Opportunism, Overconfidence and Irrationality: A Puzzling Triad

Abstract

We empirically investigate managerial decision-making in a corporate context with combinations of rational/irrational managers and investors. There are noticeable differences in insider trading among these groups, particularly when exposed to market-wide and firm-level sentiment. We find that investor sentiment in the presence of managerial overconfidence has a significant impact on insider trading. We also show that managers behave opportunistically when timing stock splits and undertaking insider trading. Our finding linking splits to insider trading is robust under various specifications. In cases where irrational managers coexist with irrational investors, our study demonstrates important implications for the firms involved.

Keywords: Overconfidence; Irrationality; Insider trading; Sentiment; Stock split

JEL Classification: G39, G40, G41

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1. Introduction

This paper seeks to build on the growing literature concerning irrationality on the part of managers and investors by undertaking detailed examination of behaviour in relation to stock split decisions and insider trading. In addition to examining the impact of one group being rational while the other is irrational, we provide the first investigation of the coexistence of both irrational managers and irrational investors. To this end we investigate how market-wide and firm-level sentiment affect rational and irrational managers' opportunistic behaviour in relation to stock splits and the timing of the market around splits, while allowing for the presence or otherwise of rationality on the part of investors.

Considerable evidence in recent decades has demonstrated that, at times, prices in financial markets deviate from fundamental value and that arbitrage fails to quickly remove such deviations (see, for example, Froot and Dabora, 1999, Mitchell, Pulvino and Stafford, 2002, Lee, Shleifer and Thaler, 1991, Shleifer and Vishny, 1997)[1]. This and other evidence relating to a range of anomalies (for example, momentum, post-earnings announcement drift, the asset-growth anomaly) is inconsistent with the traditional finance view that economic agents are rational utility maximizers. Barberis and Thaler (2003, p.1053) remark that "unfortunately, after years of effort, it has become clear that basic facts about the aggregate stock market, the cross-section of average returns, and individual trading behavior are not easily understood in this [traditional finance] framework". In addition to such deviations of price from fundamental value allowing investors to develop profitable trading strategies, they provide managers within companies with the potential to behave opportunistically, to benefit both existing shareholders and, through insider trading, themselves. Empirical evidence supports this view. For example, Baker and Stein (2004) demonstrate that managers follow a successful rule of thumb and issue equity when the market is unusually highly liquid, which they argue is a sign of a market in which irrational investors are dominant. Similarly, Jenter (2005) suggests that when managers disagree with the market regarding the pricing of their firm they pursue market timing policies in relation to corporate decisions, such as IPOs and

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[1] Gromb and Vayanos (2010) provide a comprehensive survey of the theoretical developments in the limits of arbitrage literature. Also see the survey by Barberis and Thaler (2003) for a detailed discussion of the evidence for mispricings (e.g. twin shares, index inclusions, etc.).

SEOs, and their own insider trading behaviour; they tend to purchase shares for themselves when their firms have low market valuations and sell when their firms are valued highly. More recent evidence also confirms these earlier findings. [2]

While considerable evidence exists regarding (apparently rational) managers responding to investor irrationality, there is also evidence to suggest that managers themselves exhibit irrational behaviour (e.g. Malmendier and Tate, 2005, 2008, 2015; Campbell, Gallmeyer, Johnson, Rutherford and Stanley, 2011; Schrand and Zechman, 2012; Banerjee, Humphery-Jenner, Nanda, and Tham, 2018; Aktas, Louca and Petmezas, 2019) which can lead them to pursue disruptive strategies increasing the likelihood of business failure (Hayward, Shepherd and Griffin 2006). Such irrationality is expected to impact on managerial behaviour when faced with either rational or irrational investors. Our study examines the interactions of managerial and investor rationality vs irrationality in a novel empirical setting. So far, investigations of managerial irrationality have focused on situations where investors are assumed to be rational, despite the evidence relating to irrationality on the latter's part. As Baker and Wurgler (2013, p. 405) argue "the irrational manager and irrational investor stories can certainly coexist". Malmendier and Tate (2015) agree that irrational investors and irrational managers can occur simultaneously. Despite this, to date the issue remains substantially under-researched. Similarly, consideration of the differential behavior between rational and irrational managers when faced with irrational investors has received insufficient attention. This paper seeks to address these gaps in the literature to gain understanding of issues relating to managerial rationality and how they interact with situations where investors are irrational.

We address this gap by undertaking detailed examination of behavior in relation to insider trading. In particular, we investigate the extent to which managers being rational or irrational (as measured by managerial overconfidence) affects opportunistic trading of firm insiders when faced with irrational investors (as measured by investor sentiment).[3] Thus, in addition to examining the case where investors are irrational and managers rational, we investigate the coexistence of irrational managers and irrational investors in relation to

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[2] For instance, Johnson, Kim and So (2019) find that insiders at firms with high expectations management incentives time their trades opportunistically around earnings announcements. Furthermore, Dong, Hirshleifer, and Teoh (2021) suggest that managers of overvalued firms may be more willing to undertake risky innovative activity.

[3] As Campbell et al. (2011) point out, Malmendier and Tate (2005) make a well-argued case to refer to optimism as overconfidence. We use the terms highly optimistic and overconfident managers to refer to managers who "overestimate the future performance of their firms" (Malmendier and Tate, 2015, p.40). See Moore and Healy (2008), Jin et al. (2020) and Han et al. (2022) for further discussion.

managerial opportunistic behavior. In addition to examining how insider trading behavior is affected by managerial rationality when faced with irrational investors generally, we also consider stock splits as a special case. Our choice of stock splits as the focus for our investigation is motivated by two considerations. First, as Baker, Greenwood and Wurgler (2009) argue "nominal share prices and stock splits are not associated with any confounding, 'real' motivation involving firm fundamentals" (p.2563). Second, prior studies have shown that stock splits are associated with post-announcement positive abnormal returns (see, for instance, Grinblatt, Masulis and Titman, 1984; Ikenberry, Rankine and Stice, 1996; Desai and Jain, 1997; Ikenberry and Ramnath, 2002; Titman, Wei and Zhao, 2022), creating a suitable platform for managers to time the market.[4] Specifically, we analyze managers' timing of the market in relation to insider trading around splits and in terms of the decision to split. This allows a deeper insight of managerial behavior relating to differences in rationality to be determined. The analysis has relevance for managers and owners of businesses, as it demonstrates that corporate financial decisions, including opportunistic behavior, is impacted by managerial rationality/irrationality. Such behavior has the potential to be of benefit to both the managers themselves and existing shareholders.

Our paper makes several important contributions to the finance literature. First, we contribute to the behavioural corporate finance literature, a strand of work surveyed in Baker and Wurgler (2013), by providing a better understanding of managerial behavior by considering the rationality of both managers and investors within a context which recognizes that both groups may act irrationally. The findings of major differences in behavior between rational and irrational managers in relation to insider selling and stock splits provide new insights to manager behavior. In addition, the finding of an interaction between manager and investor irrationality is important for a better understanding of managerial behavior and is of potential importance to owners. Second, we contribute to the literature on the motives for stock splits. A number of hypotheses have been put forward to explain splitting (e.g., trading range hypothesis (Copeland, 1979), signalling hypothesis (Grinblatt, Masulis and Titman, 1984), optimal tick size hypothesis (Angel, 1997), information asymmetry reduction hypothesis (Brennan and Copeland, 1988)). Baker, Greenwood and Wurgler (2009) offer a further explanation for stock splits by proposing a catering theory of nominal stock prices, where managers deliver shares at lower price levels when investors value low-price firms highly in

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[4] Devos, Elliott and Warr (2015) find that 65% of CEO stock sales occurred after the split announcement (as opposed to 35% happening before the announcement) and this opportunistic insider trading provided a $345,613 average gain to the CEO by delaying the sale until after the split announcement.

the market. Building on this argument, we examine the role of managerial overconfidence and market-wide investor sentiment in firm-level splitting activity to consider opportunistic managerial behavior.

