Pre-Earnings Announcement Over-Extrapolation*

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Abstract

Using earnings announcements as our experimental setting, we uncover evidence that individual investors over-extrapolate from past earnings announcement returns. Investors become overly optimistic about future earnings and are more likely to purchase a firm's stock immediately before the upcoming earnings announcement if recent earnings announcement returns are high. We find pricing effects around earnings announcements consistent with this behavior: A value-weighted portfolio based on pre-earnings announcement purchases earns over 17 basis points per day and a value-weighted portfolio based on a post-earnings reversal earns about 13 basis points per day.

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1 Introduction

In their seminal paper, Kahneman and Tversky (1974) highlight that experimental subjects tend to ignore the laws of probability—instead, they assess likelihoods by the degree to which an event reflects the salient characteristics of a specific class. The authors refer to this tendency as the representativeness heuristic. A number of authors (e.g., Barberis et al., 1998) have suggested that investors, guided by the representativeness heuristic, over-extrapolate, or draw strong conclusions from small samples of data. In this paper, we explore this argument by studying investor behavior around earnings announcements.

A stock that has recently had great earnings-announcement returns is representative of a stock that is a great investment during earnings announcements. As such, investors may over-extrapolate and overestimate the probability that a firm with great recent earnings announcement returns is an excellent investment during earnings announcements. Consistent with this, we find that optimistic investor forecasts are far more likely when the firm has a history of good past performance.[1] Specifically, an additional 4.4 percent of investors have forecasts that are higher than the consensus sell-side analyst forecast when a firm is in the top decile of our extropolated return measure, a weighted average of past earnings-announcement returns that places higher weights on more recent periods. The increased optimism that a firm will beat the consensus forecast is consistent with investors classifying these good past-performers as firms that will likely perform well during the upcoming earnings announcement.

Building on this observation, we predict that individual investors will "bet" on this classification. Namely, if a firm has recently had great earnings announcement returns, the investor will bet on, or purchase, the firm's stock shortly before the next earnings announcement. To test

[1]The investor forecasts in our sample come from both amateur investors and financial professionals from hedge funds, asset management firms, mutual funds, and independent research firms.

this, we first look at how individual investor behavior responds to our extrapolated return measure. We analyze household trading data from a large discount brokerage and find that past earnings announcement returns are a strong determinant of individual investor purchasing decisions in the period leading up to the next earnings announcement. Specifically, if a firm is in the top decile of our extrapolated return measure, we find that the total value of purchases in the 5-day pre-earnings announcement period will be ten percent higher than for a firm that is not in the top decile.[2] In these tests, we include firm-quarter fixed effects to capture average purchases within each firm-quarter. We then include an indicator for being in the five days before the earnings announcement, and an interaction between this indicator and the indicator for being in the top decile of the extrapolated return measure. The ten percent increase in purchases that we attribute to top-extrapolated-return firms is the amount by which their increase in purchases in the five days before the earnings announcement exceeds the increase for all other firms.

We next look to see if there are predictable patterns in asset prices consistent with this buying behavior. The prediction is that over-extrapolation of recent positive earnings announcement returns will motivate investors to purchase shares of the stock before the next earnings announcement. This would lead to a rise in the stock price, and overpricing, before the next earnings announcement. We argue that this "mispricing" will not be corrected by appealing to the limits to arbitrage literature.[3] Importantly, there is significant fundamental risk immediately before the earnings announcement. After the earnings announcement, fundamental risk decreases, and we expect the stock price to start reverting back to its "fundamental value". To summarize, we expect to see predictable patterns in returns both before and after such earnings announcements—specifically, a high value for our extrapolated return measure should predict excess positive returns before the earnings announcement, and a reversal after.

[2] Clearly, this result conjectures a setting in which investors know earnings announcement dates in advance. To ensure this, we restrict our sample for these tests to firms that have predictable earnings announcement dates.

[3] See, for example, Shleifer and Vishny (1997).

We confirm this prediction in the data, where we find that the returns in the five trading days before the earnings announcement period are strongly positively associated with the earnings announcement returns of previous quarters. We find that being in the top decile of our extrapolated return measure is associated with an additional 11 basis points of daily returns during the five days leading up to the earnings announcement. We also find evidence that this is an overreaction. If a firm is in the top decile of our extrapolated return measure, we find that daily returns are about 12 basis points lower in the five days after the earnings announcement window. These returns tests are structured like the individual purchase behavior tests mentioned above. Firm-quarter fixed effects capture the average return the firm experiences that quarter, and enable us to examine the extent to which changes from this baseline return are larger for top-extrapolated-return firms than for the rest of the sample. The 11 basis point increase in daily returns for top-extrapolated-return firms in the pre-announcement period is the amount by which the increase from base-line returns to pre-announcement returns for these firms exceeds the same increase for the rest of the sample.

We then show that we can form calendar-time portfolios based on this return predictability that, at least before transaction costs, earn significant daily alpha. For example, a value-weighted portfolio that goes long (short) firms in the top (bottom) decile of our extrapolated-return measure in the pre-earnings announcement period earns a four-factor daily alpha of more than 17 basis points. We also form portfolios based on the reversal. A value-weighted portfolio that goes long (short) firms in the bottom (top) decile of our extrapolated-return measure and in the post-earnings announcement period earns a four-factor daily alpha of about 13 basis points.

We also examine alternative beliefs. In particular, we consider an extrapolation of fundamentals, and a belief in streak continuation. Overall, our results are most consistent with investors over-extrapolating returns.

Our paper provides individual-level and market-level evidence that investors over-extrapolate.

In particular, we provide evidence of over-extrapolation of returns. By examining pre-earnings and post-earnings announcement returns, we also provide asset pricing evidence consistent with this belief formation. As such, we provide novel empirical support for the survey evidence and theoretical work on over-extrapolation.[4] We also add to the literature on short-term reversals. So and Wang (2014) document a six-fold increase in short-term return reversals during earnings announcement periods; we highlight a driver of price movements that occurs before earnings announcements.

Section 2 reviews the literature. Section 3 details the data used. Section 4 shows how investor forecasts are associated with past earnings-announcement performance. In Section 5, we look at the relation between individuals' investment decisions and previous earnings announcement returns. In Section 6, we present evidence that over-extrapolation leads to predictable patterns in returns both before and after earnings announcements. Section 7 concludes.

2 Literature Review

The representativeness heuristic refers to the tendency of individuals to ignore the laws of probability and determine likelihoods by the extent to which an event reflects the characteristics of the process that generates it or a parent population (Kahneman and Tversky, 1974). This heuristic leads to seemingly contradictory phenomena: the gambler's fallacy—the erroneous belief that random sequences should exhibit systematic reversals—and the hot-hand effect—the belief that a successful event is more likely following a sequence of successful events than after an unsuccessful event. When individuals know the true distribution, we see evidence of the gambler's fallacy. Individuals expect small random sequences to reflect the overall distribution; as such, subjects anticipate "balancing out" so that small sequences better reflect the true distribution. We see

[4]Greenwood and Shleifer (2014) review the survey evidence and find strong evidence of over-extrapolation. Barberis et al. (2015) develop a model consistent with this survey evidence that captures a number of features of actual prices and returns, such as excess volatility and the negative correlation of returns at long horizons.

evidence of the hot-hand effect when the true distribution is unknown; individuals believe that recent random sequences reflect the true distribution. After successful outcomes, individuals believe that the generating process is one that delivers successful outcomes, and they anticipate future successful outcomes (Gilovich, Vallone, and Tversky, 1985; Rabin and Vayanos, 2010). The hot-hand effect can also be termed over-extrapolation: individuals infer too much from small samples of data.

There is a large literature that examines whether investors, analysts, and firm managers exhibit over-extrapolation. Barberis, Shleifer, and Vishny (1998) consider a model where investors use the representativeness heuristic and also exhibit conservatism—the slow updating of models in the face of new evidence. In their model, investors' expectations are based on previous earnings. The authors show that the model helps explains a number of known pricing anomalies including momentum and long-term reversions. Camerer (1987) finds that investors over-extrapolate in an experimental market setting. Bloomfield and Hales (2002) also offer experimental evidence that investors over-extrapolate, consistent with regime-shifting beliefs proposed by Barberis et al. (1998). Frieder (2008) finds that net buying by small investors increases as the number of consecutive earnings surprises increases, and that this purchase activity is negatively correlated with future returns. The evidence on whether sell-side analysts over-extrapolate is mixed. De Bondt and Thaler (1990) find that analysts overreact to new information, while Teoh and Wong (2002) uncover evidence that analysts underreact to new information. Easterwood and Nutt (1999) reconcile these findings by showing that analysts underreact to negative information and overreact to positive information. Finally, Greenwood and Hanson (2015) offer evidence that management over-extrapolates from recent earnings information. The authors show that firms in the shipping industry overpay for ships and overinvest during boom periods.

In our paper, we find that investors extrapolate based on past earnings announcement

returns. As such, our work is tied to the earlier literature on return extrapolation. There is ample survey evidence that investors hold extrapolative return expectations. They believe stock prices will rise after they have previously risen and will fall after they have previously fallen; Greenwood and Shleifer (2014) review data from six different surveys and find that expectations from different surveys are strongly correlated with one another and with past returns.[5] Barberis et al. (2015) develop a model consistent with this survey evidence that captures a number of features of actual prices and returns, such as excess volatility and the negative correlation of returns at long horizons.

