Earnings Announcement Return Extrapolation*

Aytekin Ertan, London Business School
Stephen A. Karolyi, Carnegie Mellon University
Peter W. Kelly, University of Notre Dame
Robert Stoumbos, Columbia University

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Abstract

We propose that extrapolative beliefs about earnings announcement (EA) returns may contribute to our understanding of EA return patterns. We construct a theoretically-motivated measure of extrapolative investors' expectations based on a stock's recent history of EA returns. We then show that this measure explains cross-sectional variation in stock returns and investor behavior around EAs. Stocks expected to have high EA returns according to our measure experience predictable increases in prices before EAs and predictable decreases afterwards. These patterns are economically significant: investors that buy (sell) a portfolio that is long firms with high recent EA returns and short firms with low recent EA returns in the pre-EA (post-EA) period earn daily five-factor abnormal returns of 16.1 bps (18.3 bps). Using individual investor trades data and a measure of institutional trading, we find that individual and institutional investors are more likely to purchase stocks with high recent EA returns, consistent with at least a subset of investors forming extrapolative beliefs about EA returns.

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Ertan can be contacted at London Business School, London NW1 4SA, United Kingdom, +44-20-7000-8131, aertan@london.edu; Kelly at 236 Mendoza College of Business, Notre Dame IN 46556, +1-516-581-9067, pkelly6@nd.edu; Karolyi at Tepper School of Business, Carnegie Mellon University 5000 Forbes Ave Pittsburgh, PA 15213, +1-412-268-2909, skarolyi@andrew.cmu.edu; and Stoumbos at Uris Hall, 3022 Broadway, New York, NY 10027, +1-212-851-5863, rcs2188@gsb.columbia.edu.

1 Introduction

Earnings announcements (EAs) are a focal point for many investors, and drive abnormal trading volume and stock returns (e.g., Beaver 1968; Shao et al. 2020). Moreover, there is significant evidence that EAs are salient predictable events upon which investors like to gamble (e.g., Liu et al. forthcoming). A common motivation for gambling is a belief about the gambling event.[1] If investors have extrapolative expectations with respect to the principal outcome of EAs—the EA *return*—then they will believe that stocks with a recent series of high EA returns will continue to have high EA returns in the future. Gambling on these beliefs will lead to a positive demand shock, and positive price pressure, shortly before the upcoming EA. If these extrapolative beliefs are biased, we would also expect a reversal after earnings information is released and fundamental traders respond (Engelberg et al. 2018). We posit that extrapolative beliefs are an important ingredient for explaining return patterns around EAs.

The idea that investors extrapolate EA returns is grounded in significant theoretical and experimental work. In their seminal work, Tversky and Kahneman (1971, 1974) document evidence of representativeness. Representativeness captures a belief in the "law of small numbers". That is, people think the true distribution should be reflected in small samples. Consequently, when the underlying distribution is unknown, people infer it from a small sample of data. We hypothesize that people will infer the distribution of EA returns from recent EA returns, and use these inferences to predict future EA returns—in other words, that they will extrapolate future EA returns from past EA returns. We speculate that investors will focus on past EA returns rather than past fundamentals, in keeping with the observed tendency of investors to focus on returns rather than earnings (Blankespoor et al. 2019).

Our hypothesis also has foundations in recent empirical work. Landier et al. (2019) run a large-scale experiment where participants forecast a stable random process. They find that subjects

[1] Beliefs and preferences are the two important ingredients for decision-making (Barberis and Thaler 2003).

tend to exaggerate the impact of the most recent shock. Greenwood and Shleifer (2014) conduct a meta-analysis of existing surveys and conclude that individuals believe aggregate stock prices will rise after price increases and fall after price decreases. Recent work connects these and other surveys to stock price movements (Cassella and Gulen 2018; Da et al. 2020). We build on this work by providing evidence that investors extrapolate EA returns and that these beliefs can help explain EA return patterns.

Implicit in our hypothesis is that investors are focusing on EAs. There is significant evidence for this. EAs are perhaps the most important source of corporate news, and they are suitably scrutinized by market participants during "earnings season" (Fedyk 2017; Shao et al. 2020). Investors may disagree about the outcomes of EAs (Cookson and Neissner 2020) and gamble on the EA return (Liu et al. forthcoming). In summary, prior work has suggested that earnings season is a periodic and anticipated focal point for investors. We contribute to this literature by providing evidence that investors form extrapolative beliefs regarding future EA returns and this manifests itself in asset prices.

To test our hypotheses, we model investors' extrapolative expectations of future EA returns as an average of past EA returns. Our measure of the extrapolated return for a given firm's upcoming EA is the weighted average of the firm's returns around its past eight EAs, with a higher weight given to more-recent EAs. This measure of extrapolated returns incorporates both the recency and magnitude of past returns, which together characterize extrapolative beliefs (Barberis et al. 2018). We use this measure to test whether extrapolative beliefs help explain EA return patterns. Extrapolative beliefs predict a price run-up before the EA, and, if the beliefs are biased, a reversal after the EA. The results of our empirical tests confirm these predictions. In particular, our tests at the firm-day level—with extensive fixed effects and controls—indicate that stocks in the top decile of extrapolated returns experience pre-EA daily returns that are 9 basis points higher than other firms and post-EA daily returns that are 16 basis points lower.[2]

These return patterns are economically significant. To analyze their economic magnitude, we conduct a series of traditional portfolio tests. In constructing the portfolios for a given day, we consider firms that are within either the five days before or after their EA date and in either the top or bottom decile of our extrapolated return measure. One portfolio takes a long (short) position in stocks in the top (bottom) decile of extrapolated returns in the five days before the firm's EA; this portfolio takes advantage of the pre-EA run-up in returns experienced by top decile firms. A second portfolio takes a short (long) position in the top (bottom) decile in the five days after the firm's EA; this portolio takes advantage of the post-EA reversal experienced by top decile firms. On a value-weighted basis, the portfolio that takes advantage of the pre-EA run-up earns about 16 basis points per day, and the portfolio that takes advantage of the post-EA reversal earns about 15 basis points per day. Finally, we corroborate our main findings in international markets, consistent with EA return extrapolation being a global phenomenon.

Our evidence of EA return extrapolation is also related to a well-known EA return pattern: the pre-EA premium (Barber et al. 2013; Frazzini and Lamont 2007; Johnson and So 2018). The pre-EA premium refers to the run-up in prices that occurs, on average, before each EA. The fact that the run-up occurs *before* the EA is arguably surprising, since typically returns and risk are considered to occur simultaneously. We find that extrapolation, in conjunction with short-sale constraints, offers a partial explanation for the pre-EA premium, since firms with high extrapolated returns experience high returns before their EAs, whereas firms with a low extrapolated returns *do*

[2] A related finding is documented in Milian (2015), which examines a sample of firms with active exchange-traded options, and argues that these easy-to-arbitrage firms face a pre-earnings run-up and post-earnings reversal based on excessive trading by arbitrageurs on the post-earnings-announcement drift. We offer distinct evidence of investors' extrapolative beliefs based on individual investor trading behavior and the cross-section of returns around earnings announcements. Our findings also highlight the importance of recency in the autocorrelation of earnings announcement returns. The stability of our findings throughout our sample period indicates that a behavioral bias contributes to the pattern above-and-beyond the arbitrage activity documented by Milian (2015). In particular, we document extrapolative trading in the early 1990s among individual investors who are unlikely to be aware of stock market anomalies like post-earnings-announcement drift.

not experience low returns before their EAs. Taking an average across both groups of firms results in a positive return overall in the pre-EA period. The lack of low pre-EA returns for the firms with low extrapolated returns is consistent with the idea that investors are unable or unwilling to short-sell.[3] We argue that our results are a partial explanation of the pre-EA premium, since they appear to be complementary—based on a number of empirical tests—to previously documented explanations (Frazzini and Lamont 2007; Barber et al. 2013; Johnson and So 2018).

We next test our hypothesis in the arena of investor behavior before the EA. If extrapolation is the reason for the return patterns we observe, then we would expect a subset of investors to behave as if they have extrapolative beliefs. In our setting, that means increased purchasing behavior leading up to the EA of firms with high extrapolated returns. Although we do not have comprehensive data on the trading behavior of all investors, we can test our hypothesis that investors extrapolate EA returns in two settings: (1) data on individual trades from a large discount brokerage; and (2) intraday returns, which Lou et al. (2019) find to be more associated with institutional investor demand (they find overnight returns to be more associated with individual investor demand).[4]

Using granular data on the trades of individual retail investors, we uncover evidence of purchasing behavior that is consistent with extrapolative beliefs. We follow the household finance literature and focus on a dataset from a large online discount brokerage with trades by 78,000 individual investor accounts over the 1991 to 1996 period (Barber and Odean 2000, 2008; Hartzmark 2015). Prior work has found that individual investors trade around EAs (Hirshleifer et al. 2009; Dellavigna and Pollet 2009), especially when those EAs were covered in the investor's local newspaper (Engelberg and Parsons 2011). Building on this evidence, we test whether individual investors trade before EAs as if they hold extrapolative beliefs about the upcoming EA returns.

[3] There is significant evidence that investors avoid short selling: for example, Almazan et al. (2004) find that most mutual funds are restricted from short-selling by charter and only 2% actually do sell short.

[4] Related work that finds similar evidence is Berkman et al. (2012) and Aboody et al. (2018).

We find evidence consistent with EA return extrapolation by individual investors. If a stock is in the top decile of our measure of extrapolated returns, the total value of purchases in the five days before the EA is 10 percent higher than for other stocks. This increase in purchasing is consistent with some of the investors betting that the top decile stocks will continue to have high EA returns. We also explore how an individual's past trading behavior in a stock impacts their propensity to extrapolate the EA returns for that stock. Importantly, in conducting these tests on individual investor data from the online brokerage, we do not claim that the individual investors move stock prices or that their behavior is representative of all investors. Rather, these tests are a proof of concept, showing evidence that at least some investors trade as if they are extrapolating earnings announcement returns.

To better understand whether other investor groups act as if they hold extrapolative beliefs, we proxy for institutional investor demand using intraday returns. Lou et al. (2019) argue that intraday returns reflect demand pressures from institutional investors and overnight returns reflect demand pressures from individual investors. Therefore, to proxy for institutional investor trading behavior, we examine intraday return patterns in the period before the EA. We find evidence of patterns that are consistent with our daily return patterns. These intraday return patterns are consistent with the idea that EA return extrapolation happens even when trading is concentrated among institutional investors.

Overall, our results on EA returns and investor behavior suggest that investors extrapolate EA returns. These findings contribute to a literature on return patterns around EAs (e.g., Ball and Brown 1968; Ball and Kothari 1991; Kaniel et al. 2012). They also contribute to a literature on how investors anticipate EA information (e.g., Patell and Wolfson 1979; Kim and Verrecchia 1991; Barth and So 2014). In particular, our evidence suggests that extrapolation may help explain predictable return patterns around EAs, namely the pre-EA run-up and post-EA reversal.

While we highlight the importance of extrapolative beliefs in explaining EA return patterns, existing work highlights the importance of investor attention. For example, an important related paper is Aboody et al. (2010), which studies pre-EA and post-EA return patterns conditional on trailing 12-month returns. Consistent with an investor attention hypothesis, firms with high trailing 12-month returns have positive pre-EA returns and negative post-EA returns. Because trailing returns are related to our measure of extrapolated EA returns, which is a recency-weighted function of trailing EA returns, we are interested in the relationship between the two findings. Additionally, to understand whether the functional form of our extrapolated return measure contains incremental predictive power for returns and investor trading behavior, we also compare our measure to equal-weighted measures of trailing EA returns.

In horse races between these measures, we find evidence that our extrapolated return measure has incremental predictive power for both pre-EA and post-EA returns and pre-EA purchasing behavior of investors. Moreover, whereas individual investors are more likely to purchase stocks in the top decile of both our extrapolated return measure and a measure of trailing returns before EAs, investors are also more likely to sell stocks in the top decile of trailing returns. This latter finding is consistent with the investor attention hypothesis of Aboody et al. (2010), but inconsistent with extrapolation. Indeed, investors are even less likely to sell stocks in the top decile of our extrapolated return measure before the EA, which confirms a unique prediction of extrapolation. In this sense, relative to Aboody et al. (2010), we offer distinct evidence of investors' extrapolative beliefs based on individual investor trading behavior and the cross-section of returns around EAs. Our findings are complementary in that extrapolative expectations are based on investors paying attention to returns during recent EAs.

The rest of the paper is organized as follows. Section 2 discusses the data and measurement of extrapolated returns. Section 3 studies the relationship between our measure of extrapolated returns and EA return patterns, quantifies this relationship with portfolio tests, generalizes the relationship with international evidence, and relates it to the pre-EA premium. Section 4 discusses evidence of investor trading behavior using brokerage data as well as intraday returns. Section 5 examines various measures of historical returns—including our measure of extrapolated returns—

to determine which returns investors pay attention to and extrapolate from. Finally, Section 6 concludes.

2 Data and Measurement

2.1 Data

We analyze two sets of tests to explore investor extrapolation, each of which requires a different sample and different data sources. In each of these tests, we require a measure that captures investors' extrapolative beliefs about EA returns. To proxy for investor propensity for extrapolation at the firm level, we construct a measure based on past EA returns. For this measure, we obtain EA dates from Compustat and IBES and the short-window EA returns from CRSP daily files.[5]

We first explore the consequences of investor extrapolation for asset prices. If investors exhibit this behavior to a meaningful extent, there are implications for the cross-sectional predictability of stock returns. The data for this analysis come from IBES, CRSP, and Compustat. We focus on all US firm-quarters from 1991 to 2017. We calculate our dependent variables using CRSP security files pertaining to the current quarter. We measure pre-EA (post-EA) returns as the returns during the five-day period leading up to (following) the EA day. For our calendar-time portfolios, we download daily asset pricing factors from Kenneth French's website. In our returns test, we also account for attention, which we proxy for by using external media coverage. This data on news articles comes from RavenPack. The sample for these tests contains 12,203,873 firm-days (see Panel A of Table 1). In our tests that look at EA timestamps, we obtain the relevant data from Wall Street Horizons (WSH), a market intelligence company that collects and monitors corporate event data from 2006 to 2017.

[5] Similar to DellaVigna and Pollet (2009), we identify the earnings announcement date as the earlier of the IBES earnings announcement date (anndats_act) and Compustat earnings announcement date (rdq).

For both sets of tests, we obtain standard firm characteristics using Compustat and CRSP. Along with observations with missing regression variables, we also exclude firm-quarters with a share price of less than five dollars (as of the EA date) to eliminate confounding microstructure effects.[6]

Our second set of tests investigates investor trading behavior to see if it is also consistent with extrapolative beliefs. To do this, we first use a dataset of individual trades from a large discount brokerage. Barber and Odean (2000) use data from a discount broker on the trades of 78,000 investors over the 1991–1996 period. The data analyzed in Barber and Odean (2000) is the dataset that is now widely used to study investor behavior (e.g., Barber and Odean 2008; Strahilevitz et al. 2011; Hartzmark 2015). This dataset has, more specifically, been used to study investor behavior around EAs (e.g., Hirshleifer et al. 2008).

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. For reasons we explain in Section 4, we also restrict the sample to purchases and sales of firms that have predictable EA dates,[7] and in our firm-day level regressions, we exclude the date of the EA itself. Table 1 presents summary statistics. Panel B shows the key variables from the discount brokerage sample: *log(Gross Purchases)*, *log(Gross Sales)*, *# Buyers*, and *# Sellers* which represent the log of one plus the value of total purchases, the log of one plus the value of total sales, the number of buyers and the number of sellers, respectively. Across the 939,653 firm-days in this sample, most firms do not see any trades by sampled individuals on a given day. The average number of buyers and sellers on any given firm-day in the sample is very small—only 0.23 and 0.20, respectively.

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[6] We impose the minimum share-price restriction at the firm-quarter level, rather than at the firm-day level. In doing so, we keep the observation count much more stable for each firm-quarter. By contrast, performing the data exclusion at firm-day level would have included some observations and excluded some observations for firms whose share price hovers around the threshold (five dollars), which would potentially bias our estimates.

[7] First, we define a predicted EA date based on the firm's year-ago same-quarter EA dates (consistent with the EA date prediction in Cohen et al. 2007 and Aboody et al. 2010, and with EA month prediction in Barber et al. 2013). This predicted date is the same calendar day of the year-ago same quarter after adjusting for non-trading days. We then create an indicator (*Predictable EA*) recording whether the predicted EA is within two days of the actual EA in both the current quarter and the previous quarter.

2.2 *Extrapolated Return* Measurement

We define our independent variable of interest, the "extrapolated return" measure for firm *i* in quarter *t*:

$$Extrapolated\ Return_{\mathrm{it}} = \frac{1}{\sum_{k=1}^{8}\frac{1}{k}} \times \sum_{j=1}^{8}\left(\frac{1}{j} \times R_{i,t-j}\right) \quad (1)$$

This extrapolated return measure is a weighted average of returns from the firm's past eight EAs. The EA 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. We assign higher weights to more-recent quarters because survey evidence suggests that, across many independent surveys of investor expectations, the average weight attributed to the current quarter is an order of magnitude larger than the average weight assigned to the trailing four quarters (Greenwood and Shleifer 2014; Cassella and Gulen 2018). Another reason to weight more-recent quarters more heavily is that they are likely more salient to the investor (Barberis et al. 2018). Furthermore, 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.

Throughout the paper, we compare returns and trading patterns for firms in different deciles of the extrapolated return measure. For assigning extrapolated return deciles, we consider the cross-section of firms at the firm-quarter level, and form deciles within the calendar quarter. The variable *Top Decile Extrapolated Return* is an indicator that switches on when the firm-quarter is in the top decile of the extrapolated return measure for that calendar quarter. Similarly, *Bottom Decile Extrapolated Return* is an indicator that switches on when the firm-quarter is in the bottom decile.

Importantly, although we present evidence using this measure of extrapolated returns throughout the paper, we present evidence using two alternative measures of extrapolated returns in the Internet Appendix (IA Table 1.1). In particular, we apply the structural approach of Barberis et al. (2015), which explicitly defines the "sentiment" of extrapolators based on an extrapolative discount factor that determines how quickly extrapolators forget historical EA returns. We also present evidence using a naïve measure that is an equally-weighted average of past EA returns. With either of these measures, we find evidence that corroborates our main findings.

3 Implications for Earnings Announcement Returns

In this section, we analyze return patterns around EAs to determine whether they are consistent with extrapolation. If investors extrapolate past EA returns, and use their extrapolated beliefs to make bets on upcoming EAs, then we should observe a run-up in stock prices for stocks with a recent history of high EA returns. Additionally, if investors overextrapolate in some cases, then we might expect to see a return reversal for these stocks after the EA.[8] In this section, we find evidence of these return patterns.

3.1 Daily Return Regressions

We first demonstrate that return patterns before the EA are consistent with extrapolation: firms with a history of high past EA returns experience higher returns before their next EA.

