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Insider Trading in Connected Firms during Trading Bans

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Abstract

Insiders are subjected to trading bans or close periods before earnings announcements. Directors who sit on the board of more than one firm can still trade in the shares of their other firms not subject to close periods. We find that when a close period restricts trading by directors in one firm, they leverage insider information about that firm to trade in their other firms. This is supported by positive correlations between stock market reactions in close and traded firms. This correlation is also moderated by the type of relationship between the two firms and the presence of institutional investors. Given this newly documented informational advantage of insiders, policymakers may consider applying the close period to all firms where directors hold board seats.

Keywords: insider trading, connected directors, director networks, trading bans, close periods

JEL classification: G14, G34

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Content

1 Introduction

It has been amply documented that corporate insiders with access to insider information earn abnormal returns by trading their firms' shares (for a survey of the literature, see Bhattacharya, 2014). As insiders have a significant informational advantage, especially prior to major information releases, such as earnings announcements (Goldie et al., 2023), trading bans prior to information releases restrict insiders from exploiting their insider information (Jagolinzer et al., 2011). Insiders violating insider trading regulations can face severe consequences. For instance, in 2016, two investment bankers were convicted of insider trading in the United Kingdom and sentenced to 3.5 and 4.5 years of imprisonment, along with confiscation of their assets (valued at £1.7 million), as part of Operation Tabernula led by the Financial Conduct Authority (FCA).

While insiders are prohibited from trading the shares of their firms during such trading bans, they can still trade the shares of other firms. Importantly, insiders may be motivated to do so when their insider information is material and potentially affects other firms' share prices. Since insiders are not obliged to disclose share transactions in other firms in which they are not insiders, observing their overall trading while they are facing a trading ban in their firm is impossible.[4] However, there is one exception, as the trades of so-called "connected directors," who serve as executive or nonexecutive directors[5] in multiple firms, can be observed. In other words, when connected directors are prohibited from trading before an earnings announcement in one firm, their transactions in other connected firms can still be observed. Studying insider trades in connected firms is interesting for at least two reasons. First, directors subject to a trading ban in one of their firms may still be able to exploit the insider information they hold about that firm in their other firms. Hence, the results of this study have the potential to generate important insights for regulators and investors. Indeed, in April 2024, in the United States, Matthew Panuwat was found liable for purchasing stock in a competing firm based on nonpublic information about his firm's upcoming acquisition.[6] This is the Securities Exchange Commission's (SEC's) first instance of its "shadow trading" enforcement action. It is likely that regulators from other countries will follow suit in the near future. Second, studying insider trading in connected firms should further our understanding of how stock prices are correlated.

4 One exception is a recent study by Berkman et al. (2020) in which a dataset of share trades by Finnish company directors is used. The authors examine directors' transactions in the firms in which the directors hold a board seat (the focal firms) as well as their transactions in all other firms. They report that insiders realize positive abnormal returns when they trade the shares of other firms that have common directors with the focal firm.

5 In this study, we use the UK definition of "director," which encompasses both executives or officers and nonexecutives or independent directors.

6 https://www.sec.gov/enforcement-litigation/litigation-releases/lr-25970

Our analysis is based on the London Stock Exchange (LSE), where the 30-day trading ban prior to the earnings announcement[7] is formally referred to as a "close period." Before 2016, close periods before semiannual and annual earnings announcements were longer (60 days). While in the United States, trading bans (also known as "blackout periods") vary across firms, in the United Kingdom, the close period is stipulated by regulation. We investigate the following three research questions: 1) Are directors more likely to trade in their connected firms when they are prohibited from trading during a close period in one of their firms? 2) Are such transactions influenced by information that emerges during the close period? 3) Do investors effectively utilize the information from insider transactions in connected firms to trade in close firms?

What do we find? First, we observe that of the total 86,258 insider transactions during the period between 1999 and 2019, 40.7% (i.e., 35,109) were made by connected directors. Moreover, 21.0% (i.e., 7,384) of the latter transactions were made when one of the firms of the director who was trading was subject to a close period. Importantly, we find that when their trading is restricted by a close period, directors tend to trade more frequently in their connected firms. Second, the direction of trading in the connected firms (i.e., purchases or sales) is determined by whether the insider information about the firm subject to a close period is positive or negative (as measured by the earnings surprise and the market reaction to the earnings announcement). Third, we assess market reactions to insider transactions via the cumulative abnormal returns (CARs) around the announcement dates of the insider transactions. For firms subject to close periods, we also compute the CARs over the same event window used for the firms for which insider transactions took place. We find that the CARs in connected firms are positively correlated with CARs in close period firms. This positive correlation is observed across various event windows and samples and when controlling for concurrent events, such as mergers and acquisitions (M&A) and CEO turnover announcements. Nevertheless, it could still be the case that a positive correlation is brought about by broader market trends that cause synchronized movements in share prices. In other words, the observed correlation between the CARs may be driven by a momentum effect that applies to all stocks. Hence, we perform a placebo test for pairs of unconnected firms. Following this test, we do not observe correlated CARs over the same event window. We conclude that the correlated market reactions stem from connected directors' transactions rather than from market momentum.

To understand the mechanisms that underlie the positively correlated market reactions, we conduct two further analyses of the types of relationships that exist between the connected firms and the effects of institutional ownership. First, we find that the aforementioned positive correlation is strengthened by friendly relationships[8] between the connected firms, suggesting that insider information is more valuable when the connected firms are closely related. This finding is in line with those of Alldredge and Cicero (2015), Ben-David et al. (2019), and Berkman et al. (2020), who report that insiders have an informational advantage when trading shares of firms with

7 The majority of the UK firms only disclose their earnings annually.

8 A friendly relationship is defined as follows: a) the traded and close firms are identified as "partner (investor)," "customer," or "supplier" in FactSet or b) the two firms are in a sector with a Herfindahl–Hirschman index (HHI) in the top tercile among all sectors in the given year. Friendly relationships apply to 8.2% of pairs of traded and close firms in our sample, among which 4.8% are identified using the FactSet data and the remaining 3.4% are identified using the HHI.

which they are familiar, such as firms within the same industry. Second, the positive correlation is more pronounced when the connected firms have a high level of institutional ownership. This suggests that institutional investors closely monitor the trading activities of connected directors, especially during close periods. When connected directors trade shares in their other connected firms, institutional investors seize the opportunity to trade in related firms that are subject to close periods, thereby inducing a correlation in the CARs. Further analysis reveals that the stock market reactions in the connected firms do not occur synchronously, as the CARs in the firms subject to a close period appear shortly after the CARs in the traded connected firm. Hence, the CARs are synchronized, but not synchronous.

This paper makes the following major contributions to the literature: First, existing studies have concluded that, while trading bans effectively stop directors from trading prior to earnings announcements, such bans have a limited impact on trading profitability as measured by abnormal returns (Hillier and Marshall, 2002). Importantly, the literature has primarily focused on the relationship between insider information and the timing and profitability of insider transactions within a firm (Seyhun, 1986; Fidrmuc et al., 2006; Cohen et al., 2012; Akbas et al., 2020; Cziraki and Gider, 2023). By contrast, we focus on how insiders exploit informational advantages across connected firms when they face a trading ban in the firm for which they have insider information. Using a unique dataset on connected directors, we demonstrate that connected directors can partially evade trading bans by taking advantage of their insider information and trading in connected firms. This result potentially has major implications for how regulators should define insider trading. Our finding is related to that of Mehta et al. (2021), who report that when the focal firm is subject to trading restrictions, informed trading activity ("shadow trading") by institutional investors increases in business partners and competitors due to information leakage by focal firm employees. In contrast to Mehta et al. (2021), we focus on transactions made by executive and nonexecutive directors who sit on multiple boards. Another important difference between our study and that of Mehta et al. (2021) is that most connected firms in our sample are not competitors, given the substantial compliance risks that such connections create. We demonstrate that trading by these connected directors serves as an alternative channel for information dissemination. Furthermore, by focusing on connected directors rather than informed traders in general, we observe that synchronized market reactions emerge during connected directors' transactions in the traded firm as well as in the close firm, which has not been previously documented in the literature. Finally, to better understand the correlated market reactions, we examine the impact of the type of relationship between pairs of connected firms on the stock market reactions to insider trading. We find that the correlation between market reactions in the close and traded firms is stronger when the connected firms are in a friendly relationship. Finally, we investigate two potential channels to explain the correlated market reactions: information leakage and institutional investors. Our analysis of the moderation effect and timing of market reactions supports the institutional investor channel (Akbas et al., 2016). More specifically, institutional investors can capture information from close period transactions and utilize it to trade in close firms. Again, this result has important implications for how insider trading is defined.