Third, the study also adds to the insider trading literature (see for example Biggerstaff, Cicero, and Wintoki, 2020; Titman, Wei, and Zhao, 2022). Devos, Elliott and Warr (2015) find significantly higher levels of insider selling after split announcements, consistent with opportunistic CEO behavior. We provide deeper and more direct tests for opportunistic managerial behavior and examine the link between stock splits and insider trading by considering 'routine' and 'opportunistic' insider trading and 'higher' and 'lower' level insiders. Our findings provide important new insights within the field of behavioral corporate finance and shed new light on the opportunistic behavior of managers within a novel setting.

The remainder of the paper proceeds as follows. In the next section we build the theoretical framework and develop the hypotheses. Section 3 outlines the data used in the analysis. Section 4 presents analysis and results relating to the three stages of our investigation: the link between managerial overconfidence, investor sentiment, and insider trading; analysis of how managerial rationality and investor sentiment impact on the decision to undertake a stock split; and examination of differences between pre- and post-split insider trading activity and the impact that managerial rationality has on this behavior. The final section concludes.

2. Theoretical Framework

Barberis and Thaler (2003) discuss biases affecting both beliefs and preferences in the context of irrationality. While there are many such biases examined in the literature, two have attracted considerable attention and been shown to be of importance in affecting financial market behavior: namely overconfidence and sentiment. De Bondt and Thaler (1995, p. 389) refer to overconfidence as "[p]erhaps the most robust finding in the psychology of judgement" while Rabin (1998, p. 31) states that "there is a mass of psychological research that finds people are prone toward overconfidence in their judgments". Overconfidence has been shown to apply to managerial behavior, not only in terms of (apparently rational) managers responding to investor irrationality, but also by impacting on managerial behavior when faced with rational investors. For example, Baker and Wurgler (2013, p. 388) propose that "an optimistic manager never believes there is a good time to issue equity" due to being optimistic about new investment

opportunities and the firm's assets. Hence, the optimistic manager believes that existing long-term shareholders will lose if a fraction of the firm is sold, as they think the firm is undervalued.

Similarly, overconfident managers may be expected to engage in less insider selling, all else being equal. Within the Baker and Wurgler (2013) framework, irrationality comes from the management side and investors are considered to be rational, although they recognize that both investors and managers may simultaneously behave irrationally. Within this 'coexistence' view, Malmendier and Tate (2015) provide a hypothetical example of a firm's value being assessed by investors, a rational CEO, and an overconfident CEO. In their example, an overconfident CEO will always put a higher valuation on the firm than a rational CEO. In low investor sentiment periods, the valuation of both a rational CEO and an overconfident CEO will be greater than that of investors, making the irrationality of managers irrelevant for market-timing. Irrelevance of managerial irrationality can also hold for periods when market-wide investor sentiment is at very high levels, since investors' assessment of firm value will be higher than that of not only a rational manager, but also an overconfident manager. However, while there will be some periods when the decisions of a rational manager and an overconfident manager will be similar, the opportunistic behavior of rational and overconfident managers can be expected to significantly differ during other periods: for example, when investors' valuation is between that of rational and overconfident managers. In such periods (e.g., 'intermediate' levels of investor sentiment) rational managers will recognize any overvaluation by irrational investors and act opportunistically, whereas overconfident managers may still believe that the firm is undervalued, making opportunistic market-timing behavior less apparent for these overconfident managers than for rational managers. The arguments of Malmendier and Tate (2015) suggest that such differences will be more marked for higher levels of the intermediate sentiment state. Thus, investor irrationality can have a differential impact on the behavior of rational and irrational managers.

Considering the above framework, we begin our discussion by considering the roles of market-wide investor sentiment and managerial overconfidence in explaining the net selling activity of insiders. We consider the case where irrationality coexists from both management and investor angles and argue that opportunistic insider trading behavior is likely to be influenced by investor sentiment and managerial overconfidence. If managers are rational but investors are irrational, then the contrarian view of expected stock returns suggests that higher beginning-of-period investor sentiment will lead to higher insider selling. That is, rational insiders will seek to sell their holdings before an anticipated fall in prices to fundamental value.

If, on the other hand, investors are rational, and managers are irrational, overconfident managers will be less likely to sell their shares as they believe their firms to be undervalued. Alternatively, if irrationality exists on both sides, we expect irrational managers to make the same insider selling decisions as rational managers in below average and high investor sentiment periods: insider selling in high sentiment periods will be greater than in low sentiment periods. Therefore, we propose our first hypothesis as follows.

H1a: Net insider selling is larger in high sentiment periods.

Comparing the behavior of rational and irrational managers, we can argue that overconfident managers will be less likely to sell their shares compared to rational managers as they believe their firms' shares are undervalued. However, overconfident managers are expected to make different decisions to rational managers only in intermediate level sentiment periods, for reasons set out by Malmendier and Tate (2015) and discussed above. Specifically, at intermediate levels of investor sentiment, rational and overconfident managers will significantly differ in their views of firm valuation (relative to the views of investors), leading to differences in relation to opportunistic behavior. In such periods investors' valuation of a firm will be higher than that of rational managers, but lower than that of overconfident managers. We, therefore, expect that overconfident managers will sell less during periods of intermediate levels of sentiment, particularly at higher levels of the intermediate state. Therefore, our second hypothesis in relation to the impact on insider selling of manager and investor irrationality are as follows:

H1b: The impact of overconfidence on net insider selling is more adverse in intermediate (compared to low/high) sentiment periods.

Prior studies have evidenced that stock splits are linked to pre- and post-announcement positive abnormal returns (Gharghori, Maberly, and Nguyen, 2017). Furthermore, evidence suggests a contrarian response of subsequent stock returns to market-wide investor sentiment: low (high) sentiment is followed by high (low) returns, suggesting prices are relatively low (high) when sentiment is low (high). When the impact of investor sentiment on the likelihood of a stock split is considered, managers are expected to be more likely to undertake a stock split at higher levels of market-wide investor sentiment since it allows them to time insider trading activity for their own benefit. In another words, they will be able to sell in the post-split announcement period and receive higher abnormal return. Even when there is another motivation for a split (e.g., signaling, catering, etc.), the precise 'timing' of the split by

opportunistic managers is expected to be affected by investor sentiment. Hence, we expect there will be a positive relationship between investor sentiment and the likelihood of a split.

When managerial irrationality is considered, overconfident managers believe their firm to be undervalued and that the current period is not a good time to sell their shares. Therefore, we expect overconfident managers to be less likely to undertake a stock-split, since any post-split abnormal returns may be insufficient to move the stock price to the value they perceive to be correct. However, alternatively, their overconfidence about the prospects of their firm may lead them to use stock splits to try to signal good information (or possibly more accurately their (over) confidence) resulting in a higher likelihood of splits among such overconfident managers. Hence, there are competing arguments as to whether split likelihood will differ between firms with rational and overconfident managers making it difficult to make a prediction regarding the impact of overconfidence on split likelihood in low or intermediate sentiment periods. However, when market-wide investor sentiment is at high levels, investors are likely to value a firm more highly than even overconfident managers. In such a situation the investor overvaluation will lead to the behavior of overconfident managers being similar to that of rational managers regarding opportunism. Accordingly, during periods of high investor sentiment the only differentiating motive between rational and overconfident managers will be the latter's greater tendency to signal good quality of their firms. Therefore, we expect higher split likelihood when managers of a firm are overconfident and investor sentiment is high. Consequently, our hypotheses in relation to the impact of manager and investor irrationality on stock split likelihood are as follows:

H2a: Investor sentiment and the probability of a stock split are positively correlated.

