al. (1977) and Bernard and Thomas (1990) show that the post-earnings announcement drift is stronger for seasonally differenced quarterly earnings. A parallel literature has emerged on the post-revision drift (e.g., Stickel 1991; Chan et al. 1996), which shows that stock prices exhibit a drift after analysts' forecast revisions.

Investigators often attribute short-term stock price continuation to investor behavioral biases such as investor underreaction to new information (e.g., Chan et al. 1996), where the market response to recently released information is gradual so that prices exhibit predictable drift patterns. Given the drastic increase in short-term trading over the past 15 years, an interesting question is how short-term trading affects the market's response to fundamental earnings news. Conceivably, academic documentation of the post-earnings news drift and increasing arbitrage activities may eliminate such stock anomalies. In this paper, we propose an empirical approach to quantify short-term trading by combining CRSP trading volume data with 13f institutional trading data and examine its role in the market's reaction to fundamental earnings news.

3. Sample selection and descriptive statistics

3.1 Sample selection

Our initial sample contains all stocks with a price of at least $1 covered by the CRSP since 1977, when analysts' earnings forecasts first became available in I/B/E/S. Following prior literature (Bernard and Thomas 1990; Stickel 1991; Chan et al. 1996), we replicate the post-earnings announcement drift and the post-revision drift using the 1977–1994 period. To estimate our short-term trading measure, we use institutional trading data covered by Thomson Reuters Institutional Holdings databases (13f) to back out long-term institutional trading and use a difference-in-difference research design to control for long-term individual trading. Quarterly institutional data are widely available from 1985 onward, which restricts our short-term trading tests to the quarters between the first quarter of 1985 and the second quarter of 2009. As we clarify later, we use the 1985–1994 period as the estimation period, and we use the 1995–2009 period as the main testing sample, which contains 391,013 firm-quarter observations. As the Thomson Reuters Institutional Holding database contains only data at the quarterly level, the sample is composed of firm-quarter observations. Quarterly stock turnover, which is defined as trading volume divided by outstanding shares, is calculated from CRSP. To account for the double counting of dealer trades for Nasdaq firms (Gould and Kleidon 1994), Nasdaq trading volume is divided by two.

We use the Thomson Reuters Institutional Holdings database to calculate, for each quarter, institutional holdings and institutional turnover for each stock. In the U.S., investment companies, which include banks, insurance companies, parent companies of mutual funds, pension funds, university endowments, hedge funds, and numerous other types of professional investment advisors, are required to file the 13f form with the SEC every calendar quarter, which is covered by the Thomson Reuters Institutional Holdings database. However, the Thomson Reuters database does not cover all institutional holdings, since fund managers with less than

$100 million assets under their control are not required to file the 13f form, although they may still choose to do so. Also, fund managers may omit small holdings (fewer than 10,000 shares or $200,000) and confidentiality-related holdings from the 13f. Following the literature (Bushee 1998), we define institutions covered by the 13f filings as "institutional investors" and calculate institutional holdings for a given company by aggregating stock holdings across all institutional investors and then scaling by the company's outstanding shares. Institutional turnover is defined as the sum of absolute change in the holdings of a company's shares across all institutional investors divided by the average of beginning and ending institutional holdings, with shares all stock split adjusted.

In general, institutional holdings and net changes are well specified in the Thomson Reuters database. If a fund manager consistently reports its holdings on each stock, stock holdings from the previous quarter plus net change in the current quarter should be equal to stock holdings at the end of the current quarter. One issue with the data is that net changes are coded incorrectly from the second quarter of 2006 (2006Q2) to the first quarter of 2007 (2007Q1). A manual check of the data revealed that virtually all net changes appear to be coded incorrectly as stock holdings at the end of the previous quarter multiplied by minus one (-1).[5] In light of this data error, we recalculate net changes as the difference in institutional holdings between two adjacent quarters for the period between 2006Q2 and 2007Q1. If every institution reports its holdings each quarter, then the alternative approach to calculate net changes is equivalent to the main approach. To the extent that in the Thomson Reuters database the institutional investor

[5] In response to an inquiry about this issue, the Wharton Research Data Service stated that "we provide Thomson data as it is supplied from the vendor, and our policy is to maintain the data integrity so we do not make corrections or any changes to original feed that we receive from the vendor. Unfortunately, Thomson has no plans to fix this problem."

universe changes from quarter to quarter, this alternative methodology for the calculation of net changes is inferior.

Figure 1 plots value-weighted institutional ownership, institutional turnover, and stock turnover from 1985Q1 to 2009Q2. Institutional ownership steadily increases from 40% in 1985 to over 60% in 2009. Institutional turnover is remarkably stable and stays at about 20% in each quarter throughout the sample period. In contrast, quarterly stock turnover hovers around 17% between 1985 and 1994 and then increases to 115% in 2008, a result in line with the evidence in Chordia et al. (2010). The gradual increase in stock turnover beginning in the mid-1990s coincides with the emergence and rising popularity of short-term trading by hedge funds and proprietary trading desks.

3.2 Measuring short-term trading

Conceptually, short-term trading (*STT*) is meant to capture all short-term trading activities by hedge funds and traditional investors as well as individual investors. We classify institutional trading captured by 13f filings as long-term institutional trading and use 13f data and total stock turnover from CRSP to back out short-term trading.[6] Specifically, to empirically estimate the variable *STT* at the firm level, we classify investors into three categories: long-term institutional investors, long-term individual investors, and short-term traders. Therefore, we can rewrite stock turnover as follows:

[6] Institutional investors' intra-quarter trades (the purchase and subsequent sale of a stock in a single calendar quarter) are not captured by our measure of institutional turnover as institutions only file 13f forms quarterly. Such trades are classified as short-term trading and thus are properly captured in our *STT* measure. In addition, 13f database covers hedge funds, so hedge funds' long-term trading is excluded from our *STT* measure.

$$
\begin{aligned}
TO &= \frac{VOL_{TOTAL}}{SHROUT} \\
&= \frac{VOL_{INST} + VOL_{INDIV} + VOL_{STT}}{SHROUT} \\
&= \frac{VOL_{INST}}{INSTHLD} * \frac{INSTHLD}{SHROUT} + \frac{VOL_{INDIV}}{INDIVHLD} * \frac{INDIVHLD}{SHROUT} + \frac{VOL_{STT}}{SHROUT} \\
&= INSTTO * INST + INDIVTO * INDIV + STT
\end{aligned} \tag{1}
$$

where TO is stock turnover; VOL_{TOTAL} is total share volume; VOL_{INST} is share volume traded by long-term institutional investors; VOL_{INDIV} is share volume traded by long-term individual investors; VOL_{STT} is share volume traded by short-term traders; $SHROUT$ is shares outstanding; $INSTHLD$ is shares held by long-term institutional investors; $INDIVHLD$ is shares held by long-term individual investors; $INSTTO$ is institutional turnover ($VOL_{INST}/INSTHLD$); $INST$ is institutional holdings ($INSTHLD/SHROUT$); $INDIVTO$ is individual turnover ($VOL_{INDIV}/INDIVHLD$); $INDIV$ is individual holdings ($INDIVHLD/SHROUT$); and STT is short-term trading volume. As we define STT as all short-term trading activities by hedge funds and other traders not captured in the 13f database, short-term traders' holdings are zero at the end of each quarter.

The CRSP and Institutional Holding databases allow direct calculation of TO, $INSTTO$, and $INST$, but $INDIVTO$, $INDIV$, and STT are not directly observable. $INSTTO$ and $INST$ capture long-term institutional investors' holdings and trading behavior. To control for long-term individual investors' holdings and trading behavior ($INDIVTO$ and $INDIV$), we adopt a difference-in-difference approach by making the following two assumptions. (1) We take short-term trading in the 1985–1994 period as the benchmark and measure STT empirically in the 1995-2009 period as incremental short-term trading over and above this benchmark.[7] In this way,

[7] The choice of 1994 as the cutoff is arbitrary. The rationale is that the 1985–1994 period is close to a steady state in terms of trading volume and institutional trading. Our results are robust to alternative cutoffs, such as 1993, 1995, or 1996.