The rest of the paper is organized as follows: Section 2 briefly reviews the literature on restrictions on insider transactions before earnings announcements as well as the literature on insider trading, corporate networks, and trading bans. Section 3 presents four conjectures and discusses the study's methodology. In Section 4, we explain the data collection process. The empirical analysis and results are presented in Section 5. Finally, Section 6 presents our conclusions.

2 Restrictions on Insider Trading and Literature Review

2.1 Close Periods

Close periods vary across countries. In the United States, the SEC prohibits insiders from trading based on information that is not publicly available. Therefore, via their articles of association, firms impose "blackout periods" – starting two to three weeks prior to the end of each fiscal quarter – which are a common component of the insider trading compliance programs of most publicly listed firms (Bettis et al., 2000). Still, firms with better governance are more likely to adopt voluntary insider trading restrictions, including blackout periods (Dai et al., 2016).

Regarding the effectiveness of blackout periods, Garfinkel (1997) reports that insiders in the United States respond to the Insider Trading and Securities Fraud Enforcement Act by altering the timing of their trades. For example, insiders are now more likely to postpone liquidity-induced sales until after negative earnings surprises. Bettis et al. (2000) argue that blackout periods in the United States have successfully suppressed trading by insiders.

In the United Kingdom, the close period – the trading ban period imposed on insiders – was first introduced in 2005 by the Model Code as part of the Listing Rules published by the then Financial Services Authority, now the FCA.[9] Persons discharging managerial responsibilities (PDMRs)[10] in a listed company are prohibited from trading in the company's securities during close periods. The close period is defined as the period of 60 days immediately preceding the announcement of the company's annual and semiannual results.[11] The rules about close periods have been updated over time: Article 19 (11) of the UK Market Abuse Regulation (MAR), which replaced the Model

9 The Model Code can be consulted at https://www.handbook.fca.org.uk/handbook/glossary/G724.html?date=2006-03-06&page=4&starts-with=M&timeline=True.

10 According to the UK Market Abuse Regulation, PDMRs include: 1) members of the administrative, management, or supervisory bodies of that entity (i.e., an executive or nonexecutive director), and 2) senior executives who are not members of the bodies referred to above but who have regular access to insider information relating directly or indirectly to that entity and have the power to make managerial decisions affecting the future development and business prospects of that entity. In this paper, we consider executive directors and nonexecutive directors insiders. Throughout the paper, we use UK terminology (i.e., executive and nonexecutive directors, which are the equivalents of officers and directors, respectively, in the United States).

11 The close period before quarterly or semiannual results was 30 days.

Code on 3 July 2016, reduced the length of the close period to 30 days before the announcement of the interim or year-end results.[12]

2.2 Profitability of Insider Trading

Early studies, such as those of Lorie and Niederhoffer (1968) and Jaffe (1974), document how insider transactions tend to have a significant influence on share prices compared to transactions by other market participants. Market participants believe that insiders are better at timing their transactions according to future cash flow realizations (Ke et al., 2003; Piotroski and Roulstone, 2005). These findings are confirmed by later studies. For example, Fidrmuc et al. (2006), emphasize the important impacts of blockholders, including institutional investors, on the market reactions to insider trades. This study also reports anecdotal evidence that institutional investors mimic insider trades, buying shares of firms in which there are insider purchases and selling shares of firms in which there are insider sales.

More generally, Lakonishok and Lee (2001), Friederich et al. (2002), and Cohen et al. (2012) report that the informational value of an insider transaction is determined by the trade's characteristics. More specifically, sale and routine transactions typically have lower informational value than purchase and opportunistic transactions. Recent literature has identified additional factors that influence insider trading behavior and performance, including media coverage (Dai et al., 2015), accounting scandals (Agrawal and Cooper, 2015), corporate culture (Liu, 2016), and director networks (Ahern, 2017; Goergen et al., 2019). Finally, Gao et al. (2022) report that to avoid litigation risk, insiders refrain from any share trading when they anticipate impactful corporate news releases, such as M&A announcements.

Given the sensitivity of share prices to insider trading immediately before earnings announcements, most countries impose trading bans during the period preceding such announcements. Regarding the effectiveness of such trading bans, Jagolinzer et al. (2011) find that blackout periods and the firms' general counsel (chief legal officer) effectively limit the profitability and ability of insider trades to predict future operating performance. By contrast, Lee et al. (2014) report that voluntary corporate restrictions, including blackout periods, have had limited success in preventing insiders from exploiting positive private information.

In the United Kingdom, Hillier and Marshall (2002) report that although close periods affect the timing of director trades, they do not affect the profitability of such trades. Budsaratragoon et al. (2012), and Zhu and Wang (2015) report similar evidence for the Thai and Chinese markets, respectively. Although close periods have effectively restricted insiders from trading before an earnings announcement, insiders are still able to exploit their informational advantage by trading immediately before or after close periods.

12 When using the adoption of MAR in 2016 as an exogenous shock, our results are upheld.

3 Conjectures and Methodology

3.1 Trading Propensity

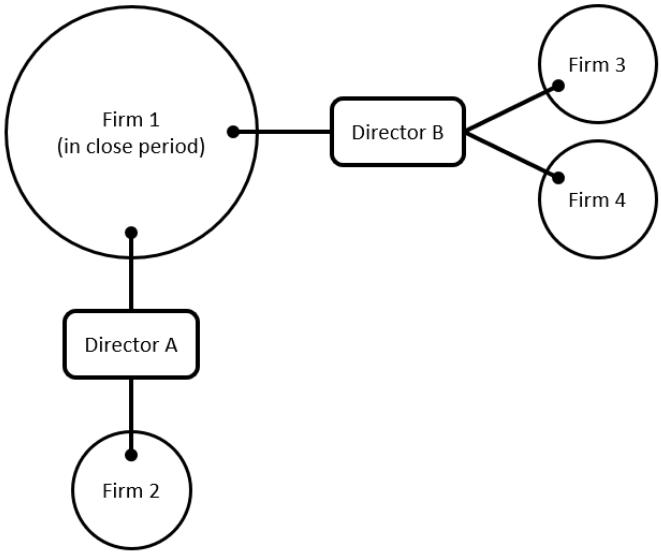
During close periods, when directors are prohibited from trading shares of their firms, they can still trade shares of other firms. For instance, suppose that Director A sits on the board of a firm that will soon announce its earnings for the latest fiscal year. As there has been much uncertainty regarding the firm's performance, the announcement is likely to impact not only the share price of the firm in question but also the share prices of other firms with related operations. Although Director A cannot trade the shares of their firm because of the close period preceding the announcement, they can still trade the shares of other affected firms. Director A is not required to disclose such transactions unless they also hold an executive or nonexecutive directorship in these firms. The director networks literature refers to such directors as *connected directors* and to firms with such directors as *connected firms*. Connected directors are required to disclose their transactions in all firms in which they are insiders.

