

Ahlatcioğlu, Aykut; Okay, Nesrin

## Article

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Borsa İstanbul Review

### Provided in Cooperation with:

Borsa İstanbul Anonim Şirketi, İstanbul

*Suggested Citation:* Ahlatcioğlu, Aykut; Okay, Nesrin (2021) : Post-earnings announcement drift: Evidence from Turkey, Borsa İstanbul Review, ISSN 2214-8469, Elsevier, Amsterdam, Vol. 21, Iss. 1, pp. 92-103,  
<https://doi.org/10.1016/j.bir.2020.09.001>

This Version is available at:

<https://hdl.handle.net/10419/340209>

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## Post-earnings announcement drift: Evidence from Turkey

Aykut Ahlatcıoğlu, Nesrin Okay\*

*Bogazici University, Turkey*

Received 7 August 2019; revised 2 September 2020; accepted 2 September 2020

Available online 11 September 2020

### Abstract

We study the post-earnings announcement drift (PEAD) anomaly and its determinants in Borsa İstanbul using quarterly earnings announcements and three different surprise measures. We find evidence supportive of the existence of PEAD in the Turkish stock market. Sorting stocks each quarter into three quantiles according to an earnings surprise measure based on past earnings, we find both statistically and economically significant difference of 2.9% in average cumulative abnormal return between high earnings surprise firms and low earnings surprise firms in the 60 days following the announcement. The hedge returns obtained using analyst forecast based surprise measure as well earnings announcement return based surprise measure are also significant at 2.9% and 2.2% respectively. The positive relation between post-announcement abnormal returns and the surprise in earnings remain significant after controlling for an extensive list of explanatory variables. Among these explanatory variables, we find that firm size has a negative impact on the magnitude of this positive association between surprise and subsequent equity returns. Finally, using two separate approaches we show that multifactor models fail to explain the return differentials following earnings announcements.

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*JEL classification:* G11; G14; G15

*Keywords:* Market efficiency; Post-earnings announcement drift; Firm size

### 1. Introduction

An anomaly in the finance and accounting literature which survived the test of time in challenging the efficient market hypothesis (EMH) is the post-earnings announcement drift (PEAD). Eugene Fama who developed EMH singles out PEAD as the only anomaly among many he analyzed in Fama (1998) as the one which survived robustness checks. PEAD was first documented by Ball and Brown (1968) and is characterized by a significantly positive relation between the surprise component in earnings announcements and the subsequent stock returns. In other words, those companies which report earnings which exceed market expectations demonstrate positive abnormal return on average while those which report earnings below market expectations

demonstrate negative abnormal return for months following the announcement. PEAD had been the subject of a wide body of literature which primarily focused on the U.S. stock market.

We aim to contribute to the understanding of market efficiency by investigating PEAD in a major emerging market. In this regard, to our knowledge this is the first study providing a thorough analysis of the drift and its determinants for Turkey. Also, unlike previous non-U.S. studies, we conduct our study using quarterly earnings announcements with three separate earnings surprise measure and a full battery of explanatory variables. This allows for a better comparison with the research done to explain PEAD in the U.S. market.

First, we show that PEAD exists in Borsa İstanbul by finding significant differential in 60-day post-announcement abnormal return between the top and bottom surprise tertile using any of the three most widely employed surprise measures found in the literature. These measures are standardized unexpected earnings using time-series forecast (SUETF),

\* Corresponding author.

*E-mail address:* [okay@boun.edu.tr](mailto:okay@boun.edu.tr) (N. Okay).

Peer review under responsibility of Borsa İstanbul Anonim Şirketi.

standardized unexpected earnings using analyst forecast (SUEAF) and earnings announcement return (EAR). We use a sample of 6,471 quarterly observations over the period 2007–2018 and find a drift of 2.9% using SUETF and 2.2% using EAR. For a subsample comprised of 2,398 company-quarter observations with at least one analyst forecast, we find PEAD of 2.9% when surprise is measured using SUEAF. Running a multivariate regression using our full sample, we also provide an extensive analysis on variables documented to have explanatory power with regards to the magnitude of the relation between the degree of surprise and future equity returns. We find that this relation remains both statistically and economically significant even after controlling for a list of control variables commonly used as proxies for firm's information environment, arbitrage risk/cost and limited investor attention. Consistent with Foster et al. (1984), we find the positive association between surprise and abnormal returns subsequent to the earnings disclosure is strengthened as firm size decreases. This finding supports investor underreaction as an explanation for PEAD. Smaller firms are more likely to have less sophisticated investor bases as well as opaquer information environments making the processing of earnings information a more difficult task.

We also demonstrate that multifactor models of Fama and French (1993) and Fama and French (2015) are not able to explain returns of monthly portfolios which takes long positions in stocks with recent positive surprises and short positions in stocks with negative surprises. Using Fama and French (2015) five-factor model, we find the resulting zero-investment portfolio has a monthly excess return of 1.2% when SUETF is used as the surprise measure followed by 0.7% for SUEAF and 0.4% for EAR. As another robustness check, for each quarterly earnings announcement we regress daily returns over the 60 trading-day window against daily factor returns of Fama and French's five-factor model. Regardless of the surprise measure we use, we find the average value of the intercept of these time-series regressions to be significantly positive for firms that fall into the positive surprise quantile  $Q_3$  and significantly negative for firms that fall into negative surprise quantile  $Q_1$ . This indicates that the five-factor model is not able to account for the abnormal patterns in returns following earnings announcement. These findings are consistent with Bernard and Thomas (1989) which provided evidence against the argument that PEAD is an artifact of incomplete risk adjustment resulting from model misspecification.

## 2. Literature on PEAD: US and international evidence

The abnormal return in the context of PEAD is the difference between the ex-post return of a security following the earnings announcement and its normal return. The normal return could be found using a risk model such as market model, capital asset pricing model (CAPM) or other more sophisticated multifactor models. There were two main competing explanations put forward for PEAD after the seminal paper of Ball and Brown (1968). The first explanation focused on the possibility of misestimation or incompleteness

of the model used to describe normal return. If a model such as CAPM fails to adjust raw returns fully for risk, observed abnormal return post earnings announcement could be the fair return compensation in exchange of the risk that is not reflected in CAPM. The second class of explanation suggests that investors do not fully react to information released at earnings announcement causing a delayed market reaction. This underreaction could be because investors are not able to efficiently process earnings information due to limited attention or other psychological biases. However, it could also be that there is a subset of investors which are not subject to these biases, but they cannot eliminate the underreaction and enforce market efficiency because of high costs or risks involved in conducting the necessary arbitrage trades.

Any explanation that is related to model misestimation/incompleteness will require those firms which post positive earnings surprise become riskier on a dimension not captured by the utilized risk model vis-a-vis those which post negative earnings surprise. Bernard and Thomas (1989) used an extensive data set covering quarterly earnings announcements for the 1974–1986 period. They found that the drift is robust to a wide range of risk-correction procedures and concluded that the evidence is not supportive of the first class of explanation based on incomplete risk adjustment. Since then, most of the research centered on the delayed market reaction explanation. One exception is Kim and Kim (2003) which provided a multifactor explanation for PEAD. First, in line with Bernard and Thomas (1989) they find that the cumulative arbitrage return over the 60 days subsequent to a quarterly earnings announcement remain significant even after adjusting for risk using well-known factor models such as the three-factor model of Fama and French (1993) as well as the four-factor model in Carhart (1997) which augments momentum to the three-factor model. Then, they propose a four-factor model to explain post-earnings announcement returns as a compensation for risk by adding a novel factor named earnings surprise risk factor to the Fama and French's three-factor model.

