

Target insiders' preferences when trading before takeover announcements: deal completion probability, premium and deal characteristics *

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Abstract

We contribute to the M&A literature by characterizing the information available to target insiders during the pre-public takeover negotiations. We analyze insider trading in target firms in the US between 2005 and 2018. First, we show that signing confidentiality agreements is an important information threshold. Second, insiders have a good grasp of deal success. They increase their net purchases only in deals with higher completion probability. Third, insiders guess the final offer price well, but their trading strategies additionally reflect their knowledge of deal characteristics. They prefer bidder-initiated, cash, privately negotiated, and strategic deals. Insiders combine several sources of information.

Keywords: Mergers and acquisitions; Insider trading; Target firms

JEL Classification: G34; G14

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1 Introduction

The board of directors of a target (selling) firm has to make many important decisions from the moment their firm is ‘in play’ for a sale. On average, the pre-public negotiation period takes around one year from the moment a deal is initiated to its public announcement. The board is concerned with optimally designing the pre-public negotiation process to achieve shareholder value maximization and fulfill its fiduciary duty. Many papers in the merger and acquisition (M&A) literature address the question of whether firms should be sold in one-to-one negotiations or rather in full-scale auctions (Boone and Mulherin, 2007; Bullock and Klemperer, 2009; Gentry and Stroup, 2019, to mention just a few). Liu and Officer (2019) focus inside the black box of pre-public negotiations and find frequent offer price revisions. In this paper, we contribute to the literature by analyzing the information environment of the pre-public selling process, by focusing on patterns of *passive* insider trading in target companies before public announcements of takeover deals. Our analysis highlights the signing of confidentiality agreements as an important information threshold that helps to resolve many uncertainties in the pre-public selling period and markedly increases the chances of a deal going through. Furthermore, we show that insiders’ perception of the final offer price is quite accurate a considerable amount of time before the deal announcement. Also, insiders are aware of the additional contribution of deal characteristics, such as deal initiation, method of payment, selling method, and buyer type, towards a higher takeover premium. Also, insiders have also a good perception of completion probability.

The literature provides strong evidence that the restrictive insider trading regulation in the US is effective in prohibiting insider buying before public announcements of takeover deals (Harlow and Howe, 1993; Agrawal and Jaffe, 1995; Agrawal and Nasser, 2012; Davis et al., 2020). Insiders possess material information, which is not in the public domain, and therefore buying before investors become aware of the increased chances of takeover premium is illegal. Despite a significant drop in insider buying, target insiders are still able to profit from their private information. Agrawal and Nasser (2012) show that up to a year before the takeover announcement insiders stop selling to such an extent that, despite a significant decrease in their buying, their net purchases increase significantly. This passive insider trading strategy is profitable but not necessarily illegal, as insiders’ decrease in selling cannot be marked as trading on material information. Davis et al. (2020) show

that insiders increase their net purchases already before deal rumour dates.

Given the restrictive regulatory environment with private material information, and Agrawal and Nasser (2012) indicating that insiders are still able to execute profitable trading strategies, we contribute to the M&A literature by answering the question of what kind of information insiders use to trade profitably. Does insider trading vary with realized takeover premium? Or do insiders instead trade on their knowledge of deal characteristics that are correlated with the final offer price, without being directly aware of the future takeover premium? Do they start trading immediately after the deal is initiated or wait until they have more precise information concerning the deal characteristics and deal success – that is, do they wait until confidentiality agreements with interested bidders are signed? Do insiders trade more for deals with higher expected completion probability? Answers to all these questions are important as they provide evidence on the information environment of pre-public merger negotiations and reveal how much insiders know during the negotiation process.

Members of the board of directors and key company managers learn about their firm being ‘in play’ no later than around the initiation date, be it a target- or bidder-initiated deal.¹ The target insiders may then adjust their trading in the company stock depending on their own expectation concerning the current takeover premium, which is the difference between the insiders’ expected final offer price and the stock price at that moment. The expected takeover premium is, however, uncertain and subjective. The insiders’ expected takeover premium is most likely affected by their guesses of the future offer price and deal characteristics, but also by their guess of the probability of deal completion. We conjecture that insiders take into account their guesses concerning completion probability and takeover premium when trading in the stock of their own firms. It is also likely that they consider their information on deal characteristics. We further conjecture that signing of confidentiality agreements is an important event because it represents a commitment for the transaction on both the seller and buyer sides. Once confidentiality agreements are signed, insiders are surer about the deal outcomes. They also have more precise information concerning the bidders’ identities and bidder competition. Thus, we hypothesize that insiders trade more once bidders start

¹The three examples in Appendix I.A in the internet appendix illustrate this and show that all board members and senior managers are involved in the decision making during the pre-public selling negotiations since the initiation. Boone and Mulherin (2007) provide a more general description of the process.

signing confidentiality agreements.

Our paper is closely related to Agrawal and Nasser (2012) who are the first to highlight the passive insider trading strategies in M&A target firms before the public announcement. Our analysis focusing on the information environment during the pre-announcement negotiation period differs from Agrawal and Nasser (2012) in three important aspects. First, their analysis focuses on a fixed period of one year (or six months) before deal public announcements across all deals and emphasizes the deal initiation as the important information dissemination point. In contrast, we carefully code the initiation date and the date of signing the first confidentiality agreement across all deals, and we therefore capture the exact timing of when insiders get access to more precise information concerning the deal. The fact that the pre-public negotiation process is relatively lengthy and varies widely across deals highlights the importance of measuring insider trading from the initiation date when trading on the expected takeover premium becomes an option or from the confidentiality agreement signing date when the information concerning negotiation outcomes becomes more reliable. Agrawal and Nasser (2012) show that profitable insider trading is concentrated within six months just prior to the deal announcement, but note that ‘this finding is consistent with [their] expectation that most takeovers talks begin within the six months before public announcement of a deal’ (page 614). Our analysis reveals that insiders possess more precise information concerning the expected premium once confidentiality agreements are signed. Special robustness tests show that insiders increase their net buying only after signing confidentiality agreements, rather than over the six-month period before the public announcements.

Second, even though Agrawal and Nasser (2012) formulate the hypothesis of stronger passive insider buying in firms with less uncertainty about takeover completion, their empirical evidence is relatively weak and indirect. They only show that insider net purchases significantly increase in friendly deals, deals without post-announcement competition, domestic acquirer, and less regulated target and assign these patterns to higher deal completion probability. We use a more precise and direct measure of deal completion probability and show more convincingly that deal completion probability matters for insider trading strategies. Third, we relate insider trading to the realized takeover premium and unexplored selling process characteristics (deal initiation, payment consideration, selling method, and buyer type) and show that insiders combine these sources of information to form profitable passive trading strategies.

We analyze open-market stock transactions by insiders in 1,802 publicly listed US target firms over the period from 2005 to 2018 using hand-collected detailed data concerning the private selling process before takeover public announcements. Our analysis of insider trading (for different insider groups and several insider trading measures) in the pre-announcement period results in three main findings. First, we show that insiders are willing to stop selling, and thus postpone satisfying their diversification and/or liquidity needs, only once bidders start signing confidentiality agreements. Even though insiders are often aware of takeover negotiations from their initiation (on average 315 days before the public announcement), they are willing to adjust their trading strategies only once more serious negotiations are underway, many uncertainties are resolved and the odds of the transaction going through increase markedly.

Second, our results show that insiders are mindful of the uncertainty associated with completion probability. Their net purchases increase significantly only in firms with higher completion probability. Note, however, that due to a lack of other options our measure of completion probability is an approximation of insiders' estimate of the odds of their deal going through to completion. Particularly, the proxy we use is the market's assessment of completion probability at the time of the deal announcement, as described in Samuelson and Rosenthal (1986). We are aware of the time lag between the two assessments of the probability, but their cross-sectional correlation should be positive: firms with higher announcement-date completion probability should also exhibit higher completion probability during the period before the announcement. Therefore, we believe that our partition into high versus low completion probability deals using the proxy is reasonable.

Third, we show that insiders combine various sources of information when trading. Their trading is correlated with the realized takeover premium, which suggests that they have a good grasp of the likely outcome. Their trading also reveals that they are aware of deal characteristics that increase the final takeover premium: bidder initiation, cash payment, selling method involving private negotiations or controlled sales,² and buyer type. Importantly, however, these deal characteristics further increase insider net purchases when compared to trading based purely on takeover premium. Adding high completion probability together with takeover premium and deal characteristics shows an additional complementary effect. We conclude that insiders combine and complement different

²Private one-to-one negotiations and controlled sales are defined in Boone and Mulherin (2009). We jointly denote them as 'informal sales.'

sources of information to trade profitably but not illegally.

Even though the current paper uses insider trading data, we would like to highlight that its main contributions relate to the M&A literature. First, we document the information environment of takeover negotiations. Our analysis shows that insiders gain important and valuable information once bidders start signing confidentiality agreements. Also, we show that insiders' perception of the final offer price is quite accurate many days before the deal announcement, and that insiders are aware of the additional contribution of deal characteristics towards a higher takeover premium. Moreover, insiders also have good perception of completion probability – they do not stop selling in deals with low completion probability.

Second, we contribute to the M&A literature by showing insiders' profit perceptions concerning deal initiation, method of payment, selling method, and the type of buyer. Masulis and Simsir (2018) argue that target deal initiation is a negative signal of firm quality. Our result that insiders are net buyers in deals that are bidder initiated, but not in target-initiated deals provides additional support for this conjecture. We also contribute to the wide discussion on payment consideration. In the pre-announcement period, insiders are strong net buyers in cash deals and seem to persistently dislike stock deals. This evidence is in conflict with models suggesting that stock payment is advantageous for target shareholders of undervalued firms (for example, Hansen, 1987). It rather suggests that target insiders consider acquirer stock as overpriced and prefer to avoid it (Shleifer and Vishny, 2003; Rhodes-Kropf and Robinson, 2008). Further, our results reveal target insiders' preferences for informal sales above full-scale auctions. The model by Bulow and Klemperer (1996) shows that auctions deliver higher premium than sequential one-to-one negotiations. Our insider trading patterns suggest higher profits from informal sales that restrict competition than from competitive full-scale auctions. This result suggests that restricting bidder competition is a deliberate step by the selling firm management and is associated with a higher expected takeover premium for target shareholders. It is in line with papers that compare takeover premium in auctions versus negotiations (Boone and Mulherin, 2007; Fidrmuc et al., 2012, 2020). Our analysis contributes also to the literature on the buyer type, our last deal characteristic (Bargeron et al., 2008; Dittmar et al., 2012). Insiders might prefer not to sell shares when they anticipate participating in the management of the company after the deal – in private equity sponsored leveraged buyouts. However, our results suggest this is not the case.

The remainder of the paper is organized as follows: Section 2 builds our hypotheses concerning insider trading in acquisition targets before takeover announcements. Section 3 introduces the data, explains the matching process and provides basic statistics. Section 4 shows and discusses the regression results, and Section 5 concludes.

2 Hypotheses

The process of selling a company usually commences when the selling firm contacts interested bidders or is approached by a bidder without any prior solicitation of interest (Boone and Mulherin, 2007). Inevitably, at this point target insiders become aware of the possible future takeover. They establish their expected takeover premium, which is the difference between their expected offer price and the stock price at the time, taking into account their expected completion probability, and they decide on their trading strategies.

Agrawal and Nasser (2012) show that target insiders increase their *net* purchases within a year of the takeover announcement, due to larger reduction of sales relative to purchases. During the pre-announcement selling process, target insiders could profit from increasing their purchases, due to the high expected takeover premium.³ However, insider trading on material information is illegal,⁴ which means that insiders should stop buying as soon as the deal is initiated. Nevertheless, insiders can strategically choose to postpone their sales until the public announcement, or even until the completion date, without violating any insider trading regulation, and still profit on their private information.⁵ Note, however, that postponing insider sales is costly for insiders as they often receive a large part of their remuneration package in the form of stock and stock options and so have high diversification and liquidity needs (Lakonishok and Lee, 2001; Fidrmuc et al., 2006).

Even though the average realized takeover premium is large and positive relative to the stock price eight weeks before the announcement, the insiders' expected takeover premium might be

³Betton et al. (2008) show high significant realized takeover premium for a large sample of US takeovers.

⁴This is due to Section 10b of the Securities Exchange Act of 1934. Moreover, Section 16b of the Securities Exchange Act of 1934 (the short-swing rule), which limits round-trip trades within six months, should further decrease insider purchases, especially in cash deals where insiders have to sell their shares at completion.

⁵Companies typically institute blackout window periods around important corporate events/announcements such as takeovers. The time when they sign confidentiality agreements seems to be very suitable for introducing such a ban on trading. Our summary statistics in Table 2 and in Table I.1 in the internet appendix show that net insider purchases and insider sales remain significantly different from zero during the period from signing confidentiality agreements to the deal announcement. These numbers show significant insider trading activity and suggest nonexistence of selling bans, at least on average.

considerably smaller earlier on, at the beginning of the takeover process. It might be lower due to lower completion probability at that moment in time and uncertainty about the deal and final buyer characteristics. As a consequence of relatively low expected takeover premium and high diversification and liquidity needs, target insiders may not change their selling patterns early in the takeover process, even though they are already aware of the fact that their firm is ‘in play’. They may stop selling only once some uncertainty concerning the takeover premium is resolved, once they have more and more precise information concerning the odds of the deal going through, deal characteristics and offer price. A significant part of the uncertainty is resolved after interested bidders sign confidentiality agreements and commit to engage in negotiations. The probability of the firm being eventually sold goes up and target insiders learn about characteristics of participating bidders which leads to a more precise estimate of the offer price. Even though insiders are aware of takeover negotiations from the initiation date, they become more certain about deal outcomes once bidders start signing confidentiality agreements. Note that the overall effect on net purchases is fully driven by insider sales. Our first hypothesis differentiates early versus later insider trading decisions in the private selling process:

HYPOTHESIS 1: Target insiders increase their net purchases before the deal announcement only once bidders start signing confidentiality agreements.

Whereas our first hypothesis focuses on time-series uncertainty associated with information insiders possess as the selling process progresses, our second hypothesis highlights the cross-sectional uncertainty associated with the deal completion. Insiders are less likely to stop selling for deals that have lower probability of completion, as lower completion probability directly translates into lower expected premium. The second hypothesis summarizes our conjectures:

HYPOTHESIS 2: Target insiders increase their net purchases before the deal announcement more in firms with higher completion probability.