Figure 1 places the above example within its broader context. Director A is a connected director because they are on the boards of two firms (i.e., Firms 1 and 2), which makes them connected firms. In other words, Firms 1 and 2 are connected via Director A. Assume that Firm 1 is the firm that is about to announce its earnings for the latest fiscal year. Hence, this firm is subject to a close period, preventing Director A from trading in that firm. This means that, for Director A, Firm 1 is a *close firm*. However, Director A can freely trade shares in connected Firm 2, assuming that this firm is not concurrently subject to a close period. Thus, Firm 2 is a *potentially traded firm*. If Director A does indeed trade in Firm 2, Firm 2 is a *traded firm*.[13] Such a transaction is then referred to as a *close period transaction*.[14]

13 The above categorization also applies to cases where a connected director has more than one external directorship (e.g., Director A), which entails multiple connected and potentially traded firms. Moreover, the categorization of the traded and close firms is dynamic. When Director A trades in Firm 1 while Firm 2 is subject to a close period, Firm 1 becomes the traded firm and Firm 2 is then categorized as the close firm.

14 Close periods are clustered in months before July because many firms release their earnings reports in March and June. However, the clustering of close periods does not necessarily result in clustered close period transactions, as directors are also more likely to encounter close periods in connected firms.

Connected Directors and Connected Firms FIGURE 1



Director A sits on the boards of both firms 1 and 2. Director B sits on the boards of firms 1, 3, and 4. Firm 1 is subject to a close period.

Given the potential uncertainty regarding Firm 1's performance over the last fiscal year, the earnings announcement is likely to have informational content. If the operations of Firms 1 and 2 are related, the director has an incentive to trade shares in the second firm before the announcement of the information by Firm 1 to exploit their informational advantage, provided that Firm 2 is not subject to a close period. This leads to our first conjecture:

C1: When trading is banned in one firm, connected directors are more likely to trade in their other connected firms.

We conduct two analyses to test the validity of C1. First, we investigate whether connected directors are more likely to trade in their connected firms when they are subject to a close period in another firm. Hence, we compare the probability that a transaction occurs during a close period to the benchmark probability that a transaction occurs randomly during a close period. Figure 1 presents two pairs of connected firms involving Director B – Firm 1 (close firm) and Firm 3 (potentially traded firm) as well as Firm 1 (close firm) and Firm 4 (potentially traded firm). For the pair of Firms 1 and 3, we first determine the actual propensity of close period transactions, defined as the number of Director B's close period transactions in Firm 3 divided by the total number of transactions they have made in Firm 3. This actual propensity is then compared to the benchmark probability, which is the probability that a transaction falls within the 30-day close period at random. The benchmark probability is calculated as 30 / (365 − 30), assuming the close period is 30 days long and a transaction can occur on any of the 365 days in the year (except during the 30-day close period).[15] The comparison

15 This is the case for the period after the enforcement of the Market Abuse Regulation (MAR) in 2016. Before the introduction of the MAR, the benchmark probability was 60 / (365 – 60).

between these two numbers then reveals whether Director B trades more in a connected firm when insider trading is banned in the close firm. We also evaluate the close period transaction propensity for Firm 1 while Firm 3 is the close firm. We then proceed by analyzing the other pair of connected firms (i.e., Firms 1 and 4) before moving on to the next connected director (i.e., Director A).

Second, we estimate the following equation via a logistic regression to explain the daily likelihood of trading for connected directors:

$$Trading\_day_{i,t} = \beta_0 + \beta\_1 * Close\_period\_(other)_{j,t} + \beta_2 * Num\_of\_directorships_{i,t} + Firm\_characteristics_{i,t-1} + \mu_i + \mu_y + \varepsilon_{i,t} \quad (1)$$

Using Figure 1 as an example, we create the indicator variable *Trading_day*, which equals 1 if Director B trades shares of Firm 3 on the day under consideration. We generate another indicator variable, *Close_period_(other)*, which equals 1 if Firm 1 is subject to a close period on that day.

These two variables describe the trading behavior of Director B in Firm 3 with and without close periods in connected Firm 1 as long as Director B is associated with both firms. Next, we analyze Director B's trading in Firm 1 while accounting for Firm 3's close period before moving onto the next pair of connected firms for the same director (i.e., Firms 1 and 4). We then move on to the next connected director (i.e., Director A). Besides *Close_period_other*, another important variable that may explain trading propensity is the number of directorships the connected director has (*Num_of_directorships*). For example, Director B holds three directorships (i.e., in Firms 1, 3, and 4) while Director A holds two (i.e., in Firms 1 and 2). When prevented from trading due to a close period in Firm 1, Director B has more options to trade elsewhere than Director A. Therefore, we expect *Num_of_directorships* to have a negative effect on the likelihood of the connected director trading in a given connected firm. Moreover, inspired by Korczak et al. (2010), we control for lagged traded firm characteristics, including board size, return on assets (ROA), leverage (total debt over total assets), institutional ownership, and firm size (the natural logarithm of total assets). CEO duality (i.e., when the roles of CEO and chairman are assumed by the same person) is included as a corporate governance measure, proxying for agency problems (Hillier et al., 2015). Finally, we control for industry fixed effects (μ_i) based on the two-digit Standard Industry Classification (SIC) code and year fixed effects (μ_y).

3.2 Trading Direction

Biggerstaff et al. (2020) report that insiders trade on their informational advantage and that their decisions about whether to purchase or sell shares are determined by their insider information. Given the context of the present study, we expect that the direction of a close period transaction (i.e., a purchase or sale) in the traded firm is determined by insider information that arises during the close period in the close firm. The question arises as to how insider information about the close firm may affect the stock price of the traded firm. The answer to this question depends on the type of relationship between the two firms. If both firms are in a competitive relationship, then positive (negative) insider information about the close firm is likely to negatively (positively) affect the stock price of the traded firm. Nevertheless, in practice, traded and close

firms connected by a common director are typically not in a competitive relationship. Indeed, in 2011, the Competition and Markets Authority (CMA), formerly the Office of Fair Trading (OFT), published guidelines (OFT, 2011) that emphasize that all executive and nonexecutive directors must comply with competition laws. More precisely, directors should actively avoid conflicts of interest, sharing competitively sensitive information, and discussing the business's future with its competitors. Consequently, directors who sit on the board of a competing firm are exposed to substantial compliance risks. Importantly, the CMA has the authority to disqualify directors and ban them from holding any directorships for up to 15 years.

Similar regulatory requirements also apply to other markets. For example, in the United States, Section 8 of the Clayton Act prohibits individuals from sitting on the boards of two competing firms. In 2022, the Department of Justice Antitrust Division announced the resignation of seven directors from their board positions in competing firms due to antitrust concerns (Office of Public Affairs, 2022).

As we focus on pairs of traded and close firms connected by common directors, competitive relationships among them are rare due to the compliance risk discussed above. In fact, many connected firms maintain friendly, partnership-based relationships. As demonstrated by Borgatti and Li (2009) in their study on firms that are connected via common directors and supply-chain relationships, director connections are typically found among firms with friendly relations. In such a context, insider information emerging from the close firm is likely to be more valuable for trading shares in the connected firm. More importantly, whether the insider information on a close firm is positive or negative will affect the direction of the trade. If the information is positive, we expect connected directors to purchase shares in the traded firm, whereas we expect them to sell shares if the converse is the case. Thus, we propose the following conjecture:

C2: Connected directors are more likely to purchase (sell) shares in the traded firm if the insider information in the close firm is positive (negative).

