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Strategic timing of corporate insiders when trading at earnings announcements

Harold Contreras[1]

Department of Management Control and Information Systems, School of Economics and Business, University of Chile, Diagonal Paraguay 257, Santiago, Chile

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ABSTRACT

This paper provides new evidence that insiders exploit their stock's mispricing after earnings announcements rather than their foreknowledge of future cash flows to make profitable trades. Insiders buy and sell more intensively shortly after the publication of earnings (from day 0 to +5) in response to market reaction to earnings announcement, and the explanatory power is higher relative to book-to-market and long-term past returns. Also, in line with insiders trading on mispricing, insiders' purchases and sales are profitable both after positive and negative earnings surprises, which indicates that their trading strategies are superior to simple contrarian or momentum strategies.

1. Introduction

Insider trading does not seem to be random, insider transactions are now significantly concentrated in a short period after earnings announcements (Lee et al., 2014). Also, insiders are contrarian investors, as they are more likely to sell (buy) shares following periods of significant price appreciation (declines). The literature is mixed regarding the reasons behind their transactions. One stream of the literature suggests that insiders trade on private information by trading profitably in a contrarian fashion against past returns and book-to-market ratio in anticipation of events that signal reversal in firm trends (Noe, 1999; Ke et al., 2003; Cheng et al., 2007). These papers suggest that insiders successfully anticipate future events that signal reversion of firms performance about which they have private information. Another stream of the literature also highlights the contrarian nature of insider trading but argues that insiders trade on mispricing of their company's stock rather than in anticipation of future price relevant events (Rozeff and Zaman, 1998; Jenter, 2005). Piotroski and Roulstone (2005) documents that insider trades reflect both contrarian beliefs about market valuations and superior information about future cash flow realization.

In this paper, we provide new evidence that insiders trade in response to stock mispricing following public announcement of earnings rather than on foreknowledge of future cash flows. Using US insider transactions from 2003 until 2016, our evidence comes in three steps. First, we provide new findings on the horse race between insiders trading passively on news that is in the public domain versus actively on foreknowledge of future cash flows. Our results show that the explanatory power of the earnings announcement market reaction as a determinant of insider trading is significantly high relatively to the book to market ratio and long-

E-mail address: hcontrer@fen.uchile.cl.

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term past performance, the two usual proxies of mispricing in the insider trading literature so far (Rozeff and Zaman, 1998; Jenter, 2005; Piotroski and Roulstone, 2005). On top of it, future cash flows do not play a role in determining insider trading strategies. As in Piotroski and Roulstone (2005), we consider future return on assets (ROA), but we add future earnings per share (EPS) and long-term future returns. The latter is a more direct measure for foreknowledge of future stock prices, which along with ROA and EPS set reasonable proxies for forthcoming firm performance.

Second, we show that even though insiders do not take advantage of material future information when trading, they time their transactions very well using publicly available information contained in the current earnings announcement return to trade profitable. We provide evidence that insiders tend to trade more aggressively immediately after the publication of earnings when abnormal returns at the announcement peak, positively or negatively, in a given quarter.

Finally, in line with trading on mispricing, we provide evidence that insider trading shortly after the news announcement (first 5 days after the announcement) is profitable, and that this is irrespective of whether news is positive or negative. In particular, we show that insider trading shortly after the publication of earnings exhibits return predictability, that is, short-term future returns are higher (lower) when insiders buy (sell) more intensively. This is contrast to past literature that finds little stock return predictability of insider trades (Lakonishok and Lee, 2001; Jenter, 2005). Also, in line with strategic timing of their trades, insider trading is profitable regardless of the direction of the news. We show that stock returns are higher (lower) when insiders buy more (sell more) after a negative (positive) market reaction to the publications of earnings. This suggests that every time they buy or sell after an earnings announcement they correctly perceive over or under reaction to the news and trade before prices revert. This means that insider trading after earnings announcements is not random or mechanic, insiders sell when market's reaction to the most recent earnings announcement pushes the stock price high relatively to their own perception of the fundamental firm value. In contrast, insiders buy when they perceive the stock price drops too low after the earnings announcement.

We contribute to the literature in various ways. First, we consider a larger and more updated sample than previous studies, especially the post-SOX period. The Sarbanes-Oxley Act, which took effect in August 2002, further tightens the reporting requirements associated with insider transactions (Brochet, 2010). Insiders are now required to report their trades within two business days from trading.[2] As a result, questions arise of whether insiders are still able to trade with an advantage and what type of information do they use when trading (Lee et al., 2014). Second, we show that both insider purchases and sales in a short window after earnings announcements (from day 0 to day 5) are profitable and exhibit return predictability.[3] Third, the fact that stock prices adjust to their trades shortly after the news announcement is in line with insiders helping investors to disentangle news information revealed at earnings announcements. Dargenidou et al. (2018) show that insider trading reduce the earnings drift anomaly (known as PEAD) in the UK. We provide further evidence in line with this finding by showing that insiders do not only help stock prices to adjust when market under-reacts to the news, but also when the market overreacts.

2. Related literature

We are not the first analysing insider trading motives around earnings announcements. The literature has established the contrarian behaviour of insiders at earnings announcements, showing that insiders are likely to sell after positive news and buy after negative news (Sivakumar and Waymire, 1994; Garfinkel, 1997). These papers conclude that this trading pattern is consistent with mispricing motives only, but they do not provide evidence of post trading returns in line with this conjecture and they do not analyse whether this trading pattern could be also associated to foreknowledge of cash flows.

Our analysis is also closely related Kolasinski and Li (2010) and to some extent to Veenman (2012). The main difference to Kolasinski and Li (2010) is that we analyse insider trading association with any mispricing, while they focus on insider purchases and sales that follow after market underreacts to earnings information. In contrast, we consider insider trading in short window after the news and show that these trades follow after market over and under react to the news announcement. Veenman (2012) shows that insider purchases reported in Form 4 filings help investors learn about the valuation implications of past earnings signals. Our results suggest that this is because insiders' purchases follow those earnings announcements when insiders disagree with the market's original interpretation of the earnings information. Insiders buy after earnings announcements when the market reaction to the earnings announcement is, in their view, too negative. Following Form 4 filings, investors adjust initial pricing errors.