We begin by plotting returns around the EA. Figure 1 plots average returns separately for firms in the top extrapolated return decile, the bottom extrapolated return decile, and all eight remaining deciles in event time from 10 trading days before the EA to five trading days after. The plot shows that returns of top decile firms increase sharply in the short period before the EA, which

[8] A potential concern is that managers may be concerned that a price run-up and reversal around earnings announcements could increase litigation risk. To the extent that investors could form a class and demonstrate loss causation due to (non-)disclosure by the managers, we might expect managers to take some action to deter EA return extrapolation. To investigate managers' incentives, we explore the relationship between securities class action lawsuits and our measure of extrapolated returns using data collected from the Stanford Securities Class Action Clearinghouse. In untabulated findings that are available upon request, we find that litigation of this type is rare: 0.61% of firm-quarter observations in our sample are the first of a class period of any type of lawsuit, and only 0.18% are the first of a class period for lawsuits related to EAs. We also find that there is no systematic difference between firms in the top decile of our extrapolated return measure and others in the propensity to be subject to litigation. Ultimately, these results suggest that litigation risk does not motivate managers to mitigate EA return extrapolation. Nevertheless, we believe that investigating the potential disciplining role of managerial incentives for investors' behavioral biases is an interesting area for future research.

is consistent with investors extrapolating that the upcoming EA return will continue to be high for top decile firms. As a benchmark for what the normal pre-EA return might be, we can examine the plot for the middle eight deciles. These firms also see an increase in returns before the EA, but it is much smaller than the increase experienced by the top decile firms. After the EA, the top decile firms experience negative returns. In other words, some of the sharp price increase before the EA is undone after the announcement.[9] This is consistent with investors pushing the stock price too high, and might indicate that some of them *over*extrapolated the EA return. In contrast, the other firms in our sample, especially those in the bottom decile, do not experience a significant price reversal after the EA.

We then run the following regression to formally test whether the return patterns are consistent with extrapolation. We double cluster standard errors by firm and by quarter:

$$
\begin{aligned}
&\textit{Daily Return}_{iqt} \\
&= \beta_1 \textit{ 5 Days Before}_{iqt} + \beta_1 \textit{ EA Window}_{iqt} + \beta_3 \textit{ 5 Days After}_{iqt} \\
&+ \beta_4 \textit{ 5 Days Before}_{iqt} \times \textit{Top Decile Extrapolated Return}_{iq} \\
&+ \beta_5 \textit{ EA Window}_{iqt} \times \textit{Top Decile Extrapolated Return}_{iq} \\
&+ \beta_6 \textit{ 5 Days After}_{iqt} \times \textit{Top Decile Extrapolated Return}_{iq} \\
&+ \beta_7 \textit{ 5 Days Before}_{iqt} \times \textit{Bottom Decile Extrapolated Return}_{iq} \\
&+ \beta_8 \textit{ EA Window}_{iqt} \times \textit{Bottom Decile Extrapolated Return}_{iq} \\
&+ \beta_9 \textit{ 5 Days After}_{iqt} \times \textit{Bottom Decile Extrapolated Return}_{iq} + \gamma_{iq} + \delta_t + \varepsilon_{iqt}. \qquad (2)
\end{aligned}
$$

This is effectively a difference-in-differences design with firm-day observations within a firm-quarter. The goal of this specification is to examine how being in the top extrapolated returns decile affects returns around the EA, while controlling for firm-quarter characteristics. The left-hand-side variable is the raw daily return for firm *i* on day *t* in quarter *q*. The baseline returns for each firm-quarter are captured by the firm-quarter fixed effects. We also include day fixed effects, which control for the market return on a given day. We have three different treatment periods: the five trading days before the EA (from day t–5 to day t–1, where day t is the EA date), the EA

[9] It is important to note that investors who hold throughout the entire 11-day window would earn positive returns. However, their returns would be even higher if they instead sold their holdings before the reversal period.

window (day t), and the five trading days after the EA (from day t+1 to day t+5). For each of these periods, we include an indicator variable that turns on whenever the firm-day is within that period (these indicators are named *5 Days Before, EA Window,* and *5 Days After*, respectively). These indicators capture the expected change in daily returns during each of these periods, compared to returns during the rest of the quarter, for firms that are *not* in the top or bottom deciles of extrapolated returns. In order to group the five days after the EA into the same quarter as the days right before and during the announcement, a firm-quarter in this test is designated to run from the sixth day after the previous EA to the fifth day after the current EA.

Our three variables of interest are the interactions between *Top Decile Extrapolated Return*, a dummy that equals one if a firm is the top decile of our extrapolated return measure, defined in Section 2.2, and the dummies *5 Days Before*, *EA Window,* and *5 Days After*. The coefficients on these three interaction terms tell us the difference between the top-decile-extrapolated-return firms and the other firms (excluding the bottom-decile firms) in the change they experience in daily returns during each of these periods as compared to the rest of the quarter. We also include interactions between *Bottom Decile Extrapolated Return*, defined as before, and *5 Days Before, EA Window,* and *5 Days After*. We do not have strong predictions for these interactions, given short-selling constraints. If investor attention were driving return patterns around the EA, then we would expect extreme values of our extrapolated return measure to be associated with positive returns. Because we see no symmetric pattern for extreme high and low extrapolated EA returns, our findings are not consistent with attention being the underlying mechanism. If attention were the underlying mechanism, then we would see similarly positive returns for bottom decile firms in the days leading up to the EA.

To further investigate alternative explanations based on attention, one specification of this regression controls for the number of Dow Jones news articles reported by RavenPack for firm *i* in the five days preceding day *t*, where day *t* is the day of the observation (remember that observations are at the firm-day level). A news article is counted only if the firm's name appeared in the headline. The RavenPack dataset we use to construct this control includes all Wall Street Journal, Barron's, MarketWatch, and Dow Jones Newswire articles from 2000Q4 to 2016Q1.

We present results for this test in Table 2. In our specification, the coefficient on the interaction between *Top Decile Extrapolated Return* and *5 Days Before* is significantly positive, in keeping with investors pushing up the price of high-extrapolated-return firms as they buy their stock in anticipation of good EA performance. The coefficient on this term indicates that returns in response to this purchasing behavior are ten basis points higher each day in the five pre-EA days than they otherwise would be (t=5.82).

The coefficient on the interaction between *Top Decile Extrapolated Return* and *5 Days After* is significantly negative.[10] Top decile firms have expected returns that are 14.6 basis points lower per day than the other firms in the sample (t=-7.89). This is consistent with the idea that investors' extrapolative beliefs are *overly* extrapolative. The reversal in returns after the EA suggests that extrapolating investors push the price too high with their pre-announcement purchases. It is important to note, however, that our results do not suggest investors who hold top decile firms throughout the entire 11-day window are hurt. They push the price too high insomuch as there is a reversal after the earnings announcement, but there is no evidence that this reversal is more negative than the pre-earnings announcement run-up.

The coefficients on the interaction between *Bottom Decile Extrapolated Return* and *5 Days Before* are either insignificant or significantly negative in all specifications. As discussed above, this indicates that our results for the top-decile firms are unlikely to be driven by increased attention, which would predict a positive coefficient for the bottom-decile firms as well. The negative coefficient is also consistent with investors making extrapolative sales of firms with a

[10] Shanthikumar (2012) finds an association between strings in earnings growth and trade imbalances surrounding earnings announcements, whereas we dissect the earnings announcement window and only find returns evidence that is consistent with extrapolative trading during the pre-announcement period. Frieder (2008) examines post-earnings-announcement trade imbalances and attributes them to overextrapolation. However, she does not show that the trade imbalances caused by consecutive positive earnings surprises are associated with negative returns. Instead, she shows that the trade imbalances are associated with negative returns after conditioning on the number of consecutive positive earnings surprises.

history of poor EA returns, but this result is not sufficiently robust to draw strong conclusions. The extrapolative sales, to the extent they occur, they do not appear to be *overly* extrapolative, since we do not see positive returns for bottom-decile firms after the EA.

Firms in the top decile of extrapolated returns also experience significantly higher returns on the day of the earnings announcement, as shown by the coefficient on the interaction between *Top Decile Extrapolated Return* and *EA Window*. Many firms announce their earnings late in the day, after the market closes, meaning that the return recorded on the day of the EA often only covers a period before the actual announcement occurs. For these late-in-the-day EAs, the return on the day of the announcement actually belongs to the pre-announcement period, so we expect the return to be higher for firms in the top decile of extrapolated returns, continuing the pattern we observe in the five days before the EA. However, to the extent that overextrapolation occurs, we would expect the opposite result for EAs that occur early in the day, because overextrapolation would likely cause the price reversal to start right after the earnings information is revealed.

To ascertain whether reversals occur within the day after the earnings information is revealed, we collect accurate EA timestamps from Wall Street Horizons to analyze the first day of returns after the EA occurs.[11] We use the accurate EA timestamps to define an indicator variable, *Late Announcer*, which switches on only if the EA is made after 4pm, when the market closes. For these EAs, we treat the next day as the date of the EA. In other words, we revise our definition of the EA date to make it occur one day after the EA date that is recorded in Compustat. (To highlight this change, we relabel EA Window as Correct EA Window, as in Berkman and Truong 2009.) Thus, the return on this revised EA date will capture the first day on which the market can react to the newly released earnings information.

[11] We opt for Wall Street Horizons following the concerns about the accuracy of IBES time stamps raised by prior work (e.g., Bradley et al. 2014; Michaely et al. 2014, 2016; Lyle et al. 2018).

In Table 3, we perform the firm-day level regressions with this revised EA date. The sample in this table runs from 2000 to 2017.[12] Columns (1), (2), and (3) show the regressions for a sub-sample that is limited to *Late Announcers*. The results yield inferences consistent with overextrapolation. As before, firms in the top decile of extrapolated returns experience higher returns in the five days before the EA and lower returns in the five days after. Unlike before, the firms in the top decile experience lower returns on the EA day, as shown by the significant negative coefficient on the interaction between *Top Decile Extrapolated Return* and *EA Window*. Thus, when we accurately determine the time of the EA, we find that the return reversal occurs during the first day after the announcement comes out. The average reversal is economically significant at between 37 bps and 43 bps.

Next, we conduct the same regressions on a sample that includes *Early announcers*, in addition to *Late announcers*. We define *Early announcer* as another indicator variable that switches on only if the Wall Street Horizon timestamp for the EA is recorded between 1am and 9am. (Since there will be a full trading day for the market to react to the earnings information, for *Early announcers*, we retain the EA day as the date provided by Compustat.) As shown in columns (4) through (6) of Table 3, we observe similar results for the main coefficients of interest. In particular, there exists an economically meaningful and statistically significant return reversal on the day of EA for both late and early announcers. Overall, our findings in Table 3 suggest that the return reversal begins right after the earnings information comes out. This indicates that the earnings information is a negative surprise for investors when the firm has had a history of high EA returns in the past.

In the Internet Appendix, we re-run the firm-day tests from Table 2 for sub-samples based on cross-sectional and time-series cuts. Regarding the former, we estimate the regressions for the top and bottom quartiles of trading volume and accruals. As shown in IA Table 2.1, these cross-

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[12] Wall Street Horizons timestamp data is available from 2006. For the period of 2000–2005, which precedes Wall Street Horizons's coverage, we obtain the time stamp data from IBES, although this procedure does not materially affect our conclusions.

sectional cuts provide additional evidence that is consistent with overextrapolation. In particular, the stock market effects of overextrapolation are more pronounced for firms with high volume. This makes sense, since volume is a proxy for attention, and investors must be paying attention in order to extrapolate. In addition, firms with larger accruals in the previous period experience a larger reversal after the EA, which indicates that extrapolation is more likely to become overextrapolation when past earnings are of low quality. This might occur because investors who extrapolate fail to account for the fact that earnings are less persistent when accruals are high (e.g., Sloan 1996).

With time-series cuts, our goal is to better understand the temporal patterns in the effect we document and speak to investors' learning over time. To this end, we perform our stock returns tests for different periods (pre-1996, 1997–2003, 2004–2010, post-2011). As IA Table 2.2 shows, our main inference is statistically and economically significant across the four subperiods. The coefficient on *Top Decile Extrap. Return* × *5 Days Before* fluctuates between 0.076 and 0.184. It seems that the pre-EA run-up in the share price of high-extrapolation firms gets weaker in the second half of our sample period (columns 3 and 4). Interestingly, however, the negative coefficient on *Bottom Decile Extrap. Return* × *5 Days Before* is significant only in the second half of our sample period (-0.0610 and -0.0629). Likewise, the post-EA reversal in the performance of high-extrapolation stocks does not get weaker over time (the coefficient on *Top Decile Extrap. Return* × *5 Days After* remains at about -0.11).

3.2 Portfolio Tests

The predictive power of our extrapolated return measure for returns around EAs suggests that we may be able to construct calendar-time trading strategies that earn abnormal returns.[13] We quantify these abnormal returns by constructing equal-weighted and value-weighted portfolios.

[13] In the Internet Appendix, we present estimates of portfolio returns across subperiods of our sample, consistent with the daily return tests presented in Section 3.1. In IA Table 3.1, we show that the portfolio returns are consistently positive throughout our sample period.

We also run factor models to relate our return patterns to well-known anomalies. At the beginning of each trading day, we consider firms in the pre-EA window—the five days before the EA date. We long a firm if it is in the top decile of our extrapolated return measure, and we short a firm if it is in the bottom decile of our extrapolated return measure.

We present our results in Panel A of Table 4. The asset pricing literature generally assumes that investors 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 portfolios. In an equal-weighted portfolio, our strategy earns a five-factor alpha of 15.6 basis points. The corresponding value-weighted five-factor alpha earns a similar 16.0 basis points. This trade can be executed about 145 days a year. In columns (3) and (4), we remove the five-firm restriction. We see similar daily alphas—the five-factor equal-weighted alpha is 16.6 basis points and the five-factor value-weighted alpha is 16.1 basis points—and an expansion in the number of days this trade can be implemented. Specifically, this strategy can be implemented, on average, about 237 days per year.

We then construct calendar-time portfolios based on the post-EA reversal. At the beginning of each trading day, we consider firms in the post-EA window, which runs from one day after the EA date to five days after. We construct a naive strategy—one that is not based on this period's earnings. We long firms in the bottom decile of our extrapolated return measure and short firms in the top decile. The results are in Panel B of Table 4. We again construct portfolios that consist of at least five firms in the long and short portfolio and present the alphas in columns (1) and (2). This strategy also earns a high alpha before transaction costs. The five-factor alpha for an equal-weighted portfolio is 11.5 basis points and for a value-weighted portfolio is 15.4 basis points. This strategy can be implemented, on average, about 145 days a year. When we remove the five-firm restriction, we see similar daily alphas—the five-factor equal-weighted alpha is 15.4 basis points and the five-factor value-weighted alpha is 18.3 basis points. This strategy can be implemented, on average, about 237 days a year.

3.3 International Evidence

We next explore the robustness of our findings in an international setting, with a sample of firms from the United Kingdom, France, and Germany.[14] We are not aware of institutional frictions that would prevent investors from exhibiting similar extrapolative behavior in these markets, so we view this analysis as a test of external validity for our primary findings in the U.S. sample.

Results for this international setting are shown in Table 5.[15] In Table 5, we again find that the coefficient on *Top Decile Extrapolated Return* × *5 Days Before* is significantly positive at the 1% level. Thus, as in the United States, the firms with the best recent history of EA returns experience a significant increase in returns during the five days before their next EA. We also find that the coefficient on *Top Decile Extrapolated Return* × *5 Days After* is significantly negative at the 5% or 10% level, depending on the specification. As with the results in the United States, this reversal in returns after the EA suggests that investors might sometimes push the price too high with their purchases, which is consistent with them having overly extrapolative beliefs rather than just extrapolative beliefs. As in the U.S. results from Table 2, the coefficient on *Top Decile Extrapolated Return* × *EA Window* is significantly positive. We conjecture that this is driven by buying that occurs before the firm's earnings are actually announced, as it is in the U.S., based on our evidence from Table 3. Unlike in the U.S. results from Table 2, the coefficient on *Bottom Decile Extrapolated* × *5 Days Before* is significantly positive at the 10% level in one specification. However, it is insignificant in the other specification, and small in magnitude relative to the coefficient on *Top Decile Extrapolated Return* × *5 Days Before*. Thus, attention is still unlikely to be the sole explanation for the pattern observed for top decile firms.

This international test provides evidence that the U.S. results have external validity. As in the U.S., firms with high extrapolated returns see a run-up in their stock prices before their next EAs and see a reversal after. This provides evidence that EA extrapolation is a general feature of investor behavior.

[14] Data for this setting is described in detail in Appendix B.
[15] The regressions in this table account for market returns on a country-by-country basis by controlling for the daily value-weighted market return for the firm's country.

3.4 Pre-Earnings-Announcement Premium

The previous subsections documented a return pattern that follows naturally from extrapolative beliefs. In this sub-section, we explore how extrapolative beliefs relate to a well-documented EA return pattern—the pre-EA premium. The pre-EA premium notes that returns are, on average, higher than usual in the period before an EA. Indeed, a large fraction of the EA premium precedes the day of the EA itself (Frazzini and Lamont 2007; Barber et al. 2013; Johnson and So 2018). While the EA may be a source of undiversifiable risk, and we may expect a risk premium for holding stock through it, the fact that there is a premium for holding stock *before* the EA is a puzzle. In this section, we first examine whether extrapolation can shed any light on this puzzle and then relate our findings to existing work on the topic.

Firms that rank high in our extrapolated return measure will, on average, see a run-up in prices before the EA. Our proposed explanation for this pattern is based on extrapolative beliefs—investors purchase a stock with high past EA returns because they expect the upcoming EA return to be similarly high, and they would like to bet on it. We might expect to see a similar pattern on the negative side: if individuals extrapolate past negative returns, they should be inclined to bet against the upcoming EA. However, it is well-known that most investors do not short-sell (Almazan et al. 2004). As such, if there is only extrapolation occurring on the positive side, we may expect to see a high average return in the period before the EA.

The average excess return[16] over the five days before the EA is about 50 bps in our sample. The average increases to 120 bps when we restrict the sample to firms in the top decile of our extrapolated return measure. This suggests that extrapolation contributes to the size of the pre-EA premium. However, it does not appear to be the sole cause of the premium. The average excess return when we restrict the sample to firms in the bottom decile of extrapolated returns is similar to the average for the full sample—about 50 bps.

[16] We subtract the S&P return to calculate the excess return.

We next evaluate the overlap between extrapolation and previously determined explanations of the pre-EA premium. We first relate our results to Barber et al. (2013), who show that the bulk of the EA premium is realized prior to the EA day. They also note that this premium is higher when the EA's abnormal idiosyncratic volatility is higher. This suggests that investors demand a premium before the EA based on their uncertainty about the upcoming announcement.