Support for the investor underreaction explanation came from a series of studies analyzing the cross-sectional variation among companies in the way PEAD manifests itself. Foster et al. (1984) is one of the first among many who shows that the magnitude of the drift is negatively correlated with the firm size based on its market capitalization at the beginning of the year earnings announcement is made. Bartov et al. (2000) and Brown and Han (2000) among others analyzed this relation further and found a negative relation between PEAD and not just size, but also other variables which could serve as proxies for the richness of the information environment and the level of investor sophistication such as percent of shares outstanding owned by institutional investors and number of analysts if any covering the stock. It stands to reason that those firms which are large, whose stocks are held by institutional investors which tend to be more sophisticated than retail investors and whose analyst covering is more extensive have a more transparent information environment and have their earnings news processed more efficiently leading the market reaction to be complete with minimal delay. Battalio and Mendenhall (2005)

also looks at the implications of investor heterogeneity within the context of earnings drift. They present evidence suggesting that different subsets of investors use different information sets. In particular, investors initiating large trades incorporate analyst forecasts in their decision-making while investors initiating small trades use an information set that is inferior to large traders ignoring the information in analyst forecasts as well as underestimating the time-series autocorrelation of earnings. Under the premise that small trades are primarily initiated by small investors, Battalio and Mendenhall (2005) concludes that it is the small unsophisticated investors with biased expectations which cause the drift.

More recently, Hirshleifer et al. (2009) and Dellavigna and Pollet (2009) looked at the behavioral underpinnings of the investor underreaction to earnings information which is hypothesized to be main cause of the drift following the announcement. Consistent with the limited attention literature in behavioral finance, Hirshleifer et al. (2009) found that investors underreaction to earnings reports increase when there are a greater number of same-day announcements made by other firms competing for the investors' attention. On the other hand, Dellavigna and Pollet (2009) found a higher PEAD for announcements on Fridays where investor attention is less compared to the other days in the week.

Another strand of the literature looks at the cross-sectional variation in limits to arbitrage. Chordia et al. (2009) analyzed the role of liquidity in PEAD returns. They find that a PEAD based monthly hedge return of 2.43% is achievable for the most illiquid stocks, whereas this return is negligibly small at 0.04% for the most liquid stocks. Yet, their transaction cost study indicates that trading costs account for almost all of the paper profits of such a strategy for illiquid stocks. Mendenhall (2004) investigates arbitrage risk rather than arbitrage cost as an explanation for delayed reaction to earnings news. They base their argument on the model of Wurgler and Zhuravskaya (2002) which envisions a world which consists of two type of investors, arbitrageurs and non-arbitrageurs. The arbitrageurs who in fact hold correct beliefs about the fundamental value of stock cannot fully exploit the drift. This is because arbitrageurs hold specialized portfolios and cannot diversify away the idiosyncratic risk of stocks which they need to buy or sell to benefit from the PEAD. Using a U.S. sample of 52,575 firm-quarter observations for the 1991–2000 period (Mendenhall, 2004), finds the drift is smaller when the arbitrage risk is lower. In particular, for firms in the highest arbitrage-risk quintile, it is found that the 3-month post-announcement abnormal return spread between the most positive surprise decile and the most negative surprise decile is 10.67% compared to only 2.97% for the firms in the lowest arbitrage-risk quintile.

A critical part of any PEAD study is defining the earnings surprise as the observed drift pattern will inevitably depend on this definition. In the literature, earnings surprise is typically measured as the standardized difference between a proxy for market expectation and actual earning realization. Livnat and Mendenhall (2006) used an extensive sample of earnings announcements in the U.S. spanning the period 1987–2003 to

compare the two most commonly used proxies; the median analyst forecast and the time-series forecast based on past earnings realizations. They find that the realized drift magnitude based on analyst forecast surprise measure is higher than the drift based on time-series forecast surprise measure. However, they also find that neither surprise measure subsumes the other and the return differential between firms with most positive surprise and firms with most negative surprise increase when both surprise measures are used. Another surprise metric which was first introduced in Chan et al. (1996) and studied in depth by Brandt et al. (2008) is the earnings announcement return (EAR) which ranks stocks according to the immediate stock price reaction around the earnings announcement. Brandt et al. (2008) using a U.S sample spanning the period 1987–2004 found that a strategy that buys and sell companies based on EAR generates an annual abnormal return of 6.3% compared to 5.6% produced using the traditional time-series forecast based measure. Furthermore, similar to Livnat and Mendenhall (2006)'s finding, they documented that a strategy which exploits both EAR and time-series forecast based measure generates an annual abnormal return of around 11%.

The international evidence on PEAD is much less extensive than the evidence for the U.S. Early studies such as those of Ariff et al. (1997), van Huffer et al. (1996) and Hew et al. (1996) do not provide conclusive evidence that PEAD exists in Singapore, Belgium and U.K. markets respectively. More recent studies use comprehensive data sets, but still mostly not directly comparable with the studies on the U.S. market which analyze PEAD within a context of quarterly earnings announcements with multiple surprise measures including analyst forecast based surprise measure. Lack of availability of reliable accounting and estimates data in quarterly frequency force most studies to resort to using annual data. However, using only annual data not only reduces number of unique observations, but also makes it challenging to define an effective earnings surprise measure. This is because, most of the information in annual earnings is likely to be priced during earlier interim earnings announcements and the market's surprise reaction if any would be to the fourth quarter results rather than the full year report. Two multi-country studies which uses annual earnings reports and analyst forecast based measure are Griffin et al. (2010) and Hung et al. (2015). Griffin et al. (2010) found PEAD is only present in 15 of the 38 markets analyzed with PEAD measured as 4.1% for developed markets compared to 4.2% for emerging markets with no statistically significant difference between the two. Hung et al. (2015) interpreted the mandatory adoption of International Financial Reporting Standards (IFRS) worldwide in 2005 as an exogenous information shock and looked at its impact on the drift behavior. They showed that the PEAD existed in 18 out of 30 countries analyzed during the pre-adoption period while this number went down to 13 after the IFRS adoption. The attenuation of the drift primarily comes from countries which adopts IFRS as the average PEAD for the adopting countries decline from 2.4% to 1.1% while for the non-adopting PEAD increased from 2.8% to 4.2%. Hung

et al. (2015) attributed this to improved financial reporting quality which make stocks easier to value. [Truong \(2011\)](#) tested the PEAD in the Chinese market using quarterly data and found statistically significant drift of 4.1% using a sample of 36,772 observations in the Chinese equity market for the 1994–2009 period. Although this study differentiates itself from previous studies in that it utilizes quarterly earnings announcement data for an extensive look at the drift anomaly and its determinants, it relies exclusively on time-series forecast based measure for this. Due to lack of availability of relevant Chinese estimates data at quarterly frequency, [Truong \(2011\)](#) was able to test analyst forecast based PEAD only at annual frequency. He found a hedge strategy based on analyst forecasts can achieve 9.5% abnormal return for the one year period following the announcement.