3. Data

Our sample of US corporate insider trades is from Thomson Financial Insider Filing Data, which contains trades by corporate insiders required to be filed via Form 4 by Section 16 of the Securities Exchange Act of 1934. Insiders required to fill in the form are company officers (executives), directors (non-executive members of the board), and beneficial owners of more than 10% of the company stock. We start our data set as of January 2003 to include only insider transactions that are reported under the more timely new rules of the Sarbanes-Oxley Act of 2002. The last year covered is 2016. We have information on the trading date, reporting (announcement) date, firm ID, the trading insider and their position within the firm, number of shares traded, transaction price and direction of trading (purchase or sale). We exclude from our data set owners of more than 10% of the company stock as their trading

[2] Increased scrutiny from investors, media and regulators should have led to less insider trading on material information.

[3] Usually sales are not informative and purchases show some weak predictability, see for example (Jeng et al., 2003; Jenter, 2005; Cohen et al., 2012).

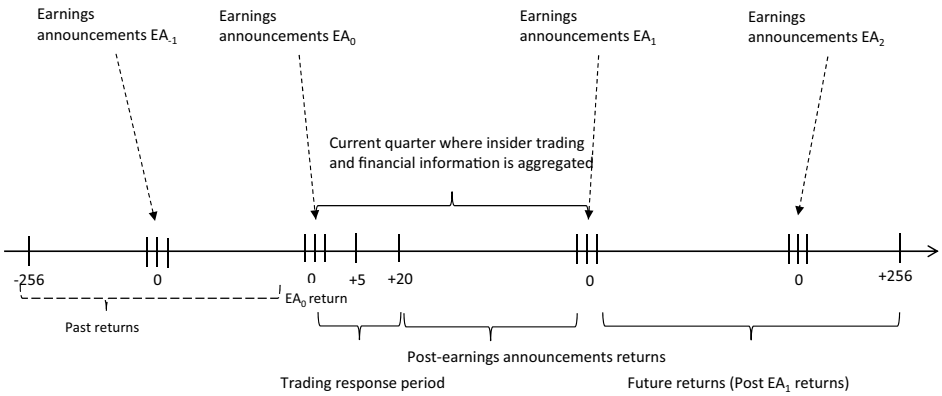

Fig. 1. Timings of earnings announcements and related abnormal returns. The figure shows the exact timings of earnings announcements and related abnormal returns relatively to the current quarter with insider transactions. The current quarter is defined as the period between 2 earnings announcements. Earnings announcement abnormal returns are always computed over 3 days around the earnings announcement date. 1, 3, 6 and 12-month returns start (end) 2 days after (before) the earnings announcement.

Table 1
Insider trading patterns after earnings announcements. The table displays number of transactions corresponding after an earnings announcement in a given quarter. The figures are categorized according to the number of days after the publication of earnings for all the firms in our sample from day 0 until 3 months. The # of insider transactions are cumulated over the days after earnings announcements when they occurred.

Days after an	All trades			Insider sales			Insider purchases		
earnings announcement	# of trades	%	acum	# of sales	%	acum	# of purch	%	acum
0 to 5 days	156,898	19.32%	19.32%	111,012	18.23%	18.23%	45,886	22.58%	22.58%
6 to 10 days	119,750	14.74%	34.06%	87,870	14.43%	32.66%	31,880	15.69%	38.27%
11 days to 1 month	186,165	22.92%	56.98%	140,395	23.05%	55.71%	45,770	22.52%	60.79%
1 to 2 months	239,168	29.45%	86.43%	184,991	30.38%	86.09%	54,177	26.66%	87.45%
2 to 3 months	110,193	13.57%	100.00%	84,694	13.91%	100.00%	25,499	12.55%	100.00%
Total	812,174			608,962			203,212		

is usually less informative (Brochet, 2010). We merge all transactions within one day of the same director in the same direction (purchases/sales), but we keep transactions if in different direction even on the same day. At this stage, we do not merge transactions over different directors. Altogether, we have 203,212 individual insider-day purchases and 608,962 individual insider-day sales.

Our analysis is built around earnings announcements that are together with other accounting information downloaded from COMPUSTAT. Fig. 1 shows our setup, timings and notation. For each quarter, we denote the two earnings announcements at the beginning and end of the quarter as EA_0 and EA_1, respectively. The numbering of earnings announcements then goes up from EA_1 to the future and down from EA_0 to the past. Accordingly, the fourth earnings announcement after the quarter when insider trading is measured is denoted EA_4 as the first one is EA_1. Thus, the period between two earnings announcements (for example EA_0 and EA_1) is a quarter and we aggregate all insider transactions on this quarterly level. Our data set includes all firm-quarters with data available in COMPUSTAT. Stock and market returns are downloaded from CRSP and the benchmarks for size and book-to-market portfolio returns are downloaded from Kenneth French's web page. Altogether, over the period from the beginning of 2003 to the end of 2016, we have data on 199,837 firm-quarters.

Table 1 shows the main patterns of insider trading after an earnings announcement. Looking at the number of insider transactions, we see that the majority of their trades occur during the first month after the publications of earnings and this is for both their sales and purchases. Also, a significant portion of transactions happen right after the announcements. In fact, 34.06% of the overall transactions are made during the first two weeks (0 to 10 days), and this pattern holds when separating between purchases and sales.

Fig. 2 plots the relative number of shares traded by insiders 60 days after an earnings announcements. The relative shares traded correspond to the daily number of shares bought or sold by insiders in firm divided by the number of shares outstanding. We see that earnings announcements have a significant effect on insiders decisions to trade, they tend to sell or buy quite intensively right after the publication of earnings. Interestingly, insiders' purchases and sales peak only at day +3 and then start decreasing but stay relatively high for the first month. This pattern of trading is likely due to restrictive 'blackout' periods imposed on insiders by their employers in order to minimize their information advantage (Bettis et al., 2000; Cohen et al., 2012; Lee et al., 2014).[4]

[4] Bettis et al. (2000) survey 1915 members of the American Society of Corporate Secretaries regarding corporate policies and restrictions on insider trading. They find that 78% of firms in their sample have explicit blackout periods. The most common policy is to ban any trading by insiders except during a trading window from day +3 through to day +12 after any quarterly earnings announcement.