STT captures newly increased short-term trading due to the rising popularity of hedge funds and proprietary trading as well as the availability of Internet trading for individuals. Figure 1 suggests that 1985–1994 reflected a steady state during which both institutional turnover and stock turnover were relatively stable. The 1985-1994 benchmark will be taken care of by our research design in Section 4, where we take a difference-in-difference approach and examine the effect of incremental short-term trading on asset pricing in the 1995–2009 period relative to the 1985-1994 period. Therefore, for simplicity, we can interpret that *STT* measures all types of short-term trading, which is conservatively assumed to be zero in the 1985-1994 period. (2) We assume that long-term individual investors' trading behavior relative to the behavior of long-term institutional investors is on average stable over time.[8] This assumption does not require long-term individual investors' trading behavior to be stable. Rather, the assumption states that, if long-term individual investors trade more during some periods, such as the financial crisis, long-term institutional investors should also trade more during the same time periods. To the extent that our assumption holds, long-term individual investors' trading is properly excluded from our *STT* measure.[9]

Assumption (1) enables calculation of *INDIVTO* and *INDIV* by setting *STT* to be zero for the 1985–1994 period, given that (1) *INST* + *INDIV* = 1 and (2) *INST**INSTTO* + *INDIV**INDIVTO* = *TO*. Assumption (2) allows us to quantify individual turnover and estimate it for the 1995–2009 period, which is the main test period for the empirical analyses. The following table summarizes the value-weighted average of key variables for the 1985–1994 time period.

[8] The availability of Internet trading is likely to increase individual investors' short-term trading but not their long-term trading.
[9] If, relative to institutional traders, individual investors trade more frequently in the 1995–2009 period than in the 1985–1994 period, such incremental trading is classified as short-term trading and is captured by our *STT* variable.

	INST	*INSTTO*	*TO*
Calculated from CRSP and Thomson Reuters	44.66%	19.96%	16.85%
	INDIV	*INDIVTO*	*INDIVTO/INSTTO*
Based on the line above and assumptions	54.32%	14.34%	71.81%

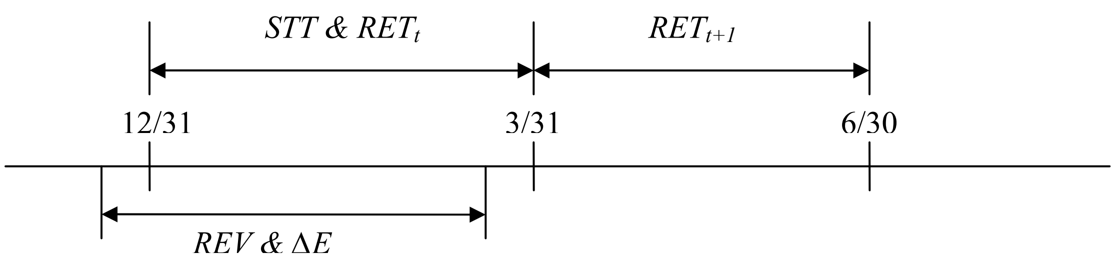
The table shows that, on average, individual turnover is about 71.81% of institutional turnover in 1985–1994. Next, using these calculations, for each firm-quarter in the main 1995–2009 sample period, we calculate short-term trading as follows:

$$\begin{aligned} STT &= TO - INSTTO * INST - INDIVTO * INDIV \\ &= TO - INSTTO * INST - (0.7181 * INSTTO) * (1 - INST) \end{aligned} \qquad (2)$$

Figure 2 shows the percentage of short-term trading in total dollar volume (value-weighted *STT* / *TO*) over time. The percentage increases from zero in early 1995 to around 78% in 2009, a remarkable number given that the SEC does not require any filing on such trading behavior.[10]

3.3 Descriptive statistics

We use earnings surprise (ΔE) and analyst earnings revision (*REV*) to proxy for fundamentals news. As *STT* is measured quarterly, we construct ΔE and *REV* quarterly to be in line with the *STT* window. The figure below illustrates how we measure these variables.



[10] Some people argue that short-term trading brings liquidity to the market. From the liquidity perspective, 78% is clearly excessive. If short-term trading provides all liquidity needed in the market, the maximum percentage is 50%, where the maximum is surely overstated as it assumes that everybody trades with short-term trading firms.

REV is the consensus analyst earnings forecast in the last month of each calendar quarter minus the consensus forecast three months prior, scaled by stock price in the last month of the calendar quarter. As I/B/E/S reports its monthly files on the third Thursday of each month, the *REV* window may lead the *STT* window by 5–10 business days, leaving the market enough time to react to the revision news. ΔE and *STT* align in such a way that the earnings announcement date falls in the *STT* window. We require the earnings announcement date to be no more than three months after the fiscal quarter ending date.

Table 1, Panel A presents summary statistics based on the main testing sample (1995–2009). On average, the firms in the sample have a market value of $287 million and a book-to-market ratio of 0.601. Institutional investors own 34.5% of the average firm. Short-term traders, on average, trade 4.3% of outstanding shares each quarter. Panel B of Table 1 shows the correlation matrix. *STT* is highly positively correlated with firm size (*SIZE*), confirming the anecdotal evidence that short-term traders focus on large-capitalization stocks. As expected from equation (2), *STT* is highly correlated with *TO* with a correlation of about 0.6. Panel C of Table 1 shows the Spearman correlation between contemporaneous stock returns and trading activities. When stock returns are positive, they are positively correlated with trading activities, with correlations of 0.227, 0.221, and 0.053 with *TO*, *INSTTO*, and *STT*, respectively. When stock returns are negative, they are negatively correlated with trading activities, with correlations of -0.174, -0.158, and -0.077 with *TO*, *INSTTO*, and *STT*, respectively. These correlations suggest that trading activities are not directional and tend to be more active for both extremely high and extremely low returns.[11]

[11] The prior literature finds that trading volume is positively correlated with past returns (e.g., Lee and Swaminathan 2000) and negatively correlated with future returns (e.g., Datar, Naik, and Radcliffe 1998). One innovation of this paper is to examine the effect of trading activities on stock returns based on the nature of news (positive vs. negative earnings news).

4. Research design and results

4.1 Research design

We face two challenges when designing empirical tests. First, as Figure 2 shows, *STT* is not stationary but increases from near zero in 1995 to about 78% in 2009. Such structural changes in trading behavior coincide with the rising popularity of hedge funds and proprietary trading in the 1995–2009 period. Second, *STT* is not directly observable and is thus measured with error, which may affect our empirical analyses.

To address these two issues, we use a difference-in-difference-in-difference approach. Specifically, in Sections 4.2 and 4.3, we first employ a fixed-effect model with both firm and time (year-quarter) fixed effects. The model of firm- and time-fixed effects is essentially equivalent to the difference-in-differences approach common in the literature. For example, to examine the impact of short-term trading on pricing of firm fundamentals, the fixed-effect model compares the market reaction to fundamentals news experienced by high-*STT* stocks with the market reaction experienced by low-*STT* stocks. The firm fixed effect controls for differences across firms, and the time fixed effect controls for differences over time, forcing the regression to estimate a difference in differences. This fixed-effect approach is widely used to test the impact of structural changes, such as the impact of algorithmic trading on liquidity (Hendershott et al. 2010) and the impact of government ownership on bank lending (Sapienza 2004). To address potential correlation among regression residuals, we allow for residuals to be clustered by firm.

Next, in Section 4.4, we use the difference between the results from the main sample period (1995–2009) and the results from the estimation period (1985–1994) to identify the impact of short-term trading. By assuming the absence of *STT* during 1985–1994, we assume that measurements from the estimation period reflect only systematic measurement error of *STT*. As long as systematic measurement error is time-invariant, the difference between the results from the 1985–1994 time period and the results from the 1995–2009 time period should reflect only the incremental effect of short-term trading on pricing of firm fundamentals. In Section 5, we specifically consider the possibility of time-varying measurement error due to the changing nature of individual trading relative to institutional trading.

4.2 Replication of the post-earnings announcement drift and the post-revision drift

In this section, we replicate the post-earnings announcement drift and the post-revision drift. With respect to the post-earnings announcement drift, Bernard and Thomas (1990) show that stock prices drift in the same direction of earnings news in the 1974-1986 period. Using a sample from 1980–1985, Stickel (1991) shows that analyst revisions in earnings forecasts affect stock prices, but prices do not immediately assimilate the information. Similarly, Chan et al. (1996) document the post-analyst revision drift in the 1977–1993 period. As we test both the post-earnings announcement drift and the post-revision drift, we use a unified sample period (1977–1994) to replicate prior studies, where 1977 represents the first year when analysts' forecast data became available in I/B/E/S. We also partition the sample into two sub-periods: 1977–1984 and 1985–1994, where the 1985–1994 sub-period is our estimation period with available institutional holding data.