A central prediction of our paper is that over-extrapolation leads to predictability in returns around earnings announcements. Specifically, we test whether previous earnings announcement returns are positively correlated with this period's pre-earnings announcement returns and negatively correlated with this period's post-earnings announcement returns. This investigation is related to a number of other empirical facts regarding earnings announcement returns. Frazzini and Lamont (2007) and Barber, DeGeorge, Lehavy, and Trueman (2013) show that stocks earn higher returns during earnings announcement months. Barth, Elliot, and Finn (1999) and Myers, Myers, and Skinner (2007) find that price to earnings multiples fall at the termination of a positive earnings streak. Ball and Brown (1968) and Foster, Olsen, and Shevlin (1984) note that even after earnings are announced, abnormal returns continue to be positive for firms with good earnings and continue to be negative for firms with bad earnings—the post earnings-announcement drift.[6] Milian (2015) argues that investors have overreacted to the post-earnings announcement drift phenomenon. He finds significantly negative autocorrelation between a firm's earnings announcement news and next period's earnings announcement return for easy-to-arbitrage firms in the 1996–2010 period. So and Wang (2014) document a six-fold increase in short-term return reversals during earnings

[5]Earlier survey evidence includes Vissing-Jorgensen (2004), Amronin and Sharpe (2014), and Bacchetta et al. (2009).

[6]Bernard and Thomas (1989) show that it is difficult to reconcile this result with a risk based explanation. In their subsequent paper, Bernard and Thomas (1990) argue that the autocorrelation in earnings surprises helps explain the post-earnings announcement drift.

announcement periods. The authors, who do not explore the source of the initial price increase or decrease before the earnings announcement, attribute the strength of these reversals to the increased inventory risks that the market maker faces.

We attribute the earnings-related anomaly we find to over-extrapolation. We are not the first paper to find that behavioral factors can drive earnings announcement returns. Chang et al. (2014) show that investors are surprised by the unsurprising; firms whose earnings are historically larger in one quarter of the year have higher returns when those earnings are typically announced. The authors attribute this anomaly to investors overweighting the earnings of recent quarters. Hartzmark and Shue (2016) document evidence that investors perceive earnings announcements in contrast to earnings announcements the day before. Loh and Warachka (2012) find that investors underreact to the continuation of earnings streaks. That is, they find that the post-earnings announcement drift is especially strong when the earnings surprise extends a streak. In contrast to our finding, the authors find that their result is consistent with the gambler's fallacy—investors believe that trends require an immediate balancing by the opposite outcome.

3 Data

3.1 Sample Construction and Variables

Our independent variable of interest is investor over-extrapolation. We construct this measure using the past earnings-announcement performance of our sample of firms. Specifically, we look at a weighted-average of the past eight earnings announcement returns.[7] We obtain earnings announcement dates from Compustat & IBES and the short-window earnings announcement returns from the CRSP daily files.[8]

[7]We weight more recent quarters more heavily as they are likely more salient to the investor ((Barberis et al., 2015)). Further, in our measurement of extrapolation, we do not adjust for market or industry returns, as raw returns are likely the most salient figure to investors. Of course, we take these factors into account in the regressions.

[8]Earnings announcement returns are calculated over the two-day trading window surrounding the earnings

As detailed in the following sections, three sets of tests explore investor over-extrapolation, and each requires a different sample. We first analyze the forecasting behavior of individuals using data from Estimize, which is a data provider that collects earnings-per-share estimates from amateur investors and financial professionals, including analysts, traders, and portfolio managers from hedge funds, asset management firms, mutual funds, and independent research firms. Estimize's data begins in 2010, and our subscription goes through 2014. Our tests use the individual investor forecasts, the consensus sell-side forecast provided by Estimize, and the actual EPS results provided by Estimize. We only keep the last forecast made by each individual for any given firm-quarter, and we drop all forecasts that Estimize has flagged as unreliable based on its algorithms.

Next we investigate the buying behavior of individuals to better identify whether extrapolated beliefs manifest themselves in trading. To do this, we use a dataset on individual trades that comes from a large discount brokerage. This data set has been used extensively (e.g. Odean, 1998; Strahilevitz et al. 2011; Hartzmark, 2014; etc.) and includes information on 78,000 household trades from 1991 through 1996. We use information on the total daily dollar value of purchases and sales and the daily number of buyers and sellers for each security to calculate our dependent variables. We restrict our sample to individual and joint-tenancy accounts to focus on individual investors, as opposed to corporations, partnerships, and pension trusts.[9] For reasons we explain in Section 5, we also restrict the sample to firms that have predictable earnings announcement dates.

In the final part of our study, we look at the equity markets to shed further light onto investor over-extrapolation. If investors exhibit this behavior to a meaningful extent, there would be implications for the cross-sectional predictability of stock returns. The data for this piece of our analysis comes from IBES, CRSP, and Compustat. We focus on all US firm-quarters from 1991 to 2014; we start in 1991 because the discount brokerage data starts then. We calculate our

announcement.

[9]The results are the same if we include the entire sample from the discount brokerage.

dependent variables using CRSP security files pertaining to the current quarter. We measure pre-earnings-announcement [post-earnings-announcement] returns as the returns during the five-day period leading up to [following] the two-day earnings announcement window. For our calendar-time portfolios, we download factors from Ken French's website.

Turning to controls, which we calculate at the firm-quarter level and use for the tests mentioned above, we obtain standard firm characteristics using Compustat (e.g., firm size, earnings growth) and the CRSP monthly files (e.g., trailing momentum, volume, volatility).[10] We measure current and lagged earnings surprises by comparing IBES actual earnings to the consensus—the most recent, individual (analyst-level), split-unadjusted forecast (Diether, Malloy, and Scherbina, 2002) that is confirmed reliable at most 90 days before the earnings announcement.[11] Along with observations with missing regression variables, we also exclude firm-quarters with a share price less than five dollars at the beginning of the quarter to eliminate confounding microstructure effects. This sample consists of 132,533 firm-quarters for which we can estimate all variables including extrapolated returns, which requires the past 8 quarters of earnings announcement returns.

3.2 Summary Statistics

Table 1 presents summary statistics. Panel A explores the sample of 6,466 firm-quarters with investor forecast data. It indicates that investors are generally too pessimistic about firm earnings per share–on average only 45 percent of the surveyed investors give forecasts that are higher than the actual earnings per share the firm eventually announces. They are usually more optimistic than the consensus sell-side analyst forecast (78% for the average firm-quarter). Unsurprisingly, the

[10] Definitions of variables of interest and control variables appear in Appendix A. Continuous independent variables are Winsorized at the 1% level.

[11] We determine this date using *revdats*, defined in IBES as the most recent date that an estimate was confirmed as accurate. Similar to DellaVigna and Pollet (2009), we identify the earnings-announcement date as the earlier of the IBES earnings announcement date (*actdats*) and Compustat earnings announcement date (*rdq*). We remove firm-quarters that are missing this quarter's or the previous quarter's earnings surprise, measured as the IBES actual earnings per share minus the median of individual forecasts.

mean of the indicator variable, *Optimistic Sell-side* is fairly small (0.27), consistent with the well-documented pattern that analysts forecasts are beaten fairly often. There are about six forecasts for each firm-quarter on average, and the standard deviation among these forecasts does not seem large (0.02—i.e., 2 cents).

Panel B details the sample obtained from the discount brokerage, which contains information about equity portfolios and trades of individuals. Across the 953,590 firm-days, most firms do not see any trades by sampled individuals on a given day. The average number of buyers and sellers from the sample is very small–only 0.106 and 0.092 respectively. This is consistent with investors holding undiversified portfolios.

Finally, Panel C provides information regarding the large, conventional sample used for cross-sectional asset-pricing tests. Consistent with existing literature documenting earnings announcement premium, the (daily) average return during earnings announcement is larger than pre- and post- periods (34 basis points vs. 13 and 9 basis points). Given the time period spanning 1990s and 2000s, it is expected to see a median earnings surprise of 1 cent. Likewise, the median dispersion of 2 cents is also in line with the prior evidence (Cheong and Thomas, 2014). We also observe that the highly skewed distributions of firm size and book-to-market ratio are normalized after log transformation.

As for the correlations in the large sample, as depicted in Table 2, lagged earnings surprise (together with the post-earnings-announcement-drift decile) and trading volume appear to have the strongest univariate relation with the indicator variable, *Top Decile Extrapolated Return*. The positive link between earnings announcement returns and the contemporaneous earnings surprise is unsurprising. Similarly, larger firms have smaller return volatility and are less likely to post losses, while firms with better earnings (surprise and growth) also have better trailing stock returns and past earnings.

4 Individual Investor Forecasts

Our first step in assessing whether investors over-extrapolate based on a firm's past performance is to see whether investor expectations become optimistic when a firm has a history of good performance. In later sections, we will provide indirect evidence that investors trade on this optimism and that this trading manifests itself in large short-term stock return predictability. For our tests, we require a measure of investors beliefs that are based on past earnings announcement return performance. Our measure, which we refer to as the extrapolated return measure, is as follows:

$$\text{Extrapolated Return}_{i,t} = \sum_{j=1}^{8} \frac{1}{j} R_{t-j} \tag{1}$$

The extrapolated return measure is a weighted average of returns from the firm's past eight earnings announcements, where the earnings announcement is a two-day window composed of the day of the announcement and the following day, since many announcements are made after the close of trading. Consistent with the idea that more recent events may be more salient, we weight more recent earnings-announcement periods more heavily.

To assess whether investor expectations are more likely to become overly optimistic when extrapolated returns are high, we consider the following regression:

$$\begin{aligned} \text{Optimism Variable}_{it} &= \beta_1 \text{Top Decile Extrapolated Return}_{it} \\ &\quad + \delta \text{Controls}_{it} + \gamma_i + \eta_t + \epsilon_{it}. \end{aligned}$$

Each observation is a firm-quarter. The *Optimism Variable* on the left-hand side represents the percentage of investor forecasts that were greater than the consensus sell-side analyst forecast for the quarter. The investor forecasts come from Estimize, and the forecasters consist of amateurs as well

as financial professionals from hedge funds, asset management firms, mutual funds, and independent research firms. In constructing the left-hand-side variable, we remove forecasts Estimize has flagged as unreliable, and we only consider the last forecast made by any investor for a given firm-quarter.