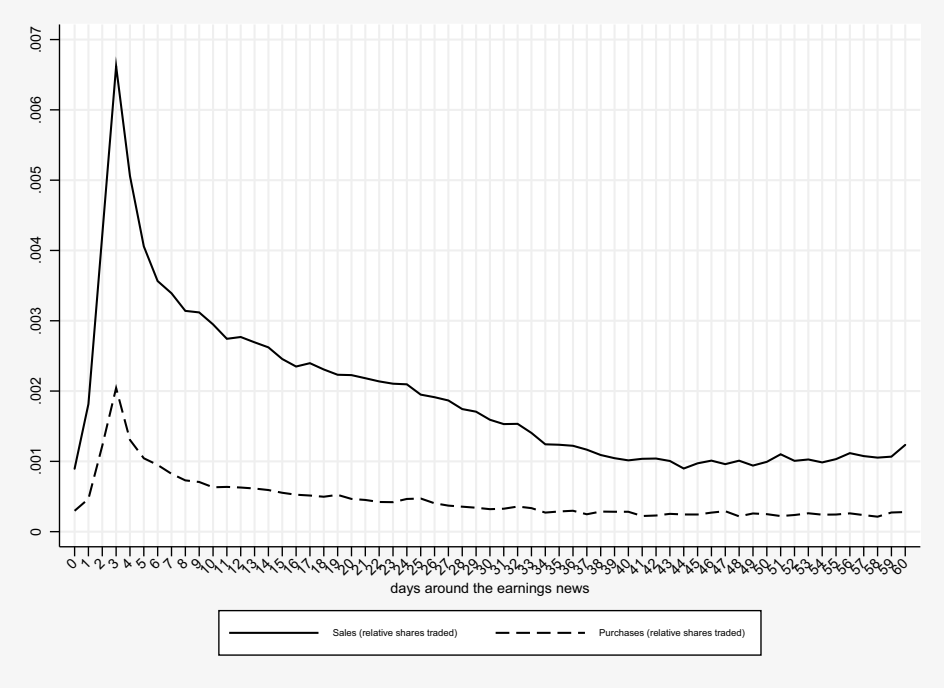

Fig. 2. Daily shares traded by insiders around earnings announcements. The figure shows the relative number of shares traded by insiders (*sales* and *purchases*). Shares traded corresponds to the daily number of shares bought or sold by insiders in a firm divided the number of shares outstanding.

Table 2
Descriptive statistics. This table displays summary statistics for insider trading on the firm-quarter level. Panel A shows summary statistics per firm-quarter and Panel B for the main variables used in the study. A quarter is defined as the time between 2 earnings announcements. Each quarter is classified as one of the following: containing (i) only insider purchases, (ii) only insider sales, (iii) both insider purchases and insider sales or (iv) no insider trading transactions. A quarter is classified as *Any trade* if it contains at least 1 transaction regardless of its direction. *Number of transactions* stands for the average of the number of all transactions (insider-days) in a quarter. *Shares traded* shows the average total number of shares traded by all insiders in a quarter as a fraction of all shares outstanding. All the remaining variables are defined in the Appendix A.

Panel A:	Unconditional statistic	No trades	Any trades	Only purchases	Only sales	Mix purch.&sales
Number of quarters	199,837	91,203	108,634	24,415	67,155	17,064
Fraction of quarters	100%	45.6%	54.4%	12.2%	33.6%	8.5%
Number of transactions (mean)	4.46	0	8.77	6.75	20.81	19.46
Number of insiders (mean)	1.56	0	3.07	3.87	6.56	7.39
Trading intensity (in %)	0.07	0	0.15	0.12	0.35	0.28

Panel B:	# observations	Mean	S.d.	25th perc.	Median	75th perc.	90th perc.
Net intensity of purchases (in %)	199,837	−0.114	0.466	−0.046	0.000	0.000	0.011
Book to market ratio	199,837	0.778	0.721	0.317	0.558	0.938	1.653
Past return	199,837	−0.034	0.422	−0.276	−0.055	0.167	0.439
EA_0 return	199,528	0.000	0.076	−0.045	−0.002	0.042	0.094
Cumulative ROA (EA_1–EA_4)	187,431	−0.007	0.159	−0.007	0.020	0.061	0.106
Cumulative EPS (EA_1–EA_4)	188,680	0.978	2.080	−0.080	0.690	1.800	3.280
Size (Market cap. in million USD)	199,837	3,069	8,453	108	441	1,827	6,716
ROA (EA_0)	199,766	−0.003	0.053	−0.002	0.006	0.018	0.032
EPS (EA_0)	199,837	0.235	0.629	−0.020	0.170	0.460	0.870
Post-EA_1 abnormal return	152,158	−0.046	0.410	−0.270	−0.054	0.149	0.406

Table 2 displays the main frequencies and summary statistics. In Panel A we display statistic by firm-quarter. We see that altogether, insiders decide not to trade in 46% of all firm-quarters in our data set. This in turn means that 54% of quarters have at least one insider trading transaction. Insider sales are more frequent than purchases: 33% of quarters contain only sales versus 12% contain only purchases. Quarters with a mix of insider purchases and sales are smaller (8.5%). The fact that insiders are more eager to sell than to buy is in line with the literature and is also documented when looking at the average per quarter of the number of transactions, insiders trading and trading intensity (the cumulative number of shares traded in the quarter as a fraction of all shares

outstanding).

Our main measure for insider trading activity is *net insider purchases*, which is the cumulative number of shares purchased less the cumulative number of shares sold in a given quarter as a fraction of all shares outstanding.

$$net\_insider\_purchases_{(i,q)} = \frac{Buys_{(i,q)} - Sells_{(i,q)}}{shares\_outs_{\cdot(i,q)}}$$

where i stands for a firm and q for a quarter. This measure of insider trading is somewhat different from the insider purchase ratio in Piotroski and Roulstone (2005). We believe this measure offers greater advantages compare to purchase ratio for two main reasons. First, our analysis is on quarterly rather yearly frequency. Our quarterly focus is important because we want to test whether insiders rely on trading on investor sentiment around earnings announcements. It also reflects the fact that insiders concentrate their trading shortly after earnings announcements (Huddart et al., 2007; Lee et al., 2014). Second, our measure naturally includes also quarters without insider trading as a useful and relatively well populated data group.[5]

Panel B of Table 2 provides summary statistics for the main variables we use in the study. We compute simple mean, standard deviation, quartiles and 90^{th} percentile across all quarters in our unbalanced panel. The resulting unconditional mean for the net intensity of insider purchases, is –0.11%, with a standard deviation of 0.46. The negative sign indicates that insiders are net sellers on average, in line with past literature. Zero median values reflect the quarters without any insider trading. The mean market capitalization is USD 3 billion and the median value is only USD 0.4 billion, which means that our data set covers many small firms. The book-to-market ratio has mean of 0.78 suggesting that the average firm is a growth firm. The mean past return is -3.4%. All returns are computed as buy and hold returns and are adjusted for 5×5 size and book-to-market portfolio returns downloaded from French's web page. The negative return reflects the fact that our data set contains comparatively many small firms that under-perform relatively to their portfolio return as reported on the French's web site.