The main idea behind our hypotheses is that insiders decide on their trading strategies depending on their estimate of the expected takeover premium at the moment of trading. It is likely that insiders have quite a good idea of the final offer price relatively early in the selling process, substantially sooner than the takeover contract is signed and announced. As a result, their trading may be strongly correlated with the realized takeover premium. Alternatively, insiders may base their

trading strategies on deal characteristics that are correlated with the offer price: deal initiation, payment consideration, selling method, and final buyer type.

The selling process is usually initiated either by a prospective bidder proposing to take over the firm or by the board of the selling company deciding that they want to consider all alternative strategic options for the future of the company and eventually they offer the firm for sale. Bidder-initiated deals are usually associated with higher realized takeover premium. The literature argues that it is due to higher bidder valuations of targets and higher target firm bargaining power in bidder-initiated deals (Masulis and Simsir, 2018; Fidrmuc and Xia, 2019; Aktas et al., 2010; DeBodt et al., 2014).

Deals paid for in cash are associated with higher realized takeover premium (Golubov et al., 2016, among others). Also, the final offer price in cash deals is more certain and fixed, while in stock deals the expected final offer price changes with the acquirer stock price. Acquirers in stock deals usually suffer negative announcement abnormal returns, further reducing the expected takeover premium (Shleifer and Vishny, 2003; Rhodes-Kropf et al., 2005; Golubov et al., 2016). As payment consideration is an important part of the negotiation process, insiders will have a good perception of the likely payment method relatively early in the process.

Target firms are sold either in full-scale auctions, controlled sales or private negotiations (Boone and Mulherin, 2009). We classify the selling method, along the dimension of formality and full pre-determination of the process, into formal full-scale auctions and informal sales, which include controlled sales and private negotiations.⁶ A formal full-scale auction is associated with a very structured process that follows multiple designed rounds and accommodates a relatively large number of bidders (Hansen, 2001). Controlled sales and private negotiations follow a less formally structured process and involve a restricted number of bidders. In controlled sales, target firms discretely canvass interest from a chosen, limited number of bidders who then counter-bid each other, while private negotiations involve only one bidder (Boone and Mulherin, 2009). On average, informal sales exhibit higher realized takeover premium relative to formal full-scale auctions, even though they involve a smaller number of bidders (Fidrmuc et al., 2012). The literature is still looking for

⁶Note that our classification differs from the classification in Boone and Mulherin (2007) who contrast private negotiations against ‘auctions,’ which include controlled sales and full-scale auctions.

a theoretical explanation for this counter-intuitive pattern.⁷

Usually, target firms have a clear preference for the type of buyer they aim for, early on in the selling process (Fidrmuc et al., 2012). Targets acquired by strategic buyers versus financial bidders usually exhibit higher realized takeover premium due to higher agency problems (Bargeron et al., 2008; Dittmar et al., 2012). Considering the realized takeover premium and the four deal characteristics, our third hypothesis is as follows:

HYPOTHESIS 3A: Target insiders make larger increase in their net purchases before the deal announcement in deals with higher realized takeover premium.

HYPOTHESIS 3B: Target insiders make larger increase in their net purchases before the deal announcement in deals that are bidder initiated, paid for in cash, sold through one-to-one negotiations or controlled sales, and eventually bought by strategic buyers.

Hypothesis 3, above, formulates our main conjecture that insiders trade overwhelmingly due to their expectation of a sizeable takeover premium. However, other, alternative effects associated with the deal characteristics may also impact insiders' decisions. The first possible candidate is the uncertainty concerning deal completion highlighted by Agrawal and Nasser (2012). Higher willingness to complete the deal in target-initiated deals increases the deal success probability and thus increases the probability of gaining a positive premium (DeBodt et al., 2014). As a result, it may be target- rather than bidder-initiated firms whose insiders increase their net purchases. Second, the formal selling process of full-scale auctions is fixed and pre-determined, and once a selling firm starts the process, it is very likely to end up with a winning bidder committed to the deal. Informal sales, in contrast, are more ad hoc and therefore more uncertain in terms of outcomes. Due to the higher associated certainty, it may be the insiders of firms sold in full-scale auctions who are motivated to increase their net purchases.

Third, Hansen (1987) provides a strong theoretical argument for why insiders in firms paid for by stock might not want to sell their shares (or might want to increase their net purchases). If target insiders believe that their firm is undervalued, they prefer stock payment, which allows them to share in the long-term value improvement of the merged firm and long-term synergies

⁷Fidrmuc et al. (2020) show that higher differentiation between potential bidders with respect to asset complementarity between the target and the bidders is associated with a smaller number of invited bidders and higher takeover premium.

created in the deal (Hansen, 1987; Bradley et al., 1988). As a result, insiders in deals paid for in stock should increase their net purchases. In contrast, models stressing bidder overvaluation predict that target insiders should avoid stock deals (Shleifer and Vishny, 2003). Finally, buyers in financial deals aim at undervalued firms that have a high potential to generate high cash flows and high revenue growth after going private (Dittmar et al., 2012; Gorbenko and Malenko, 2014; Baker et al., 2015). Moreover, private equity firms often keep the target management on board after the buyout (Fidrmuc et al., 2012). Insiders are usually motivated to increase their ownership in the target firm in order to profit on the value improvement once the firm is private. At the same time, private equity firms support higher insider ownership to align insiders' interests with their own (Wruck, 2008). Therefore, target insiders in financial deals may want to increase their net purchases.

3 Data

3.1 M&A data

The sample includes US M&A deals that were announced between January 2005 and December 2018 and are covered by the Security Database Corporation (SDC) in Thomson ONE Banker. We apply the following four selection criteria: (i) both the acquirers and targets are US companies; (ii) all targets are publicly listed firms before the deal, while acquirers could be publicly listed or private firms; (iii) the acquirers own 100% of targets' shares after the deal; (iv) targets have data in COMPUSTAT and CRSP concerning accounting information and stock price. We hand-collect and code information concerning the selling process from the 'background of the deal' section of DEFM14A, PREM14A, SC14D9 or S-4 filings, which we recover from the EDGAR filing collection provided by the SEC.⁸ We hand-collect information concerning the initiation type, initiation date and selling method. Out of 3,050 deals identified in SDC we are able to find SEC filings on EDGAR for 1,964 deals. For a further 103 deals, we are not able to classify the initiator. Finally, we are not able to get data from Compustat or CRSP for 59 targets. Altogether, the data collection results in a sample of 1,802 deal targets.

Table 1 reports deal summary statistics. Panel A shows the number of observations, mean,

⁸Note that the fact that we condition our data set on having information concerning the selling process means that we include only completed deals. Withdrawn deals do not file this information with the SEC.

standard deviation, minimum, 25th percentile, median, 75th percentile, and maximum across the set of deal variables for all target firms in our data set. All variable definitions are provided in Appendix A. We can see that the average transaction value is USD 2.2 billion and it takes 315 calendar days from the moment a deal is initiated to its public announcement. The median is somewhat lower at 222 days. It takes on average 155 calendar days from the day the first confidentiality agreement is signed to the deal announcement, but the median value is only 105 days, which indicates that for a handful of deals the period between the confidentiality-agreement and announcement dates is markedly longer than 6 months. The average market perception of deal completion probability at the announcement day is 0.62. The final realized premium relative to the price eight weeks before the public announcement is 39%. The premium increases to 40% relative to the price at the time when the first confidentiality agreement is signed and is even larger relative to the price at the initiation date, at 45%. The offer improvement mean shows that bidders increase their initial offer by 1.9%, but the distribution of the variable is significantly skewed – less than a quarter of all deals receive an offer improvement after the deal announcement.

- insert Table 1 about here -

Table 1 further shows abnormal stock returns from the initiation date up to the date of signing the first confidentiality agreement and then further up to the public announcement. The target stock price decreases on average by 3.2% (significant at the 1-percent level) between initiation and signing confidentiality agreements, and then increases by 1.3% (significant at the 5-percent level) until one day before the deal announcement. The announcement effect for 3 days around the announcement date is large at 22%, and statistically significant. Panel A also shows that target firms have relatively stable stock return volatility of 2.9% over the one-year period before initiation and 3.0% over the six-month period before signing confidentiality agreements. The sample deal characteristic frequencies show that 41% of deals are initiated by target firms, 59% are paid for in cash, 31% are sold in full-scale auctions, and 19% are acquired by financial buyers.

Panel B of Table 1 shows means across high versus low deal completion probability, high versus low premium (relative to the date of signing confidentiality agreements and split at the median) and quintile five versus quintiles three and four versus quintiles one and two of the premium. We test for differences in means for corresponding pairs using the t-test, allowing for unequal variances,

and report the significance of the test in the second column of the pair. For the premium quintile groups, the statistical significance for the difference between quintile five versus quintiles three/four is indicated in column 5; for the difference between quintiles three/four versus quintiles one/two it is shown in column 6, and for the difference between quintile five versus quintiles one/two it is reported in column 7.

The partition by the deal completion probability in the first two columns shows that deals with high completion probability have longer negotiations after signing the confidentiality agreements, higher premium, larger announcement effect, higher return volatility before initiation and before signing confidentiality agreements, higher fraction of cash payment, and higher probability to be sold in formal auctions and acquired by financial buyers. This group is also associated with significantly smaller transaction value, smaller offer improvement and lower premium relative to 8 weeks and 1 day before the public announcement date.

Columns 3 and 4 partition the sample by median value of premium. We can see that the high premium deals exhibit higher deal completion probability, offer improvement, run-up since signing confidentiality agreements, announcement return, stock return volatility, and fraction of cash payments. Also, they have a larger decrease in stock price before signing confidentiality agreements and are less likely to be target-initiated and sold in formal auctions. To get further insights into the premium effects (which are needed in section 4), we partition the sample also by quintiles of premium. Quintile five has a higher offer improvement, run-up from the confidentiality agreement date and stock return volatility. The top premium quintile is also associated with a larger decrease in stock returns before signing the confidentiality agreement and is less likely to be target initiated, paid for in stock, sold in full-scale auctions, and acquired by financial buyers. Comparing means in the last two columns, the middle two quintiles exhibit larger transaction value, deal completion probability, stock performance from the date of signing confidentiality agreement, announcement effect, and fraction of cash payment. The middle two quintiles also involve shorter negotiations and are less likely to be target initiated and sold through full-scale auctions.

Panel C of Table 1 shows means across deal characteristics – initiation, payment consideration, selling method, and type of buyer. We can see that bidder initiation, stock payment and informal sales are associated with larger deals but smaller stock return variation. Strategic deals are also larger. Target initiation, cash payment and full-scale auctions take longer to negotiate. We also

confirm the findings in the literature that bidder initiation, cash payment, informal sale, and strategic buyer are associated with larger takeover premium and exhibit larger announcement abnormal returns (Masulis and Simsir, 2018; Fidrmuc and Xia, 2019; Aktas et al., 2010; DeBodt et al., 2014; Golubov et al., 2016; Fidrmuc et al., 2012; Bargeron et al., 2008; Dittmar et al., 2012). Concerning correlations between the deal characteristics, informal sales are correlated with strategic buyers, stock payment and bidder initiation. Financial buyers are more likely to be target initiated and pay more often in cash. However, bidder initiation is not correlated with the method of payment.

3.2 Insider trading data

The insider trading data is from Thomson/Refinitiv Financial Insider Filings Data Table 1, which contains corporate insider non-derivative transactions required to be reported via Form 4 by Section 16 of the Securities Exchange Act of 1934. We have information on the transaction date, transaction price, number of shares traded, person ID, firm ID, company name, resulting shares held, and transaction code (purchase or sale). We exclude inaccurate or unreasonable filings, and transactions labeled as amendments of previous insider transactions (as in Agrawal and Nasser, 2012).⁹ If a transaction price is missing, we replace it with the CRSP closing price on the transaction date. We merge multiple purchases (sales) by the same insider on the same transaction date in the same company. We are interested in analyzing insider purchases and sales separately and, therefore, we keep both purchases and sales transacted on the same day separate. We also compute insider net purchases as purchases minus sales by the same insider on the same transaction date in the same firm.

For the purposes of our analysis, it is very important to compare insider transactions in the pre-announcement period to a non-event control period for the same firm. The pre-announcement period falls between the deal initiation date and the public announcement date.¹⁰ Because insider trading varies with the length of the pre-announcement period and across different calendar months, we define the control period exactly over the same calendar months as the pre-announcement period, but place it before the initiation date. Then we compare the change in insider trading in target firms relatively to change in insider trading in matched firms that do not experience any takeover

⁹The former are indicated by the Cleanse Indicator, ‘A’ or ‘S’, and the latter by the Amendment Indicator ‘A’.

¹⁰Agrawal and Nasser (2012) use a one-year period before the announcement date uniformly across all firms.

and remain publicly listed. This is in order to adjust the overall change in target insider trading for the ‘normal’ outcome, that is, the change in insider trading in firms that do not experience any information shock but are similar to the treatment (target) firms and operate over the same period of time. The change in insider trading from the control period to the event period for the matched firms then measures the ‘normal’ effect. We use it to adjust the overall target firms’ effect to get a clean treatment effect that is free of any time trends. This is the essence of the difference in differences approach.

We match based on the industry and total assets just before the initiation date (similar to Shrieves and Stevens, 1979; Agrawal and Nasser, 2012). Our matching procedure is as follows. From the pool of all potential matching firms with available accounting, stock price and insider trading data, we pick the firm that is in the same Fama-French 30 industry and comes the closest in terms of total assets in the same fiscal year using a $\pm 25\%$ range. In case we fail to find a matching firm, we repeat the process for the corresponding Fama-French 12 industry. If we still do not have a match, we apply the 4-digit SIC code industry and then the 3-digit, 2-digit and finally 1-digit SIC code industry. We also require that the same publicly listed firm is not matched repeatedly to different target firms. The targets that are dropped out from our data set due to unavailable SEC filing data and the acquiring firms are not included as matched firms.¹¹

We focus on trading by top executives and outside directors. Top executives are the most familiar with the day-to-day operations of their firms and therefore should have the most accurate information concerning their value and prospects (Seyhun, 1986; Fidrmuc et al., 2006). Outside directors should also be informed about the prospects of their firms and they should be quite pivotal in takeover decisions. Combining the two types of insiders creates a well-informed and relatively well-populated group. In extra tests, we also analyze four alternative insider groups: CEO, top directors, other directors, and all directors to provide a sensitivity analysis with respect to the insider definition. For each studied period, we aggregate all shares bought (sold) by each insider group over the whole period and then divide them by the length of the period in months. We do this re-scaling on a monthly basis because the length of the pre-announcement period (and its corresponding control period) varies across deals and needs to be comparable. Our main insider

¹¹All together, 1,497 target firms are matched based on FF30 industry, 224 based on FF12, 20 based on 4-digit SIC, 26 based on 3-digit SIC, 10 based on 2-digit SIC and finally 25 targets based on 1-digit SIC.

trading measure is the number of shares traded per month by each group of insiders scaled by the number of shares outstanding and is reported in basis points. We believe that scaling the number of shares traded by all shares outstanding provides the best insider trading measure as it reflects both the trading volume and the firm size. In addition to this main insider trading measure, scaled by the number of shares outstanding, we use six alternative insider trading measures: number of transactions, number of shares traded, dollar value of shares traded, and these three measures scaled by the total number of insiders in the target firm.