On the right-hand side of the regression, our variable of interest, *Top Decile Extrapolated Return*, indicates whether a firm has had a history of strong earnings-announcement performance. More precisely, each calendar quarter we sort firms into deciles based on the extrapolated return variable and construct a dummy variable, *Top Decile Extrapolated Return*, that equals one if the firm falls into the top decile of our extrapolated return measure. Our primary controls include an indicator for whether or not the sell-side consensus forecast is overly optimistic relative to the firm's actual results, an indicator for when the firm-quarter has only one Estimize forecaster, the number of Estimize forecasters for a given firm-quarter, and the standard deviation of Estimize forecasts. In some specifications, we include a large set of additional controls to further test robustness.[12] We also include firm fixed-effects, γ_i, and quarter fixed-effects, η_t, to control for fixed firm-level and quarter-level unobservables that are correlated with investor beliefs and past earnings announcement returns. We cluster our standard errors by firm and by quarter to account for within firm and within quarter covariation in investor beliefs and past earnings announcement returns. We also present results without firm fixed-effects, as our variable of interest is based on past firm performance.

Our conjecture is that, due to the representativeness heuristic, investors will consider the firm a buy if the firm has strong recent earnings announcement returns. That is, investors will over-extrapolate from recent positive earnings announcement returns and predict that the firm is likely a good investment during earnings anouncements. An investor who considers the stock a

[12]These additional controls include Earnings Surprise, Lagged Earnings Surprise, Earnings Growth, Loss Firm, Seasonal Return, Size, Book-to-Market, Accruals, Momentum, Volatility, Volume, and Forecast Dispersion. Definitions for these variables can be found in Appendix A.

buy will likely submit an estimate above the sell-side consensus.[13] As such, we expect firms with strong recent earnings announcement returns to have more estimates above the sell-side consensus. That is, extrapolative beliefs predict that the percentage of investors who are more optimistic than the prevailing sell-side consensus will increase for firms in the top decile of the extrapolated return measure. The results for this regression are in Table 3. Consistent with the prediction, being in the top decile of extrapolated returns corresponds to an approximate five percent increase in the number of investors whose earnings-per-share forecasts are more optimistic than the consensus analyst forecast for the quarter.

In Panel B of Table 3, we see if these results still hold with fundamentals extrapolation rather than returns extrapolation. We create an extrapolated surprise measure that is analogous to the extrapolated return measure, except it is measured using the sell-side analyst consensus forecast error over the past eight quarters, where the forecast error is measured as the actual earnings-per-share minus the forecast. This means that the extrapolated surprise measure is higher when a firm has a better recent history of beating the analyst forecast. As in the test in Panel A, our variable of interest in Panel B is an indicator for being in the top decile of the extrapolated surprise measure in a given calendar quarter. We find that being in the top extrapolated surprise decile also positively predicts the percentage of investors whose forecasts are more optimistic than the sell-side forecast. If we include both the extrapolated surprise measure and the extrapolated return measure in the regression, we find that each incrementally increases the percentage of optimistic investors. This is not shocking as investors are shown past earnings surprises when submitting on Estimize (i.e., past earnings surprises are made salient on the Estimize platform).

We also examine a belief in streak continuation, or the belief that a firm with recent positive earnings announcement returns will have a positive earnings announcement return next quarter.

[13] Investors submitting estimates on Estimize are shown the sell-side consensus.

It is important to distinguish this belief structure from extrapolative beliefs. An investor with extrapolative beliefs may expect a firm with negative earnings two quarters prior to be a great investment during upcoming earnings if other recent earnings announcement returns were strong. An investor with a belief in streak continuation would not hold the same expectation given the recent interruption to a streak. To test which belief structure is more appropriate, we run a horse race between a belief in streak continuation and extrapolative beliefs. We create a variable titled *Positive Return Streak*, which equals one if a firm had a positive earnings announcement return in each of the last four quarters. This variable equals one for about 8 percent of the sample. In the final two columns of Panel B of Table 3, we include *Positive Return Streak* in our regression and find that while our extrapolated return measure still predicts forecast optimism, our new positive streak measure does not.

5 Individual Investor Buying Behavior

Our hypothesis is that investors over-extrapolate from past earnings announcement returns. We predict that this belief formation will guide their future purchasing behavior—namely, we expect to see investors "bet" on earnings by purchasing shares of a stock with a high extrapolated return in the period shortly before the next earnings announcement. We test our prediction by looking at data from a large discount brokerage. We first plot purchasing behavior around earnings announcements in Figure 1, and find evidence consistent with our hypothesis. Figure 1(a) plots the mean logarithm of the total dollar value of purchases made by all sampled individuals for each trading day around the earnings announcement, and Figure 1(b) does the same for the mean number of purchase transactions. Both figures show an increase in purchasing activity before earnings announcements for all firms, and show that the increase is much sharper for firms in the top decile of our extrapolated return measure.

We next consider a regression of the following form:

$$\begin{aligned}\text{Purchasing/Selling Variable}_{iqt} &= \beta_1 \text{5-day Window}_{iqt} \\ &+\beta_2 \text{5-day Window}_{iqt} \times \text{Top Decile Extrapolated Return}_{iq} \\ &+\delta \text{Controls}_{iqt} + \gamma_i \times \eta_t + \epsilon_{iqt}.\end{aligned}$$

This test represents a sort of difference-in-differences design. Each observation is a firm-trading day, and the sample includes all trading days in the quarter, where each quarter runs from a firm's previous earnings announcement to its current earnings announcement. The *5-day Window* variable is an indicator that turns on when the firm-day falls within the five days before the earnings announcement (i.e., from day $t-5$ to day $t-1$, where day t is the earnings announcement date). These five days are the treatment period when we expect investors to purchase a security if they are trading on the earnings announcement. In the language of difference-in-differences, it represents what is usually labeled the "post" variable. The variable of interest is the interaction between the *5-day Window* indicator and the *Top Decile Extrapolated Return* variable, which is an indicator that turns on when the firm-quarter is in the top decile of extrapolated returns for that calendar quarter (measured the same as in the previous test). In the language of differences-in-differences, this is the interaction term between the "post" and "treat" variables.

The firm-quarter fixed-effects, $\gamma_i \times \eta_t$, eliminate variation at the firm-quarter level. As such, we cannot simultaneously identify coefficients on the fixed effects and the top extrapolated return decile dummy. However, these fixed effects allow us to control for all fixed firm-quarter level unobservables that are correlated with past earnings announcement returns and investor trading behavior. In particular, these focus the identifying variation on differences in investor trading behavior on days in the *5-day Window* with days outside the *5-day Window* for firms with past

earnings announcement returns that are high and low. As such, the coefficient on the *5-day Window* indicator captures the expected change in purchasing or selling in the pre-earnings-announcement period for firms that are not in the top extrapolated returns decile. The coefficient on the interaction between *5-day Window* and *Top Decile Extrapolated Return*, β_2, tells us the amount by which the pre-earnings-announcement change for firms in the top decile differs from the change for the other firms in the sample. In other words, β_2 captures any spikes or drops in pre-earnings-announcement trading activity that is systematically related to being a top-decile firm. When a variable indicating the level of purchasing is on the left-hand side, the extrapolation hypothesis predicts that β_2 will be positive, which would indicate higher pre-earnings-announcement purchasing of firms with high extrapolated returns.

To test the effect of extrapolation on purchasing behavior, the left-hand-side variable is either the logarithm of one plus the dollar value of purchases of a firm's stock made by all sampled individuals on that trading day, or it is the total number of sampled individuals who purchase the stock on that trading day. To test the effect on selling, the left-hand side variable is either the logarithm of one plus the total dollar value of sales or the number of individuals who sell the stock. The remaining control variable in the regression is a control for recent increases in trading volume. We include this to controls for an increase in attention for reasons other than high extrapolated returns. Standard errors are clustered at both the firm and quarter level.

Before conducting our test, we make an important restriction to our sample. We only consider firm-quarters where the earnings announcement date can be easily predicted by investors. The data covers a period from 1991 to 1996, when firms did not commonly pre-announce their earnings announcement dates. For investors to be able to trade on an upcoming earnings announcement, they must have a good idea of when it is going to occur. To address this, we restrict the sample to firm-quarters where the actual earnings announcement is within two days

of the predicted earnings announcement. Here, the predicted earnings announcement date is the more accurate of the exact date of last year's earnings announcement or the exact date adjusted so that the predicted announcement occurs on the same day of the week as last year's announcement.

We present the results in Table 4. Column (1) shows the result with the dollar amount of purchases on the left-hand side. Consistent with our prediction, β_2 indicates that the increase in purchases during the pre-earnings-announcement period is ten percent higher for firms that are in the top decile of extrapolated returns (t=2.65). Column (3) of Table 4 shows the result with the number of buyers on the left-hand side. In this test, β_2 indicates that firms in the top extrapolated return decile see an average increase of 0.024 more purchasers in the pre-earnings-announcement period than the other firms in the sample (t=2.75). To put this result in context, the average number of purchasers on any given firm-day in our sample is 0.106, so this represents an increase in purchasers that is 23 percent of the sample average. Being in the top decile does not have any statistically significant impact on selling behavior. Column (2) contains the results with the dollar value of sales on the left-hand side, and column (4) contains the results with the number of sellers. In both cases, β_2 is insignificantly different from zero. This non-result is also consistent with extrapolative beliefs.