To test the market reaction to earnings news and the subsequent price drift, we adopt two regression models:

$$\begin{aligned} RET_{i,t} &= \alpha_0 + \alpha_1 NEWS_{i,t} + \alpha_2 SIZE_{i,t-1} + \alpha_3 BM_{i,t-1} \\ &\quad + \alpha_4 RET\_12_{i,t-1} + \mu_i + \tau_t + \varepsilon_{i,t} \end{aligned} \tag{3}$$

$$RET_{i,t+1} = \beta_0 + \beta_1 NEWS_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 BM_{i,t} + \beta_4 RET\_12_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (4)$$

where *i* indexes the firm and *t* indexes the year. The dependent variable is either contemporaneous stock returns ($RET_{i,t}$) or future stock returns ($RET_{i,t+1}$). Fundamental earnings news (*NEWS*) is proxied either by earnings surprises (ΔE) or by analyst forecast revision (*REV*). *SIZE* is firm size. *BM* is the book-to-market ratio. *RET_12* is the past 12-month stock returns prior to earnings news. The firm and year fixed effects are denoted by μ and τ, respectively. Finally, ε is an idiosyncratic error term. Please see the appendix for detailed variable definitions. Regression (3) is to test the market's response to earnings news, whereas regression (4) is to examine the post-news drift.

Table 2 confirms the positive correlation between the market reaction and earnings news and the post-news drift documented in the prior literature. Specifically, the left block of Panel A shows that contemporary stock returns and earnings surprises are positively correlated after controlling for firm size, book-to-market ratio, and past stock returns. The right block of Panel A shows that earnings surprises are positively correlated with future stock returns, suggesting a post-earnings announcement drift. The results hold not only for the whole 1977–1994 period but also for each of two sub-periods. Panel B reports similar results when we use analyst forecast revisions as a proxy for earnings news. Overall, our research methodology confirms the post-earnings announcement drift and the post-revision drift in our sample.

4.3 The effect of short-term trading in pricing of firm fundamentals

This section addresses the role of short-term trading in the market's incorporation of news about company fundamentals into stock prices. For each type of news (ΔE or *REV*), we employ two regression models. Taking ΔE as an example,

$$RET_{i,t} = \alpha_0 + (\alpha_1 + \alpha_2 STT_{i,t}) * \Delta E_{i,t} + \alpha_3 STT_{i,t} + \alpha_4 SIZE_{i,t-1} + \alpha_5 BM_{i,t-1} + \alpha_6 RET\_12_{i,t-1} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (5)$$

$$RET_{i,t+1} = \beta_0 + (\beta_1 + \beta_2 STT_{i,t}) * \Delta E_{i,t} + \beta_3 STT_{i,t} + \beta_4 SIZE_{i,t-1} + \beta_5 BM_{i,t-1} + \beta_6 RET\_12_{i,t-1} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (6)$$

In Equation (5) the dependent variable is contemporaneous stock returns, and in Equation (6) the dependent variable is future stock returns. Following the earnings–return literature, $\alpha_1 + \alpha_2 STT$ should be positive in Equation (5). A positive coefficient on ΔE ($\beta_1 + \beta_2 STT$) in Equation (6) indicates a post-news drift, whereas a negative coefficient indicates a reversal. Of interest is the sign of β_2 relative to the signs of α_2 and β_1.

Table 3 reports the results of estimations (5) and (6), where Panel A is based on earnings surprises and Panel B is based on analysts' forecast revisions. In each panel, the dependent variables are contemporaneous stock returns in the first two models and future stock returns in the last two models. In Panel A, the first column shows that contemporaneous returns and earnings surprises are strongly positively correlated, a result consistent with the general finding in the accounting literature that stock prices react positively to earnings news. The second column shows an $\hat{\alpha}_2$ equal to 0.250 (t = 2.96), suggesting that the market reaction to earnings surprises is stronger for high-*STT* stocks. Regarding the economic magnitude, one standard deviation increase of *STT* strengthens the price reaction to earnings surprises by 24% (=0.34*0.250/0.354). The last two models, columns (3) and (4), are based on future stock returns. Column (3) shows a negative but insignificant coefficient on ΔE. A negative coefficient suggests that stock prices reverse in the subsequent three months, but the reversal is statistically insignificant. Apparently, the huge increase in short-term trading in the 1995-2009 period relative to earlier periods helps to eliminate the post-earnings drift in our sample.[12] Given that *STT* accounts for about 40% of trading volume in the 1995-2009 period, on average, we interpret the result that a reasonable level of short-term trading (40% of trading volume) makes the market more efficient. Column (4) reveals that $\hat{\beta}_2$ is significantly negative ($\hat{\beta}_2$ = -0.220, t = -3.69), suggesting that stock prices reverse more strongly for high-*STT* stocks. Our interpretation is that, when short-term trading is excessive (above average), it pushes stock price too far in the direction of earnings news and, as a result, stock prices reverse in the subsequent period.

Panel B reports the results of estimations (5) and (6) when we use analyst forecast revision to proxy for fundamentals news. The results are qualitatively similar to those reported in Panel A, with positive coefficients on *REV*STT* in regressions using contemporaneous returns and negative coefficients on *REV*STT* in regressions using future returns. One standard deviation increase of *STT* strengthens the price reaction by 8.3% (=0.34*0.472/1.925).[13] One notable difference is that the coefficient on *REV* is statistically significant in column (3) of Panel B, suggesting a stock reversal for *REV* news at the aggregate level. A stronger reversal for *REV* news relative to ΔE news is consistent with the fact that firms with analyst coverage are more likely to be followed by short-term traders, as evidenced in the strong positive correlation between *STT* and analyst coverage (spearman correlation = 0.39).

Taken together, these results suggest that short-term trading affects the market's incorporation of fundamentals information into stock prices. A reasonable level of short-term trading helps to make the market more efficient. But too much short-term trading, as evidenced

[12] In a similar vein, Green, Hand, and Soliman (2011) shows that arbitrage helps to eliminate the accrual anomaly in recent years.

[13] The economic magnitude is different between earnings surprises (Panel A) and analyst forecast revision news (Panel B) because they are two different types of earnings news with different market reactions. Apparently, the market reaction is stronger to analyst forecast revision (t-statistics around 70 on *REV*) than to earnings surprises (t-statistics around 20 on ΔE).

in the later half of the sample period, pushes stock prices too far in the direction of earnings news and, as a result, stock prices reverse in the subsequent months after the initial reaction. In fact, $\hat{\alpha}_2$ and $\hat{\beta}_2$ are very similar in magnitude but have opposite signs, suggesting that the excessive-*STT*-related market reaction to earnings news is almost fully reversed in the subsequent months.[14]

4.4 Quantifying the effect of measurement error on the variable *STT*

As short-term trading is not directly observable, some simplifying assumptions apply to empirically estimating *STT*. Consequently, *STT* is estimated with error. This section presents an attempt to gauge the effect of measurement error on the key findings.

As shown in Section 3.2, Equation (2) is used to calculate *STT* for each firm-quarter in the 1995–2009 period. Using the same equation, we can calculate *STT* for each firm-quarter in the 1985–1994 period and this *STT* estimate captures measurement error introduced in the estimation process.[15] By construction, the value-weighted average of *STT* across all firm-quarters should be zero for 1985–1994, but in a regression framework as used in this paper, the mean value of *STT* is irrelevant because it is captured by the intercept (firm and time dummies). We redo the main tests presented in Table 3 using the 1985–1994 sample. If measurement error has no impact on our results, the coefficients on key variables of interest should be close to zero.

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[14] One alternative explanation is that short-term traders identify mispricing opportunities and trade more as arbitrageurs when other investors overreact to earnings news. This mechanism is unlikely because stock price reverses in subsequent quarters, whereas short-term traders do not hold any position at the end of each quarter by construction (otherwise they have to file 13f). Short-term traders cannot profit from price reversal if they do not hold their positions long enough.