### 3. Variables and sample selection

#### 3.1. Earnings surprise measures

We use three approaches to quantify earnings surprise; standardized unexpected earnings using time-series forecast (*SUETF*), standardized unexpected earnings using analyst consensus forecast (*SUEAF*) and earnings announcement return (*EAR*). The first measure, *SUETF* assumes earnings follow a seasonal random walk model and is constructed for a given security  $i$  in quarter  $q$  as in Eq. (1a) by dividing the difference between the reported earnings for the current quarter and its value in  $q - 4$  by the market value of equity at the end of quarter  $q$ , with all measured in Turkish lira. The main advantage for this measure as opposed to using more sophisticated time-series models is that it requires minimal time-series length for earnings and hence can be measured for almost every firm-quarter observation. [Foster et al. \(1984\)](#) show that seasonal random walk model's forecast errors perform as well as more sophisticated time-series techniques.

The second measure, *SUEAF* is defined as in Eq. (1b) by dividing the difference between the reported earnings for the current quarter and the mean analyst consensus forecast by the value of market capitalization at the end of quarter  $q$ . The second measure is arguably a better proxy for the unobserved true market expectation for the earnings as forming expectations for future earnings is a primary professional task for analysts. However, not all stocks are followed by analysts and analyst expectations do not necessarily contain all the information that the market participants collectively possess.

<sup>1</sup> The size-B/M portfolios are constructed using listed stocks in Borsa İstanbul similar to [Fama and French \(1993\)](#) by the intersection of two size and three B/M groups. The groups and subsequently 6 size-B/M portfolios are formed at the end of June in each year  $t$  by creating two size quantiles and three B/M quantiles by sorting stocks on size and B/M. The size sort is based on market capitalization at the end of June and the B/M sort is based on the ratio of the book value at the last fiscal year-end in year  $t - 1$  to market capitalization at the end of year  $t - 1$ . Then, daily-returns of the equal-weighted portfolios are calculated from July of year  $t$  to June of year  $t + 1$  for each of the size-B/M portfolios.

The third measure, the earnings announcement return (*EAR*) is defined as in Eq. (1c) by subtracting the buy-and-hold return of the announcing firm  $i$  from that of the size and book-to-market (B/M) matching portfolio over the three trading day window  $[t - 1, t + 1]$  around the earnings announcement day  $t$ . At the end of June in each year  $t$ , a stock is matched to one of 6 size-B/M portfolios based on the market capitalization at the end of June in year  $t$  and the book value at the last fiscal year-end in year  $t - 1$  divided by market capitalization at the end of year  $t - 1$ .<sup>1</sup> *EAR* is advantageous as a measure, because unlike the previous two measures it reflects the degree of surprise of all market participants for the full earnings event and not just earnings. However, the main disadvantage of this measure is that other factors unrelated to the earnings news could confound the impact of the earnings during the announcement window.

$$SUETF_{i,q} = \frac{(E_{i,q} - E_{i,q-4})}{MV_{i,q}} \quad (1a)$$

$$SUEAF_{i,q} = \frac{(E_{i,q} - F_{i,q})}{MV_{i,q}} \quad (1b)$$

$$EAR_{i,q} = \prod_{k=t-1}^{t+1} (1 + R_{i,k}) - \prod_{k=t-1}^{t+1} (1 + R_{p,k}) \quad (1c)$$

To address outliers and potential non-linearities, in the literature the surprise measures are typically transformed into coded decile scores based on their rank within each calendar quarter (see for instance [Bernard and Thomas \(1990\)](#)). Since the sample size is much more limited compared to U.S. samples typically studied in the literature, we transform our *SUETF*, *SUEAF*, and *EAR* measures into coded tertile (3-quantile) scores and scale the coded score from 0 to 1. We denote the most negative surprise quantile as  $Q1$  and the most positive surprise quantile as  $Q3$ .

#### 3.2. Defining post-announcement abnormal return

The post-announcement cumulative abnormal return (*CAR* [2, 61]) measures the delayed reaction to the earnings announcement and is the main metric used in quantifying the drift phenomenon. Similar to [Hirshleifer et al. \(2009\)](#), we define *CAR*[2, 61] as in Eq. (2a), the difference between buy-and-hold return of the announcing firm  $i$  and that of the size and book-to-market (B/M) matching portfolio that the stock belongs to over the 60 trading-day window  $[t + 2, t + 61]$  following the earnings announcement date at day  $t$ .<sup>2</sup> Then, we define *PEAD*[2, 61] as the difference between average *CAR*[2, 61] for those company-quarter observations in the best surprise quantile ( $Q3$ ) and the average *CAR*[2, 61] for those company-quarter observations in the worst surprise quantile ( $Q1$ ). Consistent with [Bernard and Thomas \(1989\)](#)'s finding

<sup>2</sup> The construction of 6 size-B/M portfolios and matching of stocks to these portfolios follows the same methodology discussed in 3.1 for *EAR* surprise measure.

that most of the drift occurs in the first three calendar months (roughly corresponding to 60 trading days), we conduct most of the ensuing tests using the 60 trading-day window. However, we also conduct additional tests using  $CAR[2, 21]$  and  $CAR[2, 41]$  to observe the evolution of the relation between the degree of earnings surprise and abnormal return over event time.

$$CAR[2, 61]_{i,q} = \prod_{k=t+2}^{t+61} (1 + R_{i,k}) - \prod_{k=t+2}^{t+61} (1 + R_{p,k}) \quad (2a)$$

$$PEAD[2, 61] = \overline{CAR[2, 61]}_{i,q \in Q3} - \overline{CAR[2, 61]}_{i,q \in Q1} \quad (2b)$$

### 3.3. Explanatory variables

**Limited investor attention:** Hirshleifer et al. (2009) using a sample of quarterly earnings announcements from 1995 to 2004 in the U.S stock market found that the immediate price and volume reaction to a firm's earnings surprise is weaker and the PEAD is stronger when there is a greater number of same-day earnings announcements made by other firms. They attributed this to limited attention investors possess and being distracted from the task of valuing a firm when there are other concurrent earnings announcements. We define the variable *CONCEARNINGS* for firm  $i$  at quarter  $t$  as the number of earnings released at the same day as firm  $i$ . On the other hand, Dellavigna and Pollet (2009) using a sample of quarterly earnings announcements from 1984 to 2006 tested the investor inattention hypothesis by comparing the response to earnings announcement on Friday when investor inattention is more likely to the response in other weekdays. They found that Friday announcements have a 15% lower immediate response and 70% higher delayed response compared to non-Friday announcements. To look at the impact of announcement day on the magnitude of the drift, we define the variable *FRIDUM* which takes the value of 1 for announcements on Friday and 0 for announcements in any other day.

**Limits to arbitrage:** In a world where arbitrage is neither riskless nor costless to exploit, the magnitude of PEAD could be expected to have a positive correlation with arbitrage risk and arbitrage cost. We follow Mendenhall (2004) which uses idiosyncratic volatility as a proxy for arbitrage risk. In the PEAD context, one should expect a higher drift for stocks with higher idiosyncratic volatility as arbitrageurs will be less willing to take positions in these stocks despite believing they are mispriced. We measure the idiosyncratic volatility *IVOL* as the standard deviation of residual values from the time-series market model regression  $R_{i,k} = \alpha_{i,q} + \beta_{i,q}R_{m,k}$  we run for the trading-day window of  $[t - 61, t - 2]$  where  $t$  is the announcement date and  $R_{m,k}$  denotes daily return on the BIST-100 index. To proxy arbitrage cost (i.e transaction cost), we use a modified version of Amihud (2002) measure of illiquidity. Ben-Rephael et al. (2017) made an inflation-adjustment on Amihud (2002)'s illiquidity measure to account for outliers while Karolyi et al. (2012) presented a log-

transformed version of it.<sup>3</sup> To both account for the relatively high inflation during our sample period as well as reduce the effect of outliers, we use Karolyi et al. (2012)'s illiquidity measure with an inflation adjustment. Accordingly, we define the control variable *ILLIQUIDITY* as the average value of the logarithm of the sum of a constant and the ratio of absolute daily return by inflation adjusted daily trading volume (in millions of Turkish lira) during the trading-day window of  $[t - 61, t - 2]$  as in Eq. (3) where  $D_{i,q}$  is the number of days for which data are available for stock  $i$  in the  $[t - 61, t - 2]$  window.