H2b: At high levels of investor sentiment, firms with overconfident managers are more likely to undertake a split.

Existing evidence suggests the use of splits opportunistically in relation to various corporate decisions such as equity issuance (D'Mello, Tawatnuntachai, and Yaman, 2003) and stock financed mergers and acquisitions (Guo, Liu and Song, 2008). There are also previous studies that investigate the level of insider trading activity after other specific corporate actions. For instance, Louis, Sun and White (2010) find abnormally high net insider selling after repurchase announcements. Park and Park (2004) find a positive relationship between discretionary accruals and insider sales and Chen, Cohen and Lou (2016) demonstrate that net insider selling is higher for firms which switch their primary industry classification to favorable

industries. In view of the positive relationship between splits and pre- and post-split returns documented in prior literature, our expectation is that if managers are opportunistic, they will delay selling until after the announcement and thus net insider selling will be higher in the post-split period than in the pre-split period. In terms of managerial irrationality, it is expected that differences in CEO insider selling between pre- and post-split announcement periods will be affected by whether a manager is overconfident. Specifically, if overconfident managers believe their firm is undervalued, any increase in share value resulting from a split may be insufficient to overcome this undervaluation. Thus, we expect the difference between pre- and post-split selling behavior to be smaller for overconfident CEOs. We also expect differences between routine and opportunistic insider selling, with the latter expected to show a stronger pattern of differences in behavior between pre- and post-split periods compared to the difference for all trades. Therefore, our third set of hypotheses is as follows.

> *H3a:* CEOs opportunistically time the market by delaying selling activity until after a split announcement, resulting in net insider selling being higher in the post-split period.

> *H3b:* The difference in net insider selling between pre-split and post-split periods is smaller for overconfident CEOs.

3. Data

Our sample covers CRSP listed stocks from 1996 to 2016. Stock split data and share price data are gathered from 'CRSP Stock Events - Distribution Information' and 'CRSP Stock/Security Files', respectively, for all shares that have share codes of 10 or 11. In line with previous studies (e.g., Baker, Greenwood and Wurgler, 2009; Birru and Wang, 2016), we define regular splits as events with a CSRP distribution code of 5523 and a split ratio of greater than 1.25. As the main proxy for market-wide investor sentiment, we employ the Baker and Wurgler (BW) sentiment index (as in Baker and Wurgler (2006)), which was downloaded from Jeff Wurgler's website for the period until the end of September 2015. For validation we also estimate consistent results using the Michigan Consumer Sentiment Index (MCSI) as an alternative proxy.[5] The MCSI data, which is compiled by the University of Michigan Survey Research Center, was downloaded from the Federal Reserve Economic Data (FRED) website (to June 2017).

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[5] These results are untabulated and available upon request.

We base the proxy for managerial irrationality on Campbell et al. (2011)[6] and calculate a managerial overconfidence measure using option data downloaded from Compustat-Capital IQ ExecuComp – Annual Compensation and Company Financials for 1992-2016. The measure they develop builds on the stock option-based optimism measure of Malmendier and Tate (2005). Similar to Campbell et al. (2011, p.700), we define highly optimistic CEOs as ones who "hold stock options that are more than 100% in the money, where the average percent moneyness of the options equals the per-option realizable value divided by the estimated average exercise price."[7]

Insider trading data is extracted from the Thomson Reuters Insider Filings database for the period January 1996 to December 2016. Following Jeng, Metrick and Zeckhauser (2003) and Cohen, Malloy and Pomorski (2012), we use Securities and Exchange Commission's (SEC) Form 4 filings and concentrate on open market purchases and sales by insiders. We employ net insider selling (sells net of buys) in the year, scaled by the firm's market capitalisation (000s) at the end of the previous year, NETSELL, to investigate the impact of splits, CEO overconfidence, and investor sentiment on insider trading behavior. Employing NETSELL allows us to examine the extent to which insiders benefit from insider selling during stock split periods (i.e., selling their shares when prices are perceived to be higher than fundamental values), while taking account of firm size. Table 1 presents the summary statistics of the sample. Around 20% of the sample overall includes overconfident CEOs and open market selling by insiders is greater than buying in general, with positive average values for net sales ratio and net insider selling.

INSERT TABLE 1 ABOUT HERE

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[6] Malmendier and Tate (2015, p.41) develop an alternative measure for CEO overconfidence that incorporates "details of individual option packages" (e.g. individual grant dates, expiration dates, etc.), and hence, allows the assessment of "the timing of exercise relative to expiration (or grant) dates". However, this measure can only be constructed from 2006 onwards due to data unavailability for earlier years.

[7] Further information on requirements for, and calculation of, the option-based optimism measure is provided in the online data appendix (appendix 1).

4. Empirical findings

4.1.Managerial Overconfidence, Investor Sentiment, and Insider Selling

We start by considering hypotheses 1a-1c to examine the relationship between insider trading and managerial overconfidence and investor sentiment. To this end, we estimate equation (1):

$$NETSELL_{i,t} = \alpha + bSENT_t + cOVERCONF_{i,t} + dM/B_{i,t} + eMARET_{i,t} + f\Delta ROA_{i,t+1}$$
$$+ gMARET_{i,t+1} + hSHAREHOLDING_{i,t} + iGRANTS_{i,t}$$
$$+ jOPTIONS\_EXRC_{i,t} + u_{i,t}. \qquad (1)$$

where the dependent variable is net insider selling (sells net of buys) in the year scaled by the firm's market capitalization ($000s) at the end of the previous year, NETSELL.[8] Estimates are also undertaken using alternative dependent variables: specifically, for only opportunistic trades (OPPOR NETSELL), CEO trades (CEO NETSELL), and CEO opportunistic trades (CEO OPPOR NETSELL).

It is recognized that some insider trading is considered "routine", while other trades are considered "opportunistic". As Cohen, Malloy and Pomorski (2012) argue, routine trades may occur due to liquidity or diversification reasons with such trading not being based on any particular information about the firm. Opportunistic trades, on the other hand, "weed out uninformative signals and identify a set of information-rich trades that are powerful predictors of future firm returns, news, and events" (p. 1012). To distinguish between 'routine' and 'opportunistic' insider trading, we follow the approach used by Cohen, Malloy and Pomorski (2012) and also calculate net insider selling using only 'opportunistic' trades.[9]

The first explanatory variable of interest is a categorical sentiment variable which is calculated from beginning-of-year market-wide investor sentiment values. In this paper we generally split the sentiment values into three: 'Low sentiment' is a period where the sentiment value is below the 20th percentile, 'Medium sentiment' is where the sentiment value is between the 20th and 80th percentiles and 'High sentiment' is where the sentiment value is above the

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[8] Insider trading is commonly expressed in the 'net' form in previous related studies (e.g., Lakonishok and Lee 2001; Jenter 2005; Piotroski and Roulstone 2005; Brown, Christensen, Elliot and Mergenthaler 2012; Dong, Hirshleifer and Teoh 2012; Chen, Cohen and Lou 2016).

[9] See appendix 1 for more detail. Ali and Hirshleifer (2017) propose an alternative method for identifying opportunistic trades based on the profitability of trades by insiders before earnings announcements. We choose to use the Cohen, Malloy and Pomorski (2012) approach, since the Ali and Hirshleifer (2017) measure focuses on profitability from trading prior to a specific news item and depends in part on the skill of the insider in identifying the true worth of the information.