[15] Following assumption (1) in Section 3.2, an alternative interpretation of measurement errors is that they capture old-fashioned short-term trading in the 1985–1994 period, whereas *STT* in the 1995–2009 period captures incremental short-term trading by hedge funds and proprietary trading desks as well as individual investors owing to advanced in technology and reduced transaction costs. In interpreting the assumption in this way, we essentially test whether old-fashioned short-term trading affects pricing of firm fundamentals in the 1985–1994 period in a way similar to our *STT* variable in the 1995–2009 period. Note that short-term trading is less significant in the 1985–1994 period, as Figure 1 indicates.

Table 4 reports the results of the price discovery test. Panel A is based on earnings surprises and Panel B is based on analyst forecast revisions. In both panels, the coefficients on fundamentals news are highly positive in column (1), confirming the earnings–return relationship for the 1985–1994 period. More importantly, the coefficients on *STT*REV* and *STT*ΔE* are insignificantly different from zero across all models, suggesting that the market's incorporation of fundamentals news is uncorrelated with measurement error.

Overall, we conclude that measurement error in *STT* does not affect the market pricing in response to fundamentals news. The incremental short-term trading by hedge funds and proprietary trading desks plays a unique role in asset pricing in the 1995–2009 period.

5. Sensitivity tests and additional analyses

5.1 Whether trading volume serves as a proxy for short-term trading?

As institutional turnover is relatively stable over time, *STT* and stock turnover (*TO*) are highly correlated in the 1995–2009 sample period, with a correlation coefficient of about 0.6. Given such a high degree of correlation, one might wonder whether trading volume serves as a good proxy for short-term trading. In this section, we expand our sample to include all stocks with non-missing values of *TO* and extend the sample period back to 1977, when analysts' forecast data are first available in I/B/E/S. Then, we partition the sample period into three sub-periods—1977–1984, 1985–1994, and 1995–2009—and test whether trading volume has any impact on pricing in response to fundamentals news in each sub-period.

Table 5 reports the empirical results from the analysis on trading volume, where we use earnings surprises and analyst forecast revisions to proxy for fundamentals news in Panel A and B, respectively. The main variables of interest are *ΔE*TO* and *REV*TO*. In Panel A, the first block shows regressions of contemporaneous stock returns. Returns are positively correlated with earnings surprises, and the positive correlation is stronger for high-*TO* stocks in all three sub-periods. The second block of Panel A shows regressions of future stock returns. In all three sub-periods, stock prices drift in the direction of earnings news after the initial market reaction. Apparently, the inclusion of small stocks in Table 5 leads to an average effect of drift in the last sub-period, as opposed to an insignificant post-earnings announcement reversal in Table 3, where we require non-missing *STT*. The absence of short-term trading in these small stocks helps to preserve the post-earnings announcement drift in the overall sample, as documented in Table 5.[16] More importantly, the coefficient on Δ*E*TO* is significantly negative only in Model 6, suggesting a weaker price drift for high-*TO* stocks in the 1995–2009 sub-period. The insignificant coefficients on Δ*E*TO* in the 1977–1984 and the 1985–1994 sub-periods suggest that trading volume does not play a universal role in the market pricing of firm fundamentals.[17]

The results from the analyst revision regressions in Panel B are largely similar. The market shows a stronger response to analyst revisions for high-*TO* stocks. In Models 1 and 3 the coefficients on *REV* are significantly positive, suggesting a price drift after analyst revisions in the 1977–1984 and 1985–1994 sub-periods. Model 5 reports a negative coefficient on *REV*, indicating a price reversal in the 1995–2009 sub-period. Again, the price reversal results from the fact that we exclude small firms, as we require non-missing analyst forecast data in the test. Analysts cover roughly half of the stocks publicly traded in the U.S., and stocks with no analyst coverage are associated with less active short-term trading. More importantly, the coefficient on *REV*TO* is significantly negative only in Model 6, suggesting a stronger price reversal for high-*TO* stocks in the 1995–2009 sub-period that echoes the *STT* results in Table 3.

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[16] Taken together, the results suggest a post-earnings announcement drift using the Compustat universe. The drift is very strong among small stocks with little short-term trading. For stocks with considerable short-term trading, we observe a reversal as documented in Table 3.

[17] *STT* does not capture a universal trading volume effect. If trading volume has a consistent effect on price discovery, we should expect similar results on the interaction term across all three sub-periods,

Taken together, the above results reveal that the impact of trading volume on price discovery is not universal throughout the whole sample period (1977–2009). The results offer no evidence of price reversals and the associated effect on trading volume in the 1977–1984 and the 1985–1994 sub-periods. The turnover results are also mixed between two proxies for earnings news in the 1995–2009 sub-period. Overall, we interpret the evidence as suggesting that our *STT* variable does a better job than trading volume of capturing incremental short-term trading by hedge funds, proprietary trading desks, and individual investors owing to advanced in technology and reduced transaction costs.

5.2 Institutional vs. individual investors in short-term trading

Our *STT* measure captures both institutional and individual investors' short-term trading volume. Intuitively, institutional investors, such as hedge funds and proprietary trading desks, should be responsible for the huge increase in short-term trading over the past 15 years. However, over time individual investors have also become more active in stock trading, owing to technological advances such as the availability of online trading. As a result, overall stock turnover has increased over time and the *STT* measure could capture this increase in individual trading behavior. In this section, we examine whether institutional or individual investors contribute more to short-term trading.

To test whether individual investors contribute more to short-term trading, the following model explores cross-sectional and time-series variations in *STT*:

$$\begin{aligned} STT = {} & \beta_0 + \beta_1 INDIV + \beta_2 SIZE + \beta_3 BM + \beta_4 RET\_12 + \beta_5 sd\Delta ROE \\ & + \beta_6 sdSGR + \beta_7 DISP + \beta_8 LEV + \beta_9 (1/P) + e_t \end{aligned} \tag{7}$$

where *STT* is short-term trading, *INDIV* is individual holdings, *SIZE* is firm size, *BM* is the book-to-market ratio, and *RET_12* is the past 12-month stock returns, $sd\Delta ROE$ is earnings surprise volatility, *sdSGR* is sales growth volatility, *DISP* is analyst forecast dispersion, *LEV* is market leverage, *AGE* is firm age, *INST* is institutional holdings, 1/*P* is the inverse of stock price (see the appendix for detailed definitions).

The main variable of interest is *INDIV*. If individual investors have traded more frequently in recent years and *STT* captures such individual trading behavior, then *STT* should be higher for stocks with higher individual holdings, resulting in a positive coefficient on *INDIV*. We control for other possible factors that may determine short-term trading. First, as trading may be related to risk, we include three common return factors (*SIZE*, *BM*, and *RET_12*) as control variables. Second, short-term trading may be related to a firm's fundamental volatility. Three variables capture fundamental volatility: earnings surprise volatility (*sd*Δ*ROE*), sales growth volatility (*sdSGR*), and analyst forecast dispersion (*DISP*). Finally, prior literature suggests that leverage and market microstructure affect stock volatility and liquidity (Christie 1982; Cheung and Ng 1992). Accordingly, we include market leverage (*LEV*) and the inverse of stock price (*1/P*) in the model.

Table 6 reports the results of three incrementally richer specifications of Equation (7). Model 1 is a univariate regression of *STT* on *INDIV*. The coefficient on *INDIV* is highly negative. This finding is not consistent with the idea that an increase in individual investors' trading dominates our *STT* measure. In Model 2, we add three common return factors. We control for firm size, because size often proxies for liquidity. Model 2 shows that *STT* is positively correlated with firm size, the book-to-market ratio, and price momentum. More importantly, the coefficient on *INDIV* remains highly negative. In Model 3, we add additional proxies for fundamental volatility (*sd*Δ*ROE*, *sdSGR*, and *DISP*), market leverage, and the reciprocal of the stock price. Market leverage and stock price also capture liquidity.[18] The coefficient on *INDIV* remains highly significant, with *t*-statistics over 20.

Overall, the results are inconsistent with the view that *STT* mainly captures increased individual trading behavior over time. Rather, *STT* is more likely to capture short-term trading by hedge funds and other institutional investors.