The mean EA_0 abnormal return is zero. The overall average return on assets (ROA) corresponding to all earnings announcements is –0.003 and the earnings per share adjusted by the earnings per share in the same quarter 1 year ago and scaled by the stock price (EPS) is 0.24.[6] The corresponding values cumulated over four consecutive quarters are –0.01 and 0.98. The last four rows in Table 2 correspond to future returns measured as of the end of the quarter in which we cumulate insider trading. The mean future returns are negative across all four horizons, which is consistent with the mean for past return.

4. Results

4.1. Earnings announcement returns and future cash flow news

In this section we explore in a regression setting the question of what kind of information insiders use when trading in shares of their own firms. Table 3 shows results for models similar to Piotroski and Roulstone (2005). The dependent variable is *net insider purchases*. Concerning explanatory variables, we are primarily interested in the effect of the earnings announcement (EA_0) return together with past return and book-to-market ratio. These three variables should reflect contrarian nature of insider trading against investor sentiment. Following Piotroski and Roulstone (2005), cumulative future return on assets, ROA, over quarters EA_1 up to EA_4, represent insiders' foreknowledge of future cash flows not yet in the public domain yet. We add to this proxy, future earnings per share (EPS) and long-term future abnormal returns, as insiders could be trading on information that is not yet impounded into stock prices, but that it will be in the near future. On top of these key variables, we also control for firm size and earnings (EPS and ROA) in the current quarter (EA_0). In Panel A of Table 3 we estimate all models using firm and quarter fixed effect regressions and in Panel B we use Fama-McBeth regressions. All explanatory variables are standardized by subtracting the mean and dividing by the standard deviation to allow for direct comparison of marginal effects.[7]

The results in Panel A confirm the high explanatory power of the book-to-market ratio and past return. In column 1, the book-to-market ratio has a positive coefficient, which shows that insiders buy high book-to-market (value) firms and sell low book-to-market (growth) firms.[8] The coefficient for the past return is negative confirming that insiders also trade contrary to past returns. The economic significance of the coefficients is high.[9] A one standard deviation increase in the book-to-market ratio (past return) results in an 8.9% increase (10% decrease) in net intensity of purchases. Given that the unconditional average of net purchases is -0.11%, these are large effects. Relatively, past returns are a more relevant factor for insider trading, even more than size (the difference in the

[5] In Table 1 we show that 49% of quarters do not contain any insider trading. It's worth noting that our results remain even if we exclude quarters with no insider trading from our sample.

[6] This measure for earnings surprise corresponds to the seasonal-random walk standardize earnings surprise *(SUE)*, which has been widely used in the literature. We include this measure instead of SUE based on analysts forecasts as usually analyst's follow large firms which result in a reduced sample that can bias our findings.Foster et al. (1984) find that the seasonal random walk model performs as well as more complex time-series models.

[7] In order to provide a direct comparison of our results with past literature, we report results with no standardized variables as part of the internet appendix in Table I.1.

[8] Although is hard to evaluate whether this claim is true from the dependent variable (as it is net trading), the results in Table 4 along with the results in Table I.3 in the internet appendix, confirm this conclusion.

[9] These results are in line with past evidence, see for example Piotroski and Roulstone (2005) or Jenter (2005). Also, these results are comparable to Kolasinski and Li (2010) who have the same setup but their sample period runs from 1980 to 1997.

Table 3
Regressions for the net intensity of insider purchases. This table reports regression results when the dependent variable is the net cumulative purchases as a fraction of shares outstanding. The unit of observation is a firm-quarter and firm-quarters without any insider trading are included as zeros. We standardize all variables by subtracting the mean and dividing by the standard deviation. We report the estimated coefficient of firm and quarter fixed effects regressions in Panel A and Fama-McBeth regressions in Panel B. All variables are defined in Appendix A and winsorized at the 1st and 99th percentiles. We report Hubert/White robust standard errors and allow them to cluster within firms. [a], [b] and [c] indicate significance at the one-, five- and ten-percent levels.

	1	2	3	4
	Net insider purchases			
Panel A: Fixed effects				
Post-EA_1 abnormal return				−0.000
				(0.004)
Cum ROA (EA_1-EA_4)			−0.002	0.005
			(0.006)	(0.007)
Cum EPS (EA_1-EA_4)			−0.022[a]	−0.028[a]
			(0.005)	(0.006)
EA_0 return		−0.091[a]	−0.094[a]	−0.102[a]
		(0.003)	(0.003)	(0.004)
Past Return	−0.103[a]	−0.107[a]	−0.110[a]	−0.119[a]
	(0.004)	(0.004)	(0.004)	(0.005)
Book to market ratio	0.089[a]	0.078[a]	0.076[a]	0.089[a]
	(0.009)	(0.009)	(0.009)	(0.012)
Size	0.079[a]	0.047[b]	0.042[c]	0.052[c]
	(0.023)	(0.023)	(0.025)	(0.031)
ROA (EA_0)	−0.044[a]	−0.033[a]	−0.036[a]	−0.037[a]
	(0.005)	(0.005)	(0.006)	(0.007)
EPS (EA_0)	−0.020[a]	−0.013[a]	−0.009[b]	−0.013[a]
	(0.004)	(0.004)	(0.004)	(0.005)
Constant	0.496[a]	0.507[a]	0.582[a]	−0.043
	(0.160)	(0.154)	(0.168)	(0.038)
Observations	199,766	199,457	177,615	144,425
R^2	0.044	0.054	0.057	0.060
Firm FE	yes	yes	yes	yes
Quarter FE	yes	yes	yes	yes
Panel B: Fama-McBeth				
Post-EA_1 abnormal return				−0.021[a]
				(0.006)
Cum ROA (EA_1-EA_4)			−0.019[a]	−0.019[a]
			(0.004)	(0.005)
Cum EPS (EA_1-EA_4)			−0.019[c]	−0.011
			(0.009)	(0.008)
EA_0 return		−0.107[a]	−0.106[a]	−0.120[a]
		(0.008)	(0.010)	(0.009)
Past Return	−0.109[a]	−0.112[a]	−0.117[a]	−0.134[a]
	(0.010)	(0.010)	(0.011)	(0.011)
Book to market ratio	0.120[a]	0.115[a]	0.124[a]	0.143[a]
	(0.010)	(0.009)	(0.010)	(0.011)
Size	0.017[c]	0.014[c]	0.025[b]	0.035[a]
	(0.009)	(0.009)	(0.010)	(0.012)
ROA (EA_0)	−0.071[a]	−0.057[a]	−0.060[a]	−0.068[a]
	(0.010)	(0.011)	(0.009)	(0.010)
EPS (EA_0)	−0.007	−0.001	0.013[b]	0.005
	(0.006)	(0.006)	(0.006)	(0.006)
Constant	0.021	0.020	0.018	0.010
	(0.020)	(0.020)	(0.020)	(0.021)
Observations	199,766	199,457	177,615	144,425
R-squared	0.045	0.059	0.068	0.060

coefficients is statistically significant at the one-percent level).