80th percentile. In the first stage of the analysis the base category is a combination of low and medium sentiment periods, since hypothesis H1a relates to high sentiment periods compared to other periods. The second explanatory variable is OVERCONF, a binary variable of one if the CEO of the firm is overconfident and zero otherwise. Following Piotroski and Roulstone (2005), other explanatory control variables include firm level contrarian factors, measures of information advantage of insiders for future news and changes in insiders' holdings.[10] To gain greater insight and to examine in more detail issues relating to the coexistence of managerial and investor irrationality, we also estimate equation (1) using categorical sentiment variables for various categories, including intermediate levels. Since the bounds of intermediate levels of sentiment cannot be unambiguously determined, we undertake analysis using both a three-way and a four-way categorization. These are 1) low, medium and high; and, 2) low, moderately low, moderately high and high, where low and high are as previously defined and the medium category is split into the two moderate groups for the 20th-50th and 50th-80th percentiles. We also undertake analysis using categories at the 30th and 70th percentiles, to test for robustness. Standard errors are not only clustered by year as in Baker, Greenwood and Wurgler (2009), but also at stock level since, for instance, a CEO's decision to exercise or hold stock options (the main factor used to construct the CEO overconfidence measure) may depend on the expectations of the board of directors, as also argued by Campbell et al. (2011).[11]

Table 2 presents results of the estimates of equation 1 using fixed-effects estimations of net insider selling on market-wide investor sentiment and CEO overconfidence. The first column shows results when the dependent variable is net insider selling of all insider trades. Results for opportunistic trades of all insiders are presented in column 2 and the final two columns show results for all trades by CEOs and opportunistic trades by CEOs respectively. Before considering the two key variables of interest, it is worth noting that insiders appear to be more affected by control variables related to firm level sentiment, since the coefficients for the market-to-book ratio and contemporaneous market-adjusted return are significantly positive for all four measures. The other control variables to be consistently significantly different from zero are exercising options, which has a significantly positive effect on insider selling activity, and NYSE market capitalization decile as of the end of the previous calendar

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[10] See appendix 1 for more details on control variable construction.
[11] Although standard errors are clustered at both stock and time (year) levels which would also control for a possible serial correlation among different stocks in the same year, we've also gathered estimations also controlling for the financial crisis (via a further financial crisis dummy control variable that takes the value of 1 if the year is from the financial crisis period). Results looked qualitatively very similar and are available on request.

year and firm's earnings innovation in the following year both of which have a negative effect on insider selling activity. The coefficient for the number of shares held by executives (grants) variable is also significant and positive (negative) for all CEO trades and opportunistic CEO trading (columns 3 and 4), but not for all insider trading trades (columns 1 and 2).[12]

INSERT TABLE 2 ABOUT HERE

Turning to our variables of interest, hypothesis H1a receives clear support for both all insider selling (column 1) and opportunistic trades of all insiders (column 2), with the coefficient for 'High sentiment' being positive, sizeable and statistically significant in these two cases. However, when only CEO trades are considered there is no significant difference in high sentiment periods than in other (low and medium) periods. Nonetheless, the results in the first two columns provide evidence that net insider selling is higher in periods of high sentiment, generally consistent with managers believing that in higher sentiment periods investors overvalue the firm. The coefficient for 'OVERCONF' is negative in all four columns, and statistically significant in all cases, except opportunistic trades by CEOs. These findings are consistent with overconfident managers being unwilling to sell their shares because they believe the market to be undervaluing their stock.

In table 3 we explore the relationship between sentiment, overconfidence and insider trading in more detail, by estimating equation 1 using categorical sentiment variables as set out above.[13] We focus our attention on CEO net selling and CEO opportunistic net selling, given our expectation that CEOs will be affected more strongly by the level of overconfidence. This analysis allows consideration of hypothesis H1c, that the expected negative impact of overconfidence will be greater in periods of intermediate sentiment than in low and high sentiment periods.

INSERT TABLE 3 ABOUT HERE

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[12] While the reasons for the negative coefficient for GRANTS is not the main focus of the paper, it is consistent with the endowment effect: people require a higher sum to give up an asset they own (in this case stock options granted) than they would be prepared to pay to buy them if they do not own them, due to emotional attachment.
[13] Results using the 70th percentile as cut-offs for 'high sentiment' periods and, accordingly, 30th percentile for 'low sentiment' periods are qualitatively similar and are available from the authors on request.

Table 3 reports the coefficients in relation to the OVERCONF variable from fixed effect regressions of CEO net insider selling as in equation 1.[14] The first three rows of table 3 show results for low, medium and high sentiment splits, while the next four rows show results for low, moderately low, moderately high and high sentiment periods. The columns present the estimated coefficient, the related robust standard error of the coefficient, the number of observations, N, and the R^2. Results using the three-way sentiment split show that the coefficient is insignificantly different from zero at 'low sentiment' and "high sentiment" levels. In contrast, it is negative and significant for the medium sentiment level. Thus, consistent with hypothesis H1c, for the three-way split the impact of managerial overconfidence on net insider selling is greater in intermediate sentiment periods. These results are consistent with our expectation that at low and high levels of investor sentiment irrational (overconfident) managers will trade in a manner broadly consistent with rational managers, but that at intermediate levels of sentiment overconfident managers will sell significantly less than rational managers. Given the lack of a clear definition of the intermediate sentiment state and the arguments of Malmendier and Tate (2015), we split the medium sentiment category into two: moderately low and moderately high, with results presented in the second block in table 3. The results for moderately high sentiment periods are consistent with those for the three-way split, but the difference is more marked: for such periods, the negative impact is greater than for all medium sentiment periods, with coefficients of -1.22 vs -0.65. In contrast, the coefficient for moderately low sentiment is insignificant, again. The results are consistent with our expectations. Hence, table 3 provides strong evidence is support of hypothesis H1c. Taken together these results clearly identify differences in behavior between rational and irrational managers, with such differences depending upon the level of investor sentiment. Thus, managerial overconfidence and investor sentiment clearly interact to impact on insider selling activity, supporting all of hypotheses H1a-c.

4.2.Managerial Overconfidence, Investor Sentiment, and the Stock Split Decision

Next, we turn to consideration of the impact of manager and investor irrationality on stock split likelihood, undertaking tests of hypotheses H2a-b. To examine this issue we follow the Baker, Greenwood and Wurgler (2009) firm-level tests by estimating a Probit model at annual frequency. This enables us to examine the factors which determine the probability that a firm announces a stock split. Within a catering framework, Baker, Greenwood and Wurgler (2009)

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[14] In the interests of brevity, we only report results for the OVERCONF coefficient. Results for all coefficients are available on request.

show that managers' willingness to deliver lower prices (via stock splits) is greater when investors value low-price firms more highly. In the Probit regression the dependent variable, Pr(si,t), is a dummy taking the value 1 if a stock split is undertaken in year t and zero otherwise. Our baseline model takes the following form:

$$Pr\big(s_{i,t} = 1\big) = \alpha + bLPP_t + cp_{i,t} + dr_{i,t} + eNYSED_{i,t} + f\sigma_{i,t-1} + gp_{i,t}^{Industry}$$

$$+ u_{i,t}. \qquad (2)$$

In the baseline model the independent variables, which act as controls later when examining the impact of irrationality, are as in Baker, Greenwood and Wurgler (2009). Specifically, we have the previous year-end value-weighted low-price premium, LPP[15]; beginning-of-year log prices, p; contemporaneous annual log returns (excluding dividends), r; NYSE market capitalization decile as of the end of the previous calendar year, $NYSED$[16]; lagged volatility based on previous-year daily returns, σ; and beginning-of-year log industry average price in the matched Fama and French (1997) industry classifications, $p^{Industry}$.

To examine how irrationality impacts on stock split likelihood, we augment equation (2) by including measures to capture managerial overconfidence and investor sentiment, as previously defined. Results from estimation of the augmented equation (2) are presented in table 4. Column 1 shows results when including the managerial overconfidence and investor sentiment measures, column 2 presents results when overconfidence and categorical sentiment measures are used, while column 3 shows results including not only the overconfidence and sentiment variables, but also an interaction term. Finally, column 4 relates to a sample restricted to high sentiment periods, to examine how managerial irrationality affects the likelihood of a stock split in the presence of high investor irrationality.