Table 2 reports insider net purchases for our main insider trading measure (the fraction of firm traded) for the main group of top executives and outside directors. Panel A covers the period after confidentiality agreements are signed and Panel B the period before.¹² Columns 1 and 2 show means for the target firms in the pre-announcement and the control period, respectively. Means for matched firms in the corresponding two periods are reported in columns 3 and 4. The last four columns report differences in means and their significance, including the mean of the difference in differences (DiD mean) in the last column. We show statistics for all deals and then across six partitions: completion probability, premium, deal initiation, selling method, payment consideration, and buyer type. Note again that we use our main measure, which means that insider net purchases are reported as a fraction of shares outstanding in basis points per month. We winsorize all insider trading variables at the 5th and 95th percentiles due to a handful of large outliers which cause a large standard deviation.¹³

- insert Table 2 about here -

Panel A shows insider net purchases immediately before the public announcement after bidders start signing confidentiality agreements. For all deals together, target insiders significantly increase their net purchases in the pre-announcement period relative to the control period, and matched firms and the DiD mean in the last column is also positive and significant at the 1-percent level. Concerning the six partitions, target insiders increase their net purchases significantly only in the partitions that are in line with Hypotheses 2 and 3. Panel B shows insider trading in the

¹²For completeness, we split the insider net purchases into purchases and sales in Table I.1 in the internet appendix. Table I.2 in the internet appendix reports summary statistics for net purchases by the alternative insider trading measures, and alternative insider definitions.

¹³For net purchases, winsorizing at the 5th and 95th percentiles instead of 1st and 99th percentiles is associated with more than halving of the standard deviation, from 13.0 basis points to 5.4 basis points.

early pre-announcement period. For all deals together, target insiders significantly increase their net purchases relatively to matched firms, but the DiD mean in the last column is insignificant. Concerning the six partitions, the last column shows that the DiD mean is not significant for any of the six partitions.

Also note that net insider purchases in the target firms in the pre-announcement period in column 1 are significantly different from zero in both panels across all partitions. The negative significant means in Panel A show that even though insiders stop selling, they do not stop selling completely. Insiders across the board are still selling their company shares. This shows that target companies do not ban insider sales during takeover negotiations and our results are therefore not driven by restrictions on trading, but rather by insiders' decision to sell or not. Table I.1 in the internet appendix reports significance of means directly for insider purchases and sales and confirms that insider sales during the period since signing confidentiality agreements are significantly different from zero.

4 Results

Before we discuss the difference-in-differences (DiD) results, Table 3 tests that insider trading in target versus matched firms follows similar trends before our studied pre-announcement event period.¹⁴ This is an important assumption behind the DiD approach. Table 3 reports means for insider purchases, sales and net purchases for both target and matched firms during an earlier and later part of the control period. Note again that the control period lies before the initiation date and matches the pre-announcement event period in length and calendar months. It is split into two subperiods in the same way as the pre-announcement period is split by the date of signing the first confidentiality agreement. The last row shows differences between target and matched firms. They do not change significantly from the earlier to later control subperiods for either sales or net purchases, though the change is significant for purchases. We can conclude that insider trading in our target firms follows similar patterns to insider trading in the matched firms in the period without any sale negotiations, especially for sales and net purchases.

- insert Table 3 about here -

¹⁴Table 3 uses the main insider trading measure for the group of top executives and outside directors. Table I.3 in the internet appendix shows the tests for the alternative insider trading measures and alternative insider definitions.

Tables 5 to 12 report our main regression results for insider trading patterns in target firms before the public deal announcement date. All main specifications focus on the number of shares traded by top executives and outside directors, scaled by the number of common shares outstanding. As a sensitivity check, we also use insider transactions by CEOs, top directors, other directors, and all directors, and six alternative insider trading measures. All regressions include the following control variables: book to market decile, prior average daily market adjusted abnormal stock returns, volatility of daily stock returns, change in volatility of daily stock returns, insider ownership, R&D over total sales, liquidity, EBITDA over total assets, insider ownership, pre-announcement period length, natural log of total assets, year and industry dummies. Coefficients for control variables are reported only in Table 5, to preserve space, but are available on request for all other tables. The estimated coefficients for the control variables are consistent with the literature (see for example Lakonishok and Lee, 2001; Agrawal and Nasser, 2012). Summary statistics for the control variables are reported in Table 4 and correlation coefficients in Table I.4 in the internet appendix.

- insert Table 4 about here -

Due to the DiD set up, our main variable of interest is the interaction term ‘target x pre-announcement’ – the DiD coefficient. The two plain dummy variables are also included as regressors. All regressions are estimated using OLS because nonlinear models suffer problems with interaction terms and their interpretation. Ai and Norton (2003) show that the magnitude of the interaction effect in nonlinear models does not equal the marginal effect of the interaction term. Following Norton et al. (2004), we use simple OLS regressions that do not suffer the interaction term problem, rather than tobit models. We report Hubert/White robust standard errors in brackets.¹⁵

4.1 Signing of confidentiality agreements

Table 5 tests Hypothesis 1, that insiders adjust their net purchases only once confidentiality agreements are signed. We use the main insider trading measure and insider definition. We partition the pre-announcement period into two subperiods – after and before signing the first confidentiality agreement with a bidder, and report results for the two subperiods in columns 1 to 3 and 4 to

¹⁵Untabulated specifications with clustered standard errors at the Fama-French 30 or 49 industry levels show similar results and our conclusions are not affected.

6, respectively. Signing a confidentiality agreement is an indication of interest and commitment from a bidder and, therefore, is likely to decrease deal uncertainty. A deal becomes tangible and realistic and the expected premium increases. Column 1 shows that insiders decrease their purchases significantly in the period after signing confidentiality agreements: the DiD coefficient is negative and significant on the 1-percent level. Column 2 shows that insiders also stop selling. In fact, target insiders stop selling to such an extent that the DiD coefficient for net purchases in column 3 is significantly positive, supporting Hypothesis 1. Resolution of (part of) uncertainty by signing confidentiality agreements with potential bidders means that target insiders are better able to assess deal outcomes and decide if it is worthwhile to stop selling. The economic significance of the effect is also large: insiders increase their net purchases by 0.58 basis points per month relative to both the control period and matched firms. Note that the unconditional average monthly net purchases in target firms is -0.991 basis points in Table 2.

- insert Table 5 about here -

The DiD coefficient for insider purchases between deal initiation and signing of confidentiality agreements in column 4 is negative and significant at the 1-percent level showing that insider purchases drop immediately after deal initiation, when uncertainty about deal completion and about expected takeover premium is still quite high. Even though deal initiation takes place a long time before deal announcement (on average 315 calendar days), insiders feel constrained by legal jeopardy and stop buying immediately. At the same time, the DiD coefficient of -0.08 is markedly smaller than the DiD coefficient of -0.18 in column 1 for the period after confidentiality agreements are signed. The DiD coefficient in column 5 for insider sales shows that target insiders increase their sales, but not significantly. Uncertainty concerning the expected premium before first bidders start signing confidentiality agreements is too high and insiders are not willing to postpone their sales at this stage. Overall, target insiders do not change their net purchases at the early stages of takeover negotiations: the DiD coefficient in column 6 is negative and not significantly different from zero. These results are consistent with Hypothesis 1.

Columns 7 to 9 report insider trading effects during the whole pre-announcement period, from the deal initiation until the public announcement. Column 7 for insider purchases confirms, in line with the results in columns 1 and 4, that insiders stop buying during the whole pre-announcement

period. The DiD coefficient for insider sales in column 8 is also significant at the 5-percent level. However, the DiD coefficient is not significant for net purchases in column 9. Even though target insiders postpone their sales after their firms sign confidentiality agreements (column 3), the decrease in net purchases before the first confidentiality agreement date weakens the results.

The confidentiality agreement date coincides with the announcement date for 45 deals in our data set, and with the initiation date for 159 deals. The three dates are identical for 3 deals. To address a concern that these deals may be biasing our results, Table I.5 in the internet appendix shows results when we exclude these deals from the analysis. Conclusions from Table 5 still follow through. Further sensitivity checks in Table 6 rely on the six alternative measures of insider trading and four alternative definitions of insiders. We show only results for net purchases, as insider purchases and sales always follow a pattern as for our base regressions in Table 5.¹⁶ To increase the readability of reported results, for each regression we show only the DiD coefficient for the interaction term ‘target x pre-announcement’, even though all regressions include also the two plain dummy variables and all other control variables. We also refrain from showing results for the whole pre-announcement period, as it does not bring any additional insights. Panels A and B report the results for insider trading after and before signing confidentiality agreements, respectively, and confirm our findings in Table 5, except for CEOs in column 7. Even though CEOs do possess information about potential takeovers in their firms, they trade more cautiously than other directors since regulators and market participants may follow their transactions more closely (Fidrmuc et al., 2006). They also receive the highest number of shares as part of their remuneration package and, therefore, suffer more when not selling.

- insert Table 6 about here -

Our results in Table 5 link significant insider net purchases to the period after signing confidentiality agreements, when insiders possess more and more precise information. However, because the length of the negotiation period from signing confidentiality agreements is on average 155 calendar days (see Panel A in Table 1), one could argue that our results just confirm the finding in Agrawal

¹⁶The DiD coefficients for purchases are (with a few exceptions) significantly negative for all tested groups. The overall effect for net purchases is driven fully by the pattern for insider sales – if net purchases increase significantly, it is because sales decrease significantly.

and Nasser (2012) that insiders increase their net purchases over the fixed six-month period before the takeover public announcement. To show that signing of confidentiality agreements really matters for insider trading decisions, and to distinguish our findings from those of Agrawal and Nasser (2012), Table 7 first partitions the sample into Panel A, with deals for which the whole pre-announcement period is shorter than six months, and Panel B, with deals which have a whole pre-announcement period longer than six months. Panel A, for the short-negotiation deals, then reports results after versus before signing confidentiality agreements in columns 1 to 3 and columns 4 to 6, respectively. We can see that the DiD coefficient for net purchases in column 3 is significantly positive while it is insignificant in column 6. Similarly in Panel B, for deals with negotiations longer than six months, the DiD coefficient in column 3, covering the period after signing of confidentiality agreements, is positive and statistically significant at the 5-percent level. In contrast, the DiD coefficient in column 6, covering the six months before the deal announcement, is not significant. This further supports Hypothesis 1, that it is the signing of confidentiality agreements that matters for insider trading, and highlights our contribution relative to Agrawal and Nasser (2012). Insiders postpone their sales and increase their net purchases after the confidentiality agreements are signed regardless of the private negotiation length.

- insert Table 7 about here -

Panel C focuses on the one-month periods before and after the date of signing the first confidentiality agreement. If confidentiality agreements indeed matter, we should see that insiders decrease sales and increase net purchases during the one-month period after the confidentiality agreement signing date, but not before that date. Our results confirm this pattern. We can see that insiders indeed decrease sales and increase net purchases significantly in the one-month period after signing confidentiality agreements in columns 2 and 3, respectively, but not during the one-month period before the confidentiality date, as shown in columns 5 and 6.

To summarize, our results so far support Hypothesis 1, that target insiders increase their net purchases only once potential bidders start signing confidentiality agreements. Given the fact that the increase in net purchases is driven by a decrease in sales – insiders in target firms stop buying but at the same time postpone their sales – we believe that this pattern is more likely to concern routine rather than opportunistic trading by insiders (Cohen et al., 2012). It seems more likely

that insiders of target firms postpone their planned sales that appear periodically. Opportunistic trades, by definition, do not appear at regular intervals, and their postponement therefore would not trigger a significant average change in insider sale patterns relative to the control period and matched firms.

4.2 Completion probability

Regressions in Table 8 test Hypothesis 2, that insiders increase their net purchases more in deals that are more likely to be completed. To construct a measure of deal completion probability, we follow Samuelson and Rosenthal (1986) and derive three versions of a measure that implies completion probability from the market reaction on the deal-announcement date. For details concerning the measure construction and differences between the three measure versions see Appendix B. We use the measure to split the sample into high versus low completion probability groups, based on median values. Note that the measure is only an approximation of insiders' estimate of the odds of their deal going through to completion, as used in Hypothesis 2. We are aware of the time lag between the two assessments of the probability, but their cross-sectional correlation should be positive: firms classified into the higher completion-probability group at the public announcement date should also be classified into the higher completion-probability group during the period before the deal announcement.

- insert Table 8 about here -

In Panel A of Table 8, covering the period after signing confidentiality agreements, the DiD coefficients for deals with high completion probability in columns 1, 3 and 5 are large in magnitude and statistically significant, while the low completion probability DiD coefficients in columns 2, 4 and 6 are small and statistically insignificant. These results support Hypothesis 2, that insiders prefer keeping stocks with high completion probability and tend to avoid uncertainty. The magnitude of the increase in net purchases for the high completion probability deals is somewhat larger than for the pooled effect in Table 5 – 0.66 to 0.71 basis points, relative to 0.58 basis points for the base regression. Panel B shows that the effect of completion probability is weaker and not significant in the early negotiation period before confidentiality agreements are signed. Tables I.6 and I.7 in the internet appendix test Hypothesis 2 using the six alternative measures of insider trading and the

four alternative definitions of insiders, respectively. All results support Hypothesis 2.