In column 2, we add the earnings announcement return. The coefficient of −0.091 is significant at the one-percent level and has the expected negative sign. Insiders take into account the most recent earnings announcement return when trading. Even though the coefficient is a little smaller in size than past return, it's larger than book-to-market and size so it plays an meaningful role. Note that the average marginal effects of past return and book-to-market ratio have changed only marginally. This suggests that the three variables contain different types of information for insider trading.

In columns 3 and 4 we add the proxies for foreknowledge. The coefficient for future cumulative ROA is insignificant and the coefficient for future cumulative EPS is significantly negative, which suggests that higher future cash flow information does not

Table 4
Insiders timing ability of trading after earnings announcements. This table reports regression results when the dependent variable is the *net intensity of purchases* at two different time horizons after earnings announcements: from day 0 to day 5 and from day 6 to day 20. The unit of observation is a firm-quarter and firm-quarters without any insider trading are included as zeros. Specifications in columns 2 and 5 (3 and 6) exclude sale (purchase) quarters. Note that for sales in column 3 and 6, we report the coefficients multiplied by −1 to make the interpretation easier. We standardize all variables by subtracting the mean and dividing by the standard deviation. All variables are defined in Appendix A and winsorized at the 1st and 99th percentiles. We report Hubert/White robust standard errors and allow them to cluster within firms. [a], [b] and [c] indicate significance at the one-, five- and ten-percent levels.

	1	2	3	4	5	6
	Net intensity of purchases (0, +5)			Net intensity of purchases (+6, +20)		
	All	Purchases	Sales	All	Purchases	Sales
Panel A						
EA_0 return	−0.164[a]	−0.015[a]	0.157[a]	−0.105[a]	−0.009[a]	0.101[a]
	(0.005)	(0.001)	(0.005)	(0.004)	(0.001)	(0.004)
Past return	−0.128[a]	−0.003[a]	0.129[a]	−0.125[a]	−0.002[b]	0.128[a]
	(0.006)	(0.001)	(0.006)	(0.006)	(0.001)	(0.006)
Book to market ratio	0.062[a]	0.011[a]	−0.057[a]	0.072[a]	0.010[a]	−0.075[a]
	(0.013)	(0.003)	(0.013)	(0.012)	(0.003)	(0.013)
Size	−0.072[b]	−0.066[a]	0.003	0.014	−0.053[a]	−0.082[b]
	(0.030)	(0.007)	(0.030)	(0.031)	(0.006)	(0.033)
ROA (EA_0)	−0.026[a]	−0.004	0.023[a]	−0.026[a]	−0.001	0.025[a]
	(0.008)	(0.002)	(0.008)	(0.007)	(0.002)	(0.008)
EPS (EA_0)	−0.013[b]	−0.001	0.014[b]	−0.014[a]	−0.002	0.014[a]
	(0.006)	(0.001)	(0.006)	(0.005)	(0.001)	(0.005)
Cum ROA (EA_1-EA_4)	0.011	0.005	−0.007	−0.005	0.002	0.008
	(0.008)	(0.002)	(0.008)	(0.007)	(0.002)	(0.008)
Cum EPS (EA_1-EA_4)	−0.015[b]	0.004	0.018[a]	−0.026[a]	0.004	0.033[a]
	(0.006)	(0.001)	(0.007)	(0.007)	(0.001)	(0.007)
Post-EA1 abnormal return	−0.001	−0.003[b]	0.000	0.003	−0.000	−0.002
	(0.004)	(0.001)	(0.005)	(0.004)	(0.001)	(0.005)
Constant	−0.189[a]	0.209[a]	0.241[a]	−0.233[a]	0.252[a]	−0.301[a]
	(0.040)	(0.008)	(0.042)	(0.044)	(0.009)	(0.047)
Observations	144,432	114,802	134,048	144,432	101,514	130,167
R^2	0.056	0.019	0.050	0.050	0.022	0.047
Firm FE	yes	yes	yes	yes	yes	yes
Quarter FE	yes	yes	yes	yes	yes	yes
Panel B						
Positive EA_0 return peak	−0.368[a]	−0.012[a]	0.365[a]	−0.205[a]	−0.071[a]	0.207[a]
	(0.016)	(0.002)	(0.016)	(0.013)	(0.011)	(0.014)
Negative EA_0 return peak	0.210[a]	0.042[a]	−0.175[a]	0.161[a]	0.094[a]	−0.151[a]
	(0.010)	(0.003)	(0.010)	(0.010)	(0.008)	(0.010)
Constant	0.121[a]	0.169[a]	0.130[a]	0.109[a]	0.143[a]	0.109[a]
	(0.019)	(0.004)	(0.018)	(0.023)	(0.020)	(0.023)
Observations	144,432	114,802	134,048	144,432	101,514	130,167
R^2	0.050	0.019	0.044	0.050	0.019	0.044
Other controls	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
Quarter FE	yes	yes	yes	yes	yes	yes

increase (decrease) the intensity of insider purchases (sales).[10] Finally, the coefficient for future 1 year abnormal returns is not significant indicating that higher future returns do not increase (decrease) the intensity of insider purchases (sales) either. These results are in contrast to Piotroski and Roulstone (2005), but in line with our hypothesis that insiders do not rely on material information when trading after earnings announcements.[11]

In Panel B we estimate the same specifications using Fama-McBeth regressions and the results are very similar. Future cash flow information does not affect insider trading in a way that suggests usage of foreknowledge. Moreover, the coefficients for the earnings announcement return, past return and book to market ratio are all significant and with the expected sign. The coefficients for the EA_0

[10] The results do not change when we include only the future ROA or only the future EPS at a time. Also, our results are robust to the inclusion of earnings surprises based on analysts' forecasts. We report these results as part of the internet appendix on Table I.4. Even when the sample size shrinks as expected, the results remain the same.