$$ILLIQUIDITY_{i,q} = \frac{1}{D_{i,q}} \sum_{k=t-61}^{t-2} \ln \left( 1 + \frac{|R_{i,k}|}{VOL_{i,k} Inf_k} \right) \quad (3)$$

**Information environment and investor sophistication:** In their seminal paper, Foster et al. (1984) pointed out the negative correlation between firm size and the magnitude of the drift. Since then, it had been used as one of the main variables to control for the information environment of the firm. Larger firms arguably have a more transparent information environment as well as a more sophisticated investor base both of which could facilitate more efficient incorporation of information at the earnings announcement to price and accordingly lower PEAD. To this end, we introduce the variable *SIZE* which is the market capitalization at the end of the prior calendar year and is measured in millions of U.S. dollars. As a more direct proxy for investor sophistication, Bartov et al. (2000) used proportion of firm shares held by institutional investors as an explanatory variable. Using a U.S sample of quarterly earnings between 1989 and 1993, they found that investor sophistication as proxied by proportion of firm shares held by institutional investors is negatively correlated with the magnitude of PEAD. Bartov et al. (2000) argued that this is caused by institutional investors which are better equipped to do efficient pricing of the earnings information and attenuates the drift that follows the announcement. We define the control variable *IO* as the ratio of the sum of shares held by foreign and domestic institutional investors to total number of floating shares at the end of the prior calendar year. Another variable which is related to the information environment is the reporting lag. Chambers and Penman (1984) looked at the relation between the timeliness of earnings report and the magnitude of price reaction to the release of the earnings report. They defined timeliness as the reporting lag from the end of the fiscal period covered by the report to the date of the report. The higher the reporting lag the more information investors could gather related to the upcoming earnings report prior to the announcement. As Chambers and Penman (1984) suggested, late reporting firms allow for a longer information gathering period at which investors could benefit from other voluntary disclosures by the firm itself as well as information gleaned from earnings reports of early-announcing firms. These earnings relevant information could be embedded in the

<sup>3</sup> These along with other illiquidity measures are extensively studied in Atilgan et al. (2016) which looks at illiquidity premium in Borsa İstanbul.

prices prior to the announcement and cause the reaction to the actual announcement to be muted. Chambers and Penman (1984) tested this hypothesis for a sample of 100 randomly selected listed U.S. firms for the 1970–1976 period and did not find a significant negative relation between reporting lags and the variability of stock returns around earnings announcements except for small firms with positive announcements. On the other hand, Hirshleifer et al. (2009) with a more extensive dataset documents a negative relation between reporting lag and both the immediate and delayed market reaction to the earnings announcement. We measure the control variable *REPORTLAG* as the number of days from the quarter-end until the earnings announcement date.

**Other control variables:** Similar to Hung et al. (2015), we also use firm characteristics which include the *B/M*, the ratio of book value at the end previous fiscal year to market value of equity at the end of previous calendar year, the *BETA* estimated from regressing daily stock returns on BIST-100 index returns for the period of  $[t - 61, t - 2]$  and the *PRERET* measured as the buy-and-hold return adjusted for BIST-100 index return for the same period used in calculating beta as control variables.

### 3.4. Sample selection and summary statistics

The accounting data we use in this study comes from Rasyonet which is a local financial analysis software solutions provider to brokerage houses, asset management companies and banks while the market and earnings announcement date data comes from Bloomberg. The institutional ownership data is taken from Turkey's Central Securities Depository (MKK). Finally, to account for industry fixed-effects in our multivariate regression, we use the two-digit Global Industry Classification Standard (GICS) code which we obtain from Compustat Global Capital IQ Database.<sup>4</sup> We start with an initial full sample of 16,061 observations which consist of all company-quarters for which Rasyonet earnings data and Bloomberg announcement date data is available for the 2007–2018 period. Then, we apply the selection criteria below to reach our final full sample of 6,471 observations. To reduce the effect of outliers, we winsorize all the continuous variables at the top and bottom 1% of their quarterly distribution.

- We only include observations of firms with fiscal year ending in December. More than 95% firms listed at Borsa İstanbul have fiscal year ending in December.
- We require the accounting and market data necessary to calculate the earnings surprise measures, the post-announcement abnormal return metrics and explanatory variables to be available for all company-quarter observations.

- We only include observations of firms which has market capitalization greater than US 100mn and non-negative book value at the end of the prior year. We also require a firm to have at least two-thirds of daily returns available in the return window necessary to calculate *CAR* and *EAR*.<sup>5</sup>

The full sample is utilized for the portfolio and regression analyses we conduct using the *SUETF* and *EAR* earning surprise measures. For analyses which use *SUEAF* surprise measure as well, we use the analyst forecast sample. For this sample, in addition to the selection criteria below, we also require there is at least one analyst estimate in earnings surveys administered by the local financial news network CNBC-E up until 2014 and by Bloomberg since then. This additional requirement results in a sample size of 2,398 observations for the analyst forecast sample. Table 1 and Table 2 present descriptive statistics for the two samples used. The general tendency of analysts to cover more liquid, larger market capitalization stocks with higher institutional ownership is reflected at our sample. The median stock in the analyst forecast sample is covered by 9 analysts, has a market capitalization of US 1.3bn and 81% of its floating shares is owned by institutional investors. On the other hand, the median stock in our full sample is not covered by an analyst, has a market capitalization of US 0.4bn and 69% of its floating shares is owned by institutional investors.

## 4. Empirical results

### 4.1. Existence of PEAD in Borsa İstanbul

Fig. 1 shows the market's price reaction to earnings announcement by plotting the average cumulative abnormal return from trading day 0 to trading day 61 relative to the earnings announcement day for each surprise quantile with the surprise measure being *SUETF*. The immediate market reaction which can be measured by the cumulative abnormal return on day 1 is on average positive as expected for firms that fall into positive surprise quantile *Q3* and negative for firms that fall into negative surprise quantile *Q1*. However, the average *CAR* for the firms in quantile *Q3* continues to drift up beyond day 1, while continues to drift down for quantile *Q3* firms. This widening differential provides a preliminary graphical evidence for PEAD in our sample.

Besides *SUETF*, we utilize *SUEAF* and *EAR* which are the other two surprise measures most commonly used in the literature. Panel A of Table 3 displays the correlation between these three measures on a subsample based on the availability of all the three measures. The moderate correlation between them, in particular between *EAR* and the other two earnings-based measure indicate that they capture different aspects of

<sup>4</sup> GICS at the two-digit level is comprised of 11 sectors which are Communication services, Consumer discretionary, Consumer staples, Energy, Financials, Health Care, Industrials, Information technology, Materials, Real Estate and Utilities.

<sup>5</sup> In the rare case that an observation which otherwise satisfies the two-third daily return condition gets delisted before the end of its drift period, we assume the stock earns the return of its size-B/M matching portfolio after delisting.

Table 1  
Summary table for full sample.