To conduct our comparison, we measure abnormal idiosyncratic volatility with a methodology that is similar to Barber et al. (2013) and adapted to our setting. For each firm-year, we run a regression of daily firm returns on S&P returns from the same day as the daily return as well as each of the three previous days. The residual from this regression is the idiosyncratic return for the firm. To get a firm's abnormal idiosyncratic volatility during its EAs, we take the average of the squared idiosyncratic return during the EA periods (which run from 5 days before the announcement to 5 days after) and divide it by the average squared idiosyncratic return during the rest of the year, and we then take the square root of this quotient. We take the average across all EAs in the year to get the yearly abnormal idiosyncratic volatility. For the tests in Table 6, we use the firm's abnormal idiosyncratic volatility from the previous year rather than the current year because the value from the current year might have a mechanical relationship with the current year's pre-EA returns, and the value from the previous year should still capture some of the uncertainty in the current year's EAs.

We find that extrapolated returns and abnormal idiosyncratic volatility both increase pre-announcement returns, but they each seem to do so separately, since extrapolated returns seem to increase pre-announcement returns even after controlling for abnormal idiosyncratic volatility. We infer this from the evidence we provide in Table 6, Panel A. The coefficient on *Top Decile Extrapolated Return × 5 Days Before* and *Top Decile Idiosyncratic Volatility × 5 Days Before* are both positive and statistically significant.

We also see this pattern in a portfolio setting (Table 6: Panel B), which sorts the data on both extrapolated returns and abnormal idiosyncratic volatility. For extrapolated returns, the table sorts all firm-quarters into deciles. For abnormal idiosyncratic volatility, it sorts all firm-quarters into groups based on whether the firm was above or below the median for abnormal idiosyncratic volatility in the previous year. The table then shows the average pre-EA return within different intersections of the extrapolated returns deciles and the above- and below-median-volatility groups. Table 6 shows there is a positive relationship between pre-EA returns and extrapolated returns, and this relationship exists within both the above- and below-median-volatility groups. For firm-quarters in the above-median-volatility group, daily pre-EA returns are 0.61% (χ^2 statistic = 33.04) higher for firms in the top decile of extrapolated returns than they are for firms in the bottom decile (0.61% = 1.26% – 0.65%).[17] We also see a positive spread between top and bottom decile extrapolated return firms for firm-quarters in the below-median-volatility group, though the difference (0.15%, χ^2 statistic = 1.24) is not statistically significant. Our regression results and portfolio results suggest that extrapolative trading is complementary to a firm's abnormal idiosyncratic volatility as a contribution to the pre-EA premium.

We also note that, consistent with Barber et al. (2013), Table 6 shows that firm-quarters in the above-median-volatility group have pre-EA returns that are about double those of firm-quarters in the below-median-volatility group. This provides evidence that investors are earning an uncertainty premium before the EA.[18]

We next compare our findings to those of Frazzini and Lamont (2007). Frazzini and Lamont (2007) also note that stock prices rise before EAs, and they suggest that this rise is driven by attention considerations—in other words, EAs catch the attention of individual investors. As most individual investors do not short-sell, this increased attention will generate positive returns in the near-term.[19] We hypothesize that attention is an augmenting force for extrapolation. Without

[17] For tests of differences within volatility groups, we use a seemingly unrelated regression estimates with calendar-quarter clusters. The significance of the findings is similar if we instead cluster by firm.

[18] We also note that this premium could be related to a demand for stocks with a lottery type distribution (see Liu et al., forthcoming). Liu et al. (forthcoming) find that their results are distinct from ours, and it is plausible that gambling preferences and extrapolative beliefs could be driving this pre-earnings-announcement return.

[19] It should be noted that Barber et al. (2013) provide evidence against this by noting that the pre-earnings-announcement run-up in the international sample is higher for firms with lower volume.

paying attention to earnings, investors cannot extrapolate earnings. Therefore, we expect results to be stronger when attention is higher. We also hypothesize that our findings are complementary to attention—attention does not imply extrapolation.

To conduct our comparison, we calculate abnormal volume by considering the average over the five days before the EA date of the daily trading volume divided by the number of shares outstanding and scaling this mean value by the mean daily value of volume scaled by the number of shares outstanding during the previous year.

We find evidence that attention and extrapolation both increase pre-EA returns. We infer this from the evidence we provide in column (2) of Table 6, Panel A. The coefficients on *Top Decile Extrapolated Return* × *5 Days Before* and *Top Decile Abnormal Volume* × *5 Days Before* are both positive and statistically significant. We also see this pattern in a portfolio setting (Table 6: Panel B), which sorts the data on both extrapolated returns and abnormal volume. For extrapolated returns, the table sorts all firm-quarters into deciles. For abnormal idiosyncratic volatility, it sorts all firm-quarters into groups based on whether the firm was above or below the median for abnormal volume. The table then shows the average pre-EA return within different intersections of the extrapolated returns deciles and the above- and below-median-volume groups. Table 6 shows there is a positive relationship between pre-EA returns and extrapolated returns, and this relationship exists within both the above- and below-median-volume groups. For firm-quarters in the above-median-volume group, daily pre-EA returns are 0.44% (χ^2 statistic = 7.81) higher for firms in the top decile of extrapolated returns than they are for firms in the bottom decile. We also see a statistically significant positive spread between top and bottom decile extrapolated return firms for firm-quarters in the below-median-volatility group (0.49%, χ^2 statistic = 30.45). Our regression results and portfolio results suggest that extrapolative trading is complementary to a firm's abnormal volume as a contribution to the pre-EA premium.

Finally, we connect our results to Johnson and So (2018). Johnson and So (2018) offer evidence that the pre-EA premium is due to inventory risk from financial intermediaries.

Specifically, financial intermediaries often hold inventory and do not want to be exposed to EA risks.[20] Therefore, they use their pricing power—they set bid and ask prices in their model—to induce buy demands and ensure that average prices are *above* fundamental value.[21] Therefore, it will be more costly to incorporate negative news into the price than positive news before EAs. These asymmetric trading costs will lead to a positive bias in the pre-EA period and this will drive the pre-EA premium.

We view our results as complementary to Johnson and So (2018). As Johnson and So (2018) note, “behavioral biases or omitted frictions may be correlated with those variables as well. We therefore view our main results as being consistent with frictions in the intermediary sector playing an important role and providing a potential (but not exclusive) explanation for the patterns we document.” It is plausible that these asymmetric trading costs will lead to a positive bias in prices before the EA, and it is also plausible that these prices will be biased to an even greater degree due to extrapolative beliefs and short-sale constraints.

4 Investor Behavior

In the previous section, we related extrapolative beliefs to EA return patterns. We presented evidence that a history of high EA returns induces strong positive returns before the upcoming EA, with a reversal afterwards. In this section, we focus on the pre-EA positive returns, which we attributed to investors betting on the upcoming EA, and try to find evidence that at least some investors exhibit this betting behavior. We first directly analyze the behavior of individual

[20] Lee et al. (1993), Krinsky and Lee (1996), and So and Wang (2014) provide evidence that transactions costs increase before earnings announcements due to adverse selection—informed traders will want to bet on earnings announcements—and inventory risks.

[21] Consider a simple example: Suppose that the median investor thinks the stock is worth 6 dollars. The liquidity provider may set the ask price (she will purchase) at 5.50, and the bid (she will sell) at 6.20. Assume the liquidity provider could predict demand and knows that the demand for the stock at 6.20 will be far greater than the demand to sell the stock at 5.50. This will lead to an average price above 6 dollars and a decrease in inventory for the liquidity provider.

investors, and then we examine the behavior of institutional investors by looking at a proxy for their behavior.[22]

4.1 Aggregate Purchases by Individual Investors

We begin by investigating whether investor trading behavior is consistent with EA return extrapolation. We predict that extrapolative beliefs will guide purchasing behavior. Therefore, we expect to see investors bet on EAs by purchasing shares of a stock with a high extrapolation measure in the period shortly before the EA. We view this test as a proof of concept, providing evidence that at least some investors extrapolate. (Note that other investors could be extrapolating as well.)

We test whether individual investors exhibit returns extrapolation with individual trading data from a large discount brokerage (Barber and Odean 2000). We first plot purchasing behavior before the EA in Figure 2, and find evidence consistent with our hypothesis. Figure 2(a) has three plots of the mean *log(Gross Purchases)* for each trading day in the 40 days before the EA, where *log(Gross Purchases)* is defined as the logarithm of one plus the dollar value of purchases of a firm's stock made by all sampled individuals on a trading day. The first plot takes the mean across all firms in the top decile of the extrapolated return measure (denoted by a blue solid line with dots), the second plot takes the mean across all firms in the bottom decile (denoted by a green dashed line with diamonds), and the third plot takes the mean across all firms in the remaining eight deciles (denoted by a red dashed line with x's). Figure 2(b) has the same three plots for the mean *log(Gross Sales)*, which is defined the same as *log(Gross Purchases)* except with the dollar value of sales rather than purchases.[23]

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[22] In untabulated results, we examine the behavior of other market participants—the media, company insiders, and sell-side analysts. We find evidence of extrapolative beliefs among company insiders and do not find strong evidence of extrapolative beliefs in news articles or sell-side analyst forecasts. Results are available upon request.

[23] For the plots in Figure 2, we restrict the sample to firm-quarters with predictable earnings announcements. We make this sample restriction for the corresponding regression tests as well. For the plots, we further restrict the sample to firm-quarters that have observations for the entire window shown in the plot to ensure that changes in

Figure 2(a) shows that individual investors purchase more stock right before the EA for firms that have a recent history of high EA returns; purchasing activity for firms in the top decile of the extrapolated return measure is higher in the five days before the EA than in the preceding 35 days. This can be seen by comparing the plot for the top-decile to the solid blue horizontal line in the graph, which denotes the mean *log(Gross Purchases)* for top-decile firms in the 35 days before the five-day pre-EA period (i.e., from the 40th day before the EA to the 6th day before the EA). In contrast, purchasing activity for the bottom-decile firms is almost the same in the five days before the EA as it is in the preceding 35 days, with the exception of the day right before the EA. For the remaining eight deciles, which we consider to be a benchmark depicting normal pre-EA purchasing patterns, there is an increase in purchases in the five days before the EA. This indicates that purchases tend to increase right before the EA in general. However, the increase for these middle eight deciles is not as large as it is for the top-decile firms, indicating that the increase in purchases is higher than normal for top-decile firms.

Turning to Figure 2(b), we find a slight increase in sales in the five days before the EA for all three groups: the top-decile firms, the bottom-decile firms, and the firms in the middle eight deciles. It appears that the pre-EA increase in sales for the top and bottom deciles is similar to the increase for the middle eight deciles, suggesting that the top and bottom deciles follow a normal pattern in terms of sales before the EA. As we soon will discuss in more detail, we do not have strong predictions for the pre-EA selling behavior, since individuals typically do not sell short, and can therefore only sell if they already hold the stock.

We next use regressions with fixed effects to confirm that the patterns we observe for pre-EA purchase behavior represent statistically significant changes. We consider a regression of the following form:

$$\textit{Purchasing or Selling Variable}_{iqt}$$
$$= \beta_1 \textit{ 5 Days Before}_{iqt}$$

the plot are not driven by changes in sample composition. In IA Table 4.1 in the Internet Appendix, we describe investor purchasing behavior in firm-quarter observations with predictable EAs.

$$+ \beta_2 \textit{ 5 Days Before}_{iqt} \times \textit{Top Decile Extrapolated Return}_{iq}$$
$$+ \beta_3 \textit{ 5 Days Before}_{iqt} \times \textit{Bottom Decile Extrapolated Return}_{iq} + \gamma_{iq} + \varepsilon_{iqt}. \quad (3)$$

This test's design is similar to the design we used in the daily returns tests above, and like those tests it is similar to a traditional difference-in-differences estimator. Each observation is a firm-trading day that falls within a firm-quarter, where the firm-quarter runs from the firm's previous EA to its current EA. The subscript *i* indexes firms, *q* indexes quarters, and *t* indexes days.

The *5 Days Before* variable is an indicator that turns on when the firm-day falls within the five trading days before the EA (i.e., from day *t–5* to day *t–1*, where day *t* is the announcement date). These five days are the treatment period—the period when we expect investors to purchase a security if they are trading on the EA. The control period consists of all other days during the firm-quarter, other than the day of the EA itself, which we exclude from the sample.[24] The variable of interest is the interaction between the *5 Days Before* indicator and the *Top Decile Extrapolated Return* variable; which, as in the previous tests, is an indicator that switches on when the firm-quarter is in the top decile of the extrapolated return measure for that calendar quarter.

We include firm-quarter fixed effects, γ_{iq}, which eliminate variation at the firm-quarter level.[25] These fixed effects allow us to control for all fixed firm-quarter level unobservables that are correlated with past EA returns and investor trading behavior. In particular, these focus the identifying variation on differences in investor trading behavior on days in the *5 Days Before* and days outside the *5 Days Before* for firms with past EA returns that are high and low. As such, the coefficient on the *5 Days Before* indicator captures the expected change in purchasing or selling

[24] We exclude the day of the EA from the sample because we do not know the time of day when the announcement occurred for the EAs in this sample period. This is because our sample period for these data runs from 1991 to 1996, which does not overlap with our data on precise EA timing. If the announcement occurred after the close of the market, then the EA day should be included in the five-day period before the EA. However, if the announcement occurred earlier in the day, then it should not be included. Without knowing the timing of the announcement, we do not know how to treat each EA day, so we drop these days from the sample.

[25] Note that due to the inclusion of firm-quarter fixed-effects, we cannot simultaneously identify the coefficient on the top extrapolated return decile dummy.

in the pre-EA period for firms that are not in the top extrapolated returns decile. The coefficient on the interaction between *5 Days Before* and *Top Decile Extrapolated Return*, β_2, is an estimate of the amount by which the pre-EA change for firms in the top decile differs from the change for the other firms in the sample.[26] In other words, β_2 captures any spike or drop in pre-EA 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-EA purchasing of firms with high extrapolated returns.

We also include an interaction between *5 Days Before* and *Bottom Decile Extrapolated Return*; which, as in the previous tests, is an indicator that switches on for firms in the bottom decile of the extrapolated return measure for that calendar quarter. The interpretation of its coefficient, β_3, is the same as the interpretation for β_2: it captures any spike or drop in pre-announcement trading activity that is systematically related to being a bottom decile firm. Since we do not expect the individuals in our dataset to short sell, we do not have any strong prediction that pre-announcement sales will be higher for firms in the bottom decile. We include this interaction to explore alternative explanations based only on investor attention. If higher pre-announcement purchases of top decile firms were driven exclusively by higher investor attention, then we should also expect pre-announcement purchases of bottom decile firms to be higher since investors pay attention to extreme returns (Barber and Odean 2008). The absence of higher purchases for bottom decile firms would suggest that attention alone is not the underlying mechanism driving our results.

To test the effect of extrapolation on purchasing behavior, we use two dependent variables: *log(Gross Purchases)*, which is the logarithm of one plus the dollar value of purchases of a firm's stock made by all sampled individuals on a trading day, and *# Buyers*, which is the total number of sampled individuals who purchase the stock on a trading day. To test the effect on selling, we

[26] Except for firms in the bottom decile because we also control for the interaction between *5 Days Before* and an indicator that turns on for firms in the bottom decile of extrapolated returns.

use two analogous dependent variables: *log(Gross Sales)*, which is the logarithm of one plus the total dollar value of sales, and *# Sellers*, which is the number of individuals who sell the stock. (The variables *log(Gross Purchases)* and *log(Gross Sales)* are the variables plotted by Figures 2(a) and 2(b). Plots of the other two variables are available in the Internet Appendix in IA Figure 4.1.) We cluster standard errors at both the firm level and the quarter level.

We only consider firm-quarters where investors could have easily predicted the EA date. Our sample period for individual investor trades precedes the time at which it became common for most firms to pre-announce EA dates. This is relevant because whether investors could predict the date of the EA would determine their ability to trade on their extrapolative beliefs. Thus, we restrict this test's sample to firm-quarters where the actual EA is within two days of our predicted date for both the current quarter and the previous quarter. We define the predicted EA date as the (ex post) more accurate of the exact date of last year's EA or the exact date adjusted so that the predicted announcement occurs on the same day of the week as last year's announcement (e.g., not on a weekend).[27]

We present the results in Table 7. Column (1) shows results with the dollar value of purchases (i.e., *log(Gross Purchases)*) on the left-hand side. Consistent with our prediction, β_2, the coefficient on the interaction between *5 Days Before* and *Top Decile Extrapolated Return*, indicates that the increase in purchases during the pre-EA period is 10.3 percent higher for firms in the top extrapolated return decile (t=2.14). Column (3) of Table 7 shows the result with the number of buyers (i.e., *# Buyers*) on the left-hand side. Looking again at β_2, firms in the top extrapolated return decile see an average increase of 0.044 more purchasers per day than other firms in the pre-EA period (t=2.79). The average number of purchasers on any given firm-day in our sample is 0.23, so this represents an increase in the number of purchasers that is about one-

[27] Similar determinations of the predicted earnings announcement date have been used in the academic accounting literature (e.g., Cohen et al. 2007; Begley and Fischer 1998). In IA Table 4.2 in the Internet Appendix, in a quasi-placebo test, we show that there is little evidence of extrapolative purchases when the earnings announcement date is not predictable.

sixth of the sample average. This provides evidence that individual purchase behavior is consistent with extrapolation of past EA returns.[28]

Being in the top decile has only a marginally significant impact on selling behavior. Column (2) contains the results with the dollar value of sales (i.e., *log(Gross Sales)*) on the left-hand side. This column shows that firms in the top extrapolated return decile experience 6.7% lower sales in the five days before the EA, though this result is only marginally significant (t=1.92). In column (4), when the number of sellers (i.e., *# Sellers*) is on the left-hand side, the coefficient is insignificant. Because retail investors are unlikely to short sell (Barber and Odean 2008), this non-result is consistent with extrapolative beliefs.

The extrapolation narrative predicts that stocks with the poorest performance should be purchased to an abnormally lesser extent. The investor attention hypothesis predicts the opposite—extreme past returns should receive investors' attention, leading to greater purchases. The coefficients on the interaction between *5 Days Before* and *Bottom Decile Extrapolated Return* in the Table 7 regressions are insignificant in all four specifications. The insignificant coefficients with *log(Gross Purchases)* and *# Buyers* on the left-hand side provide comfort that the results are not solely driven by investor attention.[29] The insignificant coefficients with *log(Gross Sales)* and *# Sellers* on the left-hand side show that we do not have evidence of investors making extrapolative sales for firms with histories of low EA returns. Again, since most individual investors do not sell short, it is not surprising that we find insignificant results.[30]

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[28] Importantly, other investors who are not retail investors might be extrapolating too. We have no indication that these individual trades are the sole drivers of the return patterns we observe. Indeed, in untabulated analysis we find that total market trading volume (from CRSP) follows a pattern very similar to the individual purchases: rising for top-decile firms right before the EA. This rise in trading volume is of a similar proportion to the rise in individual purchases, indicating that other market participants might extrapolate just as much as the individuals in our sample. We corroborate this inference later in the paper with evidence that institutional investors are extrapolating EA returns.