5.3 Different windows to determine the *INDIVTO/INSTTO* ratio

The main analysis uses the 1985–1994 time period to determine the ratio of institutional turnover to individual turnover. The choice of 1985–1994 is arbitrary, although Figure 1 suggests that during this period both stock turnover and institutional turnover were in a steady state. In a robustness check, we use the 1985–1989 time period as the baseline for key calculations (see Section 3.2), and the tenor of the original findings remains unchanged. For example, the coefficients on $\Delta E*STT$ come to equal 0.249 (t = 2.97) and -0.229 (t = -3.87) in columns (2) and (5) of Panel A of Table 3, respectively. We also rerun our analysis using 1988–1989 as the baseline time period, which excludes the crash of 1987. Again, the results are qualitatively similar to the original findings.

5.4 The double-count issue for Nasdaq firms

To account for market-maker activity in calculating Nasdaq trading volume, we divide Nasdaq firms' trading volume by two in the main analysis. As a robustness check, we treat trading volume as it is and redo the analysis. This alternative specification does not significantly alter the original findings. For example, the coefficients on $\Delta E*STT$ come to equal 0.264 (t = 4.71) and -0.176 (t = -3.60) in columns (2) and (5) of Panel A of Table 3, respectively. Since market-maker activity varies across Nasdaq firms and over time, a uniform cutoff may still

[18] Traditional liquidity measures, such as trading volume and bid–ask spread, are not included in the model as these measures are directly affected by *STT*.

introduce measurement error into the trading volume measure. As an alternative approach, we exclude Nasdaq firms from the sample and find the tenor of the paper unchanged.[19] For example, the coefficients on $\Delta E*STT$ come to equal 0.167 (t = 2.45) and -0.289 (t = -4.17) in columns (2) and (5) of Panel A of Table 3, respectively.

6. Conclusions and discussion

In this paper, we empirically estimate the volume of short-term trading in the U.S. capital market and examine its effect on market pricing of firm fundamentals. Analysis shows that, in terms of trading volume, short-term trading has become the dominant force in the equity market, accounting for about 78% of total dollar trading volume in the first two quarters of 2009 (the most recent data available). Short-term trading has brought total share turnover to over 100% per quarter in recent years. In contrast, quarterly institutional turnover has been remarkably stable over time, averaging about 20% over the past 25 years.

More importantly, this study shows that a reasonable level of short-term trading helps to make the market more efficient, but too much short-term trading hinders price discovery, supporting the theoretical prediction of Froot, Scharfstein, and Stein (1992). In more recent periods, the market apparently overreacts to a firm's fundamentals news (proxied by analyst forecast revision and earnings surprises) when short-term trading is at a high volume. The incremental price changes associated with excessive short-term trading are almost entirely reversed in the subsequent periods. Taken together, the evidence suggests that, notwithstanding many benefits of short-term trading, the dominance of short-term trading in recent years (78% of trading volume) is likely to be suboptimal to the capital market.

[19] Conceptually, excluding Nasdaq firms from the sample is suboptimal, as Nasdaq was at the forefront of electronic trading and many hedge funds' strategies originated from Nasdaq.

This analysis warrants several caveats. First, as short-term trading is not directly observable, estimating the volume of short-term trading requires some simplifying assumptions. While we conduct a number of analyses to assess the effects of measurement errors on our results and are confident that the results are not driven by measurement errors, our results must be interpreted with that possibility in mind. Second, owing to data limitations we measure short-term trading at the quarterly level. The quarterly research design has some important advantages: it gives a good overall picture of short-term trading's share of total U.S. trading volume, and it describes the prolonged effect short-term trading has on price dynamics and on market efficiency. However, the quarterly research design also has some limitations. Data permitting, an interesting approach would be to use inter- or intra-day data to study the impact of short-term trading. Finally, short-term trading could have many positive effects on market efficiency that are not examined in this paper. One needs to balance different effects of short-term trading in making policy implications.

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Appendix: Variable Definitions

RET	Quarterly returns, defined as cumulative stock returns for a given calendar quarter.
INST	Institutional holdings, defined as the average of beginning and ending shares held by institutional investors divided by the average of beginning and ending outstanding shares in each calendar quarter. Both shares held by institutional investors and outstanding shares are from the Thomson Reuters Institutional Holdings database (tfn.s34).
INSTTO	Institutional turnover, defined as |CHANGE| divided by the average of beginning and ending shares held by institutional investors, where |CHANGE| is total shares traded by all institutional investors measured as the sum of the absolute value of CHANGE across all institutional investors in tfn.s34. Beginning shares equal ending shares minus net change from tfn.s34, except for the 2006Q2–2007Q1 sub-period when net changes are coded incorrectly in tfn.s34 (see Section 3 for more details). Beginning shares are derived from ending shares in the prior quarter and, together with ending shares, are used to calculate net changes for the 2006Q2–2007Q1 sub-period.
TO	Total share turnover, defined as trading volume divided by the average of beginning and ending outstanding shares in each calendar quarter. Trading volume is divided by two for Nasdaq firms in the main analysis to account for the double-count issue.
STT	Short-term trading volume, defined as TO – INST*INSTTO – (1– INST)*INSTTO* MULTIPLE, where MULTIPLE is the value-weighted average ratio of individual holding turnover to institutional holding turnover in the 1985–1994 period.
ΔE	Earnings surprises, defined as earnings per share (IBQ/(CSHOQ*AJEXQ)) in quarter q minus earnings per share in quarter q-4, deflated by stock price (PRCCQ/AJEXQ) in quarter q. All items are from Compustat quarterly.
REV	Analyst forecast revision, defined as the consensus analyst earnings forecast in the last month of each calendar quarter minus the consensus forecast three months prior, scaled by stock price in the last month of the calendar quarter.
SIZE	Firm size, defined as the logarithm of the market value of equity (CSHOQ*PRCCQ) at the beginning of quarter q. All items are from Compustat quarterly.
BM	Book-to-market ratio, defined as the ratio of the book value of equity (CEQQ) to its market value (CSHOQ*PRCCQ) at the beginning of quarter q. All items are from Compustat quarterly.
RET_12	Past 12-month stock returns, defined as accumulated 12-month stock returns starting from 12 months prior to a firm's fiscal quarter-end to 1 month prior to quarter-end.
sdΔROE	Earnings surprise volatility, measured as the standard deviation of earnings changes relative to four quarters ago scaled by average book value of equity over the past 12 quarters.
sdSGR	Sales growth volatility, measured as the standard deviation of sales growth relative to four quarters prior $((Sales_q - Sales_{q-4})/Sales_{q-4})$ over the past 12 quarters.
DISP	Analyst forecast dispersion, measured as the standard deviation of analysts' one-quarter-ahead earnings forecasts scaled by stock price. Quarterly DISP is calculated as the average of analyst forecast dispersion across three months.
LEV	Market leverage, defined as the sum of short- and long-term debt (DLTTQ+DLCQ) scaled by the market value of equity. All items are from Compustat quarterly.
P	Stock price from the CRSP monthly file, unadjusted for stock splits and stock dividends.

Figure 1 The time-series pattern of institutional ownership, institutional turnover, and stock turnover

This figure plots the time-series pattern of quarterly institutional ownership, institutional turnover, and stock turnover from the first quarter of 1985 to the second quarter of 2009. Institutional ownership is the percentage of stock shares owned by institutions as defined in the Thomson Reuters Institutional Holdings database. Institutional turnover is the turnover of institutional holdings, defined as the number of shares traded by all institutions each quarter divided by the average of beginning and ending institutional holdings. Stock turnover is total trading volume each quarter divided by outstanding shares. The sample includes all firms covered by the CRSP and Thomson Reuters Institutional Holdings databases with stock prices of no less than $1. All three series are value-weighted averages across all firms in the sample.