	Mean	S.D.	Min.	10th Pctl.	25th Pctl.	50th Pctl.	75th Pctl.	90th Pctl.	Max.
<i>CAR</i> [2, 61]	-0.00	0.16	-0.66	-0.17	-0.10	-0.02	0.07	0.19	1.07
<i>SUETF</i>	-0.00	0.07	-0.83	-0.04	-0.01	0.00	0.01	0.04	1.14
<i>EAR</i>	-0.00	0.04	-0.19	-0.04	-0.02	-0.00	0.02	0.04	0.24
<i>CONCEARNINGS</i>	33.00	31.08	1.00	4.00	8.00	19.00	53.00	84.00	112.00
<i>IVOL</i>	0.02	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.08
<i>ILLIQUIDITY</i>	0.06	0.13	0.00	0.00	0.00	0.01	0.05	0.14	2.05
<i>SIZE</i>	1500.92	2869.95	101.01	129.14	192.94	383.58	1064.58	4463.06	21906.46
<i>REPORTLAG</i>	48.90	33.58	17.12	30.00	37.00	43.00	57.00	70.00	785.00
<i>IO</i>	0.61	0.29	0.00	0.18	0.39	0.68	0.86	0.94	1.00
<i>B/M</i>	0.82	0.59	0.04	0.22	0.39	0.69	1.07	1.59	4.21
<i>BETA</i>	0.74	0.36	-0.39	0.28	0.49	0.73	0.97	1.21	2.31
<i>PRERET</i>	0.01	0.17	-0.55	-0.16	-0.09	-0.01	0.08	0.19	1.54
Observations	6471								

Table 2  
Summary table for analyst forecast sample.

	Mean	S.D.	Min.	10th Pctl.	25th Pctl.	50th Pctl.	75th Pctl.	90th Pctl.	Max.
<i>CAR</i> [2, 61]	-0.00	0.13	-0.51	-0.16	-0.09	-0.01	0.08	0.16	0.81
<i>NO.OF ANALYSTS</i>	9.73	4.52	1.00	4.00	6.00	9.00	13.00	16.00	20.55
<i>SUEAF</i>	-0.00	0.03	-0.75	-0.02	-0.00	0.00	0.01	0.02	0.55
<i>CONCEARNINGS</i>	26.37	28.80	1.00	3.00	6.00	13.00	36.00	79.00	112.00
<i>IVOL</i>	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.06
<i>ILLIQUIDITY</i>	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.03	0.77
<i>SIZE</i>	3186.04	3994.43	108.82	275.60	546.70	1275.54	4382.02	9044.13	21906.46
<i>REPORTLAG</i>	44.36	21.44	18.00	28.00	34.00	41.00	50.00	65.00	785.00
<i>IO</i>	0.75	0.19	0.07	0.43	0.65	0.81	0.90	0.95	0.99
<i>B/M</i>	0.78	0.53	0.06	0.24	0.40	0.69	1.01	1.50	2.99
<i>BETA</i>	0.84	0.34	-0.28	0.42	0.61	0.84	1.08	1.29	1.95
<i>PRERET</i>	0.00	0.12	-0.45	-0.13	-0.08	-0.01	0.07	0.15	0.75
Observations	2398								

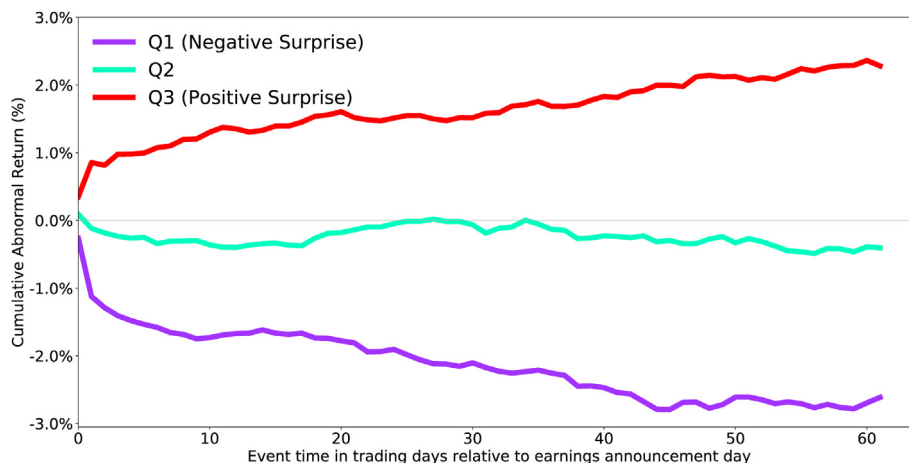


Fig. 1. Cumulative abnormal return over event time.

the surprise embedded in the earnings announcement. Fig. 2 shows average *CAR*[2, 61] across surprise quantiles. Regardless of the surprise measure used, *CAR*[2, 61] is on average positive following announcements falling under top quantile in terms of earnings surprise, while there is negative drift following announcements in negative surprise quantile. The difference in *CAR* for Q3 (positive surprise quantile) and Q1 (negative surprise quantile) points to the presence of PEAD independent of the surprise measure used. This difference also

corresponds to the return of a hedge portfolio formed on the basis of the surprise measure with long positions in all stocks at the top one-third and short positions in the bottom one-third of the surprise ranking. Panel B of Table 3 shows that the PEAD exists and is statistically significant at 1% level at all horizons for *SUETF* and *SUEAF* and at 5% level for *EAR*. The p-values are calculated using standard errors adjusted for heteroskedasticity and clustering by earnings quarter. The drift over the window [2, 61] is 2.9% when analyst and time-series

Table 3  
Correlation of surprise measures and PEAD at different horizons.

Panel A: Correlation Matrix of Surprise Measures			
	SUETF	SUEAF	EAR
SUETF	1		
SUEAF	0.455***	1	
EAR	0.238***	0.333***	1

Panel B: PEAD at Different Horizons			
	PEAD [2,21]	PEAD [2,41]	PEAD [2,61]
SUETF	0.0118*** (3.75)	0.0219*** (4.44)	0.0294*** (4.26)
SUEAF	0.0131*** (3.09)	0.0261*** (4.39)	0.0290*** (3.63)
EAR	0.00763** (2.17)	0.0121** (2.61)	0.0218*** (3.88)

t statistics in parentheses \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

forecasts are used to build the surprise measure, while it is lower at 2.2% when earnings announcement return measure is used.<sup>6</sup> Furthermore, PEAD is prevalent throughout our sample period between 2007 and 2018. PEAD is positive in 11 years out of 12 using SUETF as surprise measure, while it is positive in 10 years out of 12 using EAR and 9 years out of 12 using SUEAF.