[29] Note that while the results are unlikely to be driven *solely* by investor attention, the investors must pay attention before they extrapolate, so attention is a necessary condition for extrapolation.

[30] For robustness, we perform the regressions in Table 7 with alternative measures of extrapolated returns, including one that takes the simple average of earnings announcement returns over the past eight quarters. We present our findings in the Internet Appendix (IA Table 3.1).

The above evidence indicates that individual investors extrapolate EA returns when deciding whether to buy stock before an EA. Other evidence, in contrast, indicates that they do not extrapolate earnings itself when making this decision. In the Internet Appendix (see IA Table 4.3), we present results showing that purchases before the EA are unaffected by whether the firm had a history of good earnings surprises, where the earnings surprise is measured as either the seasonal change in earnings or the analyst forecast error.[31] Thus, consistent with the results from Blankespoor et al. (2019), the individuals in our sample seem to extrapolate returns, but not fundamentals.

4.2 Individual Investor Purchases

We next look at behavior within individuals, comparing those who have recently purchased the stock to those who have not. Perhaps all investors who have recently purchased the stock, and are thus paying more attention to it, are more likely to make extrapolative purchases before the next EA. Or perhaps only certain types of investors have the disposition to bet on an EA. To explore this, we define an indicator variable, *Watcher*, which equals one when the investor purchased the stock in the previous quarter. We consider different windows for *Watcher*. When we define *Watcher* to equal one for purchases during the five days before the firm's previous EA, we capture investors who bet on that EA. When we define it to equal one for purchases during the

[31] These results differ from those of Hirshleifer et al. (2008), who use the same dataset to examine individual trades. Hirshleifer et al. (2008) check whether the seasonal difference in standardized unexpected earnings (SUE) predicts individual investor trades right before the next earnings announcement, with the goal of determining whether individuals drive post-earnings-announcement drift. While our tests do not find a relationship between earnings growth and trades right before the next announcement, Hirshleifer et al. (2008) find that firms in both the top and bottom SUE deciles have significantly greater purchases and sales at that time. They also find marginally significant evidence (p-value=0.09) that net purchases right before the next earnings announcement are higher for firms in the top SUE decile. Our results differ from theirs because our firm-quarter fixed effects control for the baseline level of trades during the firm-quarter. In other words, our test removes the trades that would have occurred even if the earnings announcement was more than a week away. This is necessary because investors likely pay more attention to firms with extreme performance. Hirshleifer et al. (2008) do not control for the level of trades throughout the quarter, meaning their estimates also include trades that do not relate to the earnings announcement. In our tests, controlling for the baseline level of trades reveals that investors do not change their pre-announcement trading behavior based on recent earnings growth. They only do so based on the earnings announcement return.

previous EA's two-day window (i.e., EA and EA+1), we capture investors who purchased in response to the announcement's information.[32] And when we define it to equal one for purchases in the quarter preceding the previous EA, we capture investors who had reason to pay attention to that EA, but did not necessarily intend to trade around it. If we find that all three types of purchasers are more likely to extrapolate around the next EA, then we can conclude that the remaining investors—those who did not purchase the stock in the three windows—were less likely to extrapolate because they were paying less attention to the stock. On the other hand, if extrapolative purchases are only more common among the investors who bet on the previous EA by purchasing in the five days before, then we can infer that differences in attention is not the main factor at work behind differences in extrapolative behavior.

To test this argument, we construct a dataset with individual-firm-day observations. We then consider a regression of the following form for individual *j*, firm *i*, quarter *q*, and day *t*:

$$\begin{aligned} \textit{Buy}_{\text{jiqt}} = {} & \beta_1 \textit{ 5 Days Before}_{\text{iqt}} \\ & + \beta_2 \textit{ 5 Days Before}_{\text{iqt}} \times \textit{Top Decile Extrapolated Return}_{\text{iq}} \\ & + \beta_3 \textit{ 5 Days Before}_{\text{iqt}} \times \textit{Watcher}_{\text{jiq}} \\ & + \beta_4 \textit{ 5 Days Before}_{\text{iqt}} \times \textit{Top Decile Extrapolated Return}_{\text{iq}} \times \textit{Watcher}_{\text{jiq}} \\ & + \gamma_{\text{jiq}} + \varepsilon_{\text{jiqt}}. \end{aligned} \tag{4}$$

The primary distinction between this regression and those with aggregated trades (i.e., those in Section 4.1) is that this regression has observations at the individual-firm-day level.[33] Separately examining individuals allows us to track how each individual's trades change in response to their past trading behavior, which allows us to say something about the determinants of extrapolative behavior. This specification will also enable us to use individual-firm-quarter

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[32] Since we do not know when earnings is announced on the day of the EA, some of these investors will be pre-EA purchasers.

[33] As with the other tests of individual trades in Section 4.1, we make the following sample restrictions: (1) we restrict the sample to predictable earnings announcements and (2) we exclude the earnings announcement itself from the sample.

fixed effects.[34] These fixed effects control for all fixed individual-firm-quarter level unobservables that are correlated with past EA returns and investor trading behavior. They account for a particular individual's trading behavior of a specific stock in a given quarter, which might be driven by and confounded by a variety of individual and time-varying factors at the firm level. The dependent variable, *Buy,* is an indicator, which equals one if investor *j* purchases shares of firm *i* on day *t.* (In the table, we multiply *Buy* by 100 to present the coefficients as percentage points.) Our coefficient of interest is β_4. This coefficient describes the degree to which a *Watcher* will bet on the EA return (i.e., buy in the pre-EA window) of a high-extrapolated-return stock relative to all other investors. Specifically, this coefficient represents the difference in extrapolative trading behavior for *Watcher* investors relative to other investors. In these tests, standard errors are clustered at the individual-firm-quarter level.

The results are in Table 8. In each column, *Watcher* is defined based on one of the three different windows. In column (1), it is an indicator that turns on if the investor purchased the firm's stock in the five trading days before the firm's previous EA. Column (2) changes the window considered by *Watcher* to the day of and the trading day after the previous EA.[35] Column (3) changes the window again to the 63 trading days before the previous EA (i.e., the quarter before).[36]

The three types of purchasers considered in the three columns have different propensities to make extrapolative purchases, as can be seen by the coefficient on the triple-interaction of *Top Decile Extrapolated Return, Watcher,* and *5 Days Before*. In column (1), which examines those who bought right before the previous EA, the triple-interaction has a coefficient of 0.265 (t=2.22).

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[34] We assign individual-firm combinations to all days from the date of one's first reported holding to the date of his/her last reported holding. Individuals are assigned to any firm in which they ever hold a position throughout the sample. Individuals are defined based on their account numbers. Individual-firm-quarter fixed effects are dummies based on account numbers, security numbers, and earnings announcement dates.

[35] In column (2), we exclude the day after the previous EA from the sample, since *Watcher* in this column is defined based on purchases that occur on that day.

[36] We set *Watcher* to missing, and thus drop the observation from the sample, if data is missing for any of the days in the window in which *Watcher* is measured. This is especially important in column (3), when the window is 63 days long. Without this restriction, we would measure *Watcher* with 63 days for some firms and with as few as one trading day for others.

This indicates that those who bet on the previous EA are more likely to make an extrapolative purchase before the current EA. In contrast, the coefficient is insignificant in column (2) and negative in column (3), which examine, respectively, those who bought during the previous EA window and those who bought in the quarter before it. Thus other recent purchasers, who had reason to pay attention to the previous EA return, are equally likely—and, if anything, less likely—than the general population to make an extrapolative purchase before the current EA. This indicates that differences in attention do not seem to be the main explanation for differences in extrapolative behavior. We speculate that the positive coefficient in column (1) occurs because investors who purchased a top-decile firm's stock right before its previous EA had a good experience by participating in the firm's EA-return winning streak, and they again purchase right before the current EA in the expectation that the high EA returns will continue.

4.3 Institutional Investor Trading

In this section, we examine the trading behavior of institutional investors. Without data on institutional trades for academic use,[37] we rely on an indirect proxy for their trades using intraday returns. Lou et al. (2019) offer evidence that intraday returns are more associated with institutional investor demand and that overnight returns are more associated with individual investor demand.[38] Therefore, we aim to see whether our extrapolated return measure can explain pre-EA intraday returns. We consider a regression of the following form for firm *i*, during quarter *q*, on day *t*:

$$\begin{aligned} \textit{Intraday return}_{iqt} &= \beta_1 \textit{ 5 Days Before}_{iqt} \\ &+ \beta_2 \textit{ 5 Days Before}_{iqt} \times \textit{Top Decile Extrapolated Return}_{iq} \\ &+ \beta_3 \textit{ 5 Days Before}_{iqt} \times \textit{Bottom Decile Extrapolated Return}_{iq} \\ &+ \gamma_{iq} + \delta_t + \varepsilon_{iqt}. \end{aligned} \qquad (5)$$

[37] Regrettably, Abel Noser Solutions, LLC discontinued their program supporting the use of their data on institutional trades by academics.

[38] Related work that finds similar/related evidence is Berkman et al. (2012) and Aboody et al. (2018).

This test's design is similar to a traditional difference-in-differences estimator. Each observation is a firm-trading day that falls within a firm-quarter, where the firm-quarter runs from two-days after the firm's previous EA to its current EA.[39] The subscript *i* indexes firms, *q* indexes quarters, and *t* indexes days.

Variables are defined as in the previous tests. The variable of interest is the interaction between the *5 Days Before* indicator and the *Top Decile Extrapolated Return* variable. We include firm-quarter fixed effects, γ_{iq}, which eliminate variation at the firm-quarter level. These fixed effects allow us to control for all fixed firm-quarter level unobservables that are correlated with past EA returns and current quarter intraday returns. In particular, these focus the identifying variation on differences in returns in the *5 Days Before* and days outside the *5 Days Before* for firms with past EA returns that are high and low. As such, the coefficient on the *5 Days Before* indicator captures the expected change in returns in the pre-EA period for firms that are not in the top extrapolated returns decile. The coefficient on the interaction between *5 Days Before* and *Top Decile Extrapolated Return*, β_2, is an estimate of the amount by which the pre-EA change for firms in the top decile differs from the change for the other firms in the sample.[40] In other words, β_2 captures any spike or drop in returns that is systematically related to being a top decile firm. We also include day fixed effects to absorb any systematic returns on the associated day. If institutional investors exhibit extrapolative purchasing behavior, we would expect to see a positive coefficient on β_2.

We present our results in Table 9. Our results are consistent with extrapolative beliefs. Being in the top decile of extrapolated returns is associated with an intraday return more than 6 basis points higher than intraday returns when the firm is not in the top or bottom decile. For completeness, we also present results from overnight returns, which are typically associated with

[39] We exclude the day of the earnings announcement and the day after the earnings announcement for mechanical reasons. That is, the return on those two days will be part of our extrapolated return measure.

[40] Except for firms in the bottom decile because we also control for the interaction between *5 Days Before* and an indicator that turns on for firms in the bottom decile of extrapolated returns.

individual investor behavior. Examining these returns, we find evidence of extrapolation consistent with our individual trading results.

These results offer corroborating evidence for our hypothesis and evidence that extrapolative beliefs can explain return patterns around EAs. Specifically, a necessary ingredient for extrapolative beliefs to explain asset prices is that investor trades reflect extrapolative beliefs. In this section, we documented evidence that investor EA trades reflect extrapolative beliefs.

5 Comparing Extrapolated Returns to Trailing Returns

The evidence thus far provides insights into the importance of extrapolative beliefs in explaining EA return patterns. In this section, we explore possible alternative ways that investors might use past returns to extrapolate EA returns, with the goal of better understanding how investors form their beliefs. For this exploration, we let the data speak and run a horse race between our measure and two specific candidates: trailing returns and equally weighted past EA returns. Trailing returns, which are highly salient and easy to calculate, speak to attention/other forms of extrapolation and help highlight the relative importance of focusing on discrete events in the past. This alternative metric is also used by Aboody et al. (2010), who find that firms with high trailing 12-month returns have positive pre-EA returns and negative post-EA returns. The equally weighted measure of past EA returns, on the other hand, allows us to ascertain whether the recency-weighting aspect of our measure of extrapolation contains incremental predictive power for return patterns around EAs.

We consider the past returns of both the previous year and the previous two years. The previous-year option provides comparability with the measure of trailing returns in Aboody et al. (2010), and the previous-two-year measures provide comparability with our extrapolated return metric, which considers EA returns over the previous eight quarters. To ensure consistency between the measures of past returns and our measure of extrapolated returns, we construct indicators for the top and bottom deciles of trailing returns in the same manner as the indicators for the top and bottom deciles of extrapolated returns. We then conduct a pairwise horse race by pitting the trailing return and past-EA return indicators against the extrapolated return indicators in the same regression. Using these additional terms, we augment our main specifications for returns (Table 2) and individuals' trading behavior (Table 7).

In the two panels of Table 10, we present the results from a horse race between extrapolated returns and past returns. We compare the predictive ability of our extrapolated return measure to the predictive ability of equal weighted past EA returns in Panel A and that of trailing returns in Panel B. We find that our measure as well as the metrics that capture past returns have explanatory power incremental to each other. In these horse races, the top decile of extrapolated returns maintains the ability to significantly explain both the pre-EA run-up and the post-EA reversal, demonstrating that it can explain the return pattern after controlling for alternative ways investors might pay attention to past returns.

The various types of trailing returns also perform well. All incrementally predict a significant run-up before the EA, and all except for *Past 2-year EA Returns* predict a significant reversal after. Furthermore, the coefficient on *Top Decile Extrapolated Return × 5 Days Before* is significantly higher (at the 5% level) than the coefficient on *Top Decile Return Var. × 5 Days Before* in the horse race against the one-year trailing returns. Overall, it seems both extrapolated returns and trailing returns incrementally explain the return pattern, suggesting that investors pay attention to both when betting on future EAs.

Next, we consider the individual-trades tests. In Table 11, we run a horse race between the extrapolated return measure and each of the trailing return measures. When *# Buyers* is on the left-hand side, the significant positive coefficient on *Top Decile Extrapolated Return × 5 Days Before* survives in all horse races (columns 3 and 7 in both panels). Furthermore, it is significantly higher (at the 5% level) than the coefficient on *Top Decile Return Var. × 5 Days Before* in the horse race against the EA returns over the past two years. When *log(Gross Purchases)* is on the left-hand side, the significant positive coefficient on *Top Decile Extrapolated Return × 5 Days Before* survives the horse race with one-year past EA returns (column 1 in Panel A). It also remains significant against the measure of two-year trailing returns (column 5 in Panel B).

Like the return-pattern tests above, the inferences from the investor trading tests in Table 11 suggest that extrapolated returns incrementally explain pre-EA purchases after controlling for alternative measures of past returns. In particular, the findings presented in Panel A (extrapolated returns vs. past EA returns) underscore that our functional form (i.e., recency) has explanatory power for pre-EA purchases that is incremental to the equal-weighted measure of past EA returns. This test supports our measure of extrapolation. The results in Panel B (extrapolated returns vs. trailing returns) highlight that trailing returns are mainly about attention, which is consistent with the conclusion drawn by Aboody et al. (2010). This is because (*i*) purchases increase for stocks in the *bottom* decile of trailing returns as well as for those in the top decile (see columns (1) and (7) of Panel B) and (*ii*) sales, as well as purchases, increase for the stocks in the top decile of trailing returns (see columns (2) and (6) of Panel B).[41] This is in contrast to the extrapolated return measure, which sees neither an increase in purchases for its bottom decile nor an increase in sales for its top decile. This contrasting result provides further evidence that our extrapolated return measure captures extrapolation of EA returns, and not solely an increase in attention.

6 Conclusion

We propose extrapolative beliefs as a partial explanation for return patterns around EAs. We first document a return pattern that follows naturally from extrapolative beliefs—namely, we show that prices increase in the pre-EA period following high recent EA returns. The pattern is persistent over time and exists in an international sample, and a portfolio strategy based on the pattern earns economically significant excess returns. We also directly link cross-sectional variation in the pre-EA run-up to the pre-EA premium, and note that the post-EA reversal is

[41] In an additional analysis, we run the returns and individual trades tests for a third alternative, trailing returns excluding past EA returns. Our results continue to hold (untabulated).

consistent with overextrapolation, which aligns with the notion from psychology that people tend to infer too much from small samples and overextrapolate (Tversky and Kahneman 1971, 1974). We provide evidence of these extrapolative beliefs using data on individual investor trades from a large discount brokerage, as well as with a proxy for institutional investor trading. Specifically, we document evidence of extrapolative trading by individual and institutional investors. Overall, our evidence suggests that investors extrapolate past EA returns and suggests that extrapolative beliefs offer a partial explanation for puzzling return patterns around EAs.

Appendix A. Variable Definitions

Variable Name	Definition
# Buyers	# investors covered in the dataset who buy the firm's stock on a given day.
# Sellers	# investors covered in the dataset who sell the firm's stock on a given day.
5 Days After	1 for obs. that are in the 5-day period after the earnings announcement.
5 Days Before	1 for obs. that are in the 5-day period before the earnings announcement.
Bottom Decile Extrapolated Return	1 for obs. that are in the bottom decile of *Extrapolated Return* in a quarter.
Buy	1 if the investor purchases shares of the associated stock on the associated day
Daily return (%)	Daily returns in percentage points.
EA-Window	1 for obs. that are in the earnings announcement day.
Extrapolated Return	Weighted average of past 8 earnings announcement returns (See Equation 1).
log(Gross Purchases)	Log(1 + dollar value of total purchases of the firm's stock by investors in the dataset)
log(Gross Sales)	Log(1 + dollar value of total sales of the firm's stock by investors in the dataset)
log(Media Coverage)	Log(1+ # news articles about the firm during the 5-day window before the obs. day.)
Top Decile Extrapolated Return	1 for obs. that are in the top decile of *Extrapolated Return* in a quarter.
Watcher	1 if the investor purchased the firm's stock during various past windows.

Notes:

Sorted alphabetically.

Test-specific variables are defined in pertinent table captions.

Data sources are CRSP, IBES, Compustat, RavenPack, and a large discount brokerage house—detailed in Section 2.

Appendix B. Description of International Sample used in Table 5

We conduct the international tests in Table 5 for firms from the United Kingdom, France, and Germany. Our sample period spans 1994 to 2015. We are restricted because we must observe two years of earnings announcements, and EA dates first become available in the data for this sample in 1992. International data comes from Datastream and Worldscope, both of which are provided by Thomson Reuters. Daily data is available at the security level, but our tests are at the firm level. If a firm has multiple securities, we only use the one with the highest median trading volume during the sample period. We drop any firms that are listed on exchanges located outside of the countries in our sample. We follow Karolyi et al. (2012) and Griffin, Kelly, and Nardari (2010) by applying a series of screens to the Datastream data.[42]

We use the Worldscope variable "Earnings Per Share Report Date - Fiscal Period End" (variable code: "wc05905a") as our EA date variable. It records the source date for the earnings reported by the company.[43] For our tests, we only include firm-quarters where the EA date given in this Worldscope variable matches the EA date according to the IBES Unadjusted Detail file, in order to make sure that we accurately determine the five days before the EA and the five days after. We estimate that 53% of the firm-quarters with a Worldscope EA date have a matching EA date in IBES.