INSERT TABLE 4 ABOUT HERE

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[15] The annual low-price premium (LPP) figures reported in Baker, Greenwood and Wurgler (2009) are updated to the end of 2016. See appendix 1 for further details of this variable.
[16] Market equity decile breakpoints were downloaded from Kenneth French's website.

Examination of the first three columns shows a clear pattern that managerial overconfidence does not impact on the decision to split, consistent with the argument that there are competing forces influencing overconfident managers: namely, a belief that post-split abnormal returns may be insufficient to move the stock price to its perceived value; and a desire to signal their confidence in the prospects of the firm. In contrast, sentiment is seen to have a positive impact on the likelihood of a split irrespective of whether a continuous variable (columns 1 and 3) or categorical variables (column 2) are used. It should be noted that the interaction term is not significant in column 3. Thus, in line with expectations and hypothesis H2a, a higher level of market-wide investor sentiment increases the likelihood of a stock split, all else constant. In column 4, the coefficient for the overconfidence variable is positive and significant. Recall this relates to high sentiment periods only and is consistent with hypothesis 2b: at high levels of investor sentiment overconfident managers are more likely to undertake a split than are rational managers. Hence, while managerial overconfidence does not appear to interact with sentiment across the whole range of sentiment levels, it influences managerial decision making when sentiment is high, in line with expectations.

4.3.Stock Splits and Insider Selling

We now consider the impact of managerial and investor rationality on the impact of stock splits on insider selling. Before proceeding to direct tests of hypotheses 3a-b, we undertake some preliminary analysis to establish whether there is a relationship between stock splits and insider selling. Results of the preliminary analysis are presented in Table 5, where we consider whether the decision to split impacts on the level of net insider selling, by estimating an augmented fixed effect regression as presented in equation 1 for all firms in the sample. Specifically, we add a binary variable which takes the value of one if there was a stock split in the same year, SPLIT. The analysis in table 5 shows that across all scenarios considered (the same four as in table 2) there is a positive and significant coefficient for SPLIT, pointing to insiders opportunistically timing trades in the case of stock splits. The results for high sentiment and OVERCONF variables remain unchanged, although the inclusion of SPLIT results in a significant overconfidence coefficient across all four columns (compared to three in table 2).

INSERT TABLE 5 ABOUT HERE

The preliminary analysis clearly demonstrates a relationship between managerial overconfidence, the decision to split and net insider selling, consistent with expectations. To gain greater insight into the opportunistic behavior of managers we now focus exclusively on the firms which undertake a stock split. Our investigation builds on Devos, Elliott and Warr (2015) and examines immediate insider trading activity in windows around split announcements. This allows us to examine hypotheses 3a-b by determining the extent to which insiders delay selling until after a split announcement, given the association of positive stock price reactions with split announcements.[17]

To undertake investigation, net insider sell in dollar terms, is calculated, using insider trading that occurs within 10, 20, 30, and 90 days either side of the split announcement. Tests for differences between net selling in the pre- and post-split announcement windows are undertaken. The results are reported in table 6. While our hypotheses relate specifically to CEO overconfidence, we report results for all insider trading ($NETSELL, column 1), top executives ($TOPNETSELL, column 2)[18], CEOs ($CEONETSELL, column 3) and opportunistic trades by CEOs ($CEOOPPORNETSELL, column 4). Our expectation is that the impact will be stronger for top executives and CEOs, since the arguments used to develop hypotheses 3a-b relate to CEOs. For each window the first two rows show average dollar net insider selling in the pre- and post-split periods respectively. The third row shows the t-statistic for tests of differences between the two periods and the fourth row shows the number of observations.

Across all four windows and all four measures of insider selling, a clear and consistent picture emerges: insider selling in the post-split period is higher than in the pre-split period, with the differences being sizeable and significant in fifteen of the sixteen cases (the exception relates to the 181-day window for net selling where all insiders are considered, where there is no significant difference between the two periods). For example, for the 1,741 splits with insider trading activity within 10 days before or after the announcement, the post-split figure is 118% higher ((5.89/2.70) * 100 - 100) than the pre-split value for $NETSELL, with the equivalent figures across the other three measures of insider trading being 181%, 210% and 85%. These results are clearly consistent with hypothesis H3a: insiders delay selling activity

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[17] Previous evidence suggests that much of a price change comes in the run-up to the announcement (see, for example, Fama, Fisher, Jensen and Roll (1969). However, evidence suggests that the split announcement itself still leads to positive abnormal returns, see references discussed in the introduction.

[18] Similar to Lou (2014), we use the insider role level classification of Thomson Reuters (i.e., our data source for insider trading) and define top executives as including the chairman of the board, the chief executive officer, the chief operating officer, the general counsel, and the president.

until after a split announcement, with this behavior holding for all insider trades, top executives, CEOs and CEO opportunistic trades. For the 21-day window, the findings are also broadly consistent with our expectation that the difference between pre- and post-split announcement net selling will be more marked for top executives and CEOs, since the percentage increase for all trades by all insiders is lower than for top executives and CEOs. Similar findings hold for top executives and CEOs for longer windows. Against expectations the difference is lower for CEO opportunistic trades than for the other three measures, although this measure includes the opportunistic trades of both rational and overconfident CEOs and the sample size for the 21-day window is relatively small. We, therefore, examine this issue in relation to CEOs in more detail shortly. However, results in table 6 clearly suggest that, regardless of their role level within a firm, insiders have a significant tendency to opportunistically time the market.

INSERT TABLE 6 ABOUT HERE

We next examine hypothesis H3b by considering differences in pre- and post-split insider selling between rational and overconfident CEOs. In this part of the analysis, we consider only insider trading by CEOs and focus our attention on the 181-day window[19]. Table 7 reports average dollar net insider selling by CEOs for pre- and post-split announcement periods, with results presented both for CEO net insider selling (Panel A) and for CEO opportunistic insider selling (Panel B). The first column reports results for all CEOs (the results are the same as those in the third column of table 6 for the 181-day window), the second and third columns report results for overconfident and rational CEOs respectively. The rows within each panel are the same as those for each window length in table 6. The first column again shows that for all CEOs net insider selling is significantly higher post-split than pre-split, for both measures of insider selling. Examination of columns 2 and 3 allows testing of the first part of hypothesis H3b by considering overconfident and rational CEOs separately. The panels show that when either all or opportunistic insider trading by CEOs is considered, selling in the post-split period is higher for both overconfident and rational CEOs. However, consistent with the first part of the hypothesis when we consider all (opportunistic) trades the percentage increase for rational CEOs, 59% (110%), is much bigger than for their overconfident

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[19] Shorter windows have much smaller sample sizes which would make analysis of sub-sets much less reliable.

equivalents, 20% (60%). Furthermore, while the difference is significant for rational CEOs, it is insignificantly different from zero for those that are overconfident when considering all trades and only significant at 10% for opportunistic trades. The finding in column 1 of a bigger percentage increase for opportunistic trades than for all trades is consistent with the second part of hypothesis H3b (post-split announcement selling is 50% higher for all CEO trades and 85% higher for opportunistic CEO trades). A similar pattern is found across the other two columns, providing further support for the second part of H3b. These findings suggest that for those that are overconfident any increase in firm value resulting from a split is not sufficient to encourage them to change their selling behavior given their own overvaluation of stock. Overall, the results from tables 5, 6 and 7 provide clear support for our hypotheses 3a-b.