#### 4.2. Multivariate regression analysis

We conduct multivariate regression analysis for our full sample to control for variables that may potentially influence market response to earnings surprises. We run regressions of post-announcement abnormal return on the earnings surprise tertile rank, the control variables and the interaction terms of these variables with the surprise measure. We mitigate the effect of skewness in *SIZE* by using the logged value of this variable. We add industry and quarter fixed-effects and cluster standard errors by quarter to control for correlation of returns of same quarter announcements. Also, we standardize all control variables by subtracting the mean and dividing by its standard deviation. We utilize *SUETF* and *EAR* as surprise measures and three different time horizons ( $N = 21, 41, 61$ ) for *CAR*. Specifically, we estimate the following equations where  $X$  denotes the set of control variables.

$$CAR[2, N] = a_0 + a_1SUETF + \sum_{i=1}^n (b_i X_i) + \sum_{i=1}^n (c_i (SUETF * X_i)) + \varepsilon \quad (4a)$$

<sup>6</sup> In untabulated analysis, we calculate PEAD at these horizons using the alternative time-series surprise measure which standardizes the difference between reported earnings for the current quarter and its value in  $q - 4$  by its standard deviation over the previous eight quarters (see Chordia et al. (2009)). We find *PEAD*[2, 21], *PEAD*[2, 41] and *PEAD*[2, 61] to be 1.1%, 2.2% and 3.5% respectively with significance at 1% level.

$$CAR[2, N] = a_0 + a_1EAR + \sum_{i=1}^n (b_i X_i) + \sum_{i=1}^n (c_i (EAR * X_i)) + \varepsilon \quad (4b)$$

Table 4 and Table 5 show the results of these regressions. Looking at Table 4, we see that the coefficient on *SUETF* is significant at 1% level for all horizons. On the other hand at Table 5, the coefficient on *EAR* is significant at 1% level for regressions on *CAR*[2, 41] and *CAR*[2, 61] and at 5% level for the regression on *CAR*[2, 21]. Since we use surprise measures after transforming them into coded tertile scores ranging from 0 to 1 and standardize the control variables, these coefficients also represent the magnitude of PEAD when moving from the top quantile, *Q3* to the bottom quantile, *Q1* for observations with average firm characteristics. Accordingly, for *CAR*[2, 61] which represents the horizon most tested in the literature, for the average firm we find PEAD of 2.78% using *SUETF* and 2.26% using *EAR*. Both of the estimated values are economically significant and are in fact on par with the PEAD estimates found in the univariate analysis displayed on the Panel B of Table 3. Therefore, we conclude that the positive association between earnings surprise and post-announcement abnormal returns for our sample is robust to the inclusion of explanatory variables. Looking at the determinants of the drift phenomenon, we find *SIZE* to be the most important determinant for the relation between post-announcement abnormal return and the degree of surprise at the earnings announcement. In particular, the coefficients on the interaction between *SIZE* and both of the surprise measures are significant at the 5% level. We find a one-standard deviation increase in logged market value of equity decreases the sensitivity of market reactions to earnings news by 50% using *SUETF* and by 54% using *EAR*. This finding is consistent with the hypothesis that the drift is lower for larger firms, possibly because earnings information is more efficiently processed for such firms. Apart from *SIZE*, we do not find any other explanatory variable which has a bearing on the relation between *CAR* and the earnings surprise for both of the surprise measures.

#### 4.3. Explaining post-earnings announcement drift by multifactor models

In this section, we further investigate the robustness of our findings by examining whether PEAD returns can be explained by multifactor models of Fama and French (1993) and Fama and French (2015). The first approach we use is to analyze the returns of portfolios which buy or sell stocks based on the degree of earnings surprise (Hirshleifer et al. (2009); Dellavigna and Pollet (2009)). For each surprise measure, at the end of each month from June 2007 to May 2019, we sort stocks into three equally-weighted portfolios based on their most recent quarterly earnings surprise within the last three months. Then, we form zero-investment drift portfolios that are long the positive surprise portfolio *Q3* and short the negative surprise portfolio *Q1*. This results in three drift portfolios for our three surprise measures with monthly returns of  $R_{SUETF}^{Q3} - R_{SUETF}^{Q1}$ ,  $R_{SUEAF}^{Q3} - R_{SUEAF}^{Q1}$  and  $R_{EAR}^{Q3} - R_{EAR}^{Q1}$  respectively. We evaluate the abnormal return of

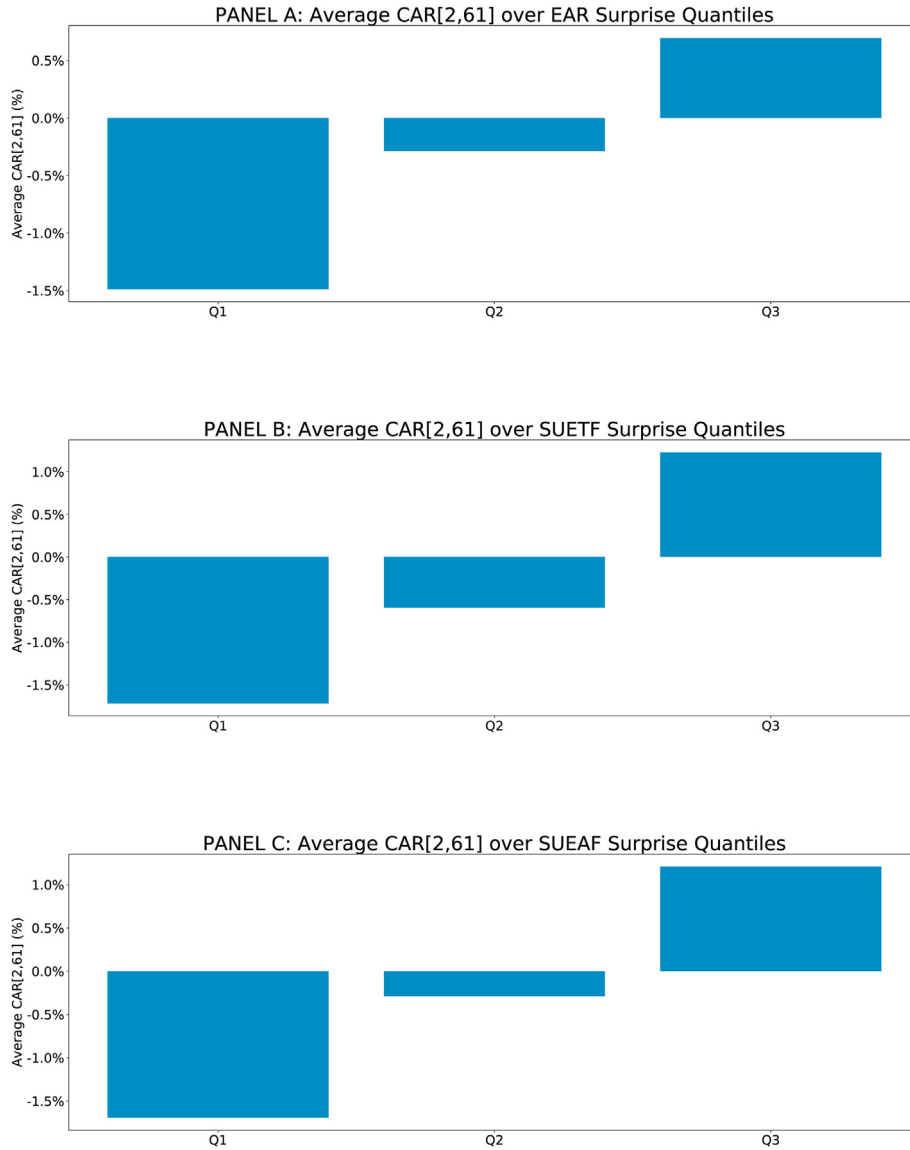


Fig. 2. Average CAR[2,61] by surprise quantiles.