4.3 Takeover premium and deal characteristics

Tables 9 to 11 test Hypothesis 3, which focuses on the takeover premium and deal characteristics as determinants of insider net purchases. In order to explore whether insiders trade depending on their intuition for high realized premium, columns 1 and 2 in Table 9 partition the sample into deals with high versus low premium, based on the median of the final offer price relative to the stock price at the confidentiality agreement date. We find that both DiD coefficients are insignificant, which contradicts Hypothesis 3A. Insider net purchases do not reflect the realized takeover premium relative to the price at the confidentiality agreement date. Insiders either cannot predict the premium or have other reasons for continuing to sell when the future offer price is higher. To investigate the issue further, columns 3 to 5 in Table 9 explore insider net purchases across premium quintiles. Interestingly, we can see that insiders are not very keen to increase their net purchases in the highest and lowest quintiles, but they increase their net purchases significantly in premium quintiles 3 and 4 – the DiD coefficient estimate in column 4 is 0.86 basis points and is significant at the 5-percent level. This suggests that insiders do take their intuition for realized premium into account.

- insert Table 9 about here -

However, the insignificant DiD coefficient in quintile 5 is very puzzling. Insiders shy away from increasing their net purchases when the realized premium to the target price on the confidentiality agreement date is very high. Further investigation of Panel B in Table 1 shows that firms with premium in quintile 5 (column 5) are firms with very high stock return volatility and very negative returns from deal initiation to signing of confidentiality agreements that reverse to very high returns from signing confidentiality agreements to one day before the deal announcement. These patterns suggest that insiders are not willing to increase their net purchases significantly in more volatile stocks with large run-ups from the confidentiality agreement date. This conjecture is supported by results reported in columns 6 and 7 in Table 9. The two columns partition the sample of target firms with high premium (from column 1) according to high versus low stock return volatility. We can see that insiders increase their net purchases significantly in low sigma firms (column 7), but

not in high sigma firms (column 6). Note that the DiD coefficient in column 7 for target firms with high premium and low stock return sigma is 0.85 basis points, 1.5-times the effect of 0.58 estimated in Table 5 for the pooled sample.¹⁷ These results suggest that insiders are shying away from increasing their net purchases in target firms with very high realized premium, because these firms tend to have more volatile stock returns. Insiders shy away from the high uncertainty and do not stop selling their stock.

Panel B of Table 9, with insider trading before signing of confidentiality agreements, shows that the DiD coefficients are negative and significant in columns 2 and 5. Insiders in firms with low realized takeover premium do not stop selling, and perhaps even slightly increase their sales, so that the overall net purchases decrease significantly in the period between deal initiation and signing of first confidentiality agreements. We believe this is due to the poor stock-return performance of these firms during the whole pre-announcement period and associated uncertainty concerning the final offer price and premium.

Table 10, partitioning the sample by the four deal characteristics, shows in Panel A that in the period after confidentiality agreements are signed, insiders increase their net purchases significantly in bidder-initiated deals (column 1), cash deals (column 3), informal sales (column 5), and strategic deals (column 7). The increase is the largest at 0.81 basis points for cash payment and the smallest at 0.57 basis points for strategic deals. The DiD coefficients for the counter-part types – target-initiated deals, stock deals, auctions, and financial deals – are not statistically significant. These patterns across partitions by deal characteristics are in line with differences in the realized premium and support Hypothesis 3B. Panel B, with net insider purchases before confidentiality agreements are signed, shows insignificant results for all four partitions. Relatively large uncertainty concerning deal outcomes discourages insiders from stopping selling. Tables I.6 and I.7 in the internet appendix test Hypothesis 3 further using the six alternative measures of insider trading and the four alternative definitions of insiders, respectively. Our conclusions are not changed.

- insert Table 10 about here -

¹⁷We do not partition premium quintile 5 into high versus low stock return sigma because we do not have enough observations left in the subgroups. We also estimate the DiD coefficients for partitions based on the premium relative to one day before the deal announcement (not reported). In line with a sizeable run-up before the deal announcement for premium quintile 5 firms, we find that insider net purchases increase significantly in the high premium subgroup when the premium disregards any stock price changes before the deal announcement.

Table 11 explores the question of which of the two insider trading determinants, future premium or deal characteristics, is more important. Are insiders really able to guess the takeover premium well, or do they just use information concerning deal characteristics to form their expectations? To explore this question, we partition the sample into six partitions, by each deal characteristic and by the three premium groups. Panel A, focusing on the period after signing confidentiality agreements, shows that for all deal characteristics, only one of the six partitions has a significant DiD coefficient – the group for premium in quintiles 3 and 4 and the dominant deal characteristic (bidder initiation, cash payment, informal sale, and strategic buyer). All these DiD coefficients are large, between 0.82 and 1.09, which represents a further sizeable increase in net purchases compared to the coefficient of 0.58 in the base regression. These large coefficients suggest complementarity between the two sources of information. Including both relatively high premium and bidder initiation (or cash payment, informal sale, strategic buyer) is associated with a larger increase in net purchases than each of the determinants on its own. Insiders do not rely only on deal characteristics when increasing their net purchases; they possess more information (intuition) concerning the final offer price.

- insert Table 11 about here -

Panel B of Table 11 covers the period before confidentiality agreements are signed. We do not see any significant DiD coefficients for premium in quintiles 5 to those in 3 and 4 and the four deal characteristics. However, the DiD coefficients are significantly negative for premium in quintiles 1 and 2 and target initiation, cash payment, and strategic buyer. Insiders keep selling shares when the expected premium is uncertain and low in the early negotiation process.

To summarize, our results in this section partially support Hypothesis 3A and fully support Hypothesis 3B. Insiders use both their intuition for the realized premium and deal characteristics when increasing their net purchases before their deal announcements. However, insiders seem to avoid deals with very high takeover premium due to their large stock return volatility. We also find a complementarity effect between premium and the deal characteristics.

4.4 Complementarity between completion probability and takeover premium

Given we find empirical support for both Hypothesis 2 and Hypothesis 3, Table 12 explores the relative importance of the completion probability versus premium and deal characteristics as determinants of net insider purchases. We form partitions by combining high versus low completion probability with the three premium partitions and then with partitions across each of the four deal characteristics. In Panel A, for the period after signing confidentiality agreements, the DiD coefficient in the first row when combining high completion probability with premium quintiles 3 and 4 (in column 4) is large and statistically significant. In contrast, all remaining DiD coefficients in the first row are relatively small and statistically insignificant. The economic effect of the significant DiD coefficient is high – insiders increase their net purchases by 1.14 basis points per month in quintiles 3 and 4. High deal completion probability does not seem to affect insiders’ unwillingness to increase their net buying in the highest premium quintile 5. Columns 10, 12 and 14 with insignificant DiD coefficients show that the size of the takeover premium does not affect net insider purchases in firms with low completion probability.

- insert Table 12 about here -

The remaining results in Table 12 show a clear pattern of complementarity between completion probability and the deal characteristics. All DiD coefficients for high completion probability combined with the dominant deal characteristic are large in magnitude and statistically significant. The coefficient estimate is the highest, at 0.88 basis points per month, for bidder initiation, and the weakest, at 0.71 basis points per month, for the buyer type. All the remaining DiD coefficients in Panel A are smaller in magnitude and statistically insignificant. These results show again that insiders combine/complement different sources of information when trading.

The partitions in Panel B, for the period before signing confidentiality agreements, show two significantly negative DiD coefficients. Low completion probability together with low premium or strategic buyer are associated with a decrease in net insider purchases. The size of the effect for low premium is especially large. This suggests that, early in the selling process, insiders are not very optimistic concerning deal outcomes in targets with low premium and low completion probability. Table I.8 in the internet appendix combines all information (completion probability, premium, and deal characteristics) together. All the results are in line with what we have discussed so far and we

do not obtain any additional insights. Also, numbers of observations in some groups become small, so we should be careful in pushing these results too far.

To summarize, the results in Table 12 suggest that including high completion probability in combination with premium or deal characteristics as a determinant of insider net purchases increases the size of the DiD coefficients markedly. We can see that insiders prefer keeping stock with high completion probability when they are bidder initiated, sold in informal sales, paid for in cash, or acquired by strategic buyers. Insiders also like high completion probability together with realized takeover premium in quintiles 3 and 4. The individual sources of information are complementary.

5 Conclusions

The main aim of this paper is to analyze what kind of information insiders use when trading in target firms during negotiations that take place before takeover public announcements. To do so, we focus on the determinants of increases in net insider purchases in the pre-announcement period after deal initiation. The main contribution of such an analysis is to characterize the insiders' information environment during deal negotiations and insiders' expectations concerning the deal success, takeover premium, and deal characteristics.

We examine insider trading patterns on a sample of 1,802 publicly listed US firms sold during the period from 2005 to 2018, using the difference-in-differences approach that controls insider trading in the same firm during a control period and, at the same time, for change in insider trading in matched firms. In line with the literature, target insiders decrease their purchases before the public announcement (Harlow and Howe, 1993; Agrawal et al., 1992; Agrawal and Nasser, 2012; Davis et al., 2020). Higher legal jeopardy motivates insiders to decrease their purchases immediately after deal initiation. As a contribution to the literature, we find a significantly large drop in insider sales only once bidders start signing confidentiality agreements, suggesting that insiders' information concerning the future deal becomes more precise and reliable at this stage, and insiders are willing to postpone their diversification and/or liquidity needs. Insiders do not stop selling significantly before bidders start signing confidentiality agreements. Early in the negotiation process, insiders' uncertainty concerning the expected premium is high and causes the insiders' trade-off to tilt in favor of their diversification and liquidity needs – they do not stop selling at this stage, even though they are aware of their firm being in play. Combining the effects for insider purchases together

with their sales, we find that insider net purchases increase significantly only after confidentiality agreements are signed.

Exploring cross-sectional determinants of insider trading, our results are threefold. First, we find that insiders increase their net buying only in firms with high completion probability. Insiders do not stop selling in deals associated with low completion probability, as it is associated with higher uncertainty and lower expected premium at the moment of trading. Second, we show that insiders increase their net purchases when the realized takeover premium is relatively high, which suggests that insiders have good knowledge/intuition of the offer price some time before contracts are signed. At the same time, insiders avoid deals with very high realized premium. Our analysis shows that this is due to insiders' preferences for deals with low stock return volatility. Insider net purchases are also significantly larger for deals with characteristics that are usually associated with higher takeover premium – bidder deal initiation, cash payment, informal sale with restricted bidding competition, and strategic buyer. Third, we find that insiders savvily combine all available information when trading. Their net purchases increase the most for deals for which all the trading determinants overlap: deals with high completion probability, and relatively higher premium and deal characteristics. Each of the determinants contributes marginally to the increase in insider net purchases.

In summary, we show that insiders use their private information strategically as they trade differently across deals with different deal and firm characteristics. Their trading is sensitive to insider trading legal restrictions, as they stop selling rather than increase buying, and it seems that insider trading patterns do not provide much information to help outside investors to detect increased probability of forthcoming deals.

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Appendix A Variable definitions

HC stands for ‘hand collection,’ OC for ‘own calculations,’ and TIF for ‘Thomson/Refinitiv Financial Insider Filings.’

Variable	Definition	Source
<i>Alternative definitions of insiders</i>		
Top executives & outside directors	Our base insider group that includes top officers and all board members that are not employed by the firm.	TIF, OC
Top directors	Insider group that includes chairman of the board, president, CEO, chief operating officer, and general counsel.	TIF, OC
Other directors	Insider group that includes all directors except top directors.	TIF, OC
All directors	Insider group that includes corporate officers and all members of the board of directors.	TIF, OC
<i>Alternative insider trading measures</i>		
Main measure: fraction of firm traded	The fraction of shares outstanding traded (purchases, sales or net purchases) by top executives & outside directors, in basis points and scaled on a monthly basis.	TIF, OC
Number of transactions	The total number of trades (purchases, sales or net purchases) by top executives & outside directors, scaled on a monthly basis.	TIF, OC
Number of shares	The total number of shares traded (purchases, sales or net purchases) by top executives & outside directors, in thousands and scaled on a monthly basis.	TIF, OC
Dollar shares	The total dollar value of shares traded (purchases, sales or net purchases) by top executives & outside directors, in USD millions and scaled on a monthly basis. It is equal to the transaction price times the total number of shares traded.	TIF, OC
Scaled number of transactions	The total number of trades (purchases, sales or net purchases) by top executives & outside directors scaled by the total number of individual insiders in the firm, multiplied by 100 and scaled on a monthly basis.	TIF, OC
Scaled number of shares	The total number of shares traded (purchases, sales or net purchases) by top executives & outside directors scaled by the total number of individual insiders in the firm, in thousands and scaled on a monthly basis.	TIF, OC
Scaled dollar shares	The total dollar value of shares traded (purchases, sales or net purchases) by top executives & outside directors scaled by the total number of individual insiders in the firm, in USD thousands and scaled on a monthly basis.	TIF, OC
<i>Partitioning variables</i>		
Deal completion probability	Following Samuelson and Rosenthal (1986), estimated as $q = (P_d - P_F)/(P_{of} - P_F)$, where P_d is the target stock price one day after the deal announcement, P_F is the fall back price and P_{of} is the final offer price. We use three versions of the measure: (i) the base measure of completion probability, q_B , with the fall back price equal to the target stock price 42 days before the deal announcement following Fidrmuc et al. (2018); (ii) the fall back measure of completion probability, q_F , with the fall back price estimated as $0.63 \times P_{-42} + 0.37 \times P_{of}$ as in Samuelson and Rosenthal (1986); and (iii) the initial offer measure of completion probability, q_I , that is derived from q_F but uses the initial offer price instead of the final offer price. q_F and q_I are also adjusted for time value of money. More details of the derivation are given in Appendix B.	SDC, CRSP