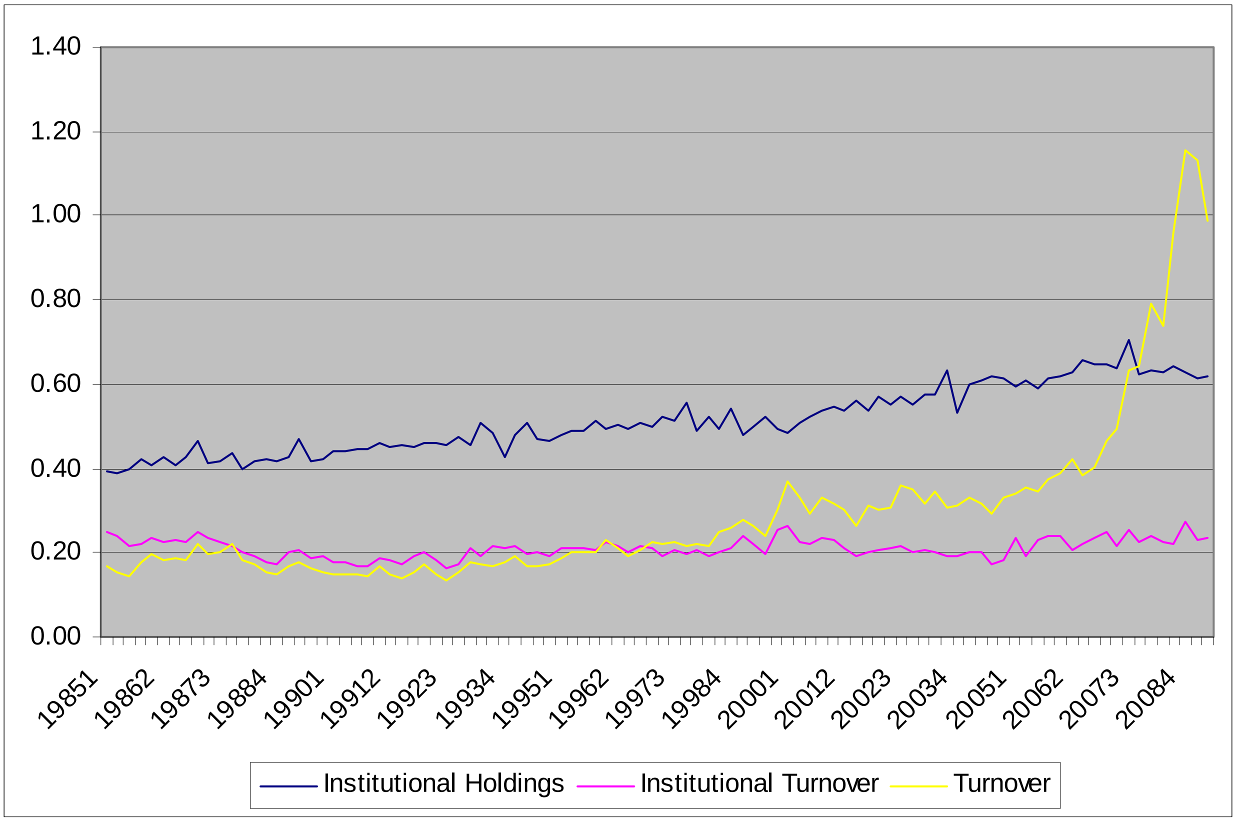

Figure 2 The percentage of short-term trading in total dollar trade volume

This figure plots the estimated volume of short-term trading as a percentage of total dollar trading volume from the first quarter of 1995 to the second quarter of 2009. Trading volume by short-term traders is calculated by subtracting trading volume by institutional and individual investors from total trading volume. Please see Section 3.2 for more details on the calculation process. The sample includes all firms covered by the CRSP and Thomson Reuters Institutional Holdings databases with stock prices of at least $1.

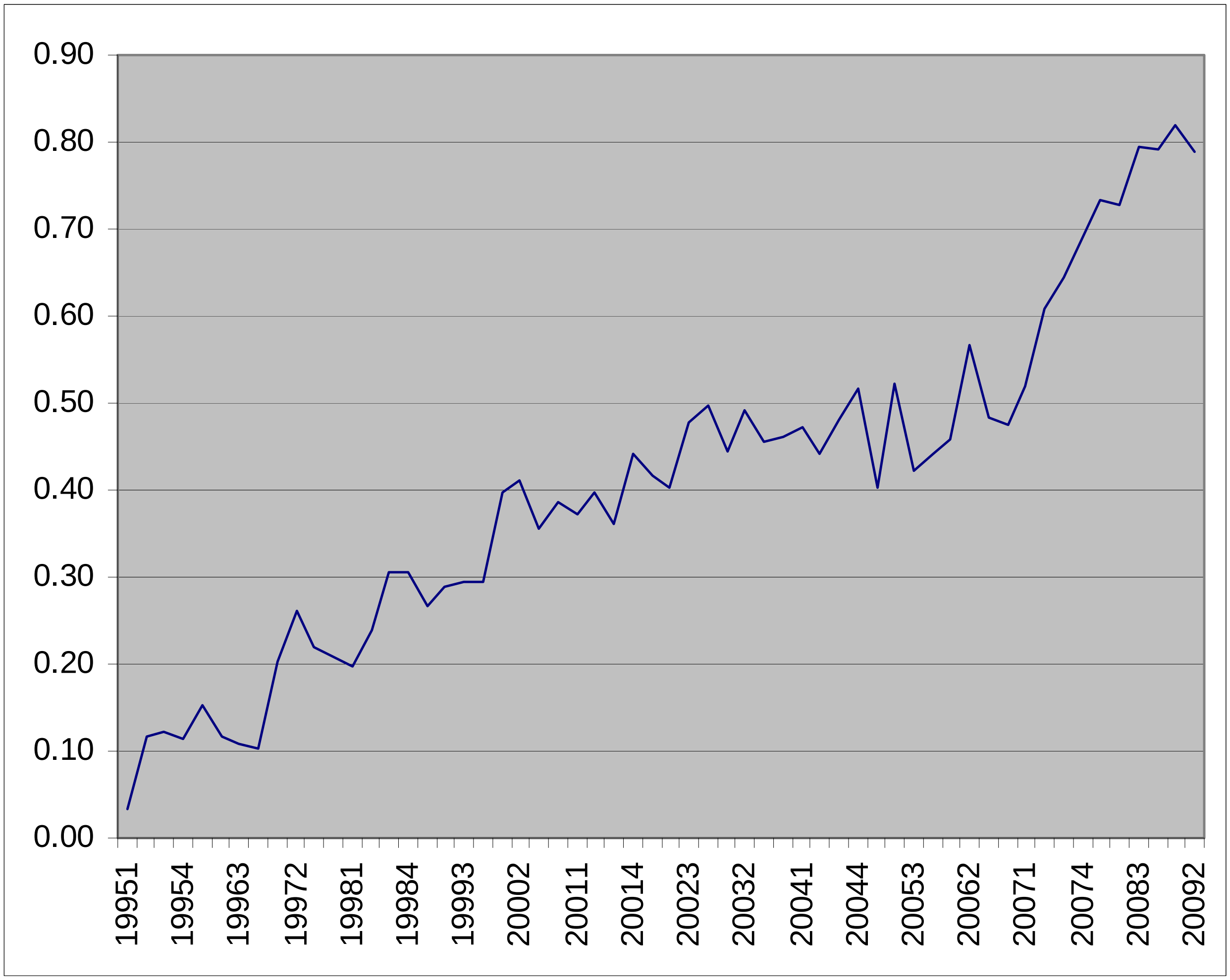

Table 1 Descriptive statistics

Panel A presents descriptive statistics for variables used in the paper and Panel B provides Pearson and Spearman correlations among key variables. *RET* is quarterly returns. *STT* is short-term trading volume. ΔE is earnings surprises. *REV* is analyst forecast revision. *SIZE* is firm size. *BM* is the book-to-market ratio. *RET_12* is the past 12-month stock returns. *TO* is stock turnover. *INST* is institutional holdings. *INSTTO* is institutional turnover. Please see the appendix for detailed variable definitions. The sample consists of 391,013 firm-quarter observations between 1995Q1 and 2009Q2 with non-missing values of *STT* and at least one earnings news variable (ΔE or *REV*). All variables except RET_t and RET_{t+1} are winsorized at 1% and 99%.