these portfolios by looking at the alphas from a time-series regression of their monthly returns on the risk factors using Fama and French (1993) three-factor model and Fama and French (2015)'s five-factor model. The five-factor model includes profitability (RMW) and investment (CMA) factors in addition to the market factor ( $R_m - R_f$ ), size (SMB) and value (HML) factors of Fama-French three-factor model. The market factor return is calculated as the excess return on the BIST-100 index where the 3-month TRY LIBOR is used as the risk-

free rate proxy. Similar to Atilgan et al. (2016), we generate these factors by forming monthly quintile portfolios from the universe of stocks listed in Borsa Istanbul. The quintile portfolios for value, size, profitability and investment factors are based on sorting stocks on their book-to-market ratio, market capitalization, operating profitability and asset growth respectively. Then for monthly factor returns, the average monthly return difference between the highest and lowest quintile portfolio is calculated.<sup>7</sup> The columns 1 through 3 of Table 6 reports the results of regressions of portfolio returns on the Fama-French three factors where the standard errors are corrected for heteroskedasticity and autocorrelation using Newey-West estimator with 12 lags. Measuring abnormal return with the intercept of these regressions, we find that SUETF and SUEAF drift portfolios have monthly abnormal returns of 1.1% and 0.8% respectively, significant at 1% level while EAR drift portfolio has an abnormal return of 0.5% significant at the 5% level. The columns 4 through 6 report

<sup>7</sup> We make sure that the accounting variables are known before the formation of monthly quintile portfolios they are used for. In particular, the monthly sorts between the end of June of year  $t$  and the end of May of year  $t + 1$  for the book-to-market ratio is based on the ratio of the book value at the last fiscal year-end in year  $t - 1$  to market capitalization at the end of year  $t - 1$ . Similarly, operating profitability is measured as the ratio of operating profit to book value at the fiscal year ending in year  $t - 1$  while asset growth is based on the change in total assets from the fiscal year ending in year  $t - 2$  to year  $t - 1$  divided by total assets in year  $t - 2$ .

Table 4  
Regression on CAR using SUETF measure for earnings surprise.

	(1)		(2)		(3)	
	CAR[2, 21]		CAR[2, 41]		CAR[2, 61]	
<i>SUETF</i>	0.0106***	(3.53)	0.0206***	(4.56)	0.0278***	(4.50)
<i>CONCEARNINGS</i>	-0.00206	(-1.08)	-0.00497*	(-1.81)	-0.00933***	(-2.86)
<i>FRIDUM</i>	0.00361**	(2.09)	0.00252	(1.07)	0.00174	(0.59)
<i>IVOL</i>	0.00177	(0.59)	0.00759	(1.48)	0.00754	(1.29)
<i>ILLIQUIDITY</i>	0.000177	(0.09)	-0.000990	(-0.23)	-0.00257	(-0.43)
<i>SIZE</i>	0.00425	(1.49)	0.00879*	(1.89)	0.00555	(0.92)
<i>REPORTLAG</i>	0.00767***	(4.27)	0.00847***	(5.66)	0.00882**	(2.59)
<i>IO</i>	-0.00200	(-0.99)	-0.00277	(-0.89)	-0.00319	(-0.81)
<i>B/M</i>	0.00150	(0.73)	0.00298	(0.90)	0.00329	(0.82)
<i>BETA</i>	0.00246	(0.71)	-0.00170	(-0.38)	0.00106	(0.20)
<i>PRERET</i>	0.00166	(0.50)	-0.00669	(-1.41)	-0.00761	(-1.33)
<i>SUETF*CONCEARNINGS</i>	-0.000304	(-0.10)	-0.000171	(-0.05)	0.00492	(1.04)
<i>SUETF*FRIDUM</i>	-0.00568**	(-2.08)	-0.00182	(-0.51)	-0.00476	(-1.06)
<i>SUETF*IVOL</i>	-0.00532	(-1.26)	-0.0169***	(-2.92)	-0.0190***	(-2.73)
<i>SUETF*ILLIQUIDITY</i>	0.00155	(0.46)	0.00428	(0.65)	0.00485	(0.57)
<i>SUETF*SIZE</i>	-0.00559	(-1.66)	-0.0158***	(-2.88)	-0.0140**	(-2.03)
<i>SUETF*REPORTLAG</i>	0.00195	(0.53)	-0.00156	(-0.66)	-0.00717	(-1.62)
<i>SUETF*IO</i>	0.00497	(1.68)	0.00403	(0.92)	0.00484	(0.82)
<i>SUETF*B/M</i>	0.000816	(0.31)	0.00196	(0.50)	0.00215	(0.47)
<i>SUETF*BETA</i>	-0.00278	(-0.71)	0.00348	(0.60)	0.00239	(0.32)
<i>SUETF*PRERET</i>	0.00384	(0.90)	0.00838	(1.29)	0.0119	(1.60)
Constant	-0.0146	(-1.62)	-0.0270**	(-2.32)	-0.0379***	(-2.75)
Fixed effects	Industry, Quarter					
No. Obs.	6471		6471		6471	
Adj. R <sup>2</sup>	0.0174		0.0253		0.0303	

*t* statistics in parentheses \**p* < 0.10, \*\**p* < 0.05, \*\*\**p* < 0.01.

Table 5  
Regression on CAR using EAR measure for earnings surprise.

	(1)		(2)		(3)	
	CAR[2, 21]		CAR[2, 41]		CAR[2, 61]	
<i>EAR</i>	0.00871**	(2.64)	0.0127***	(2.82)	0.0226***	(4.20)
<i>CONCEARNINGS</i>	-0.000168	(-0.08)	-0.00219	(-0.64)	-0.00591	(-1.55)
<i>FRIDUM</i>	0.00393*	(1.97)	0.00246	(1.04)	0.00227	(0.78)
<i>IVOL</i>	0.00330	(0.89)	0.00384	(0.94)	0.00195	(0.42)
<i>ILLIQUIDITY</i>	0.00204	(0.96)	0.00173	(0.49)	-0.000483	(-0.14)
<i>SIZE</i>	0.00495**	(2.11)	0.00525	(1.40)	0.00449	(0.94)
<i>REPORTLAG</i>	0.00814***	(3.16)	0.00926***	(6.39)	0.00754***	(3.00)
<i>IO</i>	-0.00143	(-0.61)	-0.00316	(-0.95)	-0.00306	(-0.75)
<i>B/M</i>	0.00590**	(2.65)	0.00804**	(2.59)	0.00677*	(1.97)
<i>BETA</i>	0.00150	(0.51)	0.000631	(0.17)	0.00110	(0.31)
<i>PRERET</i>	0.00295	(1.07)	-0.00460	(-1.25)	-0.00247	(-0.59)
<i>EAR*CONCEARNINGS</i>	-0.00430	(-1.56)	-0.00592	(-1.39)	-0.00248	(-0.46)
<i>EAR*FRIDUM</i>	-0.00614*	(-1.75)	-0.00168	(-0.43)	-0.00563	(-1.26)
<i>EAR*IVOL</i>	-0.00876	(-1.57)	-0.00903	(-1.23)	-0.00689	(-0.88)
<i>EAR*ILLIQUIDITY</i>	-0.00179	(-0.44)	-0.000418	(-0.09)	0.00156	(0.29)
<i>EAR*SIZE</i>	-0.00709**	(-2.26)	-0.00881*	(-1.76)	-0.0123**	(-2.15)
<i>EAR*REPORTLAG</i>	0.00178	(0.44)	-0.00617	(-1.39)	-0.00600	(-1.17)
<i>EAR*IO</i>	0.00356	(1.05)	0.00471	(0.88)	0.00431	(0.72)
<i>EAR*B/M</i>	-0.00771**	(-2.64)	-0.00748	(-1.64)	-0.00445	(-0.86)
<i>EAR*BETA</i>	-0.000142	(-0.05)	-0.000135	(-0.03)	0.00418	(0.78)
<i>EAR*PRERET</i>	0.00250	(0.58)	0.00655	(1.06)	0.00471	(0.69)
Constant	-0.0141	(-1.56)	-0.0237**	(-2.17)	-0.0358***	(-2.89)
Fixed effects	Industry, Quarter					
No. Obs.	6471		6471		6471	
Adj. R <sup>2</sup>	0.0182		0.0205		0.0258	

*t* statistics in parentheses \**p* < 0.10, \*\**p* < 0.05, \*\*\**p* < 0.01.