We restrict the sample to companies that report earnings on a quarterly basis so that we can use the same measure of extrapolated returns as we do in the U.S. sample. We use the Worldscope variable "Earnings Report Frequency" (variable code: "wc05200") to identify quarterly reporters. To guard against errors in this variable, we also make sure that the interim observations in Worldscope match the profile of a quarterly reporter, which should have four observations each year. Thus, if the "Earnings Report Frequency" variable says a firm is a quarterly reporter, but the firm has only one or two observations for the year and neither is for Q1 or Q3, then we do not treat the firm as a quarterly reporter, and we remove from the sample all of its observations for the year. On the other hand, if "Earnings Report Frequency" does not indicate the firm's reporting frequency, but the firm has four observations for the year, then we treat the firm as a quarterly reporter.

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[42] We exclude non-trading days, we exclude a firm's observations for the month if the firm has zero-return days for more than 80% of the days that month, we set returns to missing if Datastream's return index variable is below 0.01 on the current day or the previous day (Ince and Porter 2006), we set returns to missing if they are in the top or bottom 0.1% of the cross-sectional distribution within a country over time, we set the daily returns to missing if the daily return is greater than 100% on a given day or on the previous day, but the compound return over the two days is less than 20%, we set daily returns to missing if they exceed 200%, and we exclude depositary receipts, real estate investment trusts, preferred stocks, investment funds, warrants, debt, unit trusts, and other stocks with special features.

[43] Sometimes, Worldscope records the earnings report date in other variables: "wc05901", "wc05902", "wc05903", "wc05904", and "wc05905".

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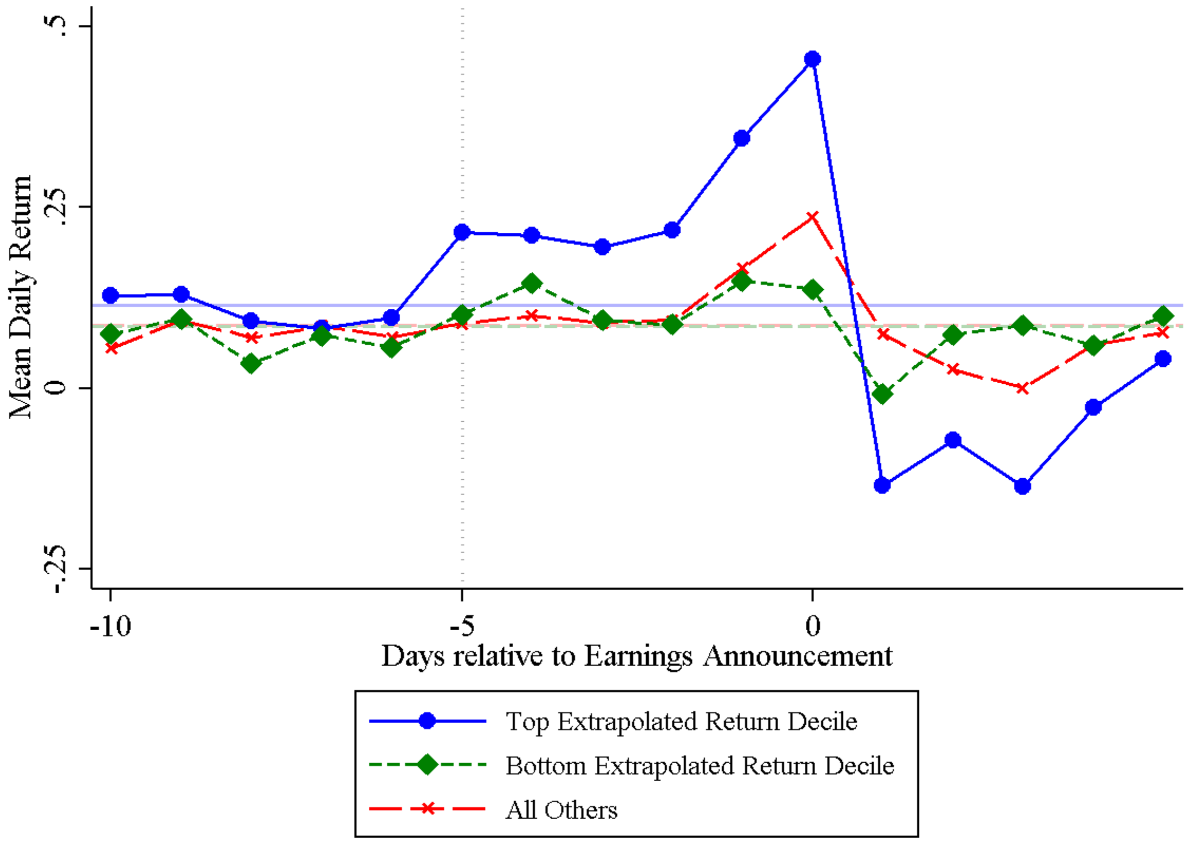
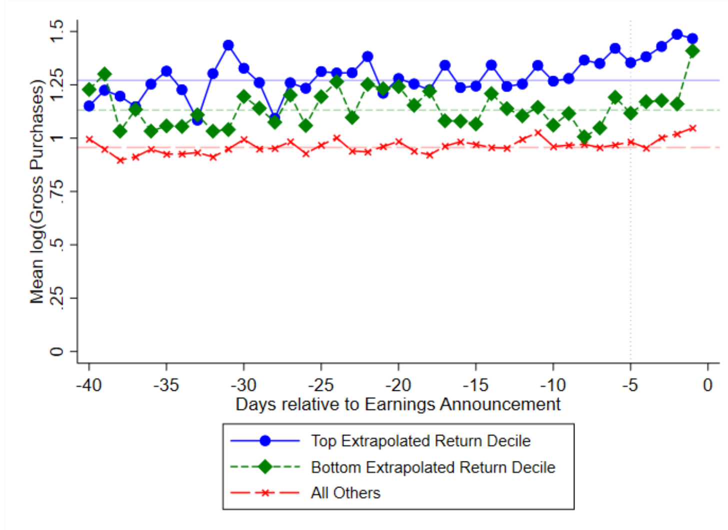


Figure 1. Extrpaolative Beliefs and Stock Returns around Earnings Announcements

This figure plots the evolution of daily average returns for firms that are in the top decile extrapolated returns group, those in the bottom decile group, and all other firms. Day 0 is the earnings announcement day. The dotted vertical line marks the start of the five-day pre-announcement period, while the horizontal lines show the mean returns value in the [-10, 5] period by group. The solid blue horizontal line shows the mean for firms in the top decile of extrapolated returns, the small-dash green horizontal line shows the mean for firms in the bottom decile, and the large-dash red horizontal line shows the mean for the firms in the remaining eight deciles.

(a) Dollar Value of Purchases



(b) Dollar Value of Sales

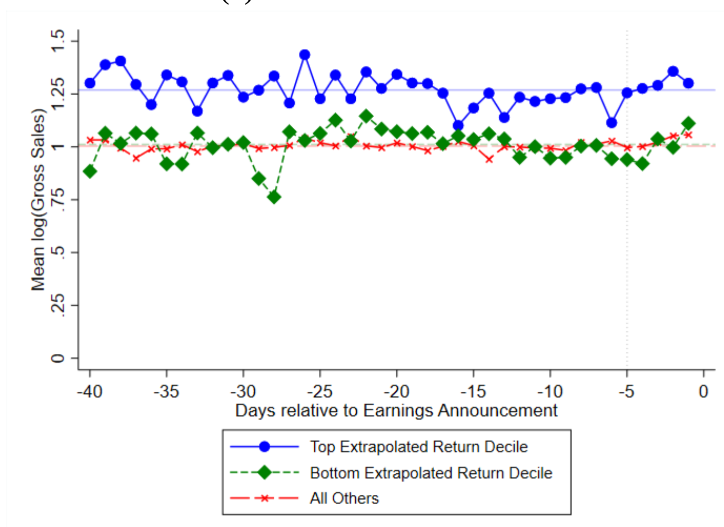


Figure 2. Individual Purchases in the Days before the Earnings Announcement

Using individual trading data from a large discount brokerage, we plot purchasing behavior in the 40 days before the EA (not including the EA). Panel (a) plots the mean *log(Gross Purchases)* for each trading day before the earnings announcement, where *log(Gross Purchases)* is defined as the logarithm of 1 plus the dollar value of total purchases of the firm's stock that day by investors within the dataset. Panel (b) does the same for the mean *log(Gross Sales)*, which is defined the same as *log(Gross Purchases)* except with the dollar value of sales rather than purchases. Both panels use a dotted vertical line to mark the start of the five-day pre-announcement period. Both panels use horizontal lines to show the mean value in the 35 days before the pre-announcement period begins, where the solid blue horizontal line shows the mean for firms in the top decile of extrapolated returns, the small-dash green horizontal line shows the mean for firms in the bottom decile, and the large-dash red horizontal line shows the mean for the firms in the remaining eight deciles.

Table 1. Descriptive Statistics

This table presents pertinent summary statistics for continuous variables and dummy variables, other than decile indicators, each of which has a mean of 0.1, by definition. The unit of analysis is the firm-day in Panels A and B. Variable definitions appear in Appendix A.

Panel A. Firm-Day Trades Sample

	Mean	SD	10%	50%	90%	# Obs.
Daily return (%)	0.077	3.16	-2.99	0	3.17	12,203,873

Panel B. Individual Investor Trades Sample

	Mean	SD	10%	50%	90%	# Obs.
log(Gross Purchases)	0.99	2.90	0.00	0.00	7.41	939,653
log(Gross Sales)	1.03	2.94	0.00	0.00	7.58	939,653
# Buyers	0.23	1.34	0.00	0.00	1.00	939,653
# Sellers	0.20	0.87	0.00	0.00	1.00	939,653

Table 2. Extrapolation and Returns around Earnings Announcements

This table shows that return patterns around earnings announcements are consistent with extrapolation of past earnings announcement returns. The unit of observation is a firm-day. The dependent variable, *Daily Return*, is returns in percentage points. *5 Days Before*, *EA Window*, and *5 Days After* are indicators for days that occur within the t–5 to t–1 window, t window, and the t+1 to t+5 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, and *Bottom Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the bottom decile. *Media Coverage* is a control for the natural logarithm of the number of news articles about the firm over the 5-day window preceding the observation day, obtained from RavenPack, available post-2000. 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. Window intercepts include the following three terms*: 5 Days Before*, *EA Window*, and *5 Days After*. Market Return is the value-weighted market return that day. All specifications include an indicator for each distinct day in the sample (i.e., Day FE) as well as an indicator for each distinct firm-quarter in the sample (i.e., Firm-quarter FE). Standard errors are clustered by firm and by quarter. T-statistics are presented in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	Daily Return (%)	*Daily Return (%)*	*Daily Return (%)*
	(1)	(2)	(3)
Top Decile Extrapolated Return × *5 Days Before*	0.100***	0.127***	0.0873***
	(5.816)	(6.422)	(3.054)
Top Decile Extrapolated Return × *EA Window*	0.182***	0.249***	0.258***
	(3.145)	(4.203)	(3.137)
Top Decile Extrapolated Return × *5 Days After*	-0.146***	-0.130***	-0.156***
	(-7.887)	(-6.316)	(-4.941)
Bottom Decile Extrapolated Return × *5 Days Before*	-0.00644	-0.0242	-0.0553***
	(-0.408)	(-1.604)	(-2.745)
Bottom Decile Extrapolated Return × *EA Window*	-0.114**	-0.150***	-0.0497
	(-2.174)	(-2.884)	(-0.727)
Bottom Decile Extrapolated Return × *5 Days After*	0.00750	-0.0107	-0.00756
	(0.388)	(-0.505)	(-0.275)
log(*Media Coverage*)			-0.0026
			(-1.280)
Observations	12,203,873	12,203,873	5,531,761
Adjusted R-squared	0.142	0.149	0.226
Momentum controls	N	Y	Y
Window intercepts and market return	Y	Y	Y
Firm-quarter FE and Day FE	Y	Y	Y

Table 3. Extrapolation and Returns Reversal on the Day of Earnings Announcement

This table uses accurate EA timestamps to demonstrate that the return reversal begins right after the announcement of earnings. The unit of observation is a firm-day. As indicated in column headings, the sample is limited to stocks that are coded as *Late Announcer* or *Early Announcer*. *Late Announcer* (*Early Announcer*) is an indicator variable that switches on if the earnings announcement is made after 4pm (before 9am). If *Late Announcer* is equal to 1, then the EA date is set to one day after the date recorded in Compustat. As a result, for *Late Announcers*, the return on the EA date mostly comes from a period after the EA occurred. (The same is true for *Early Announcers* on the Compustat EA date.) To account for this update, EA window is relabeled as *Correct EA Window* (as in Berkman and Truong 2009). All dependent and independent variables are as previously defined. Window intercepts are *5 Days Before*, *EA Window*, and *5 Days After*. Market Return is the value-weighted market return that day. Standard errors are clustered by firm and by quarter, and t-statistics are presented in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	Late Announcers			Early and Late Announcers		
	Daily Return (%)	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*
	(1)	(2)	(3)	(4)	(5)	(6)
Top Dec. Extr. Ret. × 5 Days Before	0.112***	0.139***	0.126***	0.0938***	0.125***	0.117***
	(4.663)	(5.506)	(4.264)	(4.087)	(5.015)	(3.800)
Top Dec. Extr. Ret. × Correct EA Window	-0.416**	-0.374**	-0.427**	-0.344**	-0.305**	-0.330**
	(-2.623)	(-2.356)	(-2.440)	(-2.519)	(-2.209)	(-2.209)
Top Dec. Extr. Ret. × 5 Days After	-0.0964***	-0.102***	-0.119***	-0.107***	-0.107***	-0.114***
	(-4.309)	(-4.239)	(-4.344)	(-4.747)	(-4.432)	(-4.003)
Bottom Dec. Extr. Ret. × 5 Days Before	-0.0155	-0.0446**	-0.0292	-0.0226	-0.0543***	-0.0439*
	(-0.724)	(-2.148)	(-1.148)	(-1.118)	(-2.726)	(-1.789)
Bottom Dec. Extr. Ret. × Correct EA Window	-0.0835	-0.122	-0.212	-0.119	-0.155	-0.236
	(-0.490)	(-0.712)	(-1.200)	(-0.793)	(-1.036)	(-1.542)
Bottom Dec. Extr. Ret. × 5 Days After	0.0644***	0.0372	0.0105	0.0343	0.00395	-0.0118
	(2.980)	(1.556)	(0.383)	(1.663)	(0.167)	(-0.460)
Observations	2,907,307	2,907,307	2,213,008	3,619,661	3,619,661	2,835,391
Adjusted R-squared	0.207	0.212	0.236	0.192	0.197	0.219
Media coverage	N	N	Y	N	N	Y
Momentum controls	N	Y	Y	N	Y	Y
Window intercepts and market return	Y	Y	Y	Y	Y	Y
Firm-quarter FE and Day FE	Y	Y	Y	Y	Y	Y

Table 4. Portfolio Tests

This table displays equal-weighted and value-weighted daily portfolio returns in basis points. In Panel A, the portfolio on any given day consists of firms that are within the five days before their next earnings announcement date. The long portfolio consists of firms in the top decile of our *Extrapolated Return* measure, and the short portfolio consists of firms in the bottom decile of our *Extrapolated Return* measure. In Panel B, the portfolio on any given day consists of firms that are within the five days *after* their previous earnings announcement date. In this panel, the long and short portfolios are the opposite of the previous panel: the long portfolio consists of firms that are in the bottom decile of our *Extrapolated Return* measure, and the short portfolio consists of firms that are in the top decile of our *Extrapolated Return* measure. The *Extrapolated Return* measure is equal to a weighted sum of the past 8 earnings announcement returns. In both panels, the first two columns require at least 5 firms in the long and short portfolio. The next two columns do not impose any restriction on the number of firms. The first three factors are the excess market return, the size portfolio, and the value portfolio. The five-factor model adds factors for profitability and investment. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

Panel A. Portfolio Returns Before the Earnings Announcement

	(1) EW Return	(2) VW Return	(3) EW Return	(4) VW Return
Raw Return	15.8***	16.3***	16.8***	16.1***
	(6.94)	(4.93)	(6.13)	(4.85)
Alpha	15.5***	15.4***	16.7***	15.8***
	(6.83)	(4.68)	(6.09)	(4.74)
3-Factor Alpha	15.7***	15.8***	16.8***	16.1***
	(6.91)	(4.81)	(6.12)	(4.84)
3-Factor + Momentum Alpha	15.6***	15.7***	15.9***	15.1***
	(6.92)	(4.81)	(5.83)	(4.56)
5-Factor Alpha	15.6***	16.0***	16.6***	16.1***
	(6.86)	(4.86)	(6.04)	(4.83)

Panel B. Portfolio Returns After the Earnings Announcement

	(1) EW Return	(2) VW Return	(3) EW Return	(4) VW Return
Raw Return	11.3***	15.0***	14.6***	17.5***
	(3.92)	(3.56)	(3.88)	(3.70)
Alpha	11.5***	15.6***	14.7***	17.7***
	(3.97)	(3.68)	(3.89)	(3.74)
3-Factor Alpha	11.3***	15.4***	14.7***	17.7***
	(3.92)	(3.64)	(3.90)	(3.73)
3-Factor + Momentum Alpha	11.6***	15.8***	15.7***	19.1***
	(4.03)	(3.76)	(4.17)	(4.04)
5-Factor Alpha	11.5***	15.4***	15.4***	18.3***
	(3.98)	(3.64)	(4.07)	(3.85)

Table 5. International Evidence

This table provides evidence that extrapolation occurs in other countries. The sample is composed of firm-days for firms from the United Kingdom, France, and Germany. The dependent variable is the daily stock return. *Top (Bottom) Decile Extrapolated Return* is an indicator that turns on for firms in the top (bottom) decile of the extrapolated return measure. *5 Days Before*, *EA Window*, and *5 Days After* are indicators that turn on for the five trading days before the earnings announcement, the day of the earnings announcement, and the five trading days after the earnings announcement. Both specifications control for the daily value-weighted market return for the firm's country. One specification controls for momentum by controlling 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. Both specifications control for firm-quarter fixed-effects, and cluster standard errors at the firm-quarter level. T-statistics are reported in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	Daily Return (%)	*Daily Return (%)*
	(1)	(2)
Top Decile Extrapolated Return × 5 Days Before	0.135***	0.152***
	(3.100)	(3.354)
Top Decile Extrapolated Return × EA Window	0.518***	0.571***
	(2.817)	(3.084)
Top Decile Extrapolated Return × 5 Days After	-0.0950**	-0.0909*
	(-2.233)	(-1.930)
Bottom Decile Extrapolated Return × 5 Days Before	0.0835*	0.0779
	(1.674)	(1.513)
Bottom Decile Extrapolated Return × EA Window	-0.323	-0.354*
	(-1.492)	(-1.647)
Bottom Decile Extrapolated Return × 5 Days After	-0.0255	-0.00721
	(-0.504)	(-0.139)
Observations	524,016	523,867
R-squared	0.130	0.136
Firm-Quarter FE	YES	YES
Market return and window intercepts	YES	YES
Momentum Controls	NO	YES

Table 6. Extrapolation and Returns around Earnings Announcements: Idiosyncratic Volatility, Trading Volume, and the pre-Earnings Announcement Premium

This table presents evidence on the relationship between return extrapolation and return patterns around earnings announcements. Panel A shows that return patterns around earnings announcements are consistent with extrapolation of past earnings announcement returns. The unit of observation is a firm-day. The dependent variable, *Daily Return*, is returns in percentage points. We include controls for *5 Days Before*, *EA Window*, and *5 Days After*, which are indicators for days that occur within the t–5 to t-1 window, t window, and the t+1 to t+5 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, and *Bottom Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the bottom decile. *Top (Bottom) Abnormal Volume Decile* and *Top (Bottom) Idiosyncratic Volatility Decile* equal one if the firm is in the top (bottom) decile of abnormal volume and idiosyncratic volatility, respectively. Abnormal volume is based on volume, as a fraction of number of shares outstanding, during 5 Days Before relative to the average volume, scaled by number of shares outstanding, of the firm during the previous year. Abnormal Idiosyncratic Volatility is based on values from the previous calendar year.[44] We rank values by the associated calendar quarter. We use firm-quarter and day fixed effects and cluster standard errors by firm and by quarter. ***, **, and * denote results significant at the 1%, 5%, and 10% levels. Panel B shows the average raw returns, in percentage points, during the 5-day pre-earnings-announcement period for firm-quarters that fall within different categories, which are formed by sorts based on *Extrapolated Return* on the one hand, and either *Abnormal Idiosyncratic Volatility* or *Abnormal Volume* on the other.[45, 46] The *Extrapolated Return* measure is equal to a weighted average of the past 8 earnings announcement returns. We form *Extrapolated Return* deciles by calendar quarter. ***, **, and * denote results significant at the 1%, 5%, and 10% levels. In column (4), reported in parentheses are the Chi-squared values from the comparison of coefficients in column (2) and column (3). In column (4), ^^^, ^^, and ^ denote results significant at the 1%, 5%, and 10% levels, respectively.