To assess whether insider information is positive or negative news for the traded firm, we first use the positive (negative) earnings surprise (i.e., the percentage difference between the reported earnings and the average forecasted earnings) (Wang et al., 2012). Following Ball and Kothari (1991), we then use the abnormal returns at the earnings announcement as an alternative way of assessing whether the insider information is positive or negative. We take a conservative approach: if the market reaction is in the top tercile, we conclude that the announced earnings significantly exceed market expectations. It is then likely that the insider information during the close period is positive. Likewise, a very bad market reaction (i.e., one in the bottom tercile) is likely associated with negative insider information. More specifically, we estimate the following equation via a logistic regression:

$$Insider\_purchase_{i,t} = \beta_0+\beta_1*Positive\ Information_{j,t} + \beta_2* Director\_traits_{i,t,}+ Firm\_characteristics_{i,t-1} + \mu_i+\mu_y+\varepsilon_{i,t} \quad (2)$$

where the dependent variable equals 1 if the connected director buys shares in traded firm *i* and 0 if they sell shares. *Positive Information* is an indicator variable set to 1 if the insider information in close firm *j* is positive and 0 otherwise. In some regressions,

this variable is replaced by *Negative Information*. The latter is an indicator variable set to 1 if the insider information in close firm *j* is negative and 0 otherwise. More specifically, positive (negative) insider information is captured when the earnings surprise or the market reaction (CARs [-1,1]) to the earnings announcement in the close firm is in the top (bottom) tercile and 0 otherwise. As a robustness test, we employ an alternative classification based on the top and bottom quartiles, and the results remain consistent. In Eq. (2), we include connected director traits and lagged traded firm characteristics as control variables (see Section 3.3). Finally, we control for industry fixed effects (μ_i) and year fixed effects (μ_y). To account for the connected director's decision not to trade, we apply a multinomial logistic regression whose dependent variable indicates whether only sales (-1), no transactions (0), or only purchases (1) took place in the traded firm during the close period in the close firm. We ignore cases in which a connected director makes both purchases and sales. In an alternative specification, we focus on the net transaction value, and then set the dependent variable to -1 when the connected director buys more shares than (s)he sells, +1 when (s)he sells more shares, and 0 when there is no transaction. This approach allows us to consider cases in which the connected director engages in both purchase and sale transactions within the same close period.

3.3 Correlated Market Reactions

As stated in Section 2.2, many studies document a significant market reaction (measured by CARs) to insider trades. Due to the informational value of insider trades, some investors mimic insider trades, thereby earning steady profits (Rozeff and Zaman, 1988; Fidrmuc et al., 2006). In the context of close periods, trading by connected directors in other (connected) firms may convey informational value. Thus, in response to insider trading in connected firms, sophisticated investors may trade in the close firm, as they do not face any trading restrictions given that they are not PDMRs. Hence, we expect the CARs in both firms to be positively correlated. Therefore, we propose the following conjecture:

C3: The stock market reaction following an insider transaction in a firm not subject to a close period is positively correlated with the market reaction in the connected close firm.

To test the validity of C3, we estimate ordinary least squares (OLS) regressions using the following equation:

$$CARs\_traded_{i,t} = \beta+\beta_1*CARs\_close_{j,t}+\beta_2* Transaction\_characteristics_{i,t}+ \beta_3* Director\_traits_{i,t}+\beta_4*Firm\_characteristics_{i,t-1}+ \mu_i+\mu_y+\varepsilon i,t. \quad (3)$$

The dependent variable ($CARs\_traded_{i,t}$) captures the market reaction to the insider transaction in traded firm *i*, and the main independent variable is the share price reaction in close firm *j* ($CARs\_close_{j,t}$). When a connected director trades shares in the traded firm, we calculate the CARs in the traded and close firms over the same window.

We go through the following four steps to calculate *CARs_close*: First, we account for all close periods, including those relating to annual, semiannual, and quarterly earnings announcements. The vast majority of the sample firms (67.4%) only disclose their

earnings annually, whereas 31.9% (0.7%) of firms disclose their earnings semiannually (quarterly). Second, abnormal returns are defined as the difference between the actual and expected returns, which are calculated by means of the market model, with the beta's estimation window spanning from day 200 to day 20 prior to the transaction's announcement date. The abnormal returns are then aggregated over the event window to calculate the CARs, which serve as measures of the risk-adjusted market reaction. Third, because some transactions in the traded firm are near the end of the close period,[16] the CAR event windows of the transactions might include the earnings announcement date. To avoid potential informational contamination, we exclude such transactions and retain only those for which the event period ends before the earnings announcement. The baseline model uses a 21-day event window (i.e., [-10,10]), where day zero (i.e., the event day) is the day when the insider transaction is reported.[17] We consider various alternative event windows (i.e., [0,1], [0,5], [0,10], [-1,1], and [-5,5]) in robustness tests. We also include a pre-event window (i.e., [-20,-1]) to account for a potential price runup. Finally, 32.7% of connected directors hold board positions in more than one firm. We assess their transactions and market reactions separately for each pair comprising a traded firm and the respective close firm. As a robustness test (not tabulated), we also examine the aggregate market reactions across multiple close firms associated with a given transaction (doing so does not change our findings qualitatively).

We control for the following transaction characteristics: transaction value, whether the transaction is clustered with other transactions, and whether the transaction is a routine or opportunistic transaction (Cohen et al., 2012). As for director traits, we control for directors' gender, age, and position in the firm (CEO, other executive director, chairman, nonexecutive director, etc.) as well as CEO duality. The following lagged financial control variables are included: ROA, leverage, and tangibility (fixed assets over total assets). We measure financial soundness based on the interest coverage ratio (earnings before interest and taxes (EBIT) divided by interest expenses). Dividend payout is calculated by dividing dividends per share by earnings per share and then multiplying the ratio by 100. If earnings per share is negative, then the dividend payout is set to 0. We also include analyst coverage and institutional ownership and control for industry and year fixed effects (μ_i and μ_y).

Note that Eq. (2) may suffer from sample selection bias, as we only observe market reactions when directors trade. This calls for a Heckman selection model whose dependent variable in the selection equation equals 1 if the director trades during a close period and 0 otherwise. In addition to the control variables used in Eq. (1), the selection equation considers whether the traded and close firms are from the same industry and of a comparable firm size (within the same size decile for a given year).

16 In 2.6% and 19.1% of cases, the transaction takes place one and within ten days before the earnings announcement, respectively.

17 In 88.7% of cases, the insider transaction is announced on either the day of the transaction or the following business day.

3.4 Friendly Relationships

As stated above, due to antitrust concerns, it is unlikely that connected traded and close firms are in a competitive relationship. Nevertheless, it is interesting to investigate whether the correlation between the market reactions in the traded and close firms changes with the type of relationship between the traded and close firms. Specifically, we expect a stronger positive correlation if both firms have a friendly rather than a neutral relationship. This leads us to our final conjecture:

C4: The stock market reactions of two connected firms induced by an insider trade in the traded firm are more positively correlated if they have a friendly relationship.

We estimate the following equation to test the validity of C4:

$$CARs\_traded_{i,t} = \beta_0+\beta_1*CARs\_close_{j,t}+\beta_2*Relationship_{j,t}+\beta_3*Relationship_{j,t}*CARs\_close_{j,t}+\beta_4*Transaction\_characteristics_{i,t}+\beta_5*Director\_traits_{i,t}+\beta_6*Firm\_characteristics_{i,t-1}+\mu_i+\mu_y+\varepsilon_{i,t} \quad (4)$$

$Relationship_{j,t}$ is an indicator variable set to 1 when there is a friendly relationship between the traded and close firms and 0 otherwise.

4 Data

We collect insider trading data from smartinsider.com. Our data include all disclosed share transactions by executive and nonexecutive directors in publicly listed UK companies, including those listed on the FTSE Alternative Investment Market, for the period between 1999 and 2019. It is worth noting that insider trading on the LSE differs from that in the United States in terms of timing, profitability, and share price reactions (Lakonishok and Lee, 2001; Fidrmuc et al., 2006). More specifically, the United Kingdom imposes stricter regulations on insider trading than the United States does, as it features more precisely defined trading bans and faster reporting requirements. As a result, insider trading in the United Kingdom occurs less frequently during the period in question; however, when it occurs, it tends to be more informative and consequently triggers a stronger market reaction. To obtain data on close periods, earnings announcements, and earnings forecasts, we consult the IBES database. Next, we identify connected directors and firms based on information on directors provided by BoardEx, which also provides data on other board characteristics and director traits. We collect share price data and financial characteristics from Datastream and business relationship data from FactSet.