[11] These results are robust to alternative measures of future fundamental performance. We include the magnitude of *ROA* and *EPS* at EA_1 and also average cumulative *ROA* and *EPS* from EA_1 to EA_2 (a shorter cumulative period), and the results do not change. Also, as part of the internet appendix in Table I.5, we include changes in future *ROA* and *EPS* and the result remain the same.

return, past return and book to market ratio remain relatively large across all three specifications. We see an important effect of the EA_0 return for insider trading patterns. The coefficient for future earnings is not significant, and the coefficients for ROA and future 1 year abnormal returns are significant but negative, which is against of trading on foreknowledge.

To summarize, Table 3 shows that (i) insiders do not rely on foreknowledge of future cash flows, (ii) recent earnings announcement return is an important factor influencing insider trading intensity, and (iii) the book to market ratio and past return still play an important role.[12]

4.2. Insiders' timing ability

In this section we explore the timing ability of insiders. We conjecture that if insiders take advantage of situations when the market misinterprets public information, then insiders should trade opportunistically and make profits. In the first analysis, we argue that trading patterns described in Fig. 2 do not occur by chance, but are born from windows of opportunity in which insiders can trade safely and profitable. If this is the case, then insider trading occurring at the short window after the publication of earnings should be more strongly associated to sentiment variables than trades occurring later in that quarter. Also in line with an opportunistic behaviour, insiders should trade more intensively depending on how large the market reaction to earnings news is. To test this, we split *net insider purchases* per firm-quarter at two different time windows, from day 0 to day $+5$ and from day $+6$ to day $+20$ after earnings announcements. With this partition at the dependent variable, we run the same regression as in the previous section. The results are in Table 4. Columns 1 to 3 includes specifications for trading intensity at $(0,+5)$ and columns 4 to 6 for days $(+6, +20)$.

Looking at column 1 in Panel A we see that, in line with our conjectures, earnings announcements returns, book-to-market ratio and past returns are strongly associated with trading intensity in window $(0,+5)$. Note that the coefficient for earnings returns is the largest, suggesting that those insiders who trade shortly after the publications of earnings trade more intensively on the market reaction to earnings announcements. Also, future ROA and long term returns are not significant and the coefficient for future EPS is significantly negative, which is against insider trading on foreknowledge. The results remain very similar in column 4 for trading intensity in window $(+6,+20)$, but as expected the magnitude of the coefficients drop for earnings announcements returns, suggesting insiders trading shortly after the news rely more on the earnings announcement return than insiders who trade afterwards.

In columns 2 and 3 (also in columns 4 and 6) we split the sample between purchases and sales as the effect of the explanatory variables may not be symmetrical. So, in column 2 (and 4) we drop insider sales but keep quarters with no insider trading, and in column 3 (and 6) we drop insider purchases but also keep no insider trading quarters. Note that for sales in column 3 (and 6), we report the coefficients multiplied by -1 to make the interpretation easier. We see that the three investors' sentiment variables remain significant with the expected sign for both purchases and sales in columns 2 and 3, but the coefficient for earnings announcement abnormal returns is the largest in this case. More importantly, the coefficients for the three foreknowledge proxies are insignificant or have the opposite sign. For example, the negative coefficient of long term future returns in column 2 indicates that insider tend to purchase more when future returns are lower, which goes against trading on foreknowledge. The interpretation is similar for future EPS and insiders selling. These results remain almost the same in columns 5 and 6 for trading intensity in window $(+6,+20)$, but note that the magnitudes of the coefficients drop a little, especially the coefficient for earnings announcement abnormal returns. These results suggest that insiders trade more intensively and quickly when trading against current investors' sentiment.[13]

In Panel B we explore an alternative analysis. We conjecture that if insiders are opportunistic and profit from their trades after the publication of earnings they would buy (sell) more intensively and quickly when earnings announcements returns peak negatively (positively). This is because other informed traders could step in and retain part of their gains. So, in Panel B we regress net insider purchases on two dummy variables indicating whether earnings announcements returns peak positively or negatively for a firm relative to whole sample period. Specifically, a positive (negative) peak corresponds to a dummy variable that equals to 1 when a firm reaches the top (bottom) tercile of EA_0 return and zero otherwise. As in Panel A, columns 1 to 3 consider insider trading activity from day 0 to day $+5$, and columns 3 to 6 take days $+6$ to day $+20$.

The results in column 1 show that insiders trade more intensively in window $(0,+5)$ when earnings announcements abnormal returns peak in a given quarter relative to returns for the whole sample. The negative and significant coefficient for the positive peak of earnings return suggests that insiders sell more intensively in days $(0,+5)$ when earnings announcements abnormal returns peak positively, and the positive and significant coefficient for the negative peak shows that insiders sell less (or buy more) when returns peak negatively. In other words, these results suggest that insiders sell more on average in quarters where earnings announcements returns peak positively, and buy more after returns peaking negatively. Comparing these results to column 4 with later insider trading in window $(+6, +20)$, we see that the coefficients are larger for window $(0,+5)$. This indicates that insiders trade more intensively in a contrarian way shortly after the publication of earnings when earnings returns peak, which is in line with our timing hypothesis of insiders.

[12] Excluding quarters with no insider trading does not affect the results. When excluding these quarters from the analysis the results become stronger. We report these results in Table I.2 as part of the internet appendix.

[13] One valid question is whether option related transactions have an impact on our results. We only consider open market purchases and sales and therefore we do not take into account transactions that comes from grants u other derivative securities. Option related transactions are usually associated to mechanistic trading, that is non-information driven (Ravina and Sapienza, 2010). In line with this argument, in an unreported analysis, we verify that the inclusion of these transactions has no impact in our results. We thank the referee for this suggestion.

Now columns 2 and 3 show that the pattern just described is concentrated on insider sales. In column 3, for sales, the positive coefficient of a positive peak in EA0 return means that insiders sales in window $(0,+5)$ are 36.5% standard deviation higher in quarters where earnings announcements returns peak positively relative to other quarters. The same coefficient in column 6 is less positive (-7.1%) for insider trading in window $(+6,+20)$. Now, the negative coefficient for Negative EA_0 return suggests that insiders sales in window $(0,+5)$ are 17.5% standard deviation lower in quarters where earnings announcements returns peak negatively relative to other quarters, and the magnitude of this coefficient is again lower in column 6. In other words, insiders sell more (less) intensively shortly after earnings announcements when earnings announcement returns peak positively (negatively).