In Panel B of Table 4, we examine the impact of fundamentals extrapolation on pre-earnings-announcement trades. As in the previous section, we replace the *Top Decile Extrapolated Return* variable with a variable for being in the top decile of extrapolated surprise, where extrapolated surprise is measured using the sell-side analyst consensus forecast error over the past eight quarters, with the forecast error measured as the actual earnings-per-share minus the forecast. We find that the history of surprises does not seem to predict individual purchasing behavior in the period before the earnings announcement. We also find that the extrapolated return continues to positively predict purchases when controlling for the extrapolated surprise measure. This is consistent with

our conjecture that investors pay more attention to returns and the notion that investors buy with the hope of earning a high return during earnings announcements.

We also run a horse race between extrapolative beliefs and a belief in streak continuation. As in the previous section, we add a variable based on *Positive Return Streak*, which equals one if a firm had a positive earnings announcement return in each of the last four quarters. Again, we find that this variable has little predictive power. Importantly, we find that the extrapolated return measure continues to positively predict purchases when controlling for this streak measure. This is consistent with investors holding extrapolative beliefs, and not a belief in streak continuation.

6 Earnings Announcement Returns

6.1 Regressions

Having established that individual investor purchasing behavior is positively associated with past earnings announcement returns in the period immediately leading up to the next earnings announcement date, we predict this has asset pricing implications. Specifically, we expect that if there is excess buying pressure in the period right before earnings (and this excess buying pressure is the result of over-extrapolation), then we should see a rise in the price of the stock before earnings are announced and a fall in the stock price afterwards. First, we plot returns for firms in the top decile of our extrapolated return measure. In Figure 2, we see evidence consistent with our hypothesis. Shortly before the earnings announcement, there is a sharp increase in returns for firms in the top decile of our extrapolated-return measure, and a strong reversal in the post-earnings announcement period. For the rest of the firms in the sample, we see a smaller increase in returns before the announcement, and no price reversal afterwards.

We then conduct a similar test to the one we conducted with the individual purchasing data

in Section 5:

$$\begin{aligned}\text{Daily Return}_{iqt} &= \beta_1 5 \text{ Days Before EA}_{iqt} + \beta_2 \text{EA Window} + \beta_3 5 \text{ Days After EA} \\ &+ \beta_4 5 \text{ Days Before EA}_{iqt} \times \text{Top Decile Extrapolated Return}_{iq} \\ &+ \beta_5 \text{EA Window}_{iqt} \times \text{Top Decile Extrapolated Return}_{iq} \\ &+ \beta_6 5 \text{ Days After EA}_{iqt} \times \text{Top Decile Extrapolated Return}_{iq} \\ &+ \delta \text{Controls}_{iqt} + \gamma_i \times \eta_t + \epsilon_{iqt}.\end{aligned}$$

As in Section 5, this is a difference-in-differences design with firm-day observations and firm-quarter fixed-effects. The goal of this specification is to examine how being in the top extrapolated returns decile affects returns around the earnings announcement while controlling for general cross-sectional differences in daily returns that are present on all trading days. The left-hand-side variable is the raw daily return for firm i on day t in quarter q. As with the previous test, the baseline returns for each firm-quarter are captured by the firm-quarter fixed effects. Unlike the previous test, we now have three different treatment periods: the five days before the earnings announcement (day t-5 to day t-1, where day t is the earnings announcement date), the earnings announcement window (day t to day t+1), and the five days after the earnings announcement (day t+2 to day t+6). For each of these periods, we include an indicator variable that turns on whenever the firm-day is within that period. These indicators capture the expected change in daily returns during each of these periods for firms that are not in the top extrapolated returns decile.[14] Our three variables of interest are the interactions between *Top Decile Extrapolated Return*, defined as before, and *5 Days Before EA, EA Window,* and *5 Days After EA*. The coefficients on these three interaction terms tell us the

[14] In order to group the 5 days after the earnings announcement into the same quarter as the days right before and during the announcement, a firm-quarter is designated to run from the seventh day after the previous earnings announcement to the sixth day after the current earnings announcement.

difference between the change in daily returns from the baseline period to each of these periods for high-extrapolated-return firms and the same change for the rest of the firms in the sample.

Because the extrapolated return measure is a weighted average of the previous eight quarters' earnings announcement returns, it includes the most-recent quarter's earnings announcement return. We therefore control for an indicator tracking whether the firm is in the top decile of earnings-announcement returns for the previous quarter (interacted with *5 Days Before EA, EA Window,* and *5 Days After EA*), and an indicator tracking whether or not the firm is in the top decile of analyst forecast errors for the previous quarter (again interacted with *5 Days Before EA, EA Window,* and *5 Days After EA*). These controls are used to ensure that the extrapolated returns variable is not just picking up returns in response to trading on the post-earnings-announcement drift strategy (Milian, 2015). We also control for the value-weighted market return that day.

We present results for this test in Table 5. Column (1) contains the results without the post-earnings-announcement-drift controls, column (2) contains the results with them, and column (3) adds controls for the return from day t-250 to day t-1, where day t is the trading day of the observation, as well as interactions between this variable and the indicators for the three periods around the earnings announcement. In all three specifications, the coefficient on the interaction between *Top Decile Extrapolated Return* and *5 Days Before EA* is significantly positive, which is consistent with investors pushing up the price of high-extrapolated-return firms as they buy their stock in anticipation of good earnings-announcement performance. The coefficient on this term indicates that returns in response to this purchasing behavior are 11 basis points higher each day in the five pre-earnings-announcement days than they otherwise would be (t=6.05). (The average daily return in the sample is 8 basis points.) Note that this coefficient drops very little once the post-earnings-announcement drift controls are added, and that the coefficients on the post-earnings-announcement-drift controls interacted with *5 Days Before EA* are not consistently significant and

are much smaller than the coefficient on the interaction between *Top Decile Extrapolated Return* and *5 Days Before EA*. This suggests that there is much more pre-earnings-announcement purchasing based on extrapolation than on post-earnings-announcement drift.

The coefficient on the interaction between *Top Decile Extrapolated Return* and *5 Days After EA* is significantly negative. Top-decile firms have expected returns 6 basis points lower per day than the other firms in the sample (t=-3.08), even after the post-earnings-announcement drift and momentum controls are included. This is consistent with the idea that the extrapolation by investors is *over*-extrapolation. The reversal in returns after the earnings announcement suggests that extrapolating investors push the price too high with their pre-earnings-announcement purchases.

In Panel B of Table 5, we explore the impact of fundamentals extrapolation on returns around the earnings announcement. As in previous sections, we replace the *Top Decile Extrapolated Return* variable with a variable for being in the top decile of extrapolated surprise, where extrapolated surprise is measured using the sell-side analyst consensus forecast error over the past eight quarters, with the forecast error measured as the actual earnings-per-share minus the forecast. We find that the history of surprises positively predicts pre-earnings-announcement returns, and negatively predicts post-earnings-announcement returns. However, we find that the extrapolated return results continue to be significant when controlling for the extrapolated surprise, and they are greater in magnitude and more significant than the extrapolated surprise results.

We also run a horse race between a belief in earnings streaks and extrapolative beliefs. As in previous sections, we add a variable based on *Positive Return Streak*, which equals one if a firm had a positive earnings announcement return in each of the last four quarters. We uncover asset pricing evidence more consistent with extrapolative beliefs than a belief in streak continuation. For example, the coefficient on the interaction term between the *Top Decile Extrapolated Return*

measure and the pre-earnings announcement window dummy suggests that firms in the top decile of our extrapolated return measure will earn high pre-earnings announcement period returns while the coefficient on the interaction term between *Positive Return Streak* and the pre-earnings announcement window dummy suggests that streaky firms will not.

To show the robustness of our results, we also perform a more traditional regression of the following form:

$$\text{Previous 5-Day Return}_{it} = \beta_1 \text{Top Extrapolated Return Decile}_{it} + \delta \text{Controls} + \gamma_i + \eta_t + \epsilon_{it}.$$

The prediction is that the coefficient on the *Top Extrapolated Return Decile*, defined as before, will be positive and statistically significant. That is, a high extrapolated return should be associated with higher pre-earnings announcement returns. To make sure that we are not simply picking up returns in response to trading on the post-earnings-announcement drift strategy (Milian, 2015), we control for whether the firm is in the top decile of the previous quarter's earnings-announcement returns and whether it is in the top decile of the previous quarter's earnings surprises, where surprise is measured using analyst forecast errors. We include a number of different controls that could plausibly predict earnings announcement (and potentially, pre-earnings-announcement) returns as well. These are the known predictors of returns like size, the book-to-market ratio, and momentum. Further, we control for last quarter's earnings surprise as earnings are auto-correlated (Bernard and Thomas, 1990). More directly, we control for the current period's earnings surprise, earnings growth, accruals, and a dummy that equals one if this period saw negative earnings. We also include a control equal to the average of the earnings announcement return four-quarters ago and eight-quarters ago as Chang et al. (2014) show that previous earnings in the same season can predict this period's earnings announcement return. We also account for the volume of trades,

the stock price volatility, and the standard deviation of individual analyst earnings estimates. We include firm and calendar-quarter fixed effects to control for any fixed firm-level and quarter-level unobservables. We cluster standard errors by firm and by calendar-quarter to allow for within-firm and within-quarter correlation.

We present the results in Table 6. We find that being in the top decile of our extrapolated return measure is associated with a 5-day pre-earnings announcement return that is 48 to 51 basis points higher than for firms outside the top decile. This is signifcantly larger than the average 5-day return of 13 basis points. Again, we find evidence of a reversal after earnings are announced, indicating that investors are indeed over-extrapolating and not simply trading on information. However, in this specification the reversal appears more robustly during the earnings announcement than in the period after the earnings announcement. This result can be seen in columns (3) and (4), where we replace the left-hand-side variable with the 2-day earnings announcement return (the earnings announcement window includes the day of the announcement and the following day). We find that the return is 116 to 118 basis points lower for firms in the top extrapolated return decile than for the other firms in the sample. Regressions with the returns in the five days after the earnings announcement period on the left-hand side show that the reversal seems to continue after the earnings announcement, though β_1 becomes insignificant in this case after controlling for firm fundamentals.