INSERT TABLE 7 ABOUT HERE

5. Conclusion

Coexistence of irrational managers and irrational investors is often acknowledged in the literature as a theoretical possibility (see, e.g., Baker and Wurgler, 2013 and Malmendier and Tate, 2015), yet the issue has been under-researched. In this paper we consider the impact of the interaction between irrational investors and managerial rationality, by investigating in depth issues relating to insider trading and stock splits. To this end we develop several hypotheses and carry out detailed empirical testing. Consistent with our first set of hypotheses a positive relationship is found between net selling and sentiment for all insiders, although the relationship is insignificant for CEO trades. The findings for all trades support our argument that managers believe that in higher sentiment periods investors overvalue the firm. Furthermore, we find that managerial irrationality negatively impacts significantly on net insider selling, again consistent with expectations. Further analysis of CEO trading, however, suggests that managerial overconfidence and investor sentiment interact to impact on insider selling activity. In support of our second set of hypotheses, Probit analysis demonstrates that there is a positive relationship between investor sentiment and the decision to split (there is a higher likelihood of a split during high sentiment periods) and CEO overconfidence impacts positively on the split decision.

In addition, investigation of insider trading around the split announcement date provides strong support for the view that insiders delay selling activity until after a split announcement, consistent with insiders opportunistically timing the market for their own benefit. Further analysis demonstrates that this delay is more evident for rational CEOs than overconfident CEOs and for opportunistic trades compared to all trades, illustrating the importance of considering irrationality from both managerial and investor perspectives. These results are consistent with our third set of hypotheses.

In summary, we investigate corporate decision making within a framework which takes account of managerial rationality when faced with irrational investors. The findings support the view that managers behave opportunistically in terms of insider trading and timing the market around stock splits. The latter holds both in terms of the decision of the time to split and insider trading around a split. We demonstrate key differences between the behavior of rational and irrational managers, highlighting the importance of considering managerial rationality when analyzing corporate managerial decision making.

Our paper makes important contribution to the existing literature. In terms of our key research contribution to the behavioral finance literature, we respond to the call by Baker and Wurgler (2013) and Malmendier and Tate (2015) that the irrational manager and irrational investor can coexist. In particular, we investigate the coexistence of irrational managers and irrational investors in relation to managerial opportunistic behaviour. In addition, we contribute to the literature on stock splits (Copeland, 1979; Grinblatt, Masulis and Titman, 1984; Angel, 1997; Brennan and Copeland, 1988; Baker, Greenwood and Wurgler, 2009; Devos, Elliott and Warr, 2015; Amini, Buchner, Cai, Mohamed, 2020; Titman, Wei, and Zhao, 2022) by examining the role of managerial overconfidence and market-wide investor sentiment in firm-level splitting activity. Lastly, we contribute to the insider trading literature (see for example, Biggerstaff, Cicero, and Wintoki, 2020; Titman, Wei, and Zhao, 2022) by providing a detailed examination of the level and pattern of insider trading before and after stock splits, considering coexistence of investor and managerial irrationality.

Further, these results demonstrate the importance of taking account of the coexistence of managerial and investor irrationality and the impact of sentiment and overconfidence on insider trading. While rational and irrational managers are shown to exhibit similar insider trading behavior during periods of high and low sentiment, overconfident managers sell significantly less at intermediate levels of sentiment. We also identify differences in insider

trading around splits between all insiders and high-level insiders. Results also show that insiders delay selling until after a split announcement, consistent with opportunistic timing of the market for their own ends. This adds to the argument that stock splits can be used to profit insider trading (Nguyen, Tran, and Zeckhauser, 2017) and has practical implications for firms' stakeholders as well as potential investors. In particular, the results cast light on behavioral motives of the managers for stock split and therefore, is clearly of importance to shareholders.

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TABLES

Table 1. Summary statistics

	N	Mean	Median	SD	Min	Max
Panel A: Overconfidence measure						
OVERCONF	22,635	0.20	0.00	0.40	0.00	1.00
Panel B: Net insider sell measures						
NETSELL	22,635	10.49	1.31	44.08	-170.00	450.00
OPPORNETSELL	13,405	3.19	0.48	12.40	-30.00	140.00
CEONETSELL	22,635	1.62	0.00	6.56	-30.00	80.00
CEOOPPORNETSELL	3,234	2.85	0.80	7.10	-20.00	60.00
Panel C: Control variables						
M/B	22,635	1.91	1.46	1.31	0.72	8.18
MARET$_t$	22,635	0.05	0.00	0.50	-0.82	2.20
ΔROA$_{t+1}$	22,635	-0.00	0.00	0.09	-0.40	0.33
SHAREHOLDING	22,635	6.81	6.71	1.75	0.00	10.61
GRANTS	22,635	5.61	6.03	1.87	0.00	8.43
OPTIONS_EXRC	22,635	3.40	4.02	2.61	0.00	7.82

The sample includes CRSP listed stocks during 1996-2016. *OVERCONF* is a binary variable of one if the CEO of the firm is overconfident (highly optimistic) and zero otherwise. *NETSELL* is net insider selling (sells net of buys) in the year scaled by firm's market capitalization (000s) at the end of the previous year. *OPPORNETSELL*, *CEONETSELL*, and *CEOOPPORNETSELL* consider only opportunistic trades, only CEO trades, and only CEO opportunistic trades, respectively. *M/B* is firm's market-to-book ratio at the beginning of the year, *MARET$_t$* is firm's contemporaneous 12-month buy-and-hold market-adjusted return. *ΔROA$_{t+1}$* is firm's earnings innovation in the following year. SHAREHOLDING is log of one plus the ratio of the number of shares held by executives to total shares outstanding. *GRANTS* is log of one plus options and shares of restricted stock granted scaled by total shares outstanding. *OPTIONS_EXRC* is log of one plus number of options exercised scaled by total shares outstanding. 'N' represents stock-year observations. Variables are winsorized at the 1st and 99th percentiles.

Table 2. Insider trading, CEO overconfidence and investor sentiment

	NETSELL	OPPOR NETSELL	CEO NETSELL	CEO OPPOR NETSELL
	[1]	[2]	[3]	[4]
High Sentiment	3.71***	1.33***	0.11	0.01
	[4.77]	[3.92]	[1.02]	[0.03]
OVERCONF	-6.08***	-1.00**	-0.55***	-0.93
	[-4.96]	[-2.27]	[-3.14]	[-1.63]
NYSED	-2.57***	-0.98***	-0.28***	-0.58***
	[-9.44]	[-9.16]	[-7.24]	[-4.70]
M/B	6.79***	1.12***	1.20***	0.79***
	[19.15]	[8.46]	[23.82]	[5.02]
$MARET_t$	10.52***	2.55***	1.19***	2.09***
	[16.18]	[9.83]	[12.77]	[7.37]
ΔROA_{t+1}	-8.09**	-1.81	-1.71***	-0.46
	[-2.45]	[-1.38]	[-3.69]	[-0.34]
$MARET_{t+1}$	0.60**	0.13	0.04	-0.15
	[2.40]	[1.18]	[1.05]	[-1.03]
SHAREHOLDING	-0.06	0.01	0.13***	0.28**
	[-0.21]	[0.10]	[4.40]	[2.52]
GRANTS	-0.07	0.08	-0.08***	-0.31***
	[-0.37]	[0.40]	[-3.81]	[-4.20]
OPTIONS_EXRC	1.86***	0.56***	0.47***	0.53***
	[14.76]	[11.80]	[26.00]	[10.42]
R^2	0.07	0.05	0.11	0.16
N	22,635	13,405	21,879	3,176