Panel A of Table 1 reports descriptive statistics for the insider transactions, specifically focusing on close period transactions. We compare transactions made by unconnected directors (Column 1), connected directors outside the close period (Column 2), and connected directors during the close period – i.e., so-called close period transactions (Column 3). There are 86,258 insider transactions between 1999 and 2019, 40.7% of which are made by connected directors. In turn, 21.0% of the latter transactions are made when one of the directors' firms is subject to a close period.[18] By contrast, Ali and Hirshleifer (2017) report that although many US insider transactions occur during blackout periods, such transactions prior to earnings announcements are driven by private information.

The average transaction value[19] of connected directors tends to be smaller than that of unconnected directors (Panel A). This pattern could be due to the backgrounds of the trading directors, who are more likely to hold positions such as nonexecutive director

18 A small number of the insider trades (5.1%) occur during the close periods of traded firms. Such transactions are unlikely to contain any private information. Examples of such transactions include awards (i.e., shares given to the director under award schemes such as Long-Term Incentive Plans), purchases of shares as part of a director's contractual obligations (this may be to qualify for a matching award or under a regular share purchase plan), and transfer outs (i.e., a director's holding is reduced after shares have been transferred to a third party, which may occur when a director's minor children come of age). We exclude all such transactions from our analysis.

19 The insider trading reporting threshold depends on the regulator. In the European Union, an insider only needs to report his transactions if the cumulative traded value exceeds €5,000 per calendar year. In the United Kingdom, this limit is included in Article 19 of the MAR passed in 2016 (note that Article 19 specifies the limit to be €5,000 rather than its equivalent in GBP; see https://www.fca.org.uk/markets/market-abuse/regulation#section-disclosures). In addition, smartinsider.com has a daily reporting threshold of £1,000; an insider's daily aggregate trading value below this threshold is not recorded.

or chairman. Such directors do not receive equity-based compensation, which reduces their selling potential. We note that a high percentage (26.1%) of close period transactions is conducted by chairmen. Furthermore, compared to unconnected directors, connected directors engage more in routine trading, which is defined as trading that occurs at about the same time every year (Cohen et al., 2012). Routine transactions are more likely to be driven by directors' liquidity needs and may therefore have less informational or signaling value than nonroutine (also called opportunistic) transactions. Furthermore, clustered transactions, defined as multiple transactions made on the same day by different directors, may be due to either insider information or the granting of equity-based compensation. We find a significant difference in clustered trades between connected and unconnected directors, with the latter being more likely to engage in clustered trades ($t = 9.059$).[20] Finally, among insider traders, female directors are more likely to make connected trades.

Columns 4 and 5 present descriptive statistics for the breakdown of close period transactions into purchases and sales, respectively. Connected directors tend to engage less frequently in sale transactions, which on average have a greater trade value than purchases, and this pattern is confirmed for all insider transactions (Fidrmuc et al., 2006; Goergen et al., 2019). Sale transactions are more likely to be nonroutine (or opportunistic) than purchases. We also find a significant difference in transaction clustering between purchases and sales, with the former being more likely to be clustered ($t = 3.573$). Moreover, the proportion of females and average age are significantly higher among directors involved in close period purchases compared to sales ($t = 7.709$ and $t = 8.355$, respectively). We observe that CEOs and other executives are more likely to be involved in sales. This makes sense, as such directors receive equity-based compensation. By contrast, we find that nonexecutive directors and chairmen tend to purchase more often than they sell.

20 The lower likelihood of clustered transactions among connected directors suggests that, compared to their unconnected peers, connected directors are more likely to trade on information than to mimic the transactions of other directors. This aligns with their information advantage from their networks (Goergen et al., 2019). To rule out the possibility of connected directors mimicking transactions of other directors, we test all hypotheses using a subsample of non-clustered transactions. The results remain consistent.

Descriptive Statistics

TABLE 1

Panel A. Transaction characteristics

Panel A presents insider transaction characteristics. The first column reports transactions made by unconnected directors. The second (third) column reports transactions made by connected directors outside (during) close periods. Thus, a close period transaction is one carried out by a connected director in a firm in which the director holds a board seat and that does not face a close period while the director is not allowed to trade in a connected firm subject to a close period. The fourth and fifth columns dissect the close period transactions of the third column into purchase and sale transactions separately. The number of transactions of each type is reported in Row 1. The trade value of the transaction is calculated by multiplying the number of shares traded with the share price (in GBP). An alternative value is the trade value, which is scaled by the market capitalization of the traded firm at the time of the transaction. Purchase stands for purchase transactions as a percentage of all transactions. Routine equals 1 if a transaction occurs at a similar time as in previous years. Clustered equals 1 if the transaction occurs on the same day as (an)other insider transaction(s). Female equals 1 if the trader is a female director. The CEO, chair, executive, and nonexecutive director give the percentage of transactions executed by this type of director in the traded firm. Detailed variable definitions are provided in the Appendix.

	(1)	(2)	(3)	(4)	(5)
	Unconnected directors' transactions	Connected transactions outside close periods	Close period transactions	Close period transactions: purchases	Close period transactions: sales
Number of Transactions	51,149	27,725	7,384	6,125	1,259
Trade Value (GBP)	279,730	259,384	197,304	119,598	678,238
Trade Value (% Market Cap)	0.2%	0.1%	0.1%	0.1%	0.2%
Purchase	75.2%	82.2%	83.0%	100%	0%
Routine	12.8%	17.7%	18.9%	20.0%	12.7%
Clustered	59.0%	56.8%	54.5%	55.1%	51.3%
Female	4.9%	8.6%	8.9%	9.7%	4.5%
Age	62.6	64.8	66.8	67.1	65.1
CEO	20.2%	17.8%	11.0%	9.1%	22.2%
Nonexecutive Chairman	9.5%	18.2%	26.1%	27.3%	19.4%
Executive Director	42.2%	22.8%	15.0%	12.2%	31.9%
Nonexecutive Director	28.1%	41.3%	47.8%	51.5%	26.5%

Panel B. CARs of insider transactions in traded and close firms

This panel reports the cumulative abnormal returns (CARs) of purchase and sale transactions in the traded firm and the close firm. The insider transaction is announced on day 0. The interval of the event window is denoted by the numbers in brackets. Significance at the 1%, 5%, and 10% levels is indicated by $***$, $**$, and $*$, respectively.

	Purchase		Sale	
	CARs in traded firms	CARs in close firms	CARs in traded firms	CARs in close firms
CARs [-20,-1]	-0.013***	-0.002	0.008***	-0.001
CARs [0,1]	0.008***	0.001	-0.001	0.000
CARs [0,5]	0.014***	0.001**	-0.003**	0.001
CARs [0,10]	0.015***	0.003***	-0.006***	0.005**
CARs [-1,1]	0.007***	0.001	0.000	0.000
CARs [-5,5]	0.010***	0.001	0.001	0.001
CARs [-10,10]	0.006***	0.002	0.000	0.003

Panel C. Positive or negative insider information

This panel reports whether insider information is positive or negative for connected transactions during the close period. The underlying earnings surprise statistics are reported in Row 1. Earnings surprise is calculated as (actual EPS – forecasted EPS) / forecasted EPS. Positive insider information is indicated by either earnings surprise being in the top tercile within an industry year (Row 2) or the market reaction (CARs [-1,1]) at the earnings announcement being in the top tercile (Row 4). Negative insider information is indicated by earnings surprises or share price reactions in the bottom tercile (Rows 3 and 5). Detailed variable definitions are provided in the Appendix.