Turning to controls in Table 6, same-window market returns are unsurprisingly very significant economically and statistically. Likewise, the post-earnings-announcement drift controls, *Top Previous EA Return Decile* and *Top Lagged Surprise Decile* are significant in some cases, although the coefficient estimate of the main independent variable, *Top Extrapolated Return Decile*, is incremental to these factors, and its effect is much larger.

In untabulated tests, we reperform the regressions in Table 5 and Table 6 with the sample

period restricted to the years 1991 to 1996, the years during which we have individual investor trading data, and with the sample restricted to firms whose earnings announcement dates are predictable. This sample corresponds to the sample we used to show that individual investors appear to buy firms that have a history of strong earnings announcement returns. We find that the results, including the earnings announcement reversal, still hold in this sample, indicating that the individual investors who purchased the firm's stock based on its past earnings announcement returns were over-extrapolating, and not simply trading on information.

One alternative interpretation of our result is that the predictable run-up in price and subsequent reversal comes from firms that manipulate earnings. Investors may expect firms with a history of earnings manipulation to continue to manipulate earnings in the future. Therefore, we would expect to see a run-up in prices before earnings and a large decrease when the firm is finally forced to stop manipulating earnings. However, we interpret the top decile results as evidence against such a story—it is unlikely that firms that have manipulated earnings to just beat forecasts will be in the top decile of our extrapolated return measure. Furthermore, our findings are robust to controlling for various earnings management proxies, e.g., accruals.

6.2 Portfolio Tests

The predictive power of the extrapolated return measure suggests that we may be able to construct calendar-time trading strategies that earn abnormal returns. At the beginning of each trading day, we consider firms in the pre-earnings announcement window - the five days before the earnings announcement date. We go long a firm if it is in the top decile of our extrapolated return measure and we go short a firm if it is in the bottom decile of our extrapolated return measure. We present our results in Table 7.

The asset pricing literature generally assumes that invesors only invest if they can diversify

their risk across a number of firms. As such, in Columns 1 and 2, we require at least five firms in the long and short portfolio. Our strategy for an equal-weighted portfolio earns a four-factor alpha of 16.7 basis points (t=6.74). The value-weighted four-factor alpha is a similar 17.1 basis points (t=4.74).[15] Annualized, this strategy would earn, on average, a 27% four-factor value-weighted alpha before transaction costs. (On average, we can implement this strategy 139 trading days in a year.)

When we relax the five firm restriction, we see similar daily alphas—the four-factor equal-weighted alpha is 15.2 basis points (t=5.17) and the four-factor value-weighted alpha is 14.6 basis points (t=4.16). This, of course, expands the number of trading days this strategy can be implemented. Annualized, this strategy would earn, on average, a 40% four-factor value-weighted alpha. The four-factor alpha includes a momentum factor, which is correlated with our measure. Our measure is also correlated with the post-earnings announcement drift. As such, we construct a factor based on the post-earnings announcement drift - the portfolio goes long firms in the top decile of earnings surprises and goes short firms in the bottom decile of earnings surprises. Adding this factor, we find little effect on the portfolio alphas.

We then construct calendar-time portfolios based on the post-earnings announcement reversal. At the beginning of each trading day, we consider firms in the post-earnings announcement window - two days after the earnings announcement date to six days after the earnings announcement date. We construct a naive strategy - one that is not based upon this period's earnings. A firm is in the long side of our portfolio if it is the bottom decile of our extrapolated return measure (ignoring this period's earnings) and a firm is in the short side of our portfolio if it is in the top decile of our extrapolated return measure. We present our results in Table 8. Again, we first construct portfolios that consist of at least five firms in the long and short portfolio and present

[15] Other standard portfolio alphas are of a similar magnitude.

the alphas in Columns 1 and 2. This strategy also earns a high alpha. Specifically, the four-factor alpha for an equal-weighted portfolio is 12.4 basis points (t=5.55). The value-weighted portfolio earns a similar four-factor alpha of 13.3 basis points (t=3.92).[16] Annualized, this strategy would earn, on average, a 20% four-factor value-weighted alpha before transaction costs. (On average, we can implement this strategy 139 trading days in a year.) When we relax the five firm restriction, we see similar daily alphas - the four-factor equal-weighted alpha is 13.5 basis points (t=4.90) and the four-factor value-weighted alpha is 15.2 basis points (t=4.75). Annualized, this strategy would earn, on average, a 43% four-factor value-weighted alpha.

7 Conclusion

Our paper provides individual-level and market-level evidence that investors over-extrapolate. We first examine investor forecasts of earnings per share, and find that they tend to be optimistic for firms that have a history of strong earnings announcement performance. We next look at individual investor trades using data from a large discount brokerage and uncover support for the notion that investors' purchasing decisions are driven by extrapolative beliefs. We then find market-level evidence consistent with extrapolative beliefs. Specifically, we find strong evidence of a run-up in prices before earnings announcements for firms that have historically had good earnings announcement returns and a price reversal once earnings information is released. Moreover, the trading behavior and return predictability that we uncover are not consistent with an alternative explanation based on overextrapolation of fundamentals or beliefs based on streak continuation. In conclusion, we provide empirical evidence that investors over-extrapolate recent stock returns. This evidence corroborates earlier survey and theoretical work on over-extrapolation.

[16] Other standard portfolio alphas are of a similar magnitude.

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Appendix A: Variable Definitions

Variable	Calculation
Previous 5-day returns	Buy-and-hold returns over [–5, –1]
Announcement returns	Buy-and-hold returns over [0, +1]
Forward 5-day returns	Buy-and-hold returns over [+2, +6]
Extrapolated returns (surprise)	Inverse weighted average of past *announcement returns(surprises)* from quarter –8 to –1
Positive Return Streak	1 if last 4 earnings announcement returns>0, 0 otherwise
Earnings surprise	Actual EPS minus the most recent consensus analyst forecast, unscaled, unadjusted
Forecast dispersion	Standard deviation of individual analyst forecasts
Staleness	Average of the difference between earnings ann. date and analyst forecast date
Market capitalization	$CSHOQ \times PRCCQ$
Operating cash flows	*OANCFY*, converted into quarterly levels
Accruals	*(IBQ – Operating cash flows) / (l.ATQ)*
Book-to-market ratio	$CEQQ$ / $(CSHOQ \times PRCCQ)$
Loss indicator	1 if $IBQ < 0$, and 0 otherwise
Leverage	*(DLCQ + DLTTQ) / ATQ*
Volume	6-month average of *VOL/SHROUT* leading up to the earnings announcement
Volatility	6-month standard deviation of stock returns *RET* leading up to earnings announcement
Momentum	12-month average of monthly *RET* leading up to earn. announcement
Seasonal return	Average of quarter t-4 and t-8 earnings-announcement returns
% Optimistic vs. actual	% of investors whose EPS forecasts are higher than the firm-quarter's actual EPS
% Optimistic vs. sell-side	% of investors whose EPS forecasts are higher than the sell-side analyst consensus forecast
Optimistic Sell-Side	1 if consensus sell-side analyst forecast > actual EPS, 0 otherwise
Only Forecast	1 if only one investor makes a forecast for the firm-quarter, 0 otherwise
# Investor Forecasts	Number of investors who make forecasts for the firm-quarter
Std of Investor Forecasts	Standard deviation of investor forecasts for the firm-quarter
Gross Purchases	log(1 + dollar value of total purchases of the firm's stock that day by investors in the dataset)
Gross Sales	log(1 + dollar value of total sales of the firm's stock that day by investors in the dataset)
# Buyers	The number of investors covered in the dataset who purchase the firm's stock on a given day
# Sellers	The number of investors covered in the dataset who sell the firm's stock on a given day
Volume Increase	Trading volume from day t-5 to day t-1 divided by trading volume from day t-10 to day t-6

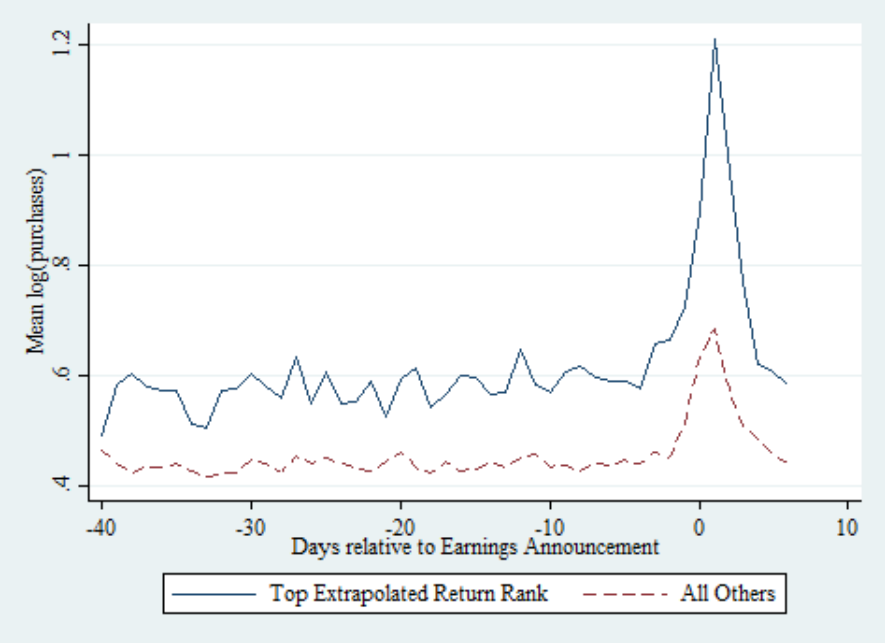
Data sources are CRSP, IBES, Compustat, Estimize, and a large discount brokerage house—detailed in Section 3.