Panel A: Descriptive statistics

	N	Mean	SD	Min	Q1	Median	Q3	Max
RET_t	391013	0.027	0.318	-0.988	-0.115	0.013	0.133	18.332
RET_{t+1}	391013	0.030	0.321	-0.988	-0.113	0.014	0.136	16.625
STT	391013	0.043	0.352	-1.156	-0.069	0.006	0.110	1.747
ΔE	301467	-0.003	0.075	-0.424	-0.008	0.001	0.007	0.330
REV	250736	-0.009	0.034	-0.230	-0.006	0.000	0.001	0.052
SIZE	309355	5.659	1.971	1.776	4.199	5.523	6.953	10.863
BM	308199	0.601	0.488	-0.267	0.281	0.499	0.784	2.732
RET_12	386170	0.125	0.576	-0.810	-0.197	0.049	0.306	2.906
TO	391013	0.280	0.366	0.005	0.068	0.157	0.338	2.280
INST	391013	0.345	0.297	0.000	0.074	0.272	0.580	1.000
INSTTO	391013	0.302	0.323	0.000	0.117	0.215	0.361	2.000

Panel B: Correlation matrix (Pearson coefficients are above the diagonal and Spearman correlations are below)

	RET_t	STT	ΔE	REV	$SIZE$	BM	RET_12	TO	$INSTTO$
RET_t	1	0.006	0.087	0.219	-0.034	0.041	0.009	0.061	0.084
STT	-0.019	1	-0.036	-0.063	0.322	-0.085	0.047	0.618	-0.340
ΔE	0.144	-0.011	1	0.290	0.001	-0.125	0.121	-0.026	0.012
REV	0.256	-0.010	0.335	1	0.126	-0.157	0.196	-0.059	-0.013
$SIZE$	0.021	0.347	-0.004	0.086	1	-0.352	0.096	0.347	-0.022
BM	0.056	-0.129	-0.084	-0.082	-0.336	1	-0.250	-0.166	-0.102
RET_12	0.048	0.017	0.223	0.253	0.169	-0.245	1	0.105	0.082
TO	0.031	0.595	0.016	0.019	0.497	-0.288	0.067	1	0.291
$INSTTO$	0.034	-0.221	0.028	0.033	0.231	-0.220	0.070	0.516	1

Panel C: Spearman correlation between trading activity and returns

		TO	INSTTO	STT
When $RET_t > 0$	RET_t	0.227	0.221	0.053
When $RET_t < 0$	RET_t	-0.174	-0.158	-0.077

Table 2 Replication of the post-earnings announcement drift and the post-revision drift

This table replicates the post-earnings announcement drift and the post-revision drift. The dependent variable is either contemporaneous stock returns (RET_t) or future stock returns (RET_{t+1}). ΔE is earnings surprises. *REV* is analyst forecast revision. *SIZE* is firm size. *BM* is the book-to-market ratio. *RET_12* is the past 12-month stock returns prior to the earnings news (earnings surprises or earnings revisions). Please see appendix for detailed variable definitions. The sample consists of 234,577 firm-quarter observations between 1977 and 1994 with non-missing value of ΔE or *REV*. All variables except RET_t and RET_{t+1} are winsorized at 1% and 99%. The regressions are pooled regressions with firm- and year-quarter fixed effects. Standard errors are clustered at the firm level.

Panel A: The market's response to earnings news and post-earnings announcement drift

	Dep. Var. = RET_t			Dep. Var. = RET_{t+1}		
	1977-1994	1977-1984	1985-1994	1977-1994	1977-1984	1985-1994
ΔE	0.333 (26.86)	0.359 (18.88)	0.321 (21.91)	0.093 (8.38)	0.108 (6.78)	0.076 (5.75)
SIZE	-0.047 (-38.30)	-0.068 (-29.87)	-0.075 (-35.93)	-0.049 (-39.23)	-0.070 (-29.98)	-0.079 (-38.69)
BM	0.025 (11.68)	0.029 (9.44)	0.031 (8.81)	0.014 (6.12)	0.018 (5.54)	0.014 (4.08)
RET_12	0.002 (1.96)	0.001 (0.69)	0.005 (3.33)	-0.002 (-1.72)	-0.004 (-2.09)	0.002 (1.66)
Firm and time fixed effects	YES	YES	YES	YES	YES	YES
R^2	0.166	0.220	0.161	0.148	0.204	0.145

Panel B: The market's response to earnings revision news and post-revision drift

	Dep. Var. = RET_t			Dep. Var. = RET_{t+1}		
	1977-1994	1977-1984	1985-1994	1977-1994	1977-1984	1985-1994
REV	1.107 (49.14)	0.885 (26.90)	1.219 (41.82)	0.155 (6.49)	0.167 (4.87)	0.130 (4.12)
SIZE	-0.051 (-37.87)	-0.092 (-28.05)	-0.084 (-36.28)	-0.044 (-36.50)	-0.087 (-25.98)	-0.069 (-34.53)
BM	0.018 (7.77)	0.009 (2.33)	0.027 (7.44)	0.012 (5.40)	0.004 (0.89)	0.022 (6.32)
RET_12	0.009 (7.49)	0.021 (9.19)	0.015 (8.86)	0.010 (7.06)	0.015 (6.68)	0.014 (7.82)
Firm and time fixed effects	YES	YES	YES	YES	YES	YES
R^2	0.263	0.320	0.261	0.223	0.291	0.215

Table 3 Regressions of stock returns on fundamentals news and short-term trading

The dependent variable is either contemporaneous stock returns (RET_t) or future stock returns (RET_{t+1}). *STT* is short-term trading. Fundamental earnings news is proxied either by earnings surprises (ΔE) or by analyst forecast revision (*REV*). *SIZE* is firm size. *BM* is the book-to-market ratio. *RET_12* is the past 12-month stock returns prior to earnings news. Please see the appendix for detailed variable definitions. The sample consists of 289,246 firm-quarter observations with non-missing value of *STT* and ΔE in Panel A and 217,516 firm-quarter observations with non-missing value of *STT* and *REV* in Panel B between 1995Q1 and 2009Q2. For other variables, we set the missing values to their means in the regressions. All variables except RET_t and RET_{t+1} are winsorized at 1% and 99%. The regressions are pooled regressions with firm- and year-quarter fixed effects. Standard errors are clustered at the firm level.

Panel A: Earnings surprises (ΔE) to proxy for fundamentals news

	Dep. Var. = RET_t		Dep. Var. = RET_{t+1}	
	(1)	(2)	(3)	(4)
ΔE	0.357 (21.88)	0.354 (21.81)	-0.022 (-1.39)	-0.019 (-1.24)
STT		0.041 (6.96)		-0.022 (-5.90)
ΔE*STT*		0.250 (2.96)		-0.220 (-3.69)
SIZE	-0.085 (-53.85)	-0.089 (-50.73)	-0.083 (-53.51)	-0.082 (-51.38)
BM	0.012 (3.57)	0.011 (3.02)	0.006 (1.99)	0.008 (2.25)
RET_12	0.001 (0.80)	0.000 (0.23)	-0.010 (-7.47)	-0.010 (-7.12)
Firm and time fixed effects	YES	YES	YES	YES
R^2	0.153	0.154	0.146	0.147

Panel B: Analyst forecast revision (*REV*) to proxy for fundamentals news

	Dep. Var. = RET_t		Dep. Var. = RET_{t+1}	
	(1)	(2)	(3)	(4)
REV	1.949 (70.45)	1.925 (69.26)	-0.239 (-6.33)	-0.220 (-5.72)
STT		0.027 (4.33)		-0.027 (-6.44)
*REV*STT*		0.472 (4.53)		-0.417 (-3.41)
SIZE	-0.089 (-51.15)	-0.091 (-47.51)	-0.085 (-48.20)	-0.083 (-45.63)
BM	0.016 (4.08)	0.015 (3.74)	0.005 (1.17)	0.006 (1.47)
RET_12	-0.011 (-6.49)	-0.011 (-6.85)	-0.010 (-6.53)	-0.010 (-6.15)
Firm and time fixed effects	YES	YES	YES	YES
R^2	0.227	0.228	0.187	0.188

Table 4 The effect of measurement error in short-term trading

The dependent variable is either contemporaneous stock returns (RET_t) or future stock returns (RET_{t+1}). *STT* is short-term trading. Fundamental earnings news is proxied either by earnings surprises (ΔE) or by analyst forecast revision (*REV*). *SIZE* is firm size. *BM* is the book to market ratio. *RET_12* is the past 12-month stock returns prior to earnings news. Please see the appendix for detailed variable definitions. The sample period is 1985–1994. The sample consists of 134,804 firm-quarter observations with non-missing value of *STT* and ΔE in Panel A and 102,625 firm-quarter observations with non-missing value of *STT* and *REV* in Panel B. For other variables, we set the missing values to their means in the regressions. All variables except RET_t and RET_{t+1} are winsorized at 1% and 99%. The regressions are pooled regressions with firm- and year-quarter fixed effects. Standard errors are clustered at the firm level.