The timing conjecture is not as strong for purchases. The fact that the coefficients for purchases in window $(0,+5)$ are lower in magnitude than in window $(+6,+20)$ means that insiders buy less intensively when earnings announcements returns peak (positively or negatively) right after the news. This suggests that insiders take a little more time to buy opportunistically after the news than to when selling.

Overall, the results in Table 4 show that insiders that trade sooner after the publications of earnings are more motivated to exploit peak abnormal returns originated at the earnings announcements, especially when selling. Insiders buy (sell) more intensively shortly after the announcement when the market reacts strongly to the news.

4.3. Short term future returns

To properly round our findings, we explore whether insider trading activity shortly after the publication of earnings exhibit return predictability. If insiders trade on mispricing generated at the earnings announcements, then prices should move according to their trades. In Table 5 we regress post EA_0 abnormal returns on insider trading activity at the two time windows of interest, that is $(0,+5)$ in Panel A and $(+6,+20)$ in Panel B. Columns 1 and 2 show the base specification, and in column 3 and 4 we interact net insider purchases with two dummy variables indicating whether earnings news is positive or negative for a firm in a given quarter. To classify a firm-quarter as good (bad) news, every calendar quarter we sort firms in terciles based on the 3-day earnings announcements abnormal return (EA abnormal returns). Consequently, good (bad) news are firms in the top (bottom) terciles of the distribution.[14]

In line with our predictions, the results in columns 1 and 2 of Panel A show that net insider purchases predict short term post-earnings announcements abnormal returns. The positive and significant coefficient for net insider purchases indicates abnormal returns are larger (lower) after 2 and 3 months of the announcement date when insiders buy (sell) more intensively in days $(0,+5)$. Interestingly, the results in column 3 and 4 show that insiders make profits regardless of the direction of the news. The positive and significant coefficient for the interaction between net insider purchases and bad news indicates that post-earnings returns are larger (lower) when insiders buy (sell) more intensively even when firms show negative news. For the interaction with good news, even when the coefficient is negative, the overall marginal effect of net insider purchases is positive after 3 months of the publication of earnings. This means that insiders also trade profitably in firms with positive news.

The result in column 3 and 4 suggests that every time insiders buy or sell shortly after an earnings announcement, they correctly perceive a mispricing and subsequently buy or sell and make profits as the stock prices revert. This is in line with insiders trading opportunistically when market has over- or under-reacted to a positive or negative earnings announcement. Furthermore, as these trades happen after the publication of earnings they are able to earn money with no risk of legal scrutiny.

For insider trading in window $(+6,+20)$ in Panel B, there is no evidence of return predictability, suggesting that only insiders who trade opportunistically shortly after the publication of earnings trade profitably. In summary, the results in this section show that insiders do not seem to trade mechanistically against investors' sentiment after earnings announcements. Insiders seem to trade opportunistically when market over- or under-react to the earnings news, indicating that they are skilful investors who pick the best time to trade. By trading shortly after the publication of earnings insiders make profits and avoid legal jeopardy. These findings are in line with the view that insiders' source of information to trade comes from situations when the market misinterprets public information rather than taking advantage of foreknowledge of future information.

5. Conclusions

The literature has shown that insiders trade in a contrarian way against past returns and book-to-market ratio. The reasons behind this contrarian trading are either foreknowledge of future material information or mispricing. With data post-SOX, our paper provides new evidence that insider trading patterns are closely associated to stock mispricing of their stock after earnings announcements, but they are not related to foreknowledge of future firm performance. Our evidence is threefold. First, we show that insider trading strategies are highly responsive to the market reaction to the most recent earnings announcements. In particular, the explanatory power of the recent earnings announcement return over the intensity of insiders' purchases and sales is higher compared to other determinants, especially for insiders transactions occurring in a short window after the publications of earnings (from day 0 to $+5$). Moreover, we also provide new evidence concerning the horse race between insiders trading passively on private interpretation of publicly disclosed information versus trading actively on foreknowledge of future earnings innovations. In contrast to Piotroski and

[14] We consider earnings returns as the proxy for earnings surprises in this section as we conjecture that insiders trade based on the market reaction to the news, and earnings returns is a more direct measure of it. In a unreported results, we also consider terciles of seasonal-random walk surprises (*SUE*) and the results hold the same.