This table reports fixed-effects estimations of net insider selling on market-wide investor sentiment and CEO overconfidence measures and other control variables for CRSP listed stocks 1996 to 2016. The dependent variable, NETSELL, is net insider selling (sells net of buys) in the year scaled by firm's market capitalization (000s) at the end of the previous year. In columns 2, 3 and 4, only opportunistic trades (OPPOR NETSELL), only CEO trades (CEO NETSELL), and only CEO opportunistic trades (CEO OPPOR NETSELL) are considered, respectively, while forming the dependent variable. The first independent variable of interest is a binary variable of one if beginning-of-year market-wide investor sentiment is high (above the 80th percentile), '*High sentiment*'. The second independent variable is *OVERCONF,* a binary variable of one if the CEO of the firm is overconfident (highly optimistic) and zero otherwise. Control variables include NYSE market capitalization decile as of the end of the previous calendar year, *NYSED*, firm's market-to-book ratio at the beginning of the year, *M/B*, firm's contemporaneous 12-month buy-and-hold market-adjusted return, $MARET_t$, firm's earnings innovation in the following year, ΔROA_{t+1}, firm's future 12-month buy-and-hold market-adjusted return during the following year, $MARET_{t+1}$, log of one plus the ratio of the number of shares held by executives to total shares outstanding, *SHAREHOLDING*, log of one plus options and shares of restricted stock granted scaled by total shares outstanding, *GRANTS*, and log of one plus number of options exercised scaled by total shares outstanding, *OPTIONS_EXRC*. *SHAREHOLDING*, *GRANTS* and *OPTIONS_EXRC* contain only CEO data for columns 3 and 4 where the dependent variable considers only CEO trading. Numbers in brackets are t-statistics. All estimations include an intercept, which is not reported for brevity. *, **, and *** denote statistical significance at the 90%, 95%, and 99% level, respectively.

Table 3. CEO overconfidence and insider trading at different levels of sentiment

		CEO NETSELL			
		Coefficient		N	R2
OVERCONF	Low sentiment	0.12	[0.36]	1175	0.15
	Medium sentiment	-0.65***	[-3.28]	17410	0.11
	High sentiment	0.14	[0.21]	3294	0.07
OVERCONF	Low sentiment	0.12	[0.36]	1175	0.15
	Moderately low sentiment	-0.11	[-0.46]	10601	0.12
	Moderately high sentiment	-1.22***	[-3.85]	7840	0.11
	High sentiment	0.14	[0.21]	3294	0.07

This table reports fixed-effects estimations of CEO net insider selling on CEO overconfidence measure and other control variables for CRSP listed stocks 1996 to 2016 at different levels of market-wide investor sentiment. The dependent variable, CEO NETSELL, is CEO net insider selling (sells net of buys) in the year scaled by firm's market capitalization (000s) at the end of the previous year. The variable of interest is a binary variable of one if the CEO of the firm is overconfident (highly optimistic) and zero otherwise, OVERCONF. 'Low sentiment' is a period if the sentiment value is below the 20th percentile. 'Medium sentiment' is a period if the sentiment value is between the 20th and 80th percentiles. 'High sentiment' is a period if the sentiment value is above the 80th percentile. 'Moderately low sentiment' is a period if the sentiment value is between the 20th and 50th percentile. 'Moderately high sentiment' is a period if the sentiment value is between the 50th and 80th percentile. Control variables are not reported for brevity and are as in Table 2 including NYSE market capitalization decile as of the end of the previous calendar year, NYSED, firm's market-to-book ratio at the beginning of the year, M/B, firm's contemporaneous 12-month buy-and-hold market-adjusted return, $MARET_t$, firm's earnings innovation in the following year, ΔROA_{t+1}, firm's future 12-month buy-and-hold market-adjusted return during the following year, $MARET_{t+1}$, log of one plus the ratio of the number of shares held by CEO to total shares outstanding, SHAREHOLDING, log of one plus options and shares of restricted stock granted for CEO scaled by total shares outstanding, GRANTS, and log of one plus number of options exercised by CEO scaled by total shares outstanding. Numbers in brackets are t-statistics. All estimations include an intercept, which is not reported for brevity. *, **, and *** denote statistical significance at the 90%, 95%, and 99% level, respectively.

Table 4. Stock Splits, Investor sentiment, and CEO overconfidence

STOCK SPLIT DECISION

	[1]	[2]	[3]	[4]
OVERCONF	0.02	0.02	0.01	0.17**
	[0.39]	[0.61]	[0.24]	[2.13]
SENT	0.19*		0.19*	
	[1.91]		[1.62]	
OVERCONF×SENT			0.04	
			[0.86]	
Medium Sentiment		1.29***		
		[11.75]		
High Sentiment		1.44***		
		[17.82]		
Controls	Yes	Yes	Yes	Yes
R^2	0.17	0.18	0.17	0.21
N	100,650	100,650	100,650	20,846

This table reports probit regressions of stock split decision on market-wide investor sentiment and CEO overconfidence measures and other control variables for CRSP listed stocks 1994 to 2016. The dependent variable, $Pr(s_{i,t} = 1)$, is one if firm i splits stock in year t and zero otherwise. The first independent variable of interest is the sentiment variable, *SENT*, calculated from beginning-of-year market-wide investor sentiment values. In column 2, a categorical sentiment variable is applied where the base category is 'low' level sentiment periods (if the sentiment value is below the 20th percentile) and estimations are gathered for 'medium' (if the sentiment value is between the 20th and 80th percentiles) and 'high' (if the sentiment value is above the 80th percentile) level sentiment periods. The second independent variable is *OVERCONF,* a binary variable of one if the CEO of the firm is overconfident (highly optimistic) and zero otherwise. Column 3 presents the interaction effect results between CEO overconfidence and market-wide investor sentiment. Column 4 displays results only during 'high' (if the sentiment value is above the 80th percentile) level sentiment periods. Control variables in all estimations, which are not reported for brevity, include previous yearend value-weighted low-price premium, *LPP*, beginning-of-year log prices, *p*, contemporaneous annual log returns (excluding dividends), *r*, NYSE market capitalization decile as of the end of the previous calendar year, *NYSED*, lagged volatility based on the previous year's daily returns, σ, and beginning-of-year log industry average price, $p^{Industry}$. Numbers in brackets are z-statistics and R^2 denotes the pseudo-R^2. All estimations include an intercept, which is not reported for brevity. Standard errors are clustered at both stock and time (year) levels. *, **, and *** denote statistical significance at the 90%, 95%, and 99% level, respectively.

Table 5. Insider trading, stock splits, CEO overconfidence and investor sentiment

	NETSELL	OPPOR NETSELL	CEO NETSELL	CEO OPPOR NETSELL
	[1]	[2]	[3]	[4]
High Sentiment	3.77***	1.36***	0.12	0.06
	[4.85]	[4.03]	[1.12]	[0.14]
OVERCONF	-6.05***	-0.98**	-0.54***	-0.94*
	[-4.95]	[-2.23]	[-3.12]	[-1.65]
SPLIT	6.09***	1.95***	1.18***	1.98***
	[3.98]	[3.71]	[5.46]	[3.70]
Controls	Yes	Yes	Yes	Yes
R^2	0.07	0.05	0.11	0.17
N	22,635	13,405	21,879	3,176

This table reports fixed-effects estimations of net insider selling on stock splits, market-wide investor sentiment and CEO overconfidence measures and other control variables for CRSP listed stocks 1996 to 2016. The dependent variable, NETSELL, is net insider selling (sells net of buys) in the year scaled by firm's market capitalization (000s) at the end of the previous year. In columns 2, 3 and 4, only opportunistic trades (OPPOR NETSELL), only CEO trades (CEO NETSELL), and only CEO opportunistic trades (CEO OPPOR NETSELL) are considered, respectively, while forming the dependent variable. The first independent variable of interest is a binary variable of one if beginning-of-year market-wide investor sentiment is high (above the 80th percentile), 'High sentiment'. The second independent variable is OVERCONF, a binary variable of one if the CEO of the firm is overconfident (highly optimistic) and zero otherwise. The third variable of interest is a binary variable of one if firm splits stock in the same year and zero otherwise, SPLIT. Control variables are not reported for brevity and are as in Table 2 including NYSE market capitalization decile as of the end of the previous calendar year, NYSED, firm's market-to-book ratio at the beginning of the year, M/B, firm's contemporaneous 12-month buy-and-hold market-adjusted return, $MARET_t$, firm's earnings innovation in the following year, ΔROA_{t+1}, firm's future 12-month buy-and-hold market-adjusted return during the following year, $MARET_{t+1}$, log of one plus the ratio of the number of shares held by executives to total shares outstanding, SHAREHOLDING, log of one plus options and shares of restricted stock granted scaled by total shares outstanding, GRANTS, and log of one plus number of options exercised scaled by total shares outstanding, OPTIONS_EXRC. SHAREHOLDING, GRANTS and OPTIONS_EXRC contain only CEO data for columns 3 and 4 where the dependent variable considers only CEO trading. Numbers in brackets are t-statistics. All estimations include an intercept, which is not reported for brevity. *, **, and *** denote statistical significance at the 90%, 95%, and 99% level, respectively.