	Mean	SD	P5	P50	P75	P95
Earnings Surprise (%)	-3.069	65.071	-52.542	1.857	6.984	45.532
Positive Information (Earnings Surprise)	0.340	0.473	0	0	1	1
Negative Information (Earnings Surprise)	0.329	0.470	0	0	1	1
Positive Information (CARs [-1,1])	0.259	0.438	0	0	1	1
Negative Information (CARs [-1,1)	0.257	0.437	0	0	1	1

Panel D. Descriptive statistics for the control variables

This panel represents statistics for the control variables. The variable CEO–Chair Duality is equal to 1 if the CEO and chairman positions are occupied by the same person and 0 otherwise. ROA is net income plus interest expense divided by total assets. Firm leverage is measured as total debt divided by total assets. The ratio of fixed assets is calculated as the book value of fixed assets divided by the total equity. Interest coverage is measured as the ratio of earnings before interest and taxes (EBIT) to interest expenses. Dividend payout is measured as the ratio of dividends per share divided by earnings per share. Firm size is the total assets (in billions of GBP) and the natural logarithm of total assets (in thousands of GBP). Number of Analysts is the number of analysts following the traded firm. Institutional ownership represents the percentage of shares owned by institutional investors. The last row describes the relationship between the traded and close firms. Friendly relationships are identified using the FactSet data and the Herfindahl–Hirschman Index of the traded and close firms' sector. Detailed variable definitions are provided in the Appendix.

	N	Mean	SD	P5	P50	P75	P95
CEO–Chair Duality	2,479	0.046	0.209	0	0	0	0
ROA	2,479	0.043	0.143	-0.211	0.060	0.101	0.181
Debt/Total Assets	2,479	0.210	0.166	0	0.2001	0.3136	0.5198
Fixed/Total Equity	2,479	0.655	0.936	0.006	0.323	0.955	2.514
Interest Coverage	2,479	34.8	171.8	-21.0	7.2	18.7	179.0
Dividend Payout	2,479	0.359	0.270	0	0.380	0.551	0.811
Total Assets (Billions of GBP)	2,479	46.300	187.000	0.019	1.376	7.161	321.000
Ln (Total Assets)	2,479	14.2	2.7	9.8	14.1	15.8	19.6
Number of Analysts	2,479	11.7	8.303	1	11	19	25
Institutional Ownership	2,479	0.140	0.132	0	0.11	0.20	0.41
Friendly Relationship	2,479	0.048	0.215	0	0	0	1

Panel E. Correlation matrix

This panel reports the pairwise Pearson correlations for the control variables. Correlations that are significant at the 1% level are highlighted in bold. Detailed variable definitions are provided in the Appendix.

		1	2	3	4	5	6	7	8	9
1	CEO–Chair Duality	1								
2	ROA	-0.021	1							
3	Debt/Total Assets	**0.137**	0.029	1						
4	Fixed/Total Equity	**0.141**	0.048	**0.477**	1					
5	Interest Coverage	**-0.063**	**0.380**	**-0.205**	**-0.090**	1				
6	Dividend Payout	**0.100**	**0.307**	0.000	0.014	**0.182**	1			
7	Ln (Total Assets)	0.021	**0.262**	**0.110**	**0.078**	0.009	**0.293**	1		
8	Number of Analysts	0.021	**0.248**	**0.081**	**0.102**	**0.110**	**0.316**	**0.760**	1	
9	Institution Ownership	**-0.063**	-0.018	-0.036	-0.038	-0.039	**-0.172**	**-0.137**	**-0.132**	1

Panel B of Table 1 reports share price reactions to close period transactions. We consider a variety of event windows (Jagolinzer et al., 2020), including [-20,-1], [0,1], [0,5], [0,10], [-1,1], [-5,5], and [-10,10]. We report market reactions around the announcement of insider transactions in both traded and close firms. For the purchase transactions, we report significantly positive market reactions for all event windows for the traded firms, except for the pre-event window [-20,-1], for which the market reaction is significantly negative for traded firms. Regarding sale transactions, CARs following transaction announcements are negative (but not always significant) for the traded firms. Similar to purchases, we observe that CARs preceding transaction announcements are significantly different from 0 for the traded firms but of the opposite sign. When comparing the market reaction in the traded firm to that in the close firm around the announcement of the transaction in the traded firm, we find that the market reactions in the close firms are slightly weaker and tend to occur after those in the traded firms (an issue which we will analyze in more depth in Table 11 below).

Panel C of Table 1 focuses on earnings surprises and share price reactions to earnings announcements. Both measures are used to assess whether insider information is positive or negative. First, earnings surprises are measured as the percentage difference between the actual earnings per share and the average forecasted value. We then define extremely positive and negative earnings surprises as the top and bottom terciles, respectively, of earnings surprises within an industry year. Second, close periods end with an earnings announcement – when the directors' insider information becomes public knowledge. At the announcement, the market is likely to react to earnings surprises. Following Ball and Kothari (1991), we use CARs [-1,1] around the announcement as a proxy for whether the insider information is positive or negative. If the CARs [-1,1] are in the top (bottom) tercile of their industry and year, we categorize such cases as strongly positive (negative) market reactions, which implies that they potentially reflect positive (negative) insider information.

Panel D reports descriptive statistics for the control variables. Most firms separate the positions of CEO and chairman (represented by the CEO duality variable being equal to 0). We measure firm performance using the ROA, whose average (median) over the entire sample period amounts to 4.3% (6.0%). The debt-to-total-assets ratio averages 21.0%, which implies that the average firm is not heavily leveraged. Although the average fixed assets-to-equity ratio amounts to 65.5%, it varies substantially across industries (not tabulated). We use the interest coverage ratio (*Interest Coverage*) – i.e., the EBIT-to-interest expense ratio – as a measure of financial soundness. The average interest coverage ratio of 34.8 indicates that the average firm is distant from financial distress. Dividend payout is measured as dividends per share divided by earnings per share. The mean (median) payout ratio amounts to 35.9% (38.0%). The natural logarithm of total assets, which measures firm size, averages 14.2 (equivalent to £4.6 billion). The average firm is followed by roughly 12 analysts. Total institutional ownership averages 14.0%.[21]

The last row of Panel D focuses on the types of relationships between traded and close firms. We classify "partner (investor)," "customer," and "supplier" relationships from FactSet as friendly relationships. Among these relationships (not tabulated), the most

21 Note that we only consider stakes of 5% or above.

common friendly ones are "customer" and "partner (investor)." FactSet provides information for only a subset of firms in our sample. For the firms that are not covered by FactSet, we evaluate their mutual relationship by examining their Herfindahl–Hirschman industry concentration index (HHI) (Rahman et al., 2021) if they belong to the same industry (based on the two-digit SIC codes). More specifically, following Fosi (2013), we use the terciles of the HHI, whereby firms in industries with an index in the top tercile are considered to be in a friendly relationship, whereas those in the bottom tercile are considered to be in a neutral or even competitive relationship. In the analysis that follows, we consider there to be a friendly relationship if a) the traded and close firms are identified as partners, customers, or suppliers in FactSet, or b) the two firms are in a sector with an HHI in the top tercile among all sectors in the given year. Among the 8.2% of friendly relationships in our sample, 4.8% are identified through FactSet, and the remaining 3.4% are classified based on the HHI.

Finally, we report the correlations between the above control variables in Panel E, which suggests that multicollinearity is not an issue given that there are no strong pairwise correlations (with the exception of the correlation between firm size and the number of analysts, which is 0.76).