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[44] To calculate abnormal idiosyncratic volatility, for each firm-year, we run a regression of daily firm returns on S&P returns from the same day as the daily return as well as each of the three previous days. The residual from this regression is the idiosyncratic return for the firm. To get a firm's abnormal idiosyncratic volatility during its earnings announcements, we take the average of the squared idiosyncratic return during the earnings announcement periods (which run from 5 days before the announcement to 5 days after) and divide it by the average squared idiosyncratic return during the rest of the year, and we then take the square root of this quotient. To get our abnormal idiosyncratic volatility measure, we take the average abnormal idiosyncratic volatility over all earnings announcements in the previous year. We then rank all values in the previous year.

[45] To calculate abnormal idiosyncratic volatility, for each firm-year, we run a regression of daily firm returns on S&P returns from the same day as the daily return as well as each of the three previous days. The residual from this regression is the idiosyncratic return for the firm. To get a firm's abnormal idiosyncratic volatility during its earnings announcements, we take the average of the squared idiosyncratic return during the earnings announcement periods (which run from 5 days before the announcement to 5 days after) and divide it by the average squared idiosyncratic return during the rest of the year, and we then take the square root of this quotient. To get our abnormal idiosyncratic volatility measure, we take the average abnormal idiosyncratic volatility over all earnings announcements in the previous year. We then rank all values in the previous year.

[46] We calculate abnormal volume by considering the average over the 5 days before the earnings announcement date of the daily trading volume divided by the number of shares outstanding and scaling this mean value by the mean daily value of volume scaled by number of shares outstanding during the previous year. We rank values by the associated calendar quarter.

Panel A. Idiosyncratic Volatility and Trading Volume

	Daily Return (%)	*Daily Return (%)*
X =	*Abnormal Idiosyncratic Volatility*	*Abnormal Volume*
	(1)	(2)
Top Decile Extrapolated Return × 5 Days Before	0.0683***	0.0884***
	(4.48)	(5.28)
Top Decile Extrapolated Return × EA Window	0.1512***	0.1880***
	(2.77)	(3.23)
Top Decile Extrapolated Return × 5 Days After	-0.0989***	-0.1433***
	(-5.48)	(-7.84)
Bottom Decile Extrapolated Return × 5 Days Before	-0.0293**	-0.0020
	(-2.06)	(-0.13)
Bottom Decile Extrapolated Return × EA Window	-0.1116*	-0.1175**
	(-1.97)	(-2.25)
Bottom Decile Extrapolated Return × 5 Days After	0.0402**	0.0095
	(2.12)	(0.49)
Top Decile **X** *× 5 Days Before*	0.0781***	0.1813***
	(2.95)	(6.91)
Top Decile **X** *× EA Window*	-0.0933	-0.0901*
	(-1.26)	(-1.70)
Top Decile **X** *× 5 Days After*	-0.1543***	-0.0584***
	(-5.26)	(-3.29)
Bottom Decile **X** *× 5 Days Before*	-0.0427***	-0.0972***
	(-3.31)	(-7.49)
Bottom Decile **X** *× EA Window*	-0.0602*	0.0859
	(-1.81)	(1.65)
Bottom Decile **X** *× 5 Days After*	0.0386**	-0.0596***
	(2.45)	(-3.69)
Observations	11,279,835	12,201,660
Adjusted R-squared	0.148	0.142
Window intercepts	Y	Y
Firm-quarter FE and Day FE	Y	Y

Panel B. Pre-Earnings-Announcement Premium

	All Extrapolated Return Deciles	Top Extrapolated Return Decile	Bottom Extrapolated Return Decile	Top – Bottom
	(1)	(2)	(3)	(4)
Above-median Values of Abnormal Idiosyncratic Volatility	0.82***	1.26***	0.65***	0.61^^^
	(5.44)	(6.94)	(3.53)	(33.04)
Below-median Values of Abnormal Idiosyncratic Volatility	0.42***	0.62***	0.47***	0.15
	(4.31)	(3.69)	(2.61)	(1.24)
Above-median Values of Abnormal Volume	1.22***	2.02***	1.58***	0.44^^^
	(7.77)	(9.14)	(6.02)	(7.81)
Below-median Values of Abnormal Volume	0.20**	0.55***	0.06	0.49^^^
	(2.11)	(4.28)	(0.43)	(30.45)

Table 7. Extrapolative Beliefs and Aggregate Individual Trades

This table shows that individual investors make more purchases before the earnings announcement for firms with a history of high past earnings announcement returns. 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, and *Bottom Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the bottom decile. *5 Days Before* 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 appear in Appendix A. Standard errors are clustered at both the firm level and the quarter level, and t-statistics are presented in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	log(Gross Purchases)	*log(Gross Sales)*	*# Buyers*	*# Sellers*
	(1)	(2)	(3)	(4)
5 Days Before	0.0301	0.00481	0.00177	0.00268
	(1.635)	(0.207)	(0.181)	(0.486)
Top Decile Extrapolated Return				
× *5 Days Before*	0.103**	-0.0666*	0.0440**	0.00284
	(2.142)	(-1.917)	(2.787)	(0.125)
Bottom Decile Extrapolated Return				
× *5 Days Before*	0.0001	-0.0303	-0.00626	0.00847
	(0.002)	(-1.034)	(-0.185)	(0.499)
Observations	939,653	939,653	939,653	939,653
R-squared	0.362	0.331	0.460	0.428
Firm-Quarter FE	YES	YES	YES	YES

Table 8. Within-Individual Trading Behavior

This table uses a sample of individual-firm-day observations, and it shows that individual investors are more likely to make extrapolative purchases when they bought the firm's stock before its previous earnings announcement but not when they bought it at other times. The dependent variable is an indicator, *Buy*, which equals one if the investor purchases shares of the associated stock on the associated day. In the table below, this variable is multiplied by 100 to present the coefficients as percentage points. *Top Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the top decile of the extrapolated return measure. *5 Days Before* is a dummy variable that equals one for observations that are in the 5-day period before the earnings announcement. *Watcher* is a dummy variable that equals one if the investor made a purchase of the firm's stock in some past window; in column (1) that window is the five trading days before the firm's previous earnings announcement, in column (2) it is the day of the previous earnings announcement and the trading day after, and in column (3) it is the 63 trading days before the firm's previous earnings announcement. Standard errors are clustered at the individual-firm-quarter level, and t-statistics are presented in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	Buy		
	(1)	(2)	(3)
5 Days Before	0.00438***	0.00216**	0.00716***
	(4.653)	(2.331)	(7.478)
Top Decile Ext. Ret. × *5 Days Before*	0.0108***	0.0137***	0.0143***
	(3.140)	(3.979)	(4.073)
Watcher × *5 Days Before*	-0.116***	-0.134***	-0.0236***
	(-4.398)	(-3.994)	(-3.674)
Top Decile Ext. Ret. × *Watcher* × *5 Days Before*	0.265**	0.00617	-0.0495**
	(2.220)	(0.0550)	(-2.065)
Watcher definition:	[–5, –1]	[0, 1]	[–63, –1]
Observations	169,943,422	166,922,359	166,510,907
R-squared	0.022	0.022	0.024
Individual-Firm-Quarter FE	YES	YES	YES

Table 9. Extrapolation by Market Participants

We examine extrapolation among market participants. We consider a sample of daily observations from two days after the earnings announcement through the day before the earnings announcement. We run regressions of returns on a dummy for the pre-earnings announcement period and terms equal to the interaction of this dummy with dummies that equal one if the firm is in the top decile of extrapolated returns or in the bottom decile of extrapolated returns. We multiply all coefficients by 100. The table below presents the results of running this regression with fixed effects and standard errors clustered by firm and by quarter. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
	Return Data	
	Intraday Return	*Overnight Return*
5 Days Before	0.03267***	0.03241***
	(5.25)	(9.32)
Top Decile Extrapolated Ret. × 5 Days Before	0.0649***	0.03305***
	(4.26)	(3.98)
Bottom Decile Extrapolated Ret. × 5 Days Before	-0.00082	-0.0081
	(-0.06)	(-1.04)
Observations	11,223,282	11,223,282
R-squared	0.1425	0.1302
Firm-Quarter FE	YES	YES
Day FE	YES	YES
Clustered at Firm	YES	YES
Clustered at Quarter	YES	YES

Table 10. Horseraces for Returns

This table shows results of regressions that replicate the main tests in Table 2 with additional RHS terms pertaining to past returns. The objective is to assess the coefficients on these additional terms and to verify that, after controlling for them, the extrapolated return measure still predicts return patterns around the EA. As before, the unit of observation is a firm-day, and the dependent variable, *Daily Return*, is returns in percentage points. *5 Days Before*, *EA Window*, and *5 Days After* are indicators for days that occur within the t–5 to t–1 window, t window, and the t+1 to t+5 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, and *Bottom Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the bottom decile. In Panel A, the additional RHS terms are *Past 1-year EA Returns* and *Past 2-year EA Returns*. These variables are cumulative returns calculated over the [0, +1] around the earnings announcements that occurred over the past one year and two years, respectively. (They differ from *Extrapolated Returns* in that they equally weight EAs regardless of recency.) In Panel B, the additional RHS terms are *Past 1-year Trailing Returns* and *Past 2-year Trailing Returns*. These variables are the cumulative returns over 252 trading days and 504 trading days prior to the earnings announcements, respectively. Window intercepts include the following three terms*: 5 Days Before*, *EA Window*, and *5 Days After*. All specifications include an indicator for each distinct day in the sample (i.e., Day FE) as well as an indicator for each distinct firm-quarter in the sample (i.e., Firm-quarter FE). Standard errors are clustered by firm and by quarter, and t-statistics are presented in the parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

Panel A. Extrapolated Returns and Trailing Earnings Announcement Returns

	(1)	(2)
	Return Var. = Past 1-year EA Returns	*Return Var.* = Past 2-year EA Returns
	Daily Return (%)	*Daily Return (%)*
Top Decile Extrapolated Return × 5 Days Before	0.0651***	0.0659***
	(3.997)	(4.149)
Top Decile Extrapolated Return × EA Window	0.128*	0.0712
	(1.855)	(1.104)
Top Decile Extrapolated Return × 5 Days After	-0.112***	-0.142***
	(-5.322)	(-7.352)
Bottom Decile Extrapolated Return × 5 Days Before	0.00566	-0.00910
	(0.339)	(-0.608)
Bottom Decile Extrapolated Return × EA Window	-0.142**	-0.139**
	(-2.381)	(-2.519)
Bottom Decile Extrapolated Return × 5 Days After	-0.0102	0.0437**
	(-0.519)	(2.283)
Top Decile Return Var. × 5 Days Before	0.0556***	0.0633***
	(3.045)	(3.710)
Top Decile Return Var. × EA Window	0.0698	0.184***
	(1.005)	(3.240)
Top Decile Return Var. × 5 Days After	-0.0623***	-0.0244
	(-2.917)	(-1.007)
Bottom Decile Return Var. × 5 Days Before	-0.0193	0.00723
	(-1.199)	(0.417)
Bottom Decile Return Var. × EA Window	0.0121	0.0188
	(0.216)	(0.348)
Bottom Decile Return Var. × 5 Days After	0.0116	-0.0872***

	(0.555)	(-4.067)
Observations	11,901,667	11,902,654
Adjusted R-squared	0.145	0.145
Window intercepts and market return	Y	Y
Firm-quarter FE and Day FE	Y	Y

Panel B. Extrapolated Returns and Trailing Returns

	(1)	(2)
	Return Var. = Past 1-year Trailing Returns	*Return Var.* = Past 2-year Trailing Returns
	Daily Return (%)	*Daily Return (%)*
Top Decile Extrapolated Return × 5 Days Before	0.0932***	0.0883***
	(5.269)	(5.094)
Top Decile Extrapolated. Return × EA Window	0.0131	0.0734
	(0.218)	(1.259)
Top Decile Extrapolated Return × 5 Days After	-0.144***	-0.139***
	(-7.363)	(-7.279)
Bottom Decile Extrapolated Return × 5 Days Before	-0.00660	-0.00488
	(-0.469)	(-0.339)
Bottom Decile Extrapolated Return × EA Window	0.0882*	-0.0273
	(1.667)	(-0.517)
Bottom Decile Extrapolated Return × 5 Days After	0.0300	0.0258
	(1.523)	(1.320)
Top Decile Return Var. × 5 Days Before	0.0363*	0.0674***
	(1.796)	(3.088)
Top Decile Return Var. × EA Window	0.711***	0.510***
	(10.71)	(7.884)
Top Decile Return Var. × 5 Days After	-0.0563*	-0.0849***
	(-1.663)	(-3.097)
Bottom Decile Return Var. × 5 Days Before	-0.00492	-0.0127
	(-0.222)	(-0.626)
Bottom Decile Return Var. × EA Window	-1.070***	-0.583***
	(-16.26)	(-9.384)
Bottom Decile Return Var. × 5 Days After	-0.162***	-0.163***
	(-4.614)	(-5.768)
Observations	11,902,654	11,902,654
Adjusted R-squared	0.145	0.145
Window intercepts and market return	Y	Y
Firm-quarter FE and Day FE	Y	Y

Table 11. Trading Behavior and Extrapolated Returns, Trailing Returns, and Past Earnings Announcement Returns

This table shows results of regressions that replicate the individual trades tests in Table 7 with additional RHS terms pertaining to past returns. The objective is to assess the coefficients on these additional terms and to verify that, after controlling for them, the extrapolated return measure still predicts individual trades before the EA. As before, the unit of observation is a firm-day. 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 appear in Appendix A. *5 Days Before, EA Window*, and *5 Days After* are indicators for days that occur within the t–5 to t–1 window, t window, and the t+1 to t+5 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, and *Bottom Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the bottom decile. In Panel A, the additional RHS terms are *Past 1-year EA Returns* and *Past 2-year EA Returns*. These variables are cumulative returns calculated over the [0, +1] around the earnings announcements that occurred over the past one year and two years, respectively. In Panel B, the additional RHS terms are *Past 1-year Trailing Returns* and *Past 2-year Trailing Returns*. These variables are the cumulative returns over 252 trading days and 504 trading days prior to the earnings announcements, respectively. Window intercepts include the following three terms*: 5 Days Before*, *EA Window*, and *5 Days After*. All specifications include an indicator for each distinct firm-quarter in the sample (i.e., Firm-quarter FE). Standard errors are clustered at both the firm level and the quarter level, and t-statistics are presented in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

Panel A. Extrapolated Returns and Trailing Earnings Announcement Returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Past returns measured over the past **one year**				Past returns measured over the past **two years**			
	log(*Gross Purchases)*	log*(Gross Sales)*	*# Buyers*	*# Sellers*	log(*Gross Purchases)*	log*(Gross Sales)*	*# Buyers*	*# Sellers*
Top Decile Extrapolated Return × 5 Days Before	0.0978**	-0.0616	0.0379*	0.0132	0.0949	-0.0942**	0.0522***	0.0117
	(2.362)	(-1.496)	(1.744)	(0.610)	(1.587)	(-2.073)	(3.574)	(0.480)
Bottom Decile Extrapolated Return × 5 Days Before	-0.0105	-0.0350	-0.0160	0.000568	0.0054	-0.0520	-0.0342	-0.00548
	(-0.202)	(-0.757)	(-0.507)	(0.0439)	(0.096)	(-1.562)	(-0.632)	(-0.445)
Top Decile Past EA Returns × 5 Days Before	0.0216	-0.00841	0.0156	-0.00736	0.0293	0.0538	-0.00564	-0.00483
	(0.340)	(-0.156)	(0.666)	(-0.665)	(0.545)	(1.132)	(-0.322)	(-0.403)
Bottom Decile Past EA Returns × 5 Days Before	0.0263	0.00227	0.0179	0.0120	0.0010	0.0382	0.0520	0.0246*

	(0.754)	(0.0593)	(0.826)	(0.877)	(0.017)	(0.970)	(1.256)	(1.869)
Observations	932,339	932,339	932,339	932,339	932,339	932,339	932,339	932,339
Adjusted R-squared	0.363	0.332	0.461	0.444	0.363	0.332	0.461	0.444
Window intercepts	Y	Y	Y	Y	Y	Y	Y	Y
Firm-quarter FE	Y	Y	Y	Y	Y	Y	Y	Y