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Variable	Definition	Source
Premium	The final offer price relatively to the stock price at the date when the first confidentiality agreement with a bidder is signed, in percentage points.	SDC, OC
Bidder initiated	Dummy variable equal to 1 for deals for which a potential buyer approaches the target firm and proposes an M&A transaction (includes both final acquirer initiated and third party initiated deals) and 0 otherwise.	HC
Target initiated	Dummy variable equal to 1 in case the board of the target firm decides to consider strategic alternatives for the future of the company and consequently contacts potential buyers and 0 otherwise.	HC
Cash (payment)	Dummy variable equal to 1 in case the acquirer offers only cash as the payment consideration and 0 otherwise.	SDC
Stock (payment)	Dummy variable equal to 1 in case the payment consideration involves stock of the acquirer company and 0 otherwise.	SDC
Informal sale	Dummy variable equal to 1 in case the target firm is sold in a controlled sale or one-to-one negotiation and 0 otherwise. Based on Boone and Mulherin (2009).	HC
Auction	Dummy variable equal to 1 in case the company is sold in a formal full-scaled auction with pre-set rules and 0 otherwise. Based on Hansen (2001).	HC
Strategic buyer	Dummy variable equal to 1 in case the target firm is eventually acquired by a private or public non-financial firm. Based on Fidrmuc et al. (2012) and Gorbenko and Manlenko (2014).	SDC
Financial buyer	Dummy variable equal to 1 in case the target firm is acquired by a firm that is majority owned by a private equity investor and 0 otherwise. Based on Fidrmuc et al. (2012).	SDC
<i>DiD regression variables</i>		
Pre-announcement	In Tables 5–12, dummy variable equal to 1 for the period from the date of signing the first confidentiality agreement to the SDC announcement date in Panel A, for the period from the initiation to the signing of the first confidentiality agreement in Panel B and for the period from the initiation to the SDC announcement date in Panel C (Table 5 only) and 0 for the control period.	TIF, OC
Control period	For each deal, period over exactly the same months as the pre-announcement period but before the private date.	OC
Target	Dummy variable equal to 1 for target firms and 0 for matched firms.	OC
Period after signing confidentiality agreement	The period from signing the first confidentiality agreement with a bidder to the public announcement.	OC
Period before signing confidentiality agreement	The period from the initiation date to the date of signing the first confidentiality agreement with a bidder.	OC
Whole pre-announcement period	The period from the initiation date to the public announcement of the deal.	OC
Total assets	Book value of total assets in USD millions; in the analysis used as a natural log.	COMPUSTAT
Market capitalization	Stock price times the number of shares outstanding one fiscal year before the beginning of the pre-announcement or control period; in the analysis used as a natural logarithm.	CRSP
Total sales	Total amount collected for providing goods and services in USD millions.	COMPUSTAT
Book to market decile	Equal to 1 to 10 after comparing a firm's book to market ratio to the NYSE book to market decile breakpoints.	COMPUSTAT

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Variable	Definition	Source
Book to market ratio	Book value of equity over market capitalization one fiscal year before the beginning of the pre-announcement or control period.	COMPUSTAT
Stock return quarter-1	Average daily market adjusted abnormal return over the first quarter before the pre-announcement or the control period. Based on Agrawal and Nasser (2012).	CRSP, OC
Stock return quarter-2	Average daily market adjusted abnormal return over the second quarter before the pre-announcement or the control period. Based on Agrawal and Nasser (2012).	CRSP, OC
Stock return volatility	The volatility of daily stock returns over the period from 250 to 126 trading days before the beginning of the pre-announcement and control period, respectively. Based on Agrawal and Nasser (2012).	CRSP, OC
Change in stock return volatility	The change in volatility of daily stock returns over the period from 125 to 1 trading day versus the period from 250 to 126 trading days before the beginning of the pre-announcement and control period, respectively. Based on Agrawal and Nasser (2012).	CRSP, OC
R&D	Research and development expenses divided by total sales.	COMPUSTAT
Liquidity	Daily average fraction of shares outstanding that is traded over one fiscal year before the beginning of the pre-announcement or control period.	CRSP, OC
EBITDA	Earnings before interest, taxes, depreciation and amortization over total assets.	COMPUSTAT
Insider ownership	The total fraction of shares outstanding owned together by the insider group just before the pre-announcement or control period.	TIF, OC
Private selling process length	The number of calendar days from the initiation date to the SDC announcement date; in regressions used as a natural logarithm.	HC
<i>Other deal variables</i>		
Transaction value	Total value paid by the acquirer less fees and expenses in USD millions.	SDC
Time since confidentiality agreement	The number of calendar days from the date when the target firm signs the first confidentiality agreement with a bidder to the SDC announcement date.	OC
Premium to eight weeks	The final offer price relatively to the stock price eight weeks before the SDC announcement date in percentage points.	SDC
Premium to initiation	The final offer price relatively to the stock price at the initiation date in percentage points.	SDC, OC
Premium to 1 day before announcement	The final offer price relatively to the stock price 1 day before the SDC announcement date in percentage points.	SDC, OC
Offer improvement	The final offer price at the completion date relatively to the initial offer price at the initiation date in percentage points.	SDC
$CAR_{init.,1db.conf.agr.}$	The target cumulative market adjusted abnormal stock return from the initiation date to the date before the first confidentiality agreement with a bidder is signed.	CRSP, OC
$CAR_{conf.agr.,1db.ann.}$	The target cumulative market adjusted abnormal stock return from the date when the first confidentiality agreement is signed with a bidder to one day before the SDC announcement date.	CRSP, OC
$CAR_{-1,+1}$	The target cumulative market adjusted abnormal stock return from one day before to one day after the SDC announcement date.	CRSP, OC
Stock return volatility before initiation	The standard deviation of daily stock returns over one year before the initiation date.	CRSP, OC
Stock return volatility before conf. agreement	The standard deviation of daily stock returns over six months before signing the first confidentiality agreement with a bidder.	CRSP, OC

Appendix B Estimation of the deal completion probability

To come up with a measure of deal completion probability, we follow Samuelson and Rosenthal (1986) who argue that the market’s assessment of completion probability could be implied from target stock prices after the deal announcement because the completion probability increases as the distance between the target stock price on a day d and the offer price, $P_{\text{of}} - P_d$, increases. If after the announcement, the stock price immediately jumps to the offer price, one could infer that the deal will be successful with certainty. Alternatively, a minimal movement no higher than the fall back price, P_F , implies that the market assess a zero probability of success. Following this logic and denoting q as the probability of success, we have that $P_d = q \times P_{\text{of}} + (1 - q) \times P_F$. We can then easily infer the market probability of success as $q = (P_d - P_F)/(P_{\text{of}} - P_F)$.

In our estimations of q , we set d equal to one – the first day after the announcement and use three different versions of the measure. Following Fidrmuc et al. (2018), the first version is a simple basic measure of deal completion probability that assumes that the target price unaffected by the deal announcement, the fall back price P_F is equal to the target price two months before the deal announcement: $q_B = (P_{+1} - P_{-42})/(P_{\text{of}} - P_{-42})$. For the second version, we estimate the fall back price following Samuelson and Rosenthal (1986) as the weighted average of P_{-42} and P_{of} : $P_F = 0.63 \times P_{-42} + 0.37 \times P_{\text{of}}$. Furthermore, we also take into account the time value of money in the following form (also following Samuelson and Rosenthal, 1986): $P_{+1} = [q \times P_{\text{of}} + (1 - q) \times P_F]/[1 + r_f]$, where $1 + r_f$ is the risk-free rate over the holding period from $d = +1$ to the deal completion date. We use daily returns on the US thirty-day treasury bills. The deal completion probability is then computed as $q_F = [(1 + r_f) \times P_{+1} - P_F]/(P_{\text{of}} - P_F)$. The third version of the measure, q_I , replaces the final offer price, P_{of} , with the initial offer price, P_{iof} , both when calculating the fall back price and the deal completion probability.

In further robustness checks, we re-estimate the fall back price, P_F , with alternative weights of (0.5, 0.5) and (0.75, 0.25) using both the final offer price and initial offer price. The partitions into high versus low deal completion probability do not change, which means that our results in Table 8 are not affected by particular weights. We do not report these results in the paper.

Table 1: Deal summary statistics

This table reports summary statistics for all deals. Panel A reports basic statistics. Panels B and C show means across sample partitions. All variables are defined in Appendix A and winsorized at the 1st and 99th percentiles except dummy variables. We test for differences in means using the *t*-test allowing for unequal variances. The significance of differences in means within partitions is indicated always in the column for the second partition, except in columns 5 to 7 in Panel B where the significance for differences between quintile 5 and quintiles 3 & 4 is indicated in column 5, between quintiles 3 & 4 and quintiles 1 & 2 in column 6 and between quintile 5 and quintiles 1 & 2 in column 7. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	# obs.	Mean	s.d.	Minimum	25 th perc.	Median	75 th perc.	Maximum
<i>Panel A</i>								
Transaction value (million USD)	1,786	2,197 ^a	5,153	6	129	464	1,819	36,179
Private selling process length	1,802	315 ^a	297	8	125	222	397	1,698
Time since confidentiality agreement	1,802	155 ^a	155	0	59	105	194	835
Deal completion probability	1,608	0.62 ^a	1.17	-4.56	0.25	0.82	0.97	6.63
Premium	1,488	39.9% ^a	66.6%	-100.0%	15.1%	31.0%	52.5%	435.1%
Premium to initiation	1,573	45.3% ^a	84.6%	-100.0%	13.2%	33.3%	59.9%	540.1%
Premium to 8 weeks	1,608	38.7% ^a	61.0%	-210.5%	16.2%	31.4%	51.1%	380.8%
Premium to 1 day b.announcement	1,607	31.1% ^a	46.7%	-100.0%	11.0%	24.5%	42.1%	278.8%
Offer improvement	1,731	1.9% ^a	11.1%	-14.3%	0	0	0	87.4%
$CAR_{init.,1db.conf.agr.}$	1,765	-3.2% ^a	27.1%	-104.2%	-8.5%	0	5.0%	92.3%
$CAR_{conf.agr.,1db.ann.}$	1,765	1.3% ^b	26.7%	-82.9%	-6.5%	0.5%	11.0%	101.2%
$CAR_{-1,+1}$	1,765	21.5% ^a	22.6%	-10.9%	3.4%	16.3%	32.2%	98.1%
Stock return volatility b. initiation	1,602	2.9% ^a	1.6%	0.9%	1.8%	2.6%	3.6%	9.3%
Stock return volatility b. conf. agr.	1,626	3.0% ^a	2.0%	0.9%	1.7%	2.4%	3.5%	11.8%
Target initiated	1,802	0.41 ^a	0.49	0	0	0	1	1
Cash payment	1,802	0.59 ^a	0.49	0	0	1	1	1
Auction	1,802	0.31 ^a	0.46	0	0	0	1	1
Financial buyer	1,802	0.19 ^a	0.39	0	0	0	1	1

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Variable	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	High completion probability	Low completion probability	High premium	Low premium	High premium	Low premium	Premium quintile 5	Premium quintiles 3 & 4	Premium quintiles 1 & 2					
<i>Panel B</i>														
Transaction value (million USD)	1,809	2,880 ^a	2,096	2,415	2,096	2,415	1,986	2,604 ^c	2,044					
Private selling process length	324	305	303	309	303	309	315	285 ^b	322					
Time since confidentiality agreement	165	145 ^b	148	151	148	151	170 ^a	126 ^a	163					
Deal completion probability	1.22	0.03 ^a	0.66	0.67	0.66	0.67	0.61 ^c	0.68	0.69					
High completion probability	n.a.	n.a.	0.56	0.46 ^a	0.56	0.46 ^a	0.53	0.55 ^a	0.45 ^b					
Premium	40.3%	45.0%	75.6%	4.2% ^a	75.6%	4.2% ^a	124.3% ^a	39.6% ^a	-1.7% ^a					
High premium	55.9%	45.9% ^a	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.					
Premium quintile 5	21.0%	19.4%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.					
Premium quintiles 3 & 4	44.6%	37.0% ^a	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.					
Premium to initiation	44.9%	51.2%	78.6%	11.8% ^a	78.6%	11.8% ^a	123.2% ^a	45.1% ^a	6.3% ^a					
Premium to 8 weeks	35.1%	42.7% ^b	60.9%	16.8% ^a	60.9%	16.8% ^a	94.6% ^a	35.0% ^a	15.0% ^a					
Premium to 1 day b.announcement	30.7%	37.0% ^a	47.8%	14.1% ^a	47.8%	14.1% ^a	71.6% ^a	30.2% ^a	11.5% ^a					
Offer improvement	0.03%	3.8% ^a	3.6%	0.3% ^a	3.6%	0.3% ^a	7.8% ^a	0.7%	0.3% ^a					
$CAR_{init.,1db.conf.agr.}$	-3.9%	-2.8%	-4.5%	-1.4% ^b	-4.5%	-1.4% ^b	-7.6% ^a	-2.3%	-1.3% ^a					
$CAR_{conf.agr.,1db.conf.agr.}$	2.0%	1.2%	11.8%	-8.0% ^a	11.8%	-8.0% ^a	20.1% ^a	5.2% ^a	-10.5% ^a					
$CAR_{-1,+1}$	27.5%	18.3% ^a	30.8%	16.2% ^a	30.8%	16.2% ^a	38.8% ^a	24.4% ^a	15.0% ^a					
Stock return volatility b. initiation	3.0%	2.8% ^a	3.2%	2.6% ^a	3.2%	2.6% ^a	3.7% ^a	2.7%	2.7% ^a					
Stock return volatility b. conf. agr.	3.0%	2.8% ^b	3.3%	2.6% ^a	3.3%	2.6% ^a	4.1% ^a	2.6%	2.7% ^a					
Target initiated	0.40	0.40	0.35	0.44 ^a	0.35	0.44 ^a	0.33	0.36 ^a	0.47 ^a					
Cash payment	0.74	0.47 ^a	0.66	0.53 ^a	0.66	0.53 ^a	0.64	0.65 ^a	0.51 ^a					
Auction	0.33	0.28 ^c	0.26	0.34 ^a	0.26	0.34 ^a	0.25	0.27 ^a	0.35 ^a					
Financial buyer	0.21	0.17 ^b	0.17	0.19	0.17	0.19	0.15	0.17	0.20 ^c					