Control variables are as of the beginning of the quarter, unless stated otherwise.

Adjusted signifies conversion of year-to-date (cash flow) items into quarterly figures.

Figure 1: Individual Purchases in the Days Before the Earnings Announcement

(a) Dollar Value of Purchases



(b) Number of Purchase Transactions

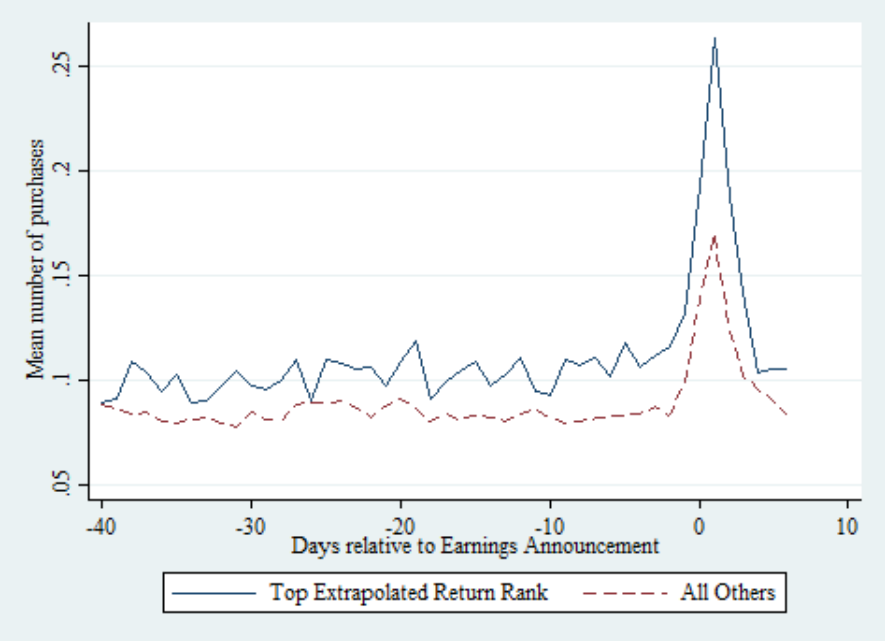


Figure 2: Returns in Days Around the Earnings Announcement

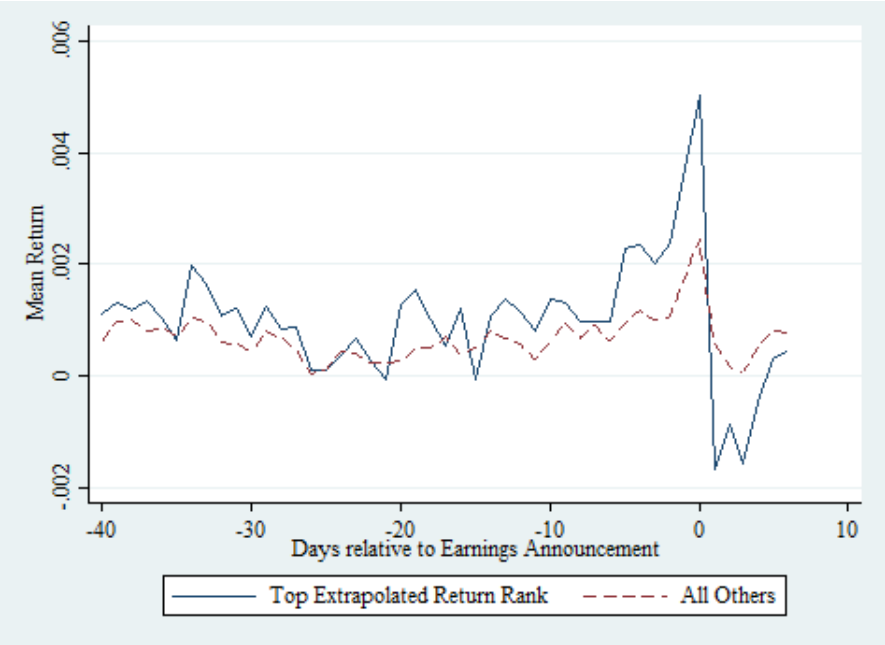


Table 1: Descriptive Statistics

This table presents pertinent summary statistics. The unit of analysis is the firm-quarter in Panels A and C and firm-day in Panel B. Variable definitions appear in Appendix A.

Panel A: Sample for Individual Investor Forecasts Tests

	Mean	Stdev	10%	50%	90%	# Obs.
% Optimistic (vs. Actual)	44.98	44.71	0	33.33	100	6,466
% Optimistic (vs. Sell-side)	78.20	31.75	25	100	100	6,466
Optimistic Sell-Side	0.27	0.45	0	0	1	6,466
Only Forecast	0.26	0.44	0	0	1	6,466
# Investor Forecasts	6.33	12.20	1	3	14	6,466
Std of Investor Forecasts	0.02	0.06	0	0.01	0.05	6,466

Panel B: Sample for Individual Investor Trades Tests

	Mean	Stdev	10%	50%	90%	# Obs.
log(Gross Purchases)	0.525	2.159	0	0	0	953,590
log(Gross Sales)	0.545	2.200	0	0	0	953,590
# Buyers	0.106	0.759	0	0	0	953,590
# Sellers	0.092	0.52	0	0	0	953,590

Panel C: Sample for Cross-sectional Return Tests

	Mean	Stdev	10%	50%	90%	# Obs.
Extrapolated returns	0.0075	0.0405	-0.0373	0.0061	0.0541	132,682
Previous five-day returns	0.0013	0.0316	-0.0303	0.0000	0.0330	132,682
Earnings announc. returns	0.0034	0.0838	-0.0855	0.0011	0.0949	132,682
Forward five-day returns	0.0009	0.0297	-0.0299	0.0000	0.0318	132,682
Log(Size)	6.86	1.63	4.89	6.70	9.07	132,682
Log(Book-to-Market)	-0.96	0.74	-1.87	-0.89	-0.12	132,682
Surprise (cents)	0.69	10.20	-8.00	1.00	9.00	132,682
Lagged Surprise (cents)	0.87	9.93	-7.00	1.00	9.00	132,682
Momentum	0.02	0.04	-0.03	0.01	0.06	132,682
Volatility	0.12	0.06	0.06	0.10	0.20	132,682
Volume	1.85	1.54	0.45	1.40	3.88	132,682
Dispersion	0.03	0.04	0.01	0.02	0.07	132,682
Earnings Growth	0.01	0.57	-0.32	0.03	0.32	132,682
Loss Firm	0.18	0.39	0.00	0.00	1.00	132,682
Accruals	-1.32	4.06	-5.40	-1.24	2.81	132,682

Table 2: Correlations

This table presents the correlations among regression variables measured in the large, cross-sectional returns sample (N = 132,682). All variables are as defined in Appendix A. Pearson's correlation coefficients are shown in the lower triangle, and Spearman's rank correlations appear above the diagonal.

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
[1]	*Top decile extr. ret.*		0.01	-0.01	-0.01	-0.09	0.00	0.05	0.17	0.06	-0.00	0.12	0.17	0.12	-0.03	0.52	0.00
[2]	*Prv. 5-day ret.*	0.01		-0.01	-0.00	0.01	0.01	0.02	0.01	0.01	0.00	-0.01	-0.00	0.01	0.00	0.01	-0.01
[3]	*Earn. ann. ret*	-0.01	-0.01		0.01	0.01	0.01	0.30	-0.01	0.12	-0.02	-0.01	-0.01	-0.02	-0.02	-0.01	-0.08
[4]	*Fwd. 5-day ret.*	-0.01	0.00	0.01		0.01	0.00	0.02	-0.00	0.01	-0.01	-0.01	-0.02	-0.01	-0.00	-0.00	-0.02
[5]	*Size*	-0.10	-0.00	-0.00	-0.00		-0.33	0.13	0.13	0.10	-0.01	0.03	-0.39	0.16	0.10	-0.01	-0.18
[6]	*Book-to-market*	0.01	0.01	0.02	-0.00	-0.32		-0.04	-0.06	-0.14	-0.04	-0.29	0.04	-0.15	0.18	0.01	0.09
[7]	*Earnings surprise*	0.04	0.02	0.22	0.01	0.10	-0.05		0.28	0.33	0.03	0.14	-0.02	0.10	0.01	0.09	-0.17
[8]	*Lagged earn. surp.*	0.12	0.00	-0.02	-0.01	0.10	-0.06	0.24		0.24	0.01	0.23	-0.02	0.11	0.01	0.30	-0.13
[9]	*Earnings growth*	0.04	0.00	0.06	0.00	0.03	-0.09	0.23	0.15		0.14	0.32	-0.06	0.00	-0.05	0.12	-0.33
[10]	*Accruals*	0.00	-0.00	-0.02	-0.01	-0.01	-0.03	0.08	0.02	0.21		0.06	-0.03	-0.04	-0.05	0.02	-0.18
[11]	*Momentum*	0.13	-0.01	-0.02	-0.01	0.00	-0.29	0.10	0.18	0.21	0.07		0.08	0.06	-0.09	0.16	-0.11
[12]	*Volatility*	0.17	0.03	-0.01	0.00	-0.33	-0.02	-0.02	-0.02	-0.02	-0.04	0.24		0.40	-0.03	-0.00	0.26
[13]	*Volume*	0.11	0.02	-0.02	-0.00	0.11	-0.14	0.05	0.05	-0.03	-0.04	0.10	0.42		0.06	-0.01	0.12
[14]	*Dispersion*	-0.03	-0.00	-0.01	-0.01	0.08	0.14	-0.07	-0.04	-0.06	-0.07	-0.07	0.01	0.10		-0.04	0.16
[15]	*Lagged PEAD*	0.51	0.01	-0.01	-0.01	-0.01	0.02	0.07	0.23	0.07	0.02	0.15	-0.00	-0.02	-0.04		-0.08
[16]	*Loss indicator*	0.00	0.00	-0.07	-0.01	-0.18	0.06	-0.22	-0.14	-0.29	-0.20	-0.09	0.28	0.12	0.17	-0.08	