Panel B. Extrapolated Returns and Trailing Returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Past returns measured over the past **one year**				Past returns measured over the past **two years**			
	log(*Gross Purchases)*	log(*Gross Sales)*	*# Buyers*	*# Sellers*	log(*Gross Purchases)*	log(*Gross Sales)*	*# Buyers*	*# Sellers*
Top Decile Extrapolated Return × 5 Days Before	0.0796	-0.0898**	0.0416**	0.00450	0.0831*	-0.0923**	0.0394**	0.00527
	(1.618)	(-2.534)	(2.555)	(0.194)	(1.776)	(-2.600)	(2.286)	(0.230)
Bottom Decile Extrapolated Return × 5 Days Before	-0.0130	-0.0351	-0.00976	0.00596	0.00447	-0.0228	-0.00909	0.0127
	(-0.274)	(-1.061)	(-0.282)	(0.328)	(0.0955)	(-0.706)	(-0.265)	(0.744)
Top Decile Trailing Returns × 5 Days Before	0.194***	0.139**	0.0348	0.0226	0.150**	0.134***	0.0438*	0.0137
	(4.044)	(2.077)	(1.367)	(1.323)	(2.479)	(2.896)	(2.011)	(1.287)
Bottom Decile Trailing Returns × 5 Days Before	0.0953**	0.0119	0.0219	0.0116	-0.00254	-0.0665	0.0194*	-0.0277**
	(2.128)	(0.285)	(0.883)	(0.871)	(-0.0690)	(-1.600)	(1.907)	(-2.758)
Observations	932,339	932,339	932,339	932,339	932,339	932,339	932,339	932,339
Adjusted R-squared	0.363	0.332	0.461	0.444	0.363	0.332	0.461	0.444
Window intercepts	Y	Y	Y	Y	Y	Y	Y	Y
Firm-quarter FE	Y	Y	Y	Y	Y	Y	Y	Y

Internet Appendix

Earnings Announcement Return Extrapolation

August 2020

Table of Contents

1. Robustness of the Measurement of Return Extrapolation

Our inferences above are based on a specific extrapolation structure—a weighted average of the past eight quarters' earnings announcement returns—as shown in equation 1 in the paper. Our motivation for the different weights is based on the fact that we want to assign greater weight to more recent events. We recognize that there could be alternative weighting schemes that have this feature. In this section, we focus on one such alternative and then present results from an equal-weighting scheme. Our alternative weighting scheme is motivated by Barberis et al. (2015), who define the "sentiment" of extrapolators to be:

$$S_t = \beta \int_{-\infty}^{t} e^{-\beta(t-s)} dP_{s-dt} \qquad (IA.1.1)$$

In their model, investors expect the price to change in direct proportion to this "sentiment" measure. Intuitively, β can be viewed as an extrapolative discount factor; when it is high, "extrapolators quickly 'forget' all but the most recent price changes." The authors use the survey data to estimate the β parameter, and approximate the value to be 0.5. We use this parameter in a measure that is related to the discretized version of their measure.[1] Specifically, we define the new extrapolated return measure as follows:

$$Extrapolated\ Return_{i,t} = \sum_{j=1}^{8} \frac{1}{1+\beta^j} R_{t-j} \qquad (IA.1.2)$$

Further, to better understand the effect of discounting and recency, we construct another measure, which does not rely on these considerations. In this specification, extrapolation is calculated as a simple average, as shown in equation IA.3.3, which is identical to equation 1 in the paper and equation IA.3.2 in the Internet Appendix, except for the weights assigned to each quarter.

$$Extrapolated\ Return_{i,t} = \sum_{j=1}^{8} \frac{1}{8} R_{t-j} \qquad (IA.1.3)$$

IA Table 3.1. presents a summary of the results from a replication of our firm-day regressions tests using these alternative measures. These estimations suggest that, under both alternative definitions of extrapolations, our inferences hold. One other observation that deserves attention is that the estimates of post-announcement reversals for the equal-weighted measure (Panel B) are weaker than those in Panel A. This pattern suggests that equal-weighting would yield a noisier interpretation of extrapolative beliefs, and supports the idea that recency is a key element in the conceptual definition of extrapolation.

[1] We recognize that their discretized version would look different. For example, one difference is that we are only considering price movements around the earnings announcement.

IA Table 1.1. Extrapolation and returns around earnings announcements—Robustness

The unit of observation is a firm-day. The dependent variable, *Daily Return*, is returns in percentage points. *5 Days Before*, *EA Window*, and *5 Days After* are indicators for days that occur within the t–5 to t–1 window, t window, and the t+1 to t+5 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 according to IA.1.2 in Panel A and IA.1.3 in Panel B. *Bottom Decile Extrapolated Return* is a dummy variable that equals one if the firm is in the bottom decile in the respective calculations. *Media coverage* is the number of news articles about the firm over the 5-day window preceding the observation day, obtained from RavenPack, available post-2000. *Market Return* is the value-weighted market return that day. 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. Structural Model 1: BGJS (beta=0.5)

	(1)	(2)	(3)	(4)
	Daily Return (%)	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*
Top Decile Extrapolated Return × 5 Days Before	0.101***	0.0978***	0.123***	0.0929***
	(5.693)	(6.324)	(6.654)	(3.036)
Top Decile Extrapolated Return × EA Window	0.206***	0.189***	0.233***	0.326***
	(3.749)	(3.390)	(3.995)	(3.964)
Top Decile Extrapolated Return × 5 Days After	-0.152***	-0.0820***	-0.0957***	-0.103***
	(-8.015)	(-3.738)	(-3.818)	(-2.764)
Bottom Decile Extrapolated Return × 5 Days Before	-0.0162	-0.0190	-0.0255	-0.0710***
	(-1.030)	(-1.169)	(-1.542)	(-3.781)
Bottom Decile Extrapolated Return × EA Window	-0.113**	-0.248***	-0.264***	-0.134
	(-2.095)	(-3.821)	(-4.019)	(-1.481)
Bottom Decile Extrapolated Return × 5 Days After	0.00194	-0.0121	-0.000540	-0.0357
	(0.0973)	(-0.595)	(-0.0242)	(-1.132)
Observations	12,203,873	10,248,621	10,248,621	4,884,520
Adjusted R-squared	0.142	0.167	0.173	0.253
Media coverage	N	N	N	Y
Momentum controls	N	N	Y	Y
PEAD controls	N	Y	Y	Y
Window intercepts and market controls	Y	Y	Y	Y
Firm-quarter FE and Day FE	Y	Y	Y	Y

Panel B. Equal-weighted Extrapolation

	(1)	(2)	(3)	(4)
	Daily Return (%)	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*
Top Decile Extrapolated Return × 5 Days Before	0.124***	0.117***	0.112***	0.104***
	(6.800)	(6.525)	(5.555)	(3.512)
Top Decile Extrapolated Return × EA Window	0.215***	0.151**	0.145**	0.244***
	(3.869)	(2.592)	(2.429)	(2.857)
Top Decile Extrapolated Return × 5 Days After	-0.112***	-0.0612**	-0.116***	-0.0534*
	(-5.231)	(-2.622)	(-4.816)	(-1.837)
Bottom Decile Extrapolated Return × 5 Days Before	0.000859	-0.00530	0.00898	-0.0175
	(0.0511)	(-0.307)	(0.517)	(-0.921)
Bottom Decile Extrapolated Return × EA Window	-0.0122	-0.0637	-0.0328	-0.00763
	(-0.248)	(-1.246)	(-0.639)	(-0.111)
Bottom Decile Extrapolated Return × 5 Days After	-0.0316	-0.0374	0.0141	0.0232
	(-1.490)	(-1.602)	(0.561)	(0.708)
Observations	12,203,873	10,248,621	10,248,621	4,884,520
Adjusted R-squared	0.142	0.167	0.173	0.253
Media coverage	N	N	N	Y
Momentum controls	N	N	Y	Y
PEAD controls	N	Y	Y	Y
Window intercepts and market controls	Y	Y	Y	Y
Firm-quarter FE and Day FE	Y	Y	Y	Y

2. Cross-sectional and Time-series Heterogeneity in Daily Return Regressions

In this section, we evaluate the robustness of, and the variation in, our findings across subsamples based on cross-sectional and time-series splits. Regarding cross-sectional cuts, we examine trading volume and accruals. We perform these tests by comparing the top and bottom quartiles of each variable. (The quartiles are calculated for each quarter separately to ensure an even distribution across the sample period.) Our main asset pricing tests look at price movement using firm quarter and day fixed effects. As can be seen in IA Table 4.1, we find evidence consistent with our hypothesis of over-extrapolation in the cross-section. For example, we find that the stock market effects of overextrapolation are more pronounced for firms with high volume. This is in line with our story as volume is a proxy for attention and in order to extrapolate investors must be paying attention. Firms with larger accruals in the previous period also appear to experience a higher reversal. This finding lends support to the idea that extrapolation bias has a bigger influence around earnings announcements when earnings are of low quality (e.g., Sloan 1996). This is consistent with the idea that individual investors extrapolate past returns, but are not able to account for the fact that earnings with high cash flows tend to be persistent, but earnings with high accruals tend to not be persistent.

IA Table 2.1. Cross-sectional variation in extrapolation

This table replicates the main regression model presented in column (2) of Table 2 of the main paper across subsamples as indicated in column headings. The unit of observation is a firm-day, and all variables are as previously defined.

	(1)	(2)	(3)	(4)
	Small *Volume*	Large *Volume*	Small *Accruals*	Large *Accruals*
	Daily Return (%)	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*
Top Decile Extrap. Return × 5 Days Before	0.0740***	0.148***	0.108***	0.112***
	(2.708)	(6.357)	(3.440)	(4.387)
Top Decile Extrap. Return × EA Window	0.678***	0.0271	0.228**	0.309***
	(4.876)	(0.292)	(2.128)	(3.047)
Top Decile Extrap. Return × 5 Days After	-0.0422	-0.164***	-0.0335	-0.229***
	(-0.980)	(-5.308)	(-0.928)	(-6.235)
Observations	3,054,723	3,047,172	3,054,153	3,047,206
Adjusted R-squared	0.113	0.192	0.144	0.146
Window intercepts	YES	YES	YES	YES
Firm-Quarter and Day FE	YES	YES	YES	YES
Momentum Controls	YES	YES	YES	YES

In the time-series, our main inferences hold over the sample period (IA Table 4.2). Specifically, high-extrapolation stocks are associated with positive pre-earnings-announcement returns, followed by a significant reversal in the post-earnings-announcement period. Relatively speaking, the pre-earnings-announcement run-up in prices is more pronounced in the first half of the sample period, whereas the evidence on post-earnings-announcement reversal is stronger in the second half of our sample period.

IA Table 2.2. Cross-time variation in extrapolation

This table replicates the main regression model presented in column (2) of Table 2 of the main paper across subsamples as indicated in column headings. The unit of observation is a firm-day, and all variables are as previously defined.

	(1)	(2)	(3)	(4)
	pre-1996	1997-2003	2004-2010	post-2011
	Daily Return (%)	*Daily Return (%)*	*Daily Return (%)*	*Daily Return (%)*
Top Decile Extrap. Return × 5 Days Before	0.118**	0.184***	0.0760***	0.0761***
	(2.477)	(4.840)	(2.971)	(3.455)
Top Decile Extrap. Return × EA Window	0.0576	0.250*	0.303**	0.125
	(0.543)	(1.789)	(2.108)	(0.966)
Top Decile Extrap. Return × 5 Days After	-0.125**	-0.0488	-0.105***	-0.109***
	(-2.670)	(-0.922)	(-2.813)	(-3.231)
Bottom Decile Extrap. Return × 5 Days Before	0.0251	0.0693	-0.0610**	-0.0629**
	(0.898)	(1.601)	(-2.214)	(-2.204)
Bottom Decile Extrap. Return × EA Window	-0.307*	-0.487***	-0.261*	-0.117
	(-1.938)	(-3.829)	(-1.961)	(-1.236)
Bottom Decile Extrap. Return × 5 Days After	0.0439	-0.0660	-0.00322	0.0826*
	(1.219)	(-1.518)	(-0.0858)	(1.968)
Observations	1,845,790	2,900,608	2,892,240	2,609,989
Adjusted R-squared	0.072	0.124	0.272	0.237
Momentum controls	Y	Y	Y	Y
Window intercepts	Y	Y	Y	Y
Firm-quarter FE and Day FE	Y	Y	Y	Y

Coupled with the estimation results in IA Table 1.1, which summarize the robustness of our inferences to alternative definitions of returns extrapolation, we believe these attempts add further credibility to our conclusions.

3. Portfolio Splits by Time

We also look at the performance of the trading strategy over time. We split the sample at the beginning of 2004. The results are similar across the different subsamples (IA Table 5.1). The only exception is that, while the value-weighted reversal is strong, the equal-weighted reversal is much weaker in the first half of the sample. This is consistent with the idea that attention to earnings announcements, a necessary ingredient for extrapolative purchases, especially to small firms' earnings announcements, was weaker in the first half of the sample.

IA Table 3.1. Portfolio Returns

This table displays equal-weighted and value-weighted daily portfolio returns in basis points. In Panel A, 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 our *Extrapolated Return* measure and are in the pre-earnings announcement window. In Panel B, 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+1, t+5]. 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 *Extrapolated Return* measure is equal to a weighted sum of the past 8 earnings announcement returns. The first three factors are the excess market return, the size portfolio, and the value portfolio. The five-factor model adds factors for profitability and investment. ***, **, and * denote results significant at the 1%, 5%, and 10% levels.

Panel A: Portfolio Returns Before the Earnings Announcement

	Equal-Weighted 1991–2004	Equal-Weighted 2005–2018	Value-Weighted 1991–2004	Value-Weighted 2005–2018
Raw	16.8***	16.8***	14.0**	18.5***
Alpha	16.6***	16.7***	13.2**	18.3***
3-Factor Alpha	16.1***	16.6***	12.8**	18.2***
3-Factor + Momentum Alpha	15.4***	16.3***	12.2**	17.8***
5-Factor Alpha	15.7***	16.6***	12.5**	18.3***

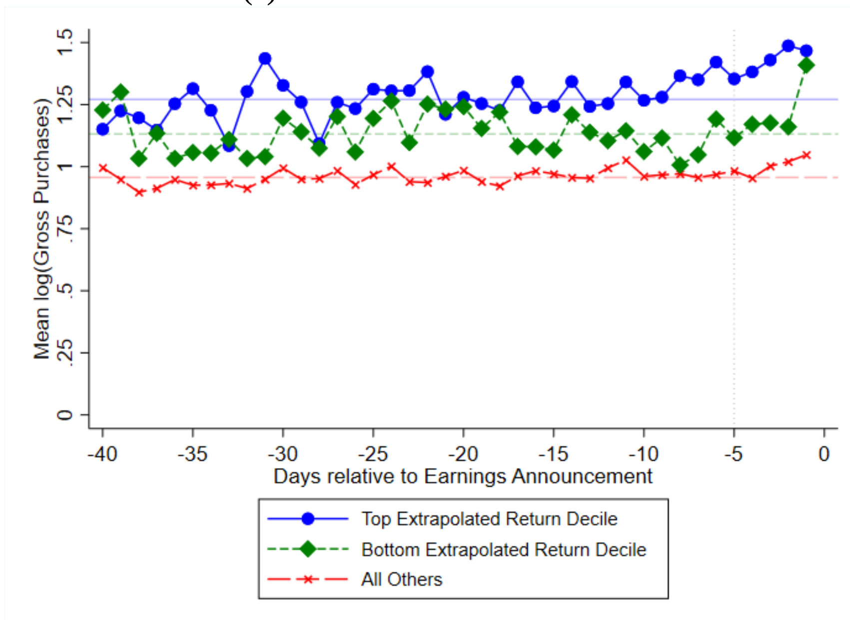
Panel B: Portfolio Returns After the Earnings Announcement

	Equal-Weighted 1991–2004	Equal-Weighted 2005–2018	Value-Weighted 1991–2004	Value-Weighted 2005–2018
Raw	8.0	21.8***	15.7**	19.8***
Alpha	7.8	22.1***	15.5**	20.0***
3-Factor Alpha	8.0	22.2***	15.5**	20.3***
3-Factor + Momentum Alpha	8.7	22.6***	16.9**	20.9***
5-Factor Alpha	9.2*	22.0***	16.4**	20.3***

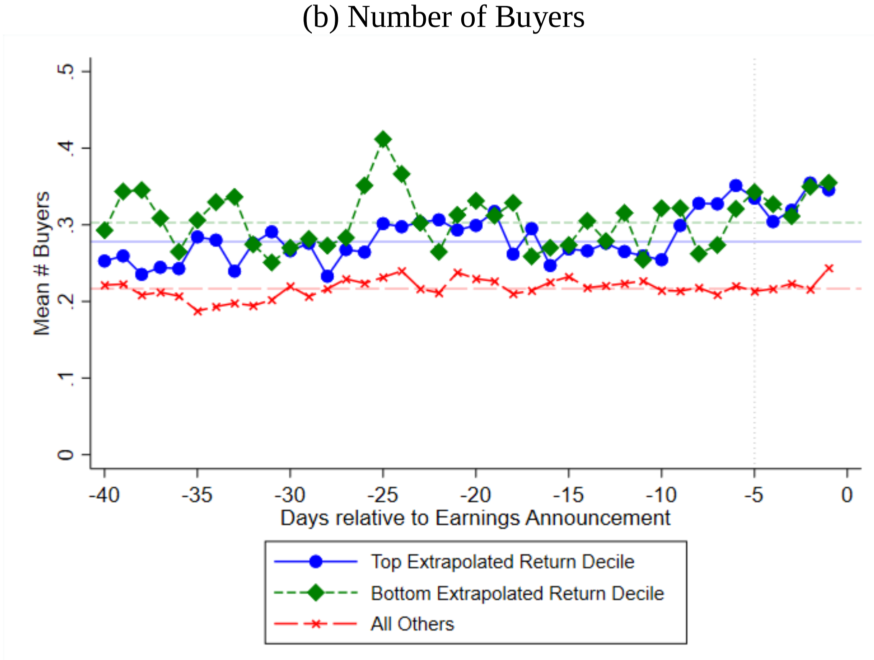
4. Further Exploration of Extrapolative Trades by Individual Investors

IA Figure 4.1. Individual Investor Trades Before the Earnings Announcement
Panels (a) and (c) below come directly from Figure 2 in the paper. Panels (b) and (d) make the same plots for the variables *# Buyers* and *# Sellers*. In contrast to purchase activity, sales activity does not change much in the five days before the earnings announcement, as compared to the previous 35 days.