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Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Bidder initiated	Target initiated	Cash payment	Stock payment	Informal sale	Auction	Strategic buyer	Financial buyer
<i>Panel C</i>								
Transaction value (million USD)	2,752	1,392 ^a	1,545	3,091 ^a	2,733	992 ^a	2,504	1,348 ^a
Private selling process length	262	390 ^a	349	267 ^a	279	394 ^a	310	328
Time since confidentiality agreement	135	184 ^a	172	131 ^a	130	210 ^a	153	161
Deal completion probability	0.60	0.66	0.68	0.55 ^b	0.62	0.64	0.64	0.58
High completion probability	0.50	0.50	0.62	0.33 ^a	0.48	0.53 ^c	0.53	0.43 ^a
Premium	42.3%	36.2% ^c	44.7%	33.3% ^a	42.1%	34.8% ^c	42.8%	31.6% ^a
High premium	53.8%	44.2% ^a	56.1%	41.6% ^a	52.6%	43.9% ^a	51.8%	45.0% ^b
Premium quintile 5	22.2%	16.6% ^a	21.8%	17.4% ^b	21.3%	16.8% ^b	21.8%	14.7% ^a
Premium quintiles 3 & 4	42.5%	36.0% ^b	44.1%	34.1% ^a	41.7%	35.9% ^b	40.7%	37.7%
Premium to initiation	49.0%	39.9% ^b	51.3%	36.6% ^a	47.6%	40.4%	48.5%	36.5% ^b
Premium to 8 weeks	41.9%	34.0% ^b	41.6%	34.6% ^b	40.5%	34.8% ^c	41.6%	30.8% ^a
Premium to 1 day b.announcement	32.3%	29.2%	35.3%	25.0% ^a	32.5%	27.9% ^c	33.9%	23.2% ^a
Offer improvement	2.3%	1.4% ^c	1.9%	1.9%	2.1%	1.5%	1.9%	1.9%
$CAR_{init.,1db,conf,agr.}$	-0.8%	-6.7% ^a	-3.5%	-2.8%	-3.4%	-2.7%	-2.9%	-4.0%
$CAR_{conf,agr.,1db,ann.}$	4.2%	-3.0% ^a	0.6%	2.2%	3.4%	-3.5% ^a	1.4%	1.0%
$CAR_{-1,+1}$	22.5%	20.0% ^b	25.9%	15.4% ^a	22.4%	19.4% ^a	22.8%	17.9% ^a
Stock return volatility b. initiation	2.9%	3.0% ^c	3.1%	2.7% ^a	2.9%	3.1% ^b	3.1%	2.6% ^a
Stock return volatility b. conf. agr.	2.9%	3.1% ^b	3.2%	2.7% ^a	2.9%	3.3% ^a	3.1%	2.6% ^a
Target initiated	n.a.	n.a.	0.41	0.41	0.30	0.66 ^a	0.39	0.47 ^a
Cash payment	0.60	0.59	n.a.	n.a.	0.53	0.75 ^a	0.53	0.87 ^a
Auction	0.18	0.50 ^a	0.39	0.19 ^a	n.a.	n.a.	0.27	0.41 ^a
Financial buyer	0.17	0.21 ^c	0.27	0.06 ^a	0.14	0.30 ^a	n.a.	n.a.

Table 2: Summary statistics for insider trading before the deal public announcement

The table presents mean insider net purchases in target (matched) firms during the pre-announcement and control period in columns 1 & 2 (3 & 4), respectively. Panels A and B report means for insider net purchases after signing confidentiality agreements (up to the public announcement) and before signing confidentiality agreements (starting at the initiation date), respectively. Insiders are top executives and outside directors. We measure net purchases as fraction of shares outstanding in basis points, scale them on a monthly basis and winsorize them at the 5th and 95th percentiles. The data covers 1,802 target and 1,802 matched firms. All variables are defined in Appendix A. We test for differences in means using the *t*-test allowing for unequal variances. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	Target firms		Matched firms		Mean difference			
	Pre-ann. (1)	Control (2)	Pre-ann. (3)	Control (4)	(1) vs (2)	(1) vs (3)	(3) vs (4)	(1)–(2) vs (3)–(4)
<i>Panel A: After signing confidentiality agreement</i>								
All deals	-0.991 ^a	-1.739	-1.964	-2.222	0.749 ^a	0.973 ^a	0.258 ^c	0.491 ^a
High comp. probability	-1.241 ^a	-2.062	-2.158	-2.364	0.822 ^a	0.917 ^a	0.206	0.616 ^b
Low comp. probability	-0.903 ^a	-1.675	-1.741	-2.163	0.772 ^a	0.838 ^a	0.423 ^c	0.350
High premium	-1.326 ^a	-1.983	-1.943	-2.356	0.658 ^a	0.617 ^a	0.413 ^c	0.245
Low premium	-0.703 ^a	-1.759	-1.787	-2.319	1.056 ^a	1.084 ^a	0.531 ^b	0.525 ^b
Premium quintile 5	-1.360 ^a	-1.796	-2.281	-2.912	0.435	0.920 ^b	0.631	-0.196
Premium quintiles 3 & 4	-1.182 ^a	-2.185	-1.895	-2.142	1.003 ^a	0.713 ^a	0.247	0.756 ^b
Premium quintiles 1 & 2	-0.675 ^a	-1.597	-1.628	-2.245	0.922 ^a	0.953 ^a	0.618 ^b	0.304
Bidder initiated	-1.031 ^a	-1.764	-1.862	-2.077	0.733 ^a	0.831 ^a	0.215	0.519 ^b
Target initiated	-0.932 ^a	-1.703	-2.110	-2.431	0.771 ^a	1.178 ^a	0.321	0.450
Cash	-1.203 ^a	-2.201	-2.242	-2.440	0.998 ^a	1.039 ^a	0.198	0.800 ^a
Stock	-0.680 ^a	-1.063	-1.556	-1.902	0.383 ^b	0.877 ^a	0.346	0.037
Informal sale	-1.030 ^a	-1.790	-1.814	-1.940	0.760 ^a	0.784 ^a	0.126	0.634 ^a
Auction	-0.903 ^a	-1.626	-2.299	-2.852	0.723 ^a	1.397 ^a	0.553 ^c	0.170
Strategic buyer	-1.002 ^a	-1.782	-1.900	-2.165	0.780 ^a	0.898 ^a	0.266	0.515 ^a
Financial buyer	-0.942 ^a	-1.554	-2.240	-2.467	0.613 ^b	1.299 ^a	0.227	0.386
<i>Panel B: Before signing confidentiality agreement</i>								
All deals	-1.364 ^a	-1.550	-1.787	-2.015	0.186	0.423 ^a	0.228	-0.042
High comp. probability	-1.615 ^a	-1.900	-2.061	-2.100	0.285	0.446 ^b	0.040	0.245
Low comp. probability	-1.305 ^a	-1.457	-1.639	-1.996	0.152	0.334 ^c	0.357	-0.205
High premium	-1.333 ^a	-1.541	-1.990	-2.051	0.208	0.657 ^a	0.061	0.147
Low premium	-1.564 ^a	-1.702	-1.677	-2.130	0.138	0.114	0.452 ^c	-0.314
Premium quintile 5	-1.040 ^a	-1.408	-2.093	-2.449	0.369	1.053 ^a	0.356	0.013
Premium quintiles 3 & 4	-1.683 ^a	-1.806	-1.931	-1.883	0.123	0.248	-0.048	0.171
Premium quintiles 1 & 2	-1.418 ^a	-1.544	-1.607	-2.118	0.126	0.189	0.511 ^c	-0.384
Bidder initiated	-1.336 ^a	-1.554	-1.662	-1.846	0.218	0.325 ^c	0.184	0.034
Target initiated	-1.405 ^a	-1.544	-1.968	-2.259	0.139	0.564 ^b	0.291	-0.151
Cash	-1.656 ^a	-1.907	-2.078	-2.254	0.252	0.422 ^b	0.176	0.075
Stock	-0.937 ^a	-1.026	-1.362	-1.665	0.089	0.425 ^b	0.303	-0.214
Informal sale	-1.435 ^a	-1.615	-1.654	-1.865	0.180	0.219	0.211	-0.031
Auction	-1.206 ^a	-1.405	-2.085	-2.351	0.199	0.879 ^a	0.266	-0.067
Strategic buyer	-1.405 ^a	-1.543	-1.727	-2.029	0.138	0.321 ^b	0.302 ^c	-0.164
Financial buyer	-1.187 ^a	-1.577	-2.049	-1.955	0.391	0.862 ^a	-0.094	0.485

Table 3: Testing difference in differences assumptions

This table reports means for insider purchases, sales and net purchases for 1,802 target and 1,802 matched firms over the control period. The control period lies before the initiation date and matches the pre-announcement event period in length and calendar months. The table reports means across the earlier versus later control period, where the cutoff date corresponds to the confidentiality agreement date in the event period. Insiders are top executives and outside directors. Purchases, sales and net purchases are measured as fraction of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. We test for differences in means using the *t*-test allowing for unequal variances. ^a, ^b and ^c in columns 2, 4 and 6 indicate significance of differences in the corresponding partition at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)
	Purchases		Sales		Net purchases	
	Earlier c. period	Later c. period	Earlier c. period	Later c. period	Earlier c. period	Later c. period
Target firms	0.193	0.270	1.740	2.068	-1.550	-1.739
Matched firms	0.185	0.215	2.223	2.513	-2.015	-2.222
Target vs. matched	0.009	0.056 ^b	-0.483	-0.444	0.465	0.483

Table 4: Summary statistics for control variables in the difference in differences regressions

This table reports summary statistics for control variables included in Tables 5 to 12 for 1,802 target and 1,802 matched firms (columns 1 & 2 and columns 3 & 4, respectively). Panels A and B report the statistics for the whole pre-announcement and control period, respectively. The control period lies before the initiation date and matches the pre-announcement event period in length and calendar months. The private selling process length is a deal characteristic and by construction matched firms do not have any values. We fill in the missing observations with the corresponding deal values because the private selling process length is still an important regressor in the cross-section of firms. All variables are defined in Appendix A and winsorized at the 1st and 99th percentiles. In column 5, we test for differences in means using the t -test allowing for unequal variances. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent level.

	(1)	(2)	(3)	(4)	(5)
	Target firms		Matched firms		Mean
	Mean	St. dev	Mean	St.dev	difference
<i>Panel A: Whole pre-announcement period</i>					
Total assets (million USD)	2,138	5,108	2,237	5,347	-99
Log of total assets	6.164	1.825	6.159	1.878	0.005
Market Capitalization (million USD)	1,425	3,479	1,850	4,121	-424 ^a
Ln (Market capitalization)	5.664	1.960	5.942	1.896	-0.277 ^a
Book to market decile	5.258	3.142	5.072	3.030	0.185 ^c
Stock return quarter-2	-0.027%	0.379%	0.005%	0.346%	-0.032% ^b
Stock return quarter-1	-0.034%	0.408%	0.019%	0.355%	-0.053% ^a
Stock return volatility	2.808%	1.641%	2.750%	1.736%	0.058%
Change in stock return volatility	0.097%	1.182%	-0.037%	1.167%	0.134% ^a
R&D	0.228	1.108	0.250	1.180	-0.022
Liquidity	0.716%	0.677%	0.652%	0.629%	0.063% ^a
EBITDA	0.035	0.192	0.050	0.200	-0.015 ^b
Insider ownership	0.067	0.140	0.078	0.165	-0.010 ^b
Private selling process length	315	297	315	297	
<i>Panel B: Control period</i>					
Total assets (million USD)	1,938	4,791	2,075	5,168	-137
Log of total assets	5.948	1.963	6.018	1.926	-0.070
Market Capitalization (million USD)	1,253	3,317	1,615	3,810	-362 ^a
Ln (Market capitalization)	5.288	2.266	5.593	2.181	-0.305 ^a
Book to market decile	5.240	3.126	4.987	3.027	0.253 ^b
Stock return quarter-2	0.012%	0.412%	0.011%	0.380%	0.001%
Stock return quarter-1	-0.015%	0.399%	0.006%	0.370%	-0.020%
Stock return volatility	3.063%	1.901%	2.883%	1.764%	0.180% ^a
Change in stock return volatility	-0.064%	1.265%	-0.025%	1.215%	-0.039%
R&D	0.237	1.115	0.327	1.493	-0.091 ^b
Liquidity	0.697%	0.679%	0.642%	0.643%	0.054% ^b
EBITDA	0.028	0.206	0.044	0.222	-0.016 ^b
Insider ownership	0.076	0.182	0.079	0.170	-0.003

Table 5: Insider trading in target firms before public announcements: pooled results