Table 6  
Performance of PEAD portfolios.

	(1)	(2)	(3)	(4)	(5)	(6)
	$R_{SUETF}^{Q3} - R_{SUETF}^{Q1}$	$R_{SUEAF}^{Q3} - R_{SUEAF}^{Q1}$	$R_{EAR}^{Q3} - R_{EAR}^{Q1}$	$R_{SUETF}^{Q3} - R_{SUETF}^{Q1}$	$R_{SUEAF}^{Q3} - R_{SUEAF}^{Q1}$	$R_{EAR}^{Q3} - R_{EAR}^{Q1}$
Constant	0.0112*** (4.70)	0.00773*** (2.62)	0.00466** (2.06)	0.0117*** (4.97)	0.00710** (2.38)	0.00423 (1.53)
$R_m - R_f$	0.0942* (1.78)	0.118** (2.18)	-0.142** (-2.24)	0.0924* (1.68)	0.126** (2.22)	-0.137** (-2.26)
SMB	0.0648* (1.72)	0.0299 (0.39)	-0.101 (-1.25)	0.0197 (0.34)	0.0478 (0.40)	-0.0827 (-1.08)
HML	-0.119* (-1.79)	-0.00377 (-0.04)	0.0405 (0.28)	-0.129** (-1.99)	-0.00197 (-0.02)	0.0434 (0.29)
RMW				-0.0831 (-0.94)	0.0706 (0.40)	0.0542 (0.45)
CMA				0.0358 (0.40)	0.115 (1.27)	0.0531 (0.65)
No. of Obs.	144	144	144	144	144	144
Adj. $R^2$	0.0313	0.0442	0.0893	0.0256	0.0395	0.0794

t statistics in parentheses \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Table 7  
Average of Regression Coefficients of Post-Earnings Announcement Returns on Fama and French (2015) Factors  
(Model:  $R_{it} - R_{ft} = \alpha_i + \beta_{1i}(R_{mt} - R_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t + \beta_{4i}CMA_t + \beta_{5i}RMW_t + \varepsilon_{it}$ ).

		$\hat{\alpha}_i$	$\hat{\beta}_{1i}$	$\hat{\beta}_{2i}$	$\hat{\beta}_{3i}$	$\hat{\beta}_{4i}$	$\hat{\beta}_{5i}$	Sample Size
Panel A: SUETF Portfolios								
SUETF	Q1	-0.000261 (-4.07)	0.730 (82.98)	0.176 (12.35)	0.103 (7.83)	-0.000744 (-0.06)	-0.00693 (-0.49)	2173
	Q2	-0.0000206 (-0.34)	0.730 (84.15)	0.138 (10.45)	0.00560 (0.45)	-0.00659 (-0.53)	0.0215 (1.74)	2139
	Q3	0.000228 (3.54)	0.739 (87.73)	0.148 (11.32)	0.0828 (6.95)	0.0118 (0.91)	-0.00478 (-0.37)	2159
Panel B: SUEAF Portfolios								
SUEAF	Q1	-0.000214 (-2.45)	0.796 (62.39)	0.0536 (2.90)	0.0986 (5.70)	-0.0277 (-1.55)	-0.00740 (-0.39)	817
	Q2	0.0000784 (1.10)	0.866 (60.86)	0.0307 (1.87)	-0.00632 (-0.40)	-0.00275 (-0.16)	0.0134 (0.86)	780
	Q3	0.000297 (3.63)	0.814 (60.49)	-0.0158 (-0.85)	0.0644 (3.82)	-0.0107 (-0.57)	-0.00300 (-0.16)	801
Panel C: EAR Portfolios								
EAR	Q1	-0.000139 (-2.17)	0.770 (87.72)	0.179 (12.75)	0.0676 (5.16)	0.00133 (0.10)	-0.000538 (-0.04)	2173
	Q2	-0.0000377 (-0.61)	0.714 (85.10)	0.158 (12.08)	0.0660 (5.40)	0.0210 (1.65)	0.00586 (0.45)	2139
	Q3	0.000122 (1.90)	0.715 (82.43)	0.125 (9.34)	0.0582 (4.80)	-0.0176 (-1.36)	0.00425 (0.33)	2159

abnormal returns which are of a similar magnitude to results in columns 1 through 3 and are measured using Fama-French five-factor model. The abnormal return is statistically significant at the 1% level for the SUEAF drift portfolio, 5% level for the SUEAF portfolio, but no longer significant at the 5% level for the EAR portfolio. These findings are generally supportive of our univariate and multivariate regression results and show both statistically and economically significant abnormal returns for PEAD-based monthly portfolios.

The second robustness exercise we employ follows the approach in Kim and Kim (2003). For each quarterly earnings announcement at day  $t$ , we regress daily returns over the 60

trading-day window of  $[t + 2, t + 61]$  on daily returns of five factors of Fama and French (2015). Panel A of Table 7 presents the average of the time-series regression coefficients of Fama-French's five-factor model and their t-statistics in each of the three SUETF portfolios. The standard errors of the reported averages are calculated using the variance of the estimated coefficients of time-series regressions. Looking at the intercept estimate, we find an average daily abnormal return of -0.026% for the negative surprise quantile Q1 with a t-statistic of -4.07, significant at 1% level while the average daily abnormal return is 0.023% for the positive surprise quantile Q3 with a t-statistic of 3.54, significant again at the 1% level. On the other hand, the Q2

quantile which includes neutral earnings announcements has an average abnormal return which is not statistically significantly different from 0. The results in Panel B and Panel C of Table 7 show that results are qualitatively similar when we use *SUEAF* or *EAR* as surprise measures. This analysis also leads us to conclude that the five-factor model of Fama and French (2015) is not able to capture the earnings surprise related variation in returns following earnings announcements.

## 5. Conclusion

In this study, we examine PEAD in Turkey by looking at quarterly earnings announcements and different surprise measures allowing for a direct comparison with similar studies conducted for the U.S. market. We document that the drift anomaly is economically and statistically significant using different surprise measures and at different horizons. Also, we observe that PEAD is fairly stable over our sample period of 2007–2018 with positive PEAD recorded in the overwhelming majority of the years. The drift phenomenon remains significant after controlling for a full battery of explanatory variables documented to have a bearing on it. Using any of the two surprise measures for our full sample, we find increasing firm size weakens the positive relation between earnings surprise and post-announcement returns. This lends supports to the view that PEAD is caused by investor underreaction to earnings news. However, we were not able to find similar strong evidence that the strength of this relation varies with other variables that are documented to be proxies for limited investor attention or limits to arbitrage. Supporting the robustness of our findings, we demonstrate that neither Fama and French (1993)'s three-factor model nor Fama and French (2015)'s five-factor model are able to fully explain the returns of monthly earnings surprise based portfolios. We reach the same conclusion with an alternative approach which adjusts post-announcement daily raw returns for risk using Fama and French (2015) factors. These analyses provide further support to the view that the PEAD is caused by delayed market reaction rather than incorrect risk measurement.

## Declaration of Competing Interest:

There is no conflict of interest.

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