5 Results

5.1 Trading Propensity

According to C1, directors trade more frequently in their connected firms when they are banned from trading in one of their other firms (i.e., a close firm). To test the validity of this conjecture, we compare the actual propensity of connected directors to engage in close period transactions to a benchmark propensity of directors' transactions occurring randomly during the close period.[22] The benchmark propensity that a connected director's transaction in the traded firm coincidentally falls within the 30-day close period of the close firm is 19.7% – i.e., 60 / (365 − 60) – before the introduction of the MAR and 8.9% – i.e., 30 / (365 − 30) –after the MAR. If the close period does not alter connected directors' propensity for trading, the actual propensity should be similar to the benchmark propensity. However, the actual propensity of close period transactions among all transactions is 22.4% before the introduction of the MAR and 11.4% after its introduction. Both trading propensities are significantly higher than the benchmark probability (*t*-statistics are 8.622 and 4.596, respectively). In an untabulated analysis, we consider the following two scenarios: First, the close period of the traded firm overlaps with the close period of the close firm. This reduces the benchmark probability, as it becomes less likely that a transaction coincidentally falls within the 30- or 60-day close period. In this scenario, the actual propensity exceeds the benchmark probability by a greater margin, in which case C1 remains valid. Second, 28.4% of connected directors serve on the boards of more than two firms. In these cases, a transaction can be associated with multiple close firms and hence multiple close periods, and the actual and benchmark probability for having a close period transaction increases. For directors with more than two directorships, we calculate the benchmark probability as the average probability of having a close period transaction for each connected director. We still find that the actual probability is significantly above the benchmark probability.

Next, we examine connected directors' daily trading propensity via a logistic regression based on Eq. 1. Column 1 of Table 3 suggests that a director's likelihood of trading increases when she or he is restricted from trading in connected firms. We arrive at the same conclusion for the subsamples of purchases and sales (Columns 2 and 3) and when controlling for firm characteristics (Column 4) as well as industry and year fixed effects (Column 5). The last two columns reveal that directors are more likely to trade in larger firms, those with CEO duality, larger boards, poor performance, and less institutional ownership, with CEO duality and the last variable potentially reflecting weaker corporate governance.

22 While many directors do not trade at all during the sample period, the following analysis is conditional on directors trading. Furthermore, as C1 implies, we focus on connected directors in this analysis.

Insider Trading Propensity (logit) TABLE 2

This table reports logistic regressions explaining insider trading propensity. In Columns 1, 4, and 5, the dependent variable equals 1 if the connected director has made at least one transaction on the day. Columns 2 and 3 focus on purchase and sale transactions, respectively. Close Period (Other) equals 1 if the connected director is restricted by a close period in another firm on the day of trading. Number of Directorships is the total number of directorships the connected director has. We control for firm characteristics as well as industry and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	(1) Trading Day	(2) Purchase Day	(3) Sale Day	(4) Trading Day	(5) Trading Day
Earnings Surprise	0.041***	0.036**	0.084**	0.048***	0.056***
(%)	(0.015)	(0.016)	(0.042)	(0.016)	(0.016)
Number of	-0.163***	-0.143***	-0.333***	-0.135***	-0.127***
Directorships	(0.007)	(0.007)	(0.022)	(0.007)	(0.007)
CEO–Chair Duality				0.310***	0.249***
				(0.032)	(0.033)
Board Size				0.034***	0.012***
				(0.003)	(0.003)
ROA				-0.263***	-0.153***
				(0.039)	(0.041)
Debt/Total Assets				-0.105***	-0.119***
				(0.037)	(0.043)
Institutional				-0.584***	-0.613***
Ownership				(0.046)	(0.047)
Ln (Total Assets)				0.113***	0.123***
				(0.004)	(0.005)
Constant	-6.101***	-6.287***	-7.757***	-7.668***	-7.379***
	(0.018)	(0.019)	(0.056)	(0.048)	(0.072)
Industry	No	No	No	No	Yes
Year	No	No	No	No	Yes
N	17,312,391	17,312,391	17,312,391	12,628,423	12,627,811
Pseudo R^2	0.002	0.001	0.005	0.011	0.013

5.2 Trading Direction

The next step is to validate or reject C2. We investigate whether the direction of the connected directors' transactions (i.e., a sale or a purchase) is determined by whether the insider information about the firm subject to a close period is positive or negative. First, we focus on earnings surprises as a proxy for the positive or negative nature of the insider information. Although this is not confirmed by Column 2 of Table 3, the logistic regression in Column 1 of Table 3 suggests that positive insider information in the close firm during the close period increases the likelihood of a connected director making a purchase in connected firms. In the same vein, negative insider information about a close firm reduces the purchase propensity in connected firms (Column 3).

Second, we consider strong market reactions (i.e., those in the top and bottom terciles) at the time of the earnings announcement as another proxy for positive or negative

insider information. Columns 4 and 5 suggest that purchase transactions in connected firms are more (less) likely to occur when the insider information for the close firm is positive (negative). Importantly, the effect of insider information is also economically significant. More specifically, with positive (negative) insider information, a purchase transaction is 23.9% more (15.0% less) likely to occur. Finally, although the occurrence of sale transactions (not tabulated) is associated with negative earnings surprises, the effect is small and becomes insignificant when we control for extremely positive or negative insider information via indicator variables.

In Table 4, we utilize a multinomial logistic regression to explicitly consider the cases in which directors do not engage in any trades. In Column 1, we ignore any cases in which a connected director both purchases and sells shares. Hence, we assign a value of -1 to the dependent variable if the connected director engages in sales but not purchases and a value of 1 if the connected director engages only in purchases. The base case is represented by a value of 0, and it corresponds to the connected director not making any transactions during the close period. In Column 2, we include all cases. Hence, the dependent variable equals -1 if all the director's transactions result in net sales during the close period, 0 for no transactions, and 1 for net purchases.[23] Using the same set of control variables and fixed effects as in Table 3, we find that earnings surprises are significantly and positively related to the likelihood of purchase transactions. However, we do not find any such effect for the sale transactions. These results partially support C2, as the likelihood of a purchase is greater when the insider information is positive. However, we find no indication that the likelihood of a sale is greater when the insider information is negative. Again, this could be due to the relatively low number of observations we have for insider sales. To sum up, the trading decisions of connected directors are closely associated with insider information within the close firm. Paired with the evidence of increased propensity for trading (Section 5.1), our findings suggest that when constrained by trading bans, connected directors may exploit insider information and trade in their connected firms.[24]

Insider Trading Direction and Positive or Negative Close Firm Insider Information (logit) TABLE 3

This table reports logistic regressions that explain whether the insider trading direction (purchase vs. sale) is determined by positive or negative insider information about the close firm. In Columns 1 to 5, the dependent variable equals 1 if the connected director has made net purchases in the traded firm when they are prohibited from trading in the close firm because of a close period and 0 if the connect director has made net sales. In Column 1, positive or negative insider information about the close firm is captured by the earnings surprise, which is the percentage difference between the actual earnings and the average earnings estimate. In Columns 2 and 3, we capture positive (negative) insider information earnings surprises in the top (bottom) tercile at the earnings announcement. In Columns 4 and 5, positive (negative) insider information is captured by positive (negative) market reactions (CARs [-1,1]) in the top (bottom) tercile. We control for connected director traits, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

23 In only three cases, the connected directors engaged in purchase and sale transactions of the same amount, resulting in a net transaction value of zero. We have omitted these cases.

24 In addition to trading propensity and direction, we examine the timing of the trading measured as the number of days between a trade and the end of the close period. We find that the timing of close period transactions does not depend on the nature of the insider information in the close firm (untabulated).