This table reports OLS estimation results for insider purchases, sales and net purchases in target and matched firms before the takeover public announcement date. Insiders are top executives and outside directors. We measure insider trades as fraction of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. Columns 1 to 3 report results for insider trading after signing confidentiality agreements (up to the public announcement), columns 4 to 6 for insider trading before signing confidentiality agreements (starting at the initiation date) and columns 7 to 9 for insider trading during the whole pre-announcement period. The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		
	After signing confidentiality agreement						Before signing confidentiality agreement						Whole pre-announcement period						
	Purchases	Sales	Purchases	Sales	Net purchases	Purchases	Sales	Purchases	Sales	Net purchases	Purchases	Sales	Net purchases	Purchases	Sales	Net purchases	Purchases	Sales	Net purchases
Target x pre-announcement	-0.180 ^a (0.027)	-0.748 ^a (0.228)	-0.180 ^a (0.027)	-0.748 ^a (0.228)	0.582 ^a (0.222)	-0.081 ^a (0.025)	0.080 (0.221)	-0.081 ^a (0.025)	0.080 (0.221)	-0.153 (0.221)	-0.264 ^a (0.041)	-0.523 ^b (0.266)	0.233 (0.266)	-0.264 ^a (0.041)	-0.523 ^b (0.266)	0.233 (0.266)	-0.264 ^a (0.041)	-0.523 ^b (0.266)	0.233 (0.266)
Pre-announcement	-0.031 (0.021)	-0.229 (0.180)	-0.031 (0.021)	-0.229 (0.180)	0.137 (0.175)	0.013 (0.019)	-0.170 (0.171)	0.013 (0.019)	-0.170 (0.171)	0.179 (0.170)	-0.003 (0.031)	-0.190 (0.210)	0.185 (0.209)	-0.003 (0.031)	-0.190 (0.210)	0.185 (0.209)	-0.003 (0.031)	-0.190 (0.210)	0.185 (0.209)
Target	0.063 ^a (0.022)	-0.360 ^b (0.177)	0.063 ^a (0.022)	-0.360 ^b (0.177)	0.397 ^b (0.172)	0.015 (0.019)	-0.458 ^a (0.166)	0.015 (0.019)	-0.458 ^a (0.166)	0.455 ^a (0.166)	0.079 ^b (0.032)	-0.606 ^a (0.203)	0.683 ^a (0.203)	0.079 ^b (0.032)	-0.606 ^a (0.203)	0.683 ^a (0.203)	0.079 ^b (0.032)	-0.606 ^a (0.203)	0.683 ^a (0.203)
Total assets	-0.033 ^a (0.005)	-0.210 ^a (0.043)	-0.033 ^a (0.005)	-0.210 ^a (0.043)	0.187 ^a (0.041)	-0.013 ^a (0.004)	-0.124 ^a (0.042)	-0.013 ^a (0.004)	-0.124 ^a (0.042)	0.106 ^b (0.042)	-0.040 ^a (0.007)	-0.296 ^a (0.051)	0.246 ^a (0.051)	-0.040 ^a (0.007)	-0.296 ^a (0.051)	0.246 ^a (0.051)	-0.040 ^a (0.007)	-0.296 ^a (0.051)	0.246 ^a (0.051)
Book to market decile	0.002 (0.003)	0.025 (0.021)	0.002 (0.003)	0.025 (0.021)	-0.019 (0.021)	0.005 ^b (0.002)	-0.011 (0.020)	0.005 ^b (0.002)	-0.011 (0.020)	0.012 (0.020)	0.007 ^c (0.004)	0.049 ^c (0.025)	-0.043 ^c (0.025)	0.007 ^c (0.004)	0.049 ^c (0.025)	-0.043 ^c (0.025)	0.007 ^c (0.004)	0.049 ^c (0.025)	-0.043 ^c (0.025)
Stock return quarter-2	-3.490 ^c (1.866)	72.199 ^a (16.039)	-3.490 ^c (1.866)	72.199 ^a (16.039)	-74.179 ^a (15.767)	-3.540 ^c (1.842)	75.470 ^a (15.006)	-3.540 ^c (1.842)	75.470 ^a (15.006)	-77.647 ^a (14.972)	-7.059 ^b (3.021)	109.412 ^a (18.936)	-111.873 ^a (18.800)	-7.059 ^b (3.021)	109.412 ^a (18.936)	-111.873 ^a (18.800)	-7.059 ^b (3.021)	109.412 ^a (18.936)	-111.873 ^a (18.800)
Stock return quarter-1	-1.476 (1.980)	53.793 ^a (14.300)	-1.476 (1.980)	53.793 ^a (14.300)	-52.112 ^a (13.923)	-5.913 ^a (1.870)	70.733 ^a (14.346)	-5.913 ^a (1.870)	70.733 ^a (14.346)	-74.934 ^a (14.305)	-6.591 ^b (3.119)	93.469 ^a (17.104)	-97.831 ^a (17.214)	-6.591 ^b (3.119)	93.469 ^a (17.104)	-97.831 ^a (17.214)	-6.591 ^b (3.119)	93.469 ^a (17.104)	-97.831 ^a (17.214)
Stock return volatility	1.120 (0.716)	-13.246 ^b (5.147)	1.120 (0.716)	-13.246 ^b (5.147)	14.866 ^a (4.991)	1.667 ^b (0.687)	-19.421 ^a (4.735)	1.667 ^b (0.687)	-19.421 ^a (4.735)	19.146 ^a (4.761)	3.575 ^a (1.103)	-20.126 ^a (6.110)	21.381 ^a (6.158)	3.575 ^a (1.103)	-20.126 ^a (6.110)	21.381 ^a (6.158)	3.575 ^a (1.103)	-20.126 ^a (6.110)	21.381 ^a (6.158)
Change in stock return volatility	0.899 (0.784)	-21.137 ^a (5.601)	0.899 (0.784)	-21.137 ^a (5.601)	21.129 ^a (5.509)	1.434 ^b (0.701)	-25.637 ^a (5.157)	1.434 ^b (0.701)	-25.637 ^a (5.157)	25.626 ^a (5.155)	2.465 ^b (1.176)	-35.098 ^a (6.394)	36.855 ^a (6.460)	2.465 ^b (1.176)	-35.098 ^a (6.394)	36.855 ^a (6.460)	2.465 ^b (1.176)	-35.098 ^a (6.394)	36.855 ^a (6.460)
R&D	0.010 (0.010)	-0.028 (0.063)	0.010 (0.010)	-0.028 (0.063)	0.028 (0.062)	-0.003 (0.008)	-0.090 ^b (0.041)	-0.003 (0.008)	-0.090 ^b (0.041)	0.094 ^b (0.040)	0.002 (0.014)	-0.115 ^c (0.066)	0.112 ^c (0.066)	0.002 (0.014)	-0.115 ^c (0.066)	0.112 ^c (0.066)	0.002 (0.014)	-0.115 ^c (0.066)	0.112 ^c (0.066)
Liquidity	-2.715 ^b (1.156)	66.310 ^a (10.752)	-2.715 ^b (1.156)	66.310 ^a (10.752)	-67.207 ^a (10.536)	-2.229 ^b (1.023)	91.983 ^a (11.496)	-2.229 ^b (1.023)	91.983 ^a (11.496)	-93.103 ^a (11.470)	-3.717 ^b (1.741)	123.698 ^a (13.425)	-123.715 ^a (13.405)	-3.717 ^b (1.741)	123.698 ^a (13.425)	-123.715 ^a (13.405)	-3.717 ^b (1.741)	123.698 ^a (13.425)	-123.715 ^a (13.405)
EBITDA	-0.083 (0.060)	0.795 ^c (0.427)	-0.083 (0.060)	0.795 ^c (0.427)	-0.944 ^b (0.421)	-0.106 ^b (0.051)	1.464 ^a (0.381)	-0.106 ^b (0.051)	1.464 ^a (0.381)	-1.620 ^a (0.382)	-0.204 ^b (0.090)	1.515 ^a (0.491)	-1.707 ^a (0.498)	-0.204 ^b (0.090)	1.515 ^a (0.491)	-1.707 ^a (0.498)	-0.204 ^b (0.090)	1.515 ^a (0.491)	-1.707 ^a (0.498)
Insider ownership	0.427 ^a (0.069)	6.797 ^a (0.603)	0.427 ^a (0.069)	6.797 ^a (0.603)	-5.765 ^a (0.577)	0.401 ^a (0.061)	6.112 ^a (0.597)	0.401 ^a (0.061)	6.112 ^a (0.597)	-5.644 ^a (0.596)	0.941 ^a (0.110)	10.331 ^a (0.750)	-8.968 ^a (0.756)	0.941 ^a (0.110)	10.331 ^a (0.750)	-8.968 ^a (0.756)	0.941 ^a (0.110)	10.331 ^a (0.750)	-8.968 ^a (0.756)
Private selling process length	0.043 ^a (0.007)	0.115 ^c (0.066)	0.043 ^a (0.007)	0.115 ^c (0.066)	-0.067 (0.063)	0.066 ^a (0.006)	0.338 ^a (0.060)	0.066 ^a (0.006)	0.338 ^a (0.060)	-0.275 ^a (0.060)	0.081 ^a (0.011)	0.245 ^a (0.078)	-0.165 ^b (0.078)	0.081 ^a (0.011)	0.245 ^a (0.078)	-0.165 ^b (0.078)	0.081 ^a (0.011)	0.245 ^a (0.078)	-0.165 ^b (0.078)
Constant	0.045 (0.079)	0.870 (0.591)	0.045 (0.079)	0.870 (0.591)	-2.979 ^a (0.537)	-0.209 ^a (0.075)	-0.548 (0.564)	-0.209 ^a (0.075)	-0.548 (0.564)	0.468 (0.559)	-0.135 (0.118)	0.604 (0.715)	-0.675 (0.710)	-0.135 (0.118)	0.604 (0.715)	-0.675 (0.710)	-0.135 (0.118)	0.604 (0.715)	-0.675 (0.710)
# observations	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897
F	9.261 ^a	11.40 ^a	9.261 ^a	11.40 ^a	10.93 ^a	8.789 ^a	12.30 ^a	8.789 ^a	12.30 ^a	11.97 ^a	12.17 ^a	16.53 ^a	14.85 ^a	11.97 ^a	12.17 ^a	16.53 ^a	11.97 ^a	12.17 ^a	16.53 ^a
R ²	8.50%	10.90%	8.50%	10.90%	9.40%	9.10%	12.10%	9.10%	12.10%	11.50%	11.80%	16.60%	14.70%	11.50%	11.80%	16.60%	11.50%	11.80%	16.60%

Table 6: Insider trading in target firms before public announcements: six alternative insider trading measures and four alternative insider definitions

This table reports OLS estimation results for insider net purchases for six alternative measures of insider trading and four alternative definitions of insiders in target and matched firms before the takeover public announcement date. The six alternative measures (by top executives and outside directors and scaled on a monthly basis) include the number of transactions, number of shares in thousands, dollar shares in USD millions, scaled number of transactions in hundreds, scaled number of shares in thousands, and scaled dollar shares in USD thousands (columns 1 to 6). The four alternative insider groups include CEOs, top directors, other directors, and all directors (columns 7 to 10) and we use the fraction of shares outstanding traded in basis points per month. All insider trades are winsorized at the 5th and 95th percentiles. Panels A and B report results for insider trading after signing confidentiality agreements (up to the public announcement) and before signing confidentiality agreements (starting at the initiation date), respectively. The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All regressions include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), which are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Number transactions	Number shares	Dollar shares	Scaled #tran.	Scaled #shares	Scaled \$shares	CEO	Top directors	Other directors	All directors
Target x pre-announcement	0.135 ^a (0.048)	2.318 ^a (0.808)	0.074 ^a (0.028)	0.534 ^b (0.246)	0.092 ^b (0.039)	0.092 ^b (0.039)	0.043 (0.045)	0.166 ^b (0.073)	0.347 ^b (0.147)	0.534 ^b (0.238)
# observations	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897
F	13.15 ^a	11.26 ^a	11.60 ^a	8.830 ^a	10.40 ^a	10.40 ^a	5.882 ^a	7.030 ^a	9.387 ^a	10.03 ^a
R ²	10.00%	10.10%	11.20%	7.10%	7.90%	7.90%	5.60%	6.70%	9.20%	9.60%
<i>Panel A: After signing confidentiality agreement</i>										
Target x pre-announcement	-0.044 (0.050)	0.247 (0.815)	0.023 (0.029)	-0.231 (0.236)	-0.031 (0.039)	-0.628 (1.023)	0.027 (0.032)	0.027 (0.060)	-0.038 (0.145)	-0.175 (0.238)
# observations	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897	5,897
F	14.59 ^a	14.31 ^a	13.64 ^a	11.15 ^a	11.85 ^a	13.25 ^a	7.381 ^a	8.563 ^a	10.84 ^a	12.02 ^a
R ²	11.30%	12.50%	12.80%	8.70%	11.00%	12.00%	7.90%	8.60%	10.70%	11.60%
<i>Panel B: Before signing confidentiality agreement</i>										

Table 7: Insider trading in target firms before public announcements: importance of signing confidentiality agreements

This table reports OLS estimation results for insider purchases, sales and net purchases in target and matched firms before the takeover public announcement date. Insiders are top executives and outside directors. We measure insider trades as fraction of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. Panels A and B condition on the whole private selling process being shorter than or longer than six months, respectively. Panel A further conditions on the period after signing confidentiality agreements (up to the public announcement) in columns 1 to 3 and on the period before signing confidentiality agreements (starting at the initiation date) in columns 4 to 6. Panel B further conditions on the period after signing confidentiality agreements (up to the public announcement) in columns 1 to 3 and on the period within six months before the public announcement date in columns 4 to 6. Panel C focuses on one-month periods after and before signing confidentiality agreements in columns 1 to 3 and 4 to 6, respectively. The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All regressions include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), which are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)
	Purchases	Sales	Net purchases	Purchases	Sales	Net purchases
<i>Panel A: Whole pre-announcement period shorter than six months</i>						
	<i>After signing confid. agreement</i>			<i>Before signing confid. agreement</i>		
Target x pre-announcement	-0.163 ^a (0.037)	-0.736 ^b (0.347)	0.622 ^c (0.337)	-0.056 ^c (0.029)	-0.182 (0.322)	0.104 (0.319)
# observations	2,349	2,349	2,349	2,349	2,349	2,349
F	3.373 ^a	4.778 ^a	4.574 ^a	2.200 ^a	3.560 ^a	3.402 ^a
R ²	7.60%	10.50%	8.90%	4.90%	7.00%	6.60%
<i>Panel B: Whole pre-announcement period longer than six months</i>						
	<i>After signing confid. agreement</i>			<i>Six-month period before ann. date</i>		
Target x pre-announcement	-0.193 ^a (0.038)	-0.748 ^b (0.300)	0.573 ^b (0.292)	-0.283 ^a (0.046)	-0.468 (0.318)	0.233 (0.317)
# observations	3,548	3,548	3,548	3,548	3,548	3,548
F	6.312 ^a	8.178 ^a	9.153 ^a	10.91 ^a	8.972 ^a	8.294 ^a
R ²	9.00%	12.10%	10.20%	9.20%	13.00%	11.80%
<i>Panel C: One-month period around confidentiality date</i>						
	<i>One-month after confidentiality date</i>			<i>One-month before confidentiality date</i>		
Target x pre-announcement	-0.001 ^a (0.000)	-0.028 ^a (0.009)	0.026 ^a (0.009)	-0.011 ^a (0.004)	-0.058 (0.165)	0.049 (0.159)
# observations	5,897	5,897	5,897	5,897	5,897	5,897
F	3.915 ^a	6.749 ^a	6.770 ^a	3.375 ^a	6.067 ^a	6.000 ^a
R ²	3.00%	6.30%	6.30%	2.70%	5.50%	5.40%

Table 8: Insider trading in target firms before public announcements: cross-sectional uncertainty