Panel A: Earnings surprises (ΔE) to proxy for fundamentals news

	Dep. Var. = RET_t		Dep. Var. = RET_{t+1}	
	(1)	(2)	(3)	(4)
ΔE	0.458 (25.79)	0.457 (25.88)	0.040 (2.48)	0.039 (2.39)
STT		-0.029 (-4.34)		-0.035 (-6.65)
ΔE*STT*		0.017 (0.12)		0.086 (0.95)
SIZE	-0.079 (-36.10)	-0.078 (-35.37)	-0.077 (-37.79)	-0.075 (-37.15)
BM	0.016 (3.77)	0.018 (4.04)	0.001 (0.26)	0.002 (0.70)
RET_12	0.000 (0.02)	0.000 (0.05)	-0.001 (-0.64)	-0.001 (-0.62)
Firm and time fixed effects	YES	YES	YES	YES
R^2	0.189	0.189	0.171	0.172

Panel B: Analyst forecast revision (*REV*) to proxy for fundamentals news

	Dep. Var. = RET_t		Dep. Var. = RET_{t+1}	
	(1)	(2)	(3)	(4)
REV	1.433 (42.97)	1.427 (43.18)	-0.003 (-0.08)	-0.011 (-0.32)
STT		-0.004 (-0.52)		-0.044 (-6.29)
*REV*STT*		0.353 (1.46)		0.024 (0.09)
SIZE	-0.084 (-36.35)	-0.084 (-36.00)	-0.070 (-32.21)	-0.069 (-31.65)
BM	0.010 (2.37)	0.011 (2.41)	0.014 (3.21)	0.016 (3.73)
RET_12	-0.012 (-5.55)	-0.012 (-5.53)	0.001 (0.31)	0.001 (0.55)
Firm and time fixed effects	YES	YES	YES	YES
R^2	0.260	0.260	0.226	0.226

Table 5 The effect of trading volume on the pricing of firm fundamentals

The dependent variable is either contemporaneous stock returns (RET_t) or future stock returns (RET_{t+1}). *TO* is trading volume as a percentage of outstanding shares. Fundamental earnings news is proxied either by earnings surprises (ΔE) or by analyst forecast revision (*REV*). *SIZE* is firm size. *BM* is the book-to-market ratio. *RET_12* is the past 12-month stock returns. Please see the appendix for detailed variable definitions. All variables except RET_t and RET_{t+1} are winsorized at 1% and 99%. The regressions are pooled regressions with firm- and year-quarter fixed effects. Standard errors are clustered at the firm level.

Panel A: Earnings surprises (ΔE) to proxy for fundamentals news

	1977–1984		1985–1994		1995–2009	
	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var. = RET_t					
ΔE	0.364 (19.10)	0.365 (18.52)	0.327 (22.13)	0.338 (22.29)	0.304 (23.05)	0.326 (23.87)
TO		0.631 (22.41)		0.380 (27.65)		0.222 (28.52)
ΔE*TO*		0.541 (1.93)		1.115 (5.64)		0.630 (7.86)
SIZE	-0.068 (-29.88)	-0.076 (-29.63)	-0.075 (-35.95)	-0.088 (-37.40)	-0.090 (-55.93)	-0.105 (-55.68)
BM	0.029 (9.44)	0.031 (9.71)	0.031 (8.83)	0.029 (8.20)	0.029 (9.22)	0.030 (9.06)
RET_12	0.001 (0.65)	-0.012 (-5.53)	0.005 (3.31)	-0.005 (-3.02)	0.007 (6.48)	0.000 (0.37)
R^2	0.220	0.273	0.162	0.188	0.147	0.168
	Dep. Var. = RET_{t+1}					
ΔE	0.110 (6.84)	0.103 (6.46)	0.078 (5.80)	0.077 (5.72)	0.039 (3.12)	0.039 (2.98)
TO		-0.073 (-5.51)		-0.063 (-9.08)		-0.028 (-7.36)
ΔE*TO*		-0.091 (-0.61)		-0.067 (-0.70)		-0.123 (-2.63)
SIZE	-0.070 (-29.96)	-0.069 (-29.51)	-0.079 (-38.68)	-0.077 (-37.35)	-0.085 (-53.92)	-0.083 (-51.32)
BM	0.018 (5.55)	0.018 (5.36)	0.014 (4.08)	0.014 (4.05)	0.022 (7.51)	0.022 (7.38)
RET_12	-0.004 (-2.10)	-0.003 (-1.55)	0.002 (1.66)	0.004 (2.68)	-0.001 (-1.23)	-0.000 (-0.38)
R^2	0.204	0.205	0.145	0.146	0.142	0.144

Panel B: Analyst forecast revision (*REV*) to proxy for fundamentals news

	1977–1984		1985–1994		1995–2009	
	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var. = RET_t					
REV	0.887 (26.93)	0.846 (25.01)	1.220 (41.88)	1.237 (42.14)	1.813 (69.64)	1.787 (69.68)
TO		0.460 (16.22)		0.206 (18.14)		0.128 (22.46)
*REV*TO*		2.122 (4.23)		2.714 (9.92)		1.239 (14.05)
SIZE	-0.092 (-28.08)	-0.092 (-21.43)	-0.084 (-36.33)	-0.089 (-33.42)	-0.094 (-54.89)	-0.103 (-52.87)
BM	0.009 (2.33)	0.012 (2.97)	0.027 (7.43)	0.026 (7.08)	0.032 (8.80)	0.034 (9.31)
RET_12	0.021 (9.19)	0.009 (3.38)	0.015 (8.86)	0.004 (2.31)	0.008 (6.58)	0.003 (2.43)
R^2	0.320	0.356	0.261	0.278	0.225	0.235
	Dep. Var. = RET_{t+1}					
REV	0.168 (4.89)	0.173 (4.90)	0.130 (4.12)	0.124 (3.92)	-0.102 (-2.94)	-0.101 (-2.75)
TO		-0.073 (-5.49)		-0.070 (-11.46)		-0.028 (-7.77)
*REV*TO*		-0.209 (-0.58)		-0.394 (-1.89)		-0.224 (-2.14)
SIZE	-0.087 (-26.01)	-0.087 (-25.21)	-0.069 (-34.60)	-0.068 (-34.48)	-0.079 (-48.42)	-0.077 (-46.03)
BM	0.004 (0.88)	0.001 (0.26)	0.022 (6.32)	0.022 (6.29)	0.028 (7.57)	0.028 (7.42)
RET_12	0.015 (6.68)	0.015 (6.16)	0.014 (7.83)	0.017 (9.48)	0.001 (0.55)	0.002 (1.45)
R^2	0.290	0.290	0.215	0.216	0.188	0.188

Table 6 Regressions of short-term trading on individual holdings

The dependent variable is short-term trading (*STT*). *INDIV* is individual holdings. *SIZE* is firm size. *BM* is the book-to-market ratio. *RET_12* is the past 12-month stock returns. *sd*Δ*ROE* is earnings surprise volatility. *sdSGR* is sales growth volatility. *DISP* is analyst forecast dispersion. *LEV* is market leverage. 1/*P* is the inverse of stock price. Please see the appendix for detailed variable definitions. All variables are winsorized at 1% and 99%. Standard errors are clustered at the firm level.

	(1)	(2)	(3)
INTERCEPT	0.277 (61.82)	0.031 (2.92)	-0.012 (-0.79)
INDIV	-0.373 (-61.91)	-0.273 (-37.21)	-0.342 (-35.17)
SIZE		0.028 (23.04)	0.036 (20.33)
BM		0.014 (5.39)	-0.009 (-1.62)
RET_12		0.021 (11.25)	0.034 (11.46)
sdROE			0.057 (5.39)
sdSGR			0.006 (5.39)
DISP			10.61 (21.37)
LEV			0.011 (5.12)
1/P			-0.024 (-1.18)
R^2	0.097	0.148	0.186
No. of observations	391,013	307,535	144,259