Table 3: Investor EPS Forecasts

The unit of observation is a firm-quarter. *% Optimistic (vs. sell-side)* is the percentage of investors whose EPS forecasts are higher than the sell-side analyst consensus forecast. *Top Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the top decile of the extrapolated return measure for the calendar quarter. The extrapolated return measure is equal to $\sum_{j=1}^{8} \frac{1}{j} R_{t-j}$, where R_{t-j} is the earnings announcement return from period $t-j$. *Optimistic Sell-Side* is an indicator variable that equals 1 if the consensus sell-side analyst forecast is greater than the actual realization of EPS, and equals 0 otherwise. *Only Forecast* is an indicator that that equals 1 if only one investor makes a forecast for the firm-quarter, and equals 0 otherwise. *# Investor Forecasts* is the number of investors who make forecasts for the firm's EPS that quarter. *Std of Investor Forecasts* is the standard deviation of investor forecasts for the firm-quarter. *Top Previous EA Ret. Decile* [*Top Lagged Surprise Decile*] is an indicator variable that switches on if the firm is in top decile of the previous earnings announcement return distribution [previous earnings surprise distribution]. Additional controls include the following variables, the measurement of which is detailed in Appendix A: *Size, Book-to-market Ratio, Return Momentum, Volatility, Trading Volume, Earnings Growth, Earnings Surprise, Lagged Surprise, Forecast Dispersion, Loss Firm, Accruals* and *Seasonal Return*. Variable definitions appear in Appendix A. T-statistics (presented in parentheses) are robust to within-firm and within-quarter correlation and heteroskedasticity. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

Panel A: Investor EPS Forecasts

	(1)	(2)	(3)	(4)	(5)	(6)
	% Optimistic vs. Sell-side	% Optimistic vs. Sell-side	% Optimistic vs. Sell-side	% Optimistic vs. Sell-side	% Optimistic vs. Sell-side	% Optimistic vs. Sell-side
Top Decile Extrapolated Ret.	9.440***	8.625***	8.269***	8.334***	4.409***	5.134**
	(7.944)	(6.540)	(6.909)	(5.236)	(3.085)	(2.636)
Optimistic Sell-Side			-9.775***	-1.581	-8.377***	-2.380*
			(-10.77)	(-1.550)	(-12.30)	(-1.912)
Only Forecast			-0.185	0.632	-0.0948	0.546
			(-0.0755)	(0.411)	(-0.0383)	(0.341)
No. of Investor Forecasts			0.0314	-0.0110	0.0855*	0.0134
			(0.680)	(-0.272)	(1.816)	(0.256)
Std. Deviation of Investor Forecasts			-20.93**	-29.33***	-22.15***	-35.76***
			(-2.526)	(-3.478)	(-3.119)	(-3.493)
Observations	7,074	6,973	6,463	6,349	6,133	6,017
R-squared	0.041	0.304	0.035	0.311	0.077	0.327
Firm FE	NO	YES	NO	YES	NO	YES
Quarter FE	YES	YES	YES	YES	YES	YES
Additional Controls	NO	NO	NO	NO	YES	YES
SEs clustered by firm and quarter	YES	YES	YES	YES	YES	YES

Panel B: Investor EPS Forecasts:
Comparing Returns Extrapolation to Surprise Extrapolation and Expectation of Streak Continuation

	(1) % Optimistic vs. Sell-side	(2) % Optimistic vs. Sell-side	(3) % Optimistic vs. Sell-side	(4) % Optimistic vs. Sell-side	(5) % Optimistic vs. Sell-side	(6) % Optimistic vs. Sell-side
Top Decile Extrapolated Surp.	10.79***	10.46***	7.349***	6.840***		
	(5.567)	(5.563)	(4.603)	(4.399)		
Top Decile Extrapolated Ret.		6.003***		6.251***	6.632***	7.007***
		(3.869)		(3.183)	(4.208)	(3.349)
Positive Return Streak					0.486	-1.881
					(0.472)	(-1.256)
Optimistic Sell-Side	-8.749***	-8.589***	-2.588*	-2.549*	-8.681***	-2.575*
	(-10.83)	(-10.56)	(-1.884)	(-1.850)	(-11.04)	(-1.904)
Only Forecast	-0.429	-0.266	0.227	0.307	-0.555	0.321
	(-0.172)	(-0.107)	(0.137)	(0.188)	(-0.221)	(0.201)
No. of Investor Forecasts	0.0635**	0.0570*	-0.0173	-0.0193	0.0531*	-0.0194
	(2.195)	(1.901)	(-0.415)	(-0.454)	(1.853)	(-0.470)
Std Deviation of Investor Forecasts	-14.91*	-14.30*	-29.51***	-29.60***	-7.459	-28.18***
	(-2.164)	(-2.092)	(-3.171)	(-3.176)	(-1.455)	(-3.109)
Observations	6,099	6,099	5,988	5,988	6,136	6,020
R-squared	0.053	0.055	0.315	0.317	0.047	0.317
Firm FE	NO	NO	YES	YES	NO	YES
Quarter FE	YES	YES	YES	YES	YES	YES
Additional Controls*	YES	YES	YES	YES	YES	YES
Clustered by Firm and Quarter	YES	YES	YES	YES	YES	YES

*Lagged earnings surprise is not included as an additional control in the first four columns

Table 4: Individual Trades

The unit of observation is a firm-day. *Top Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the top decile of the extrapolated return measure. The extrapolated return measure is equal to $\sum_{j=1}^{8} \frac{1}{j} R_{t-j}$, where R_{t-j} is the earnings announcement return from period $t-j$. *5-Day Window* is a dummy variable that equals one for observations that are in the 5-day period before the earnings announcement. The left-hand-side variable is the log value of total purchases, the log value of total sales, the number of buyers, and the number of sellers, respectively. Definitions of these dependent variables and additional controls appear in Appendix A. T-statistics (presented in parentheses) are robust to within-firm and within-quarter correlation and heteroskedasticity. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

Panel A: Individual Trades

	[1]	[2]	[3]	[4]
	log(Gross Purchases)	log(Gross Sales)	# Buyers	# Sellers
5-day window	0.0156	0.00939	-0.000271	0.00248
	(1.341)	(0.762)	(-0.0607)	(1.075)
Top Decile Extrapolated Ret.× 5-day window	0.102**	-0.0356	0.0243**	0.00213
	(2.653)	(-0.952)	(2.751)	(0.130)
Volume Increase	0.00125**	0.000614**	0.000348**	0.000153**
	(2.383)	(2.333)	(2.329)	(2.383)
Observations	953,590	953,590	953,590	953,590
R-squared	0.337	0.307	0.430	0.384
Firm-quarter FE	YES	YES	YES	YES
Clustered at Firm	YES	YES	YES	YES
Clustered at Quarter	YES	YES	YES	YES

Panel B: Individual Trades:
Comparing Returns Extrapolation to Surprise Extrapolation and Expectation of Streak Continuation

	(1)	(2)	(3)	(4)	(5)	(6)
	log(Gross Purchases)	log(Gross Purchases)	No. of Buyers	No. of Buyers	log(Gross Purchases)	No. of Buyers
5-Day Window	0.0349**	0.0244	0.00487	0.00274	0.0140	-0.000316
	(2.110)	(1.415)	(0.958)	(0.519)	(1.176)	(-0.0677)
Top Decile Extrapolated Surp. x 5-Day	0.0490	0.0317	0.00247	-0.00103		
	(1.189)	(0.762)	(0.115)	(-0.0472)		
Top Decile Extrapolated Ret. x 5-Day		0.154**		0.0310**	0.0950**	0.0241***
		(2.824)		(2.857)	(2.444)	(2.837)
Positive Return Streak x 5-Day					0.0306	0.000863
					(0.965)	(0.0917)
Volume Increase	0.00188**	0.00188**	0.000576**	0.000576**	0.00125**	0.000348**
	(2.545)	(2.544)	(2.456)	(2.456)	(2.383)	(2.329)
Observations	605,041	605,041	605,041	605,041	953,590	953,590
R-squared	0.340	0.340	0.429	0.429	0.337	0.430
Firm-Quarter FE	YES	YES	YES	YES	YES	YES
Clustered at Firm	YES	YES	YES	YES	YES	YES
Clustered at Quarter	YES	YES	YES	YES	YES	YES

Table 5: Extrapolation and Return Predictiability

The unit of observation is a firm-day. *5 Days Before EA, EA Window,* and *5 Days After EA* are indicators for days that occur within the t-5 to t-1 window, t to t+1 window, and the t+2 to t+6 window, respectively, where t is the earnings announcement date. *Top Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the top decile of the extrapolated return measure. The extrapolated return measure is equal to $\sum_{j=1}^{8} \frac{1}{j} R_{t-j}$, where R_{t-j} is the earnings announcement return from period $t-j$. *Market Return* is the value-weighted market return that day. *Top Previous EA Return Decile* [*Top Lagged Surprise Decile*] is an indicator variable that switches on if the firm is in top decile of the previous earnings announcement return distribution [previous earnings surprise distribution]. The momentum controls include a control for the return from day t-250 to day t-1, as well as interactions between this variable and the indicators for the three periods around the earnings announcement. T-statistics (presented in parentheses) are robust to within-firm-quarter correlation and heteroskedasticity. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