This table reports OLS estimation results for insider net purchases in target and matched firms before the public announcement date for high versus low deal completion probability split by median values. Insiders are top executives and outside directors. We measure insider trades as fraction of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. We use three different measures of deal completion probability: the base measure q_B (columns 1 and 2), the fall back measure q_F (columns 3 and 4), and the initial offer measure q_I (columns 5 and 6), all defined in Appendix B. Panels A and B cover insider trading after signing confidentiality agreements (up to the public announcement) and before signing confidentiality agreements (starting at the initiation date), respectively. The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All regressions include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), which are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)
	q_B		q_F		q_I	
	High probability	Low probability	High probability	Low probability	High probability	Low probability
<i>Panel A: After signing confidentiality agreement</i>						
Target x pre-announcement	0.673 ^b (0.339)	0.405 (0.313)	0.658 ^b (0.335)	0.425 (0.317)	0.706 ^b (0.333)	0.344 (0.318)
# observations	2,781	2,711	2,781	2,711	2,786	2,702
F	6.524 ^a	5.754 ^a	6.323 ^a	5.726 ^a	5.820 ^a	5.673 ^a
R ²	8.70%	12.30%	8.80%	12.10%	9.60%	12.40%
<i>Panel B: Before signing confidentiality agreement</i>						
Target x pre-announcement	0.270 (0.339)	-0.419 (0.312)	0.223 (0.336)	-0.386 (0.314)	0.058 (0.340)	-0.210 (0.311)
# observations	2,781	2,711	2,781	2,711	2,786	2,702
F	6.635 ^a	6.899 ^a	5.703 ^a	6.739 ^a	5.969 ^a	6.532 ^a
R ²	9.80%	15.00%	10.20%	14.40%	10.20%	14.40%

Table 9: Insider trading in target firms before public announcements: realized premium

This table reports OLS estimation results for insider net purchases in target and matched firms before public announcements across partitions by realized takeover premium. Insiders are top executives and outside directors. We measure insider trades as fraction of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. Panel A covers insider trading after signing confidentiality agreements (up to the public announcement), while Panel B covers insider trading before signing confidentiality agreements (starting at the initiation date). The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All regressions include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), which are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	High premium	Low premium	Premium quintile 5	Premium quintiles 3 & 4	Premium quintiles 1 & 2	High sigma	Low sigma
<i>Panel A: After signing confidentiality agreement</i>							
Target x pre-announcement	0.283 (0.356)	0.495 (0.322)	-0.060 (0.595)	0.861 ^b (0.382)	0.211 (0.350)	-0.082 (0.509)	0.847 ^c (0.484)
# observations	2,560	2,592	1,001	2,091	2,060	1,452	1,108
F	5.428 ^a	5.692 ^a	4.081 ^a	4.159 ^a	4.890 ^a	3.911 ^a	4.077 ^a
R ²	10.70%	12.00%	17.80%	8.90%	13.90%	12.80%	10.10%
<i>Panel B: Before signing confidentiality agreement</i>							
Target x pre-announcement	0.199 (0.341)	-0.597 ^c (0.332)	0.011 (0.569)	0.327 (0.374)	-0.773 ^b (0.361)	0.331 (0.461)	0.089 (0.508)
# observations	2,560	2,592	1,001	2,091	2,060	1,452	1,108
F	6.330 ^a	6.767 ^a	3.492 ^a	5.910 ^a	5.159 ^a	3.484 ^a	4.283 ^a
R ²	12.20%	13.20%	16.40%	13.20%	14.00%	11.80%	17.00%

Table 10: Insider trading in target firms before public announcements: deal characteristics

This table reports OLS estimation results for insider net purchases in target and matched firms before the public announcement date for bidder versus target deal initiation (columns 1 and 2), cash versus stock payment (columns 3 and 4), informal sale versus formal auction (columns 5 and 6), and strategic versus financial buyer (columns 7 and 8). Insiders are top executives and outside directors. We measure insider trades as fraction of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. Panel A covers insider trading after signing confidentiality agreements (up to the public announcement), while Panel B covers insider trading before signing confidentiality agreements (starting at the initiation date). The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All regressions include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), which are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Initiation		Payment		Selling method		Buyer type	
	bidder	target	cash	stock	inf.sale	auction	strategic	financial
<i>Panel A: After signing confidentiality agreement</i>								
Target x pre-announcement	0.577 ^b (0.291)	0.548 (0.342)	0.812 ^a (0.309)	0.282 (0.306)	0.699 ^a (0.265)	0.259 (0.399)	0.573 ^b (0.245)	0.485 (0.519)
# observations	3,485	2,412	3,562	2,335	4,064	1,833	4,781	1,116
F	6.845 ^a	5.711 ^a	6.575 ^a	4.974 ^a	7.022 ^a	6.116 ^a	8.778 ^a	3.272 ^a
R ²	9.10%	11.60%	8.20%	11.70%	8.30%	14.30%	10.40%	8.40%
<i>Panel B: Before signing confidentiality agreement</i>								
Target x pre-announcement	-0.068 (0.287)	-0.209 (0.347)	0.029 (0.304)	-0.375 (0.309)	-0.180 (0.264)	-0.066 (0.402)	-0.278 (0.246)	0.434 (0.498)
# observations	3,485	2,412	3,562	2,335	4,064	1,833	4,781	1,116
F	7.166 ^a	7.712 ^a	9.702 ^a	4.393 ^a	9.069 ^a	5.837 ^a	11.64 ^a	4.080 ^a
R ²	8.80%	16.20%	11.40%	10.30%	10.40%	14.90%	11.50%	13.80%

Table 11: Complementarity between takeover premium and deal characteristics

This table reports OLS estimation results for insider net purchases in target and matched firms before public announcements across different partitions for takeover premium and deal characteristics. Insiders are top executives and outside directors. We measure insider trades as percentage of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. Panel A covers insider trading after signing confidentiality agreements (up to the public announcement), while Panel B covers insider trading before signing confidentiality agreements (starting at the initiation date). The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All specifications include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), but their coefficients are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Premium q5		Premium q3&4		Premium q1&2		Premium q5		Premium q3&4		Premium q1&2	
	bidder	target	bidder	target	bidder	target	cash	stock	cash	stock	cash	stock
Target x pre-ann.	-0.241 (0.711)	0.361 (1.029)	0.952 ^b (0.482)	0.809 (0.641)	0.239 (0.484)	0.229 (0.511)	-0.385 (0.797)	0.519 (0.854)	1.086 ^b (0.483)	0.414 (0.627)	0.574 (0.542)	-0.094 (0.454)
# observations	674	327	1,343	748	1,089	971	664	337	1,395	696	1,033	1,027
F	3.311 ^a	3.044 ^a	3.495 ^a	2.263 ^a	3.153 ^a	3.001 ^a	6.049 ^a	2.444 ^a	3.244 ^a	1.890 ^a	4.285 ^a	2.368 ^a
R ²	18.30%	29.60%	6.70%	12.90%	15.30%	16.60%	16.90%	31.30%	9.90%	13.10%	16.10%	13.10%
	inf.sale	auc.	inf.sale	auc.	inf.sale	auc.	strat.	fin.a.	strat.	fin.a.	strat.	fin.a.
Target x pre-ann.	-0.074 (0.684)	0.074 (1.253)	0.950 ^b (0.440)	0.621 (0.747)	0.415 (0.440)	-0.275 (0.569)	-0.153 (0.654)	0.156 (1.340)	0.823 ^b (0.420)	1.032 (0.935)	0.295 (0.389)	-0.034 (0.771)
# observations	750	251	1,513	578	1,336	724	850	151	1,718	373	1,651	409
F	2.716 ^a	2.643 ^a	2.848 ^a	2.305 ^a	2.963 ^a	3.040 ^a	3.906 ^a	2.191 ^a	3.919 ^a	2.081 ^a	4.019 ^a	1.851 ^a
R ²	15.40%	32.40%	8.40%	16.80%	14.70%	20.60%	18.10%	39.80%	9.00%	11.90%	15.50%	20.40%
	bidder	target	bidder	target	bidder	target	cash <td>stock</td> <td>cash <td>stock</td> <td>cash <td>stock</td> </td></td>	stock	cash <td>stock</td> <td>cash <td>stock</td> </td>	stock	cash <td>stock</td>	stock
Target x pre-ann.	0.108 (0.673)	-0.375 (1.087)	0.503 (0.474)	0.081 (0.620)	-0.633 (0.494)	-0.885 ^c (0.527)	0.240 (0.739)	-0.382 (0.887)	0.540 (0.475)	-0.104 (0.596)	-1.008 ^c (0.551)	-0.463 (0.469)
# observations	674	327	1,343	748	1,089	971	664	337	1,395	696	1,033	1,027
F	2.379 ^a	2.786 ^a	3.019 ^a	3.809 ^a	2.298 ^a	3.710 ^a	3.224 ^a	1.649 ^c	4.364 ^a	2.378 ^a	4.090 ^a	2.308 ^a
R ²	15.70%	24.20%	10.20%	22.20%	11.80%	20.30%	18.20%	21.50%	13.00%	18.10%	17.20%	12.50%
	inf.sale	auc.	inf.sale	auc.	inf.sale	auc.	strat.	fin.a.	strat.	fin.a.	strat.	fin.a.
Target x pre-ann.	-0.285 (0.653)	0.826 (1.248)	0.302 (0.439)	0.424 (0.724)	-0.697 (0.445)	-0.958 (0.610)	-0.160 (0.624)	0.473 (1.482)	0.287 (0.419)	0.405 (0.792)	-0.819 ^b (0.404)	-0.377 (0.785)
# observations	750	251	1,513	578	1,336	724	850	151	1,718	373	1,651	409
F	2.468 ^a	2.798 ^a	4.031 ^a	2.694 ^a	3.386 ^a	3.011 ^a	3.017 ^a	1.434 ^c	5.746 ^a	2.355 ^a	4.356 ^a	2.355 ^a
R ²	15.70%	26.60%	12.70%	19.00%	11.90%	24.20%	16.20%	34.30%	14.60%	17.50%	14.10%	26.20%

Panel A: After signing confidentiality agreement

Panel B: Before signing confidentiality agreement

Table 12: Cross-sectional uncertainty versus takeover premium and deal characteristics

This table reports OLS estimation results for insider net purchases in target and matched firms before the public announcement date across different partitions for deal completion probability, realized takeover premium, and deal characteristics. Insiders are top executives and outside directors. We measure insider trades as percentage of shares outstanding in basis points, scaled on a monthly basis and winsorized at the 5th and 95th percentiles. Panel A covers insider trading after signing confidentiality agreements (up to the public announcement), while Panel B covers insider trading before signing confidentiality agreements (starting at the initiation date). The data covers 1,802 target and 1,802 matched firms. We report Hubert/White robust standard errors in parentheses. All regressions include a set of control variables (dummy variables for target firms and control period, book to market decile, market adjusted daily stock returns, volatility of daily stock returns, change in volatility of daily stock returns, R&D over total sales, liquidity, insider ownership, EBITDA over total assets, pre-announcement period length, log value of total assets, year and industry dummies), which are not reported. All explanatory variables are defined in Appendix A and winsorized at the 1th and 99th percentiles except dummy variables. ^a, ^b and ^c indicate significance at the one-, five- and ten-percent levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)								
	High completion probability								Low completion probability															
	Premium q5				Premium q3&4				Premium q1&2				Premium q5				Premium q3&4				Premium q1&2			
	bidder	target	cash	stock	inf.sale	auc.	strat.	fina.	bidder	target	cash	stock	inf.sale	auc.	strat.	fina.								
Target x pre-ann.	0.882 ^b (0.437)	0.352 (0.531)	0.804 ^b (0.409)	0.397 (0.593)	0.844 ^b (0.406)	0.312 (0.600)	0.709 ^c (0.374)	0.455 (0.776)	0.241 (0.408)	0.650 (0.483)	0.541 (0.500)	0.249 (0.384)	0.585 (0.386)	-0.065 (0.594)	0.415 (0.347)	0.366 (0.720)								
# observations	1,682	1,099	2,075	706	1,872	909	2,196	588	1,596	1,115	1,291	1,420	1,920	791	2,244	467								
F	4.468 ^a	2.825 ^a	5.163 ^a	2.287 ^a	4.167 ^a	3.029 ^a	5.754 ^a	1.737 ^a	3.182 ^a	4.066 ^a	3.754 ^a	3.222 ^a	3.614 ^a	3.496 ^a	5.249 ^a	1.845 ^a								
R ²	10.30%	10.80%	9.00%	13.10%	9.60%	14.80%	9.80%	12.40%	10.00%	19.30%	12.90%	15.30%	10.10%	21.60%	13.30%	16.70%								
Target x pre-ann.	Premium q5				Premium q3&4				Premium q1&2				Premium q5				Premium q3&4				Premium q1&2			
# observations	535	2,058 ^a	14.70%	0.756 (0.853)	0.390 (0.515)	-0.309 (0.576)	0.356 (0.621)	0.524 (0.407)	-0.288 (0.614)	0.343 (0.388)	-0.023 (0.680)	0.286 (0.402)	0.356 (0.621)	0.524 (0.407)	-0.288 (0.614)	0.343 (0.388)	-0.023 (0.680)							
F	2.058 ^a	14.70%	0.756 (0.853)	0.390 (0.515)	-0.309 (0.576)	0.356 (0.621)	0.524 (0.407)	-0.288 (0.614)	0.343 (0.388)	-0.023 (0.680)	0.286 (0.402)	0.356 (0.621)	0.524 (0.407)	-0.288 (0.614)	0.343 (0.388)	-0.023 (0.680)								
R ²	14.70%	10.70%	10.70%	13.00%	10.40%	12.70%	10.20%	16.00%	9.90%	26.30%	16.80%	13.40%	13.70%	24.30%	15.40%	20.80%								
Target x pre-ann.	0.371 (0.438)	0.133 (0.536)	0.286 (0.402)	0.356 (0.621)	0.524 (0.407)	-0.288 (0.614)	0.343 (0.388)	-0.023 (0.680)	-0.348 (0.397)	-0.477 (0.493)	-0.194 (0.503)	-0.611 (0.379)	-0.607 (0.370)	0.030 (0.570)	-0.667 ^c (0.342)	0.676 (0.772)								
# observations	1,682	1,099	2,075	706	1,872	909	2,193	588	1,596	1,115	1,291	1,420	1,920	791	2,244	467								
F	4.880 ^a	2.707 ^a	5.422 ^a	2.044 ^a	5.256 ^a	2.708 ^a	5.259 ^a	2.127 ^a	3.206 ^a	5.948 ^a	4.800 ^a	2.890 ^a	4.653 ^a	3.722 ^a	5.880 ^a	2.156 ^a								
R ²	11.60%	10.70%	10.70%	12.40%	10.40%	12.70%	10.20%	16.00%	9.90%	26.30%	16.80%	13.40%	13.70%	24.30%	15.40%	20.80%								

Panel A: After signing confidentiality agreement

Panel B: Before signing confidentiality agreement