Table 5

Future returns. This table reports fixed (firm and time) effects regressions for future abnormal returns, which are defined as buy and hold abnormal returns over 2 and 3 months after the EA_0 earnings announcement adjusted by the corresponding 5x5 size and book-to-market portfolio returns. Panels A report specifications considering *net intensity of purchases* from day 0 to day 5 after EA_0, while Panel B takes from day 6 to day 20. All variables are winsorized at the 1st and 99th percentiles and standardized by subtracting the mean and dividing by the standard deviation. They are defined in Appendix A. We report Hubert/White robust standard errors and allow them to cluster within firms. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Future returns	1 (+6, +46)	2 (+6, +66)	3 (+6, +46)	4 (+6, +66)
Panel A:				
Net insider purchases (0, +5)	0.011^a	0.012^a	0.016^a	0.014^a
	(0.002)	(0.002)	(0.004)	(0.004)
EA_0 return	0.031^a	0.015^a		
	(0.003)	(0.003)		
Bad news			−0.041^a	−0.024^a
			(0.005)	(0.006)
Bad news × net insider purchases (0, +5)			0.014^b	0.012^c
			(0.006)	(0.007)
Good news			0.023^a	0.001
			(0.005)	(0.005)
Good news × net insider purchases (0, +5)			−0.015^a	−0.009^c
			(0.005)	(0.005)
Past return	0.024^a	0.020^a	0.024^a	0.020^a
	(0.003)	(0.003)	(0.003)	(0.003)
Book to market ratio	−0.016^c	−0.032^a	−0.017^c	−0.032^a
	(0.009)	(0.010)	(0.009)	(0.010)
Size	−0.453^a	−0.620^a	−0.456^a	−0.622^a
	(0.017)	(0.019)	(0.017)	(0.019)
ROA (EA_0)	0.042^a	0.019^b	0.043^a	0.020^b
	(0.008)	(0.008)	(0.008)	(0.008)
EPS (EA_0)	0.031^a	0.025^a	0.032^a	0.026^a
	(0.005)	(0.005)	(0.005)	(0.005)
Constant	−0.269^a	−0.216^a	−0.267^a	−0.211^a
	(0.038)	(0.037)	(0.038)	(0.037)
Observations	144,251	144,126	144,251	144,126
R^2	0.027	0.032	0.003	0.001
Firm FE	yes	yes	yes	yes
Quarter FE	yes	yes	yes	yes
Panel B:				
Net insider purchases (+6, +20)	−0.009^a	−0.003	−0.003	0.002
	(0.003)	(0.003)	(0.004)	(0.004)
EA_0 return	0.028^a	0.012^a		
	(0.003)	(0.003)		
Bad news			−0.039^a	−0.022^a
			(0.006)	(0.006)
Bad news × net insider purchases (+6, +20)			0.006	0.003
			(0.007)	(0.007)
Good news			0.016^a	−0.004
			(0.006)	(0.006)
Good news × net insider purchases (+6, +20)			−0.016^a	−0.013^b
			(0.005)	(0.005)
Past return	0.019^a	0.016^a	0.019^a	0.016^a
	(0.004)	(0.004)	(0.004)	(0.004)
Book to market ratio	−0.007	−0.024^b	−0.007	−0.024^b
	(0.010)	(0.011)	(0.010)	(0.011)
Size	−0.561^a	−0.739^a	−0.564^a	−0.741^a
	(0.020)	(0.022)	(0.020)	(0.022)
ROA (EA_0)	0.046^a	0.017^c	0.047^a	0.018^b
	(0.009)	(0.009)	(0.009)	(0.009)
EPS (EA_0)	0.026^a	0.020^a	0.026^a	0.020^a
	(0.005)	(0.005)	(0.005)	(0.005)
Constant	−0.255^a	−0.201^a	−0.250^a	−0.194^a
	(0.041)	(0.040)	(0.041)	(0.040)
Observations	151,903	151,769	151,903	151,769
R^2	0.044	0.059	0.044	0.059
Firm FE	yes	yes	yes	yes
Quarter FE	yes	yes	yes	yes

Roulstone (2005), our results show that insider purchases or sales are not associated with future earnings innovations in a way that would suggest foreknowledge.

We also provide evidence that insiders time their transactions in a smart way after earnings announcements, so that they can trade profitably with no risk of legal scrutiny. We show that insiders trade more intensively shortly after the publication of earnings, when earnings announcement return peaks either positively or negatively in their firm for a given quarter relative to the whole sample period. Finally, in line with insiders trading on mispricing we show that insiders who trade shortly after news trade profitably irrespective of the direction of the news. Insiders buy or sell more intensively when market has under- and over-reacted to earnings announcements. As a result of this misvaluation stock prices adjust later to insider trades.

Altogether, our analysis suggests that insiders trade strategically and wisely, and use their private information to evaluate the extent of their firms' stock mispricing after public announcements of earnings when their informational advantage is relatively small and the risk of prosecution is minimized. As stock prices adjust to their trades possibly back to fundamental values, it might help to detect stock price deviations and, therefore, enhance stock market efficiency. In a broad perspective, our results are consistent with the view that US insider trading regulation is effective in minimizing insider trading on foreknowledge that is harmful to information collection and price discovery of outside investors (Ausubel, 1990; Fishman and Hagerty, 1992; Leland, 1992). However, insiders are still able to profit from their deep and intimate knowledge of their firms but in ways that seem to enhance rather than harm stock price efficiency.

Appendix A. Variable definitions

Variable	Definition	Source
Book to market ratio	Book value of equity corresponding to the previous quarter over the market cap 2 days before the earnings announcement EA_0.	COMPUSTAT
Cumulative ROA	Sum of returns on assets from EA_1 to EA_4. See the definition of ROA.	COMPUSTAT
Cumulative EPS	Sum of EPS from EA_1 to EA_4. See the definition of EPS.	COMPUSTAT
EA_0 return	Raw stock return over 3 days $(^{-}1, +1)$ around EA_0 adjusted for the corresponding 5x5 size and book-to-market portfolio return as downloaded from the Kenneth French web site. Computed as the buy and hold return.	CRSP, French's web site
EPS (EA_0)	Net earnings before extraordinary items per share less the earnings per share four quarters back all scaled by the closing stock price 2 days before the announcement date. Corresponds to the earnings announcement at the beginning of the quarter EA_0.	COMPUSTAT
Future return	The raw stock return beginning 6 or 20 days after EA_0 adjusted for the corresponding 5x5 size and book-to-market portfolio return as downloaded from the Kenneth French web site. Computed as the buy and hold abnormal return over the horizons of 2 to 3 months (46 and 66 trading days).	CRSP, French's web site
Negative EA_0 return peak	categorical variable equals to 1 for a firm that reaches the bottom tercile of the 3-day earnings-announcement abnormal return $(-1, +1)$ for the whole sample period and 0 otherwise.	CRSP, French's web site
Net intensity of purchases	The difference between the fraction of shares bought and sold by insiders in a given quarter. The fraction of shares bought (sold) by insiders is the total number of shares bought (sold) by all officers and directors in the quarter scaled by the number of shares outstanding. We also split net insider purchases at two time horizons after earnings announcements, first from day 0 to day 5 and then from day 6 to day 20.	Thomson Financial
Past return	The raw stock return over 12 months (265 trading days) ending 6 days before EA_0 adjusted for the corresponding 5x5 size and book-to-market portfolio return as downloaded from the Kenneth French web site, computed as the buy and hold abnormal return.	CRSP, French's web site
Positive EA_0 return peak	Categorical variable equals to 1 for a firm that reaches the top tercile of the 3-day earnings-announcement abnormal return $(-1, +1)$ for the whole sample period and 0 otherwise.	CRSP, French's web site
Post-EA_1 abnormal return	The raw stock return over 12 months (265 trading days) beginning 2 days after EA_1 adjusted for the corresponding 5x5 size and book-to-market portfolio return as downloaded from the Kenneth French web site, computed as the buy and hold abnormal return.	CRSP, French's web site
Quarter	Period between 2 earnings announcements.	COMPUSTAT
ROA (EA_0)	Net earnings before extraordinary items over total assets.	COMPUSTAT
Size	Stock price times the number of shares outstanding 2 days before the earnings announcement date, in regressions used in a logarithmic transformation.	COMPUSTAT

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.frl.2019.07.015

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