Panel A: Extrapolation and Return Predictability

	(1)	(2)	(3)
	Daily Return	Daily Return	Daily Return
5 Days Before EA	0.000519***	0.000467***	0.000566***
	(4.019)	(3.577)	(3.447)
EA Window	0.000859***	0.00103***	0.00132***
	(4.324)	(4.718)	(5.007)
5 Days After EA	-0.000208*	1.30e-05	0.000204
	(-1.720)	(0.103)	(1.198)
Top Extrap. Ret. Dec. × 5 Days Before	0.00105***	0.000928***	0.00125***
	(6.052)	(5.572)	(5.560)
Top Extrap. Ret. Dec. × EA Window	-0.000303	0.000316	0.000805
	(-0.684)	(0.544)	(1.304)
Top Extrap. Ret. Dec. × 5 Days After	-0.00121***	-0.000559***	-0.000626***
	(-8.079)	(-3.392)	(-3.077)
Market Return	0.969***	1.031***	1.023***
	(39.33)	(41.94)	(41.48)
Top Prev. EA Ret. Dec. × 5 Days Before		7.33e-05	7.03e-05
		(0.406)	(0.384)
Top Prev. EA Ret. Dec. × EA Window		-0.00107*	-0.000881
		(-1.693)	(-1.356)
Top Prev. EA Ret. Dec. × 5 Days After		-0.000667***	-0.000366**
		(-4.147)	(-2.180)
Top Prev. Surprise Dec. × 5 Days Before		0.000211	0.000461***
		(1.577)	(3.223)
Top Prev. Surprise Dec. × EA Window		-0.00111***	-0.000617
		(-2.638)	(-1.411)
Top Prev. Surprise Dec. × 5 Days After		-0.000829***	-0.000479***
		(-6.238)	(-3.197)
Observations	10,800,227	8,735,669	8,735,669
R-squared	0.123	0.146	0.151
Firm-Quarter FE	YES	YES	YES
Momentum Controls	NO	NO	YES
Clustered at Firm and Quarter	YES	YES	YES

Panel B: Extrapolation and Return Predictiability:
Comparing Returns Extrapolation to Surprise Extrapolation and Expectation of Streak Continuation

	(1)	(2)	(3)	(4)
	Daily Return	Daily Return	Daily Return	Daily Return
5 Days Before EA	0.000506***	0.000429***	0.000546***	0.000562***
	(3.398)	(3.044)	(3.117)	(3.426)
EA Window	0.00121***	0.00123***	0.00154***	0.00124***
	(5.118)	(5.074)	(5.470)	(4.738)
5 Days After EA	-3.87e-05	4.61e-05	0.000281	0.000227
	(-0.286)	(0.353)	(1.597)	(1.336)
Top Extrap. Surp. Dec. × 5 Days Before	0.000405***	0.000324**	0.000133	
	(3.107)	(2.478)	(0.751)	
Top Extrap. Surp. Dec. × EA Window	-0.000766*	-0.000751*	-0.000386	
	(-1.814)	(-1.808)	(-0.844)	
Top Extrap. Surp. Dec. × 5 Days After	-0.000638***	-0.000549***	-0.000512***	
	(-4.765)	(-4.050)	(-3.278)	
Top Extrap. Ret. Dec. × 5 Days Before		0.000907***	0.00124***	0.00123***
		(4.852)	(5.226)	(5.462)
Top Extrap. Ret. Dec. × EA Window		-0.000165	0.000872	0.000372
		(-0.305)	(1.273)	(0.611)
Top Extrap. Ret. Dec. × 5 Days After		-0.000999***	-0.000679***	-0.000494**
		(-5.613)	(-3.051)	(-2.452)
Positive Return Streak × 5 Days Before				8.95e-05
				(0.674)
Positive Return Streak × EA Window				0.00154***
				(3.641)
Positive Return Streak × 5 Days After				-0.000465***
				(-2.938)
Market Return	1.052***	1.052***	1.044***	1.023***
	(41.50)	(41.50)	(41.18)	(41.48)
Observations	7,452,090	7,452,090	7,452,090	8,735,669
R-squared	0.161	0.161	0.166	0.151
Firm-Quarter FE	YES	YES	YES	YES
PEAD Controls	NO	NO	YES	YES
Momentum Controls	NO	NO	YES	YES
Clustered at Firm and Quarter	YES	YES	YES	YES

Table 6: Extrapolation and Return Predictability, Alternative Specification

The unit of observation is a firm-quarter. *Top Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the top decile of the extrapolated return measure. The extrapolated return measure is equal to $\sum_{j=1}^{8} \frac{1}{j} R_{t-j}$, where R_{t-j} is the earnings announcement return from period $t-j$. *Previous 5-day Market Ret.*, *Earnings Ann. Market Ret.*, and *Forward 5-day Market Ret.* are S&P 500 returns measured over the same period as the corresponding dependent variable. *Top Previous EA Ret. Decile* [*Top Lagged Surprise Decile*] is an indicator variable that switches on if the firm is in top decile of the previous earnings announcement return distribution [previous earnings surprise distribution]. Additional controls include the following variables, the measurement of which is detailed in Appendix A: *Size, Book-to-market Ratio, Return Momentum, Volatility, Trading Volume, Earnings Growth, Earnings Surprise, Lagged Surprise, Forecast Dispersion, PEAD Rank, Loss Firm, Accruals* and *Seasonal Return.* Variable definitions appear in Appendix A. T-statistics (presented in parentheses) are robust to within-firm and within-quarter correlation and heteroskedasticity. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
	Previous 5-day return	Previous 5-day return	Earn. ann. Return	Earn. ann. Return	Forward 5-day return	Forward 5-day return
Top Decile Extrapolated Ret.	0.00511***	0.00480***	-0.0118***	-0.0116***	-0.00205***	-0.000803
	(6.870)	(5.643)	(-9.281)	(-8.291)	(-2.823)	(-0.952)
Previous 5-day Market Ret.	1.071***	1.091***				
	(24.02)	(24.74)				
Earnings Ann. Market Ret.			1.011***	1.044***		
			(25.26)	(27.16)		
Forward 5-day Market Ret.					1.012***	1.040***
					(24.12)	(24.99)
Top Previous EA Ret. Decile	0.000542	-0.000282	-0.000975	-0.00283**	-0.00234***	-0.00298***
	(0.695)	(-0.336)	(-0.781)	(-2.411)	(-3.176)	(-3.856)
Top Lagged Surprise Decile	0.00280***	0.00192**	-0.00269***	-0.000528	-0.00315***	-0.00163**
	(4.116)	(2.391)	(-2.872)	(-0.522)	(-4.858)	(-2.078)
Observations	149,372	132,682	149,372	132,682	149,342	132,682
R-Squared	0.204	0.223	0.096	0.159	0.189	0.206
Firm FE	YES	YES	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES	YES	YES
Additional Controls	NO	YES	NO	YES	NO	YES
Clustered by firm and quarter	YES	YES	YES	YES	YES	YES

Table 7: Portfolio Returns Before the Earnings Announcement

This table displays equal-weighted and value-weighted daily portfolio returns in basis points. The long portfolio consists of firms that are in the top decile of our extrapolated-return measure and are in the pre-earnings announcement window [t-5,t-1]. The short portfolio consists of firms that are in the bottom decile of our extrapolated return measure and are in the pre-earnings announcement window. The first two columns require at least 5 firms in the long and short portfolio. The first three factors are the excess market return, the size portfolio, and the value portfolio. The fourth factor is a momentum factor. PEAD is a factor based on the post-earnings announcement drift. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)
	Equal-Weighted	Value-Weighted	Equal-Weighted	Value-Weighted
Raw	17.1***	17.7***	16.1***	15.8***
	(7.02)	(5.03)	(5.48)	(4.47)
Alpha	16.9***	17***	16***	15.4***
	(6.93)	(4.84)	(5.45)	(4.37)
3-Factor Alpha	17.1***	17.4***	16***	15.7***
	(6.99)	(4.96)	(5.46)	(4.44)
4-Factor Alpha	16.9***	17.2***	15.2***	14.6***
	(6.96)	(4.92)	(5.17)	(4.16)
4-Factor+PEAD	16.7***	17.1***	16.2***	15.5***
	(6.74)	(4.74)	(5.35)	(4.23)

Table 8: Portfolio Returns After the Earnings Announcement

This table displays equal-weighted and value-weighted daily portfolio returns in basis points. In the first four columns, the long portfolio consists of firms that are in the bottom decile of our extrapolated return measure and are in the post-earnings announcement window [t+2,t+6]. The short portfolio consists of firms that are in the top decile of our extrapolated return measure and are in the post-earnings announcement window. The first two columns require at least 5 firms in the long and short portfolio. The first three factors are the excess market return, the size portfolio, and the value portfolio. The fourth factor is a momentum factor. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)
	Naive	Naive	Naive	Naive
	Equal-Weighted	Value-Weighted	Equal-Weighted	Value-Weighted
Raw	12.1***	12.8***	12.5***	14.2***
	(5.40)	(3.76)	(4.52)	(4.29)
Alpha	12.2***	13.2***	12.5***	14.3***
	(5.44)	(3.89)	(4.53)	(4.34)
3-Factor Alpha	12.1***	13***	12.5***	14.2***
	(5.41)	(3.82)	(4.52)	(4.31)
4-Factor Alpha	12.4***	13.3***	13.5***	15.6***
	(5.55)	(3.92)	(4.90)	(4.75)