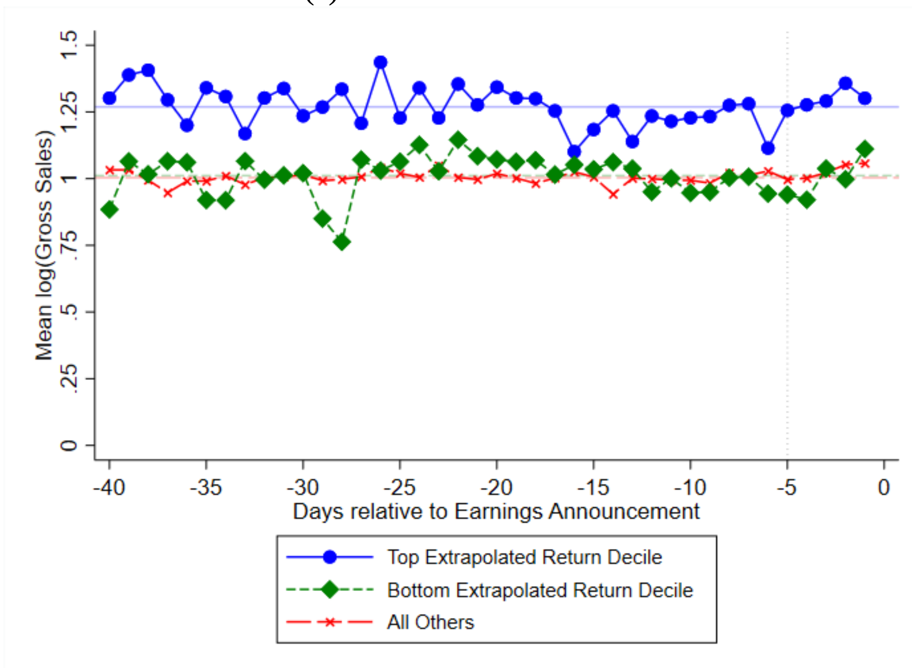
(a) Dollar Value of Purchases



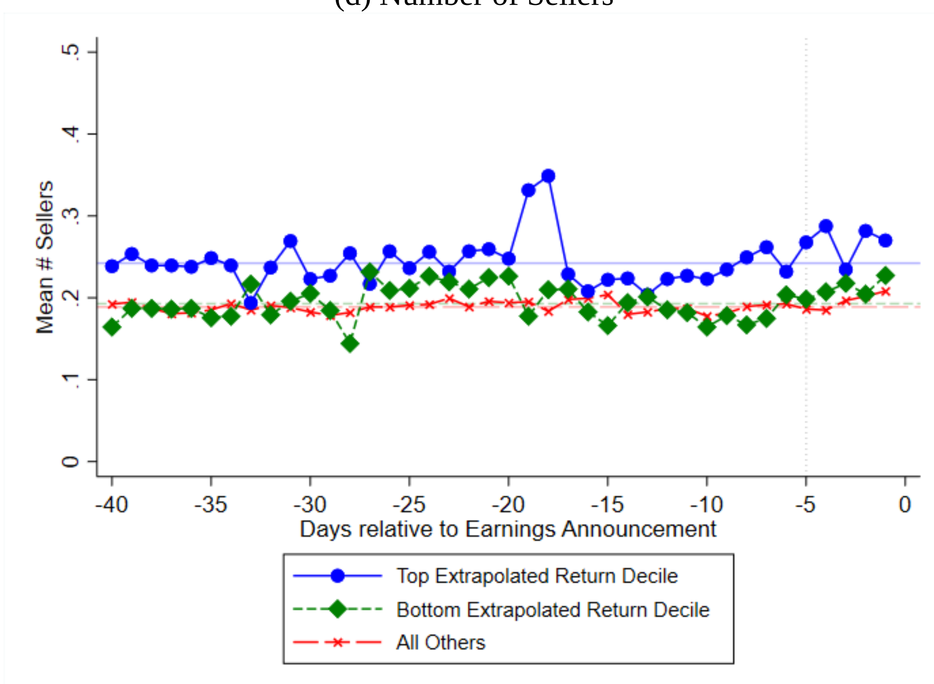
(b) Number of Buyers



(c) Dollar Value of Sales



(d) Number of Sellers

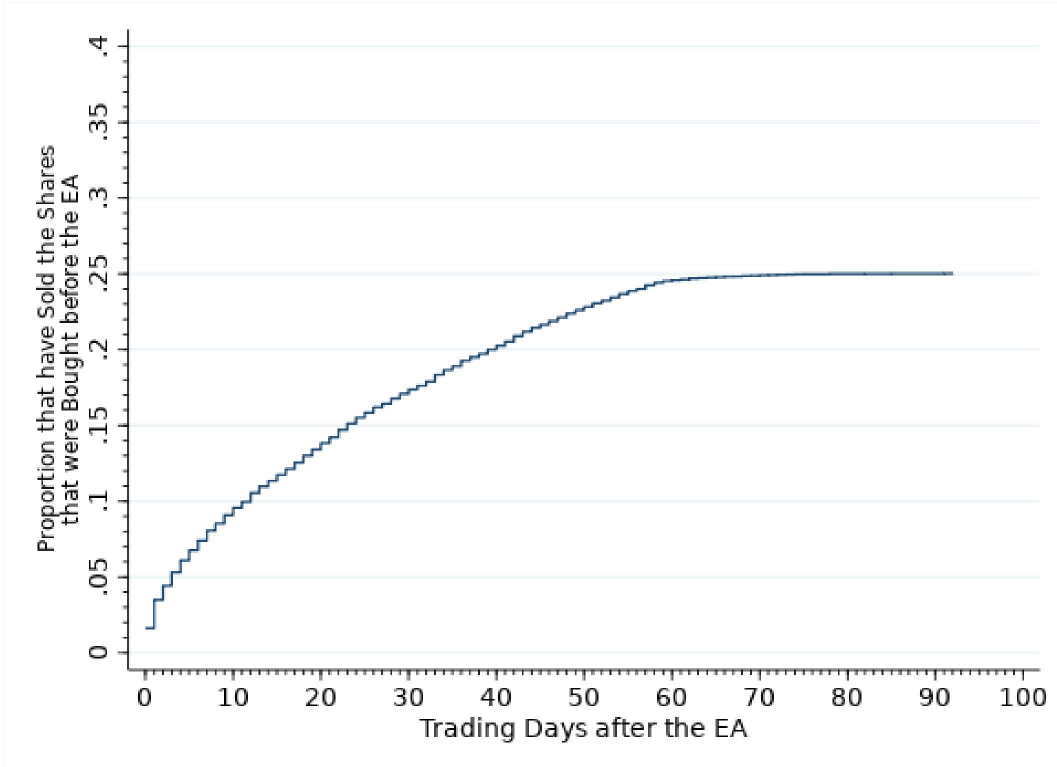


To assess, whether a EA date is predictable, we implement the following approach that is broadly consistent with prior work (e.g., Cohen et al. 2007; Aboody et al. 2010): First, we define a *predicted EA date* based on the firm's year-ago same-quarter EA dates This predicted date is the same calendar day of the year-ago same quarter after adjusting for non-trading days. (For instance for 10 June 2010, the predicted EA date is 10 June 2011; if 10 June 2011 is a non-trading day, then we consider 11 June 2011.) We then create an indicator (*Predictable EA*) recording whether the predicted EA is within two days of the actual EA in both the current quarter and the year-ago same quarter.

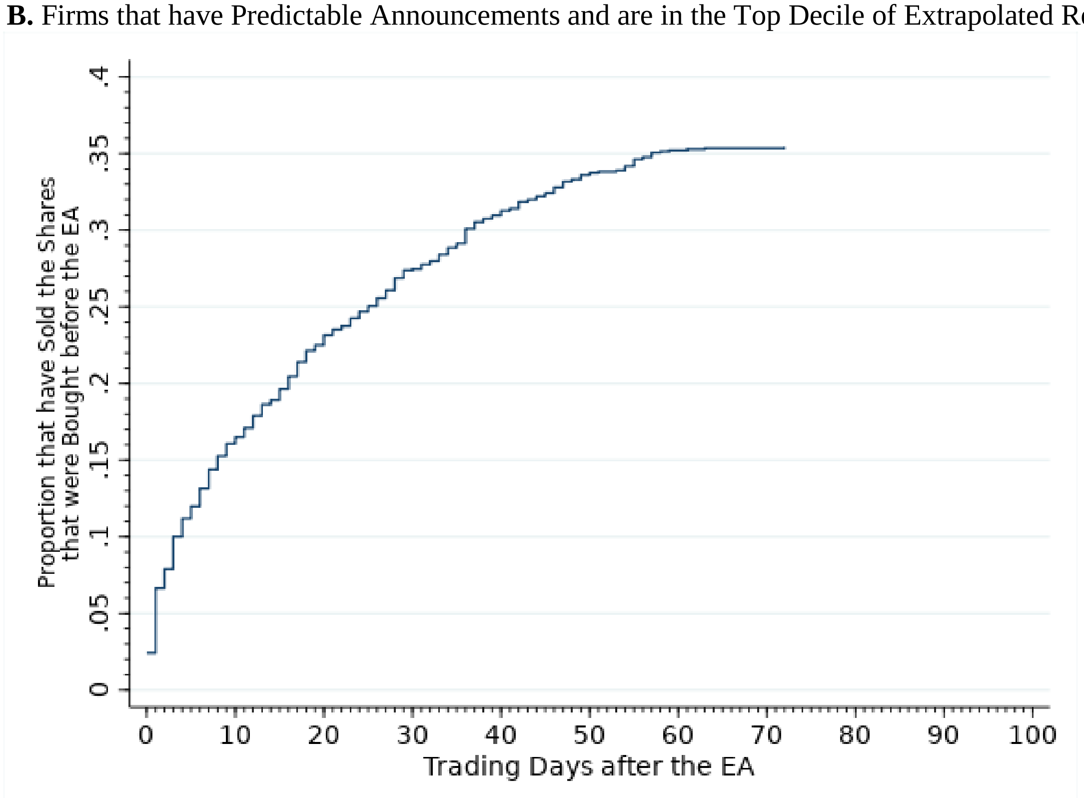
IA Figure 4.2. The Timing of Reversals for Pre-Announcement Purchases

A sizable fraction of purchases made within the five days before an earnings announcement are fully reversed within a couple weeks after the earnings announcement. We show this in the two plots below, where the x-axis is the number of trading days after the earnings announcement and the y-axis is the proportion of pre-announcement purchases that have been sold by that trading day. The two plots differ only because the second one restricts the sample to firms in the top decile of the extrapolated returns measure. The sample for both plots consists of all instances where an individual purchased stock in the five days before an earnings announcement. The sample is restricted to firm-quarters with predictable earnings announcements to increase the chances that the individuals anticipated the earnings announcement date. We track each purchase in the sample until the five-day period before the next earnings announcement. In both plots, a pre-announcement purchase is considered to be sold on the day that the entire purchase has been reversed. The first plot shows that 5% of all pre-announcement purchases are reversed by the third day after the earnings announcement. The second plot shows that 5% are reversed by the first day after the announcement when we restrict the sample to firm-quarters with high extrapolated returns. By ten trading days after the earnings announcement, the entire pre-announcement purchase has been reversed for about 10% of purchases in general and a bit more than 15% in the case of firms with high extrapolated returns. The plots also show the fraction of purchases that remain unsold by the time the next five-day pre-announcement period arrives. The first plot shows that, in general, about 75% of the purchases remain unsold by that time. The second plot shows that, in the case of firms with high extrapolated returns, about 65% remain unsold. So a majority of the purchasers appear to have made a long-term investment.

Panel A. Firms that have Predictable Announcements



Panel B. Firms that have Predictable Announcements and are in the Top Decile of Extrapolated Returns



IA Table 4.1. Individual purchase behavior for firm-quarters with predictable EAs

This table contains descriptive statistics for all purchases by the individual investors in our sample. It restricts the sample to firm-quarters with predictable earnings announcement dates (with "predictable" defined the same as in the paper). The rows show the frequency of purchases in the 5 days before the earnings announcement, the day of the earnings announcement, and all other days in the quarter. The first column shows all purchases during firm-quarters with predictable earnings announcements. The third column, labeled "Buys Pre-EA", further restricts the sample to individuals who have made a pre-earnings-announcement purchase within the past year (i.e., the past 252 trading days), where pre-earnings-announcement refers to the 5 days before the earnings announcement. The fifth column, labeled "Watcher", replaces the "Buys Pre-EA" restriction with a restriction to instances where the individual purchased shares of the firm during the five days before the firm's previous earnings announcement. The second, fourth, and sixth columns combine each of these sample restrictions with an additional restriction to firm-quarters in the top decile of extrapolated returns, which is labeled "Extrapolated" in the table.

On average, each firm-quarter has about 63 trading days. If individual purchases were evenly distributed throughout the quarter, then we'd expect 7.94% of purchases to occur during the five days before the earnings announcement and 1.59% to occur during the earnings announcement day itself. In the full sample of firm-quarters with predictable earnings announcements (i.e., the "All" column), the five-day period before the earnings announcement gets 7.90%, which is about what we would expect if purchases were evenly distributed across the days of the quarter. However, it gets more than we would expect when we restrict the sample to firms in the top decile of extrapolated returns (i.e., "Extrapolated") or to individuals who have made a pre-announcement purchase within the past year (i.e., "Buys Pre-EA"). Interestingly, it gets less than we would expect when we restrict the sample to individuals who bought the stock in the previous pre-announcement period (i.e., "Watcher"). But then it gets the highest proportion of purchases when we combine the "Watcher" restriction with the "Extrapolated" restriction. So when individuals purchase a firm's shares during the previous pre-announcement period, they are generally less likely to repeat the pre-announcement purchase in the firm's next quarter, but they are more likely to repeat it if the firm is in the top decile of extrapolated returns.

	All		Extrapolated		Buys Pre-EA		Buys Pre-EA & Extrapolated	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
5 days pre-EA	16,752	7.90%	1,771	8.46%	4,551	8.32%	580	8.75%
Day of EA	5,188	2.45%	625	2.99%	1,548	2.83%	224	3.38%
Other days	190,135	89.65%	18,530	88.55%	48,586	88.85%	5,828	87.88%
Total	212,075	100.00%	20,926	100.00%	54,685	100.00%	6,632	100.00%

IA Table 4.2. Replication of aggregate individual trades test for EAs with predictable and unpredictable dates

In this table, we compare individual purchases for the sample with predictable announcements versus the sample with unpredictable announcements. In this table's tests, the left-hand side is a variable representing individual purchases for the firm-day, either the dollar value of purchases or the number of buyers. Columns (1) and (2) restrict the sample to firms with predictable earnings announcement dates, and columns (3) and (4) restrict it to the remaining firms, which do not have predictable earnings announcement dates. Note that columns (1) and (2) in the table below are identical to Table 6 in the paper (specifically, columns (1) and (3) of Table 2).

	(1)	(2)	(3)	(4)
	log(Gross Purchases)	*# Buyers*	*log(Gross Purchases)*	*# Buyers*
5 Days Before	0.0301	0.00177	0.0213	0.00322
	(1.635)	(0.181)	(1.344)	(0.597)
Top Decile Extrapolated Ret. × 5 Days Before	0.103**	0.0440**	-0.000316	-0.000208
	(2.142)	(2.787)	(-0.0119)	(-0.0218)
Bottom Decile Extrapolated Ret. × 5 Days Before	7.16e-05	-0.00626	-0.0687**	-0.0150
	(0.00150)	(-0.185)	(-2.207)	(-1.135)
Observations	939,653	939,653	1,552,463	1,552,463
R-squared	0.362	0.460	0.307	0.413
Predictable EA	**YES**	**YES**	**NO**	**NO**
Firm-Quarter FE	YES	YES	YES	YES
Clustered at Firm	YES	YES	YES	YES
Clustered at Quarter	YES	YES	YES	YES

IA Table 4.3. Fundamentals vs. Returns Extrapolation in Purchasing Behavior

This table provides some evidence that the individuals in our sample trade as if they are extrapolating fundamentals, but the evidence is weak. In contrast, it continues to find significant evidence that they extrapolate returns. It presents results from additional tests with proxies for fundamentals extrapolation as regressors. *Top Decile Extrapolated Surprise* and *Top Decile Extrapolated Growth* are dummy variables that equal one if the firm is in the top decile of the extrapolated surprise or extrapolated growth measures, and *Bottom Decile Extrapolated Surprise* and *Bottom Decile Extrapolated Growth* are dummy variables that equal one if the firm is in the bottom decile. Analogous to extrapolated returns, these measures are equal to $\frac{1}{\sum_{k=1}^{8}\frac{1}{k}} \times \sum_{j=1}^{8}(\frac{1}{j} \times X_{t-j})$, where X_{t-j} is either the analyst forecast error from quarter $t-j$ for extrapolated surprise or the seasonal change in quarterly EPS from quarter $t-j$ for extrapolated growth. *Positive Return Streak* is a dummy variable that switches on for firm-quarters with positive earnings-announcement returns over the past four quarters. All other dependent and independent variables are as defined in the Appendix of the paper. Standard errors are clustered at both the firm level and the quarter level, and t-statistics are presented in parentheses. ***, **, and * denote results significant at the 1%, 5%, and 10% levels, respectively.

	(1) *log(Gross Purchases)*	(2) *log(Gross Purchases)*	(3) *log(Gross Purchases)*	(4) *# Buyers*	(5) *# Buyers*	(6) *# Buyers*	(7) *log(Gross Purchases)*	(8) *# Buyers*
5 Days Before	0.0486**	0.0332*	0.0294	0.00654	0.00552	0.00204	0.0302	0.00230
	(2.090)	(1.844)	(1.140)	(0.860)	(0.549)	(0.186)	(1.626)	(0.226)
Top Decile Extrapolated Surp. × 5 Days Before	0.0876		0.0444	0.0197		0.00977		
	(1.504)		(0.810)	(0.543)		(0.258)		
Bottom Decile Extrapolated Surp. × 5 Days Before	-0.0571		-0.0551	-0.0311		-0.0262		
	(-1.178)		(-1.107)	(-0.564)		(-0.400)		
Top Decile Extrapolated Growth × 5 Days Before		0.0759	0.104		0.00944	0.0160		
		(1.552)	(1.464)		(0.404)	(0.436)		
Bottom Decile Extrapolated Growth × 5 Days Before		-0.0325	-0.0233		-0.0208	-0.0154		
		(-0.723)	(-0.369)		(-1.505)	(-0.477)		
Top Decile Extrapolated Ret. × 5 Days Before			0.151**			0.0565***	0.103**	0.0463***
			(2.416)			(2.845)	(2.245)	(3.046)
Bottom Decile Extrapolated Ret. × 5 Days Before			0.0195			-0.000222	1.22e-07	-0.00679
			(0.306)			(-0.00456)	(2.54e-06)	(-0.199)
Positive Return Streak × 5 Days Before							-0.00127	-0.00937
							(-0.0292)	(-0.546)
Observations	705,005	885,858	663,711	705,005	885,858	663,711	939,653	939,653
R-squared	0.369	0.368	0.374	0.459	0.462	0.460	0.362	0.460
Firm-Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES

The results in columns (1) and (4) show that whether or not a firm has a history of high earnings surprises relative to analyst forecasts does not seem to predict individual purchases in the period before the earnings announcement. Columns (2) and (5) show that a history of high seasonal quarterly EPS growth also does not predict these purchases. In columns (3) and (6), we run a horse race between extrapolated returns and the two measures of extrapolated fundamentals. Even after controlling for possible extrapolation based on earnings surprises and earnings growth, the positive coefficient on the interaction between *Top Decile Extrapolated Return* and *5 Days Before* shows that investors make pre-earnings-announcement purchases based on the history of earnings announcement returns.