Table 6. Net insider sell centered on stock split announcements (in $m)

	$NETSELL	$TOP NETSELL	$CEO NETSELL	CEO $OPPOR NETSELL
21-day window				
Pre-split	2.70	1.87	1.92	1.75
Post-split	5.89	5.25	5.97	3.24
t-statistics of differences	[4.28]***	[4.08]***	[3.45]***	[1.85]*
N	1,741	711	435	92
41-day window				
Pre-split	4.85	3.08	3.31	2.49
Post-split	9.12	6.27	6.70	4.08
t-statistics of differences	[2.76]***	[2.61]***	[1.93]*	[1.71]*
N	2,291	1,061	678	143
61-day window				
Pre-split	6.44	3.20	3.26	2.59
Post-split	11.88	7.20	7.52	4.55
t-statistics of differences	[2.31]**	[3.45]***	[2.66]***	[1.98]**
N	2,604	1,302	876	186
181-day window				
Pre-split	28.57	6.22	5.32	3.08
Post-split	22.76	8.41	7.98	5.70
t-statistics of differences	[-0.64]	[3.34]***	[3.54]***	[3.10]***
N	3,186	2,147	1,553	320

This table reports net insider sell in $m (insider sells net of insider buys in $m) in various period windows around stock splits announcements (within 10, 20, 30 and 90 days before and after announcements) for CRSP listed split stocks 1996 to 2016 with data for insider trading information. Day-0 (announcement day) trading is excluded from totals. Observations are removed from the sample if there is another split announcement within 90 days before or after a split announcement. $NETSELL is net insider sell in $m. $TOPNETSELL is the net insider sell of top executives in $m. $CEONETSELL is the net insider sell of CEOs in $m. $OPPORNETSELL is the net insider sell of only opportunistic trades in $m. Numbers in brackets are the t-statistics of paired t-tests. *, **, and *** denote statistical significance at the 90%, 95%, and 99% level, respectively.

Table 7. Overconfidence, sentiment and insider selling centered on stock split (in $m)

	TOTAL	OVERCONFIDENT CEO	RATIONAL CEO
Panel A: $CEONETSELL (in $m)			
181-day window			
Pre-split	5.32	5.96	5.13
Post-split	7.98	7.16	8.18
t-statistics of differences	[3.54]***	[1.15]	[2.97]***
N	1,553	523	997
Panel B: $CEOOPPORTUNISTICNETSELL (in $m)			
181-day window			
Pre-split	3.08	4.44	2.10
Post-split	5.70	7.11	4.41
t-statistics of differences	[3.10]***	[1.68]*	[2.47]**
N	320	137	172

This table reports net insider sell in $m (insider sells net of insider buys in $m) in period windows 90 days before and after announcements for CRSP listed split stocks 1996 to 2016 with data for insider trading information. Day-0 (announcement day) trading is excluded from totals. Observations are removed from the sample if there is another split announcement within 90 days before or after a split announcement. $CEONETSELL is the CEO net insider sell in $m. $CEOOPPORTUNISTICNETSELL is the CEO net insider sell of only opportunistic trades in $m. Numbers in brackets are the t-statistics of paired t-tests. *, **, and *** denote statistical significance at the 90%, 95%, and 99% level, respectively.

APPENDIX – Further Definitions

Further information on the option-based optimism measure discussed in the 'Data' section:

As in Campbell et al. (2011, p.700), we also "require that a CEO exhibits the option-holding behavior at least twice during the sample period" and assign "the high-optimism classification beginning with the first time the CEO exhibits the behavior". Similarly, we also estimate the average exercise price using Core and Guay's (2002) approximation method ("the realizable value per option is calculated as the total realizable value of the exercisable options (ExecuComp variable OPT_UNEX_EXER_EST_VAL) divided by the number of exercisable options (OPT_UNEX_EXER_NUM). The per-option realizable value from the stock price at the fiscal year end (PRCCF) is then subtracted to obtain an estimate of the average exercise price of the options"). Although our analysis begins in 1996, we construct the managerial overconfidence measure using the longest period of time for which we have data. If we constructed the measure using only data from 1996 onwards, then a manager who demonstrates option-holding behavior in, say, 1995 and 2003, but not again in the sample period would not be classed as overconfident given the requirement for two such occurrences, whereas inclusion of the longest possible sample period ensures they are included as overconfident.

Further information on the routine/opportunistic trades in the 'Empirical Findings' section:

How an insider trade is defined as 'routine' is discussed in detail in Cohen, Malloy and Pomorski (2012). In short, a 'routine' trader is defined "as an insider who placed a trade in the same calendar month for at least three consecutive years" (p. 1017). Consequently, all trades made by traders who do not meet this definition are classed as 'opportunistic' trades.

Further information on the control variables discussed in the 'Empirical Findings' section:

Firm level contrarian factors are firm's market-to-book ratio at the beginning of the year, M/B and firm's contemporaneous 12-month buy-and-hold market-adjusted return, $MARET_t$. Measures of information advantage of insiders for future news are firm's earnings innovation in the following year, ΔROA_{t+1} and firm's future 12-month buy-and-hold market-adjusted return during the following year, $MARET_{t+1}$. Changes in insiders' holdings are log of one plus the ratio of the number of shares held by executives to total shares outstanding, SHAREHOLDING, log of one plus options and shares of restricted stock granted scaled by total shares outstanding, GRANTS, and log of one plus number of options exercised scaled by total shares outstanding, OPTIONS_EXRC. To measure firm's contemporaneous market-adjusted return ($MARET_t$) we calculate the 12-month buy-and-hold return during fiscal year t less the 12-month buy-and-hold return on the S&P 500 index during fiscal year t and the equivalent for MARETt+1. The firm's earnings innovation is measured as Return-on-Assets for year t+1 less that of year t. Return-on-Assets is Income before Extraordinary items, scaled by average total assets. We use Compustat Annual Updates - Fundamentals Annual file to calculate ΔROA_{t+1}. SHAREHOLDING, GRANTS and OPTIONS_EXRC are calculated using data from ExecuComp – Annual Compensation data file. When CEO trades are considered, the last two variables relate to CEOs.

Further information on the low-price premium discussed in in the 'Empirical Findings' section:

Consistent with Baker, Greenwood and Wurgler (2009), low-priced and high-priced stocks are identified to be those with a per-share price below the 30th percentile and above the 70th percentile of NYSE common stocks, respectively. The low-price premium is then the log difference in the value-weighted average market-to-book ratios of low- and high-priced stocks. As in Baker, Greenwood and Wurgler (2009), the market-to-book ratio is calculated as book assets minus book equity plus market equity, all divided by book assets, using Compustat-Capital IQ North America.