	(1) Purchase = 1	(2) Purchase = 1	(3) Purchase = 1	(4) Purchase = 1	(5) Purchase = 1
Earnings Surprise	0.001**				
	(0.000)				
Positive Information (Earnings Surprise)		0.021			
		(0.056)			
Negative Information (Earnings Surprise)			-0.120**		
			(0.056)		
Positive Information (CARs [-1,1])				0.214***	
				(0.082)	
Negative Information (CARs [-1,1])					-0.162*
					(0.085)
Board Size	-0.004	0.010	0.048***	-0.044	-0.044
	(0.015)	(0.018)	(0.019)	(0.030)	(0.030)
% Nonexecutive	-0.317	-0.203	-1.643***	0.154	0.160
	(0.253)	(0.252)	(0.262)	(0.621)	(0.621)
% Female	0.911***	1.099***	-2.877***	-1.723*	-1.746*
	(0.341)	(0.335)	(0.197)	(0.898)	(0.903)
CEO–Chair Duality	0.132	0.327	0.138	-0.740*	-0.724*
	(0.207)	(0.322)	(0.343)	(0.402)	(0.399)
ROA	0.004	0.005	0.004	0.974*	0.976*
	(0.003)	(0.003)	(0.003)	(0.578)	(0.575)
Debt/Total Assets	0.000	0.000	-0.002	-0.197	-0.187
	(0.002)	(0.002)	(0.002)	(0.453)	(0.454)
Fixed/Total Equity	0.000	0.000	0.000	0.120	0.118
	(0.000)	(0.000)	(0.000)	(0.078)	(0.078)
Interest Coverage	0.000	-0.000	-0.000	-0.029	-0.029
	(0.000)	(0.000)	(0.000)	(0.038)	(0.038)
Dividend Payout	-0.001	-0.001	-0.002*	-0.270	-0.269
	(0.001)	(0.001)	(0.001)	(0.267)	(0.267)
Ln (Total Assets)	0.138***	0.141***	-0.005	-0.127**	-0.129**
	(0.028)	(0.031)	(0.026)	(0.062)	(0.062)
Number of Analysts	-0.002	0.003	0.010*	-0.036**	-0.035**
	(0.005)	(0.006)	(0.006)	(0.015)	(0.015)
Institutional Ownership	-0.002	-0.002	-0.006***	0.155	0.153
	(0.002)	(0.002)	(0.002)	(0.517)	(0.518)
Constant	-6.140***	-6.264***	-6.238***	5.966***	6.099***
	(0.482)	(0.496)	(0.498)	(1.271)	(1.289)
Industry	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
N	44,333	46,953	46,953	44,333	43,087
Pseudo R^2	0.035	0.018	0.018	0.200	0.200

Insider Trading Direction and Close Firm Insider Information (Multinomial logit)

TABLE 4

This table reports multinomial logistic regressions that explain whether insider trading in the traded firm occurs because the insider information about the close firm is positive or negative (proxied by the earnings surprise). The multinomial logit 1 ignores cases in which a connected director both purchases and sells shares in the traded firm (the subsample is labeled "specific transactions only"). For this multinomial logit, the dependent variable equals -1 if the connected director sells shares but does not buy shares in the traded firm when the close firm is subject to a close period, 0 if the connected director does not trade (the base case), and 1 if the connected director only purchases shares. For multinomial logit 2, we consider all cases; the dependent variable equals -1 if all of the connected director's transactions result in net sales during the close period in the close firm, 0 for no transactions, and 1 for net purchases. For both multinomial logits, the base case is 0 (i.e., no trades). We control for the characteristics of the connected director and the traded firm as well as industry and time fixed effects (FE). Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	(1) Specific transactions only			(2) Net transaction value		
Dependent variable	-1 (Sale)	0 (No transaction, the base case)	1 (Purchase)	-1 (Net sales)	0 (No transaction, the base case)	1 (Net Purchases)
Earnings surprise	-0.001		0.001**	-0.001		0.001**
	(0.001)		(0.000)	(0.000)		(0.000)
Controls	Yes		Yes	Yes		Yes
Industry FE	Yes		Yes	Yes		Yes
Year FE	Yes		Yes	Yes		Yes
N	56,716			56,945		
Pseudo R^2	0.044			0.046		

5.3 Market Reactions for Traded and Close Firms

We show the results of the OLS regressions that test the validity of C3 (in Table 5. We report a positive and significant correlation between the market reaction (CARs [-10,10]) to a trade in the traded firm (for which event day 0 is the day of the transaction announcement in the traded firm) and the CARs over the same period for the close firms (ditto) across various regression specifications. This pattern applies to all the regressions – i.e., those without (Column 1) and with the control variables (Column 2) as well as those with both the control variables and fixed effects (Column 3). The standard errors are again clustered at the firm level. We find similar evidence for insider sales. In line with other studies on insider trading (e.g., Brochet, 2010; Hillier et al., 2015; Goergen et al., 2019), for purchase transactions, we find that the magnitude of the CARs is explained by the relative size of the insider transaction, which is proxied by the transaction value expressed as a percentage of the traded firm's market capitalization.

Our results further imply that when insider trading is prohibited during the close period, a positive (negative) market reaction is observed in the close firm if the connected director acquires (sells) shares in the traded (connected) firm (see Panel B

of Table 1 and Table 12 below).[25] While the CARs in Table 5 are based on the window of [-10,10], Table 6 reruns the regressions for alternative windows, including all the control variables and the industry and year fixed effects. The table confirms that for purchases, the positive and significant correlation between the traded and close market reactions is not sensitive to the length of the event window. For sales, we find a similar positive relationship, except for the [-20,-1] window, for which the correlation is not significant.

Market Reactions to Connected Directors' Transactions in Traded and Close Firms TABLE 5

This table presents OLS regressions that explain the correlation between market reactions in the traded and close firms around connected directors' transactions during close periods. The dependent variable is the CARs of the traded firm over the period of -10 days to +10 days around the announcement of the transaction. The primary independent variable is the CARs of the close firm over the same event window. We control for transaction value and timing, connected director traits, traded firm characteristics, and industry and time fixed effects (FE). Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

25 When the traded firm is connected to more than one close firm, we analyze the correlation of the CARs for each close firm. In an untabulated robustness test, we evaluate the average market reactions across multiple close firms and obtain qualitatively similar results.

	Purchases			Sales		
	(1) CARs traded [-10,10]	(2) CARs traded [-10,10]	(3) CARs traded [-10,10]	(4) CARs traded [-10,10]	(5) CARs traded [-10,10]	(6) CARs traded [-10,10]
CARs_close [-10,10]	0.122*** (0.028)	0.188*** (0.044)	0.184*** (0.045)	0.173*** (0.040)	0.144*** (0.053)	0.135*** (0.052)
Trade Value (% Market cap)		5.986*** (1.939)	6.153*** (1.976)		0.616 (1.143)	0.374 (1.164)
Routine		-0.004 (0.011)	-0.007 (0.011)		-0.004 (0.010)	0.002 (0.010)
Clustered		-0.003 (0.010)	-0.002 (0.010)		-0.013 (0.009)	-0.014 (0.010)
Female		0.008 (0.012)	0.009 (0.012)		-0.000 (0.016)	0.001 (0.016)
Age		0.019 (0.041)	-0.005 (0.041)		0.048 (0.049)	0.044 (0.060)
CEO		0.010 (0.014)	0.012 (0.014)		0.044* (0.026)	0.037* (0.022)
Chairman		0.009 (0.009)	0.011 (0.009)		0.002 (0.025)	0.005 (0.024)
Executive Director		0.001 (0.012)	-0.003 (0.012)		0.028 (0.023)	0.025 (0.019)
CEO–Chair Duality		0.013 (0.021)	0.019 (0.025)		0.215* (0.118)	0.194* (0.109)
ROA		0.067* (0.040)	0.096** (0.044)		0.215 (0.162)	0.155 (0.142)
Debt/Total Assets		-0.075** (0.033)	-0.073** (0.033)		-0.074* (0.045)	-0.041 (0.040)
Fixed/Total Equity		-0.001 (0.005)	-0.001 (0.005)		0.010** (0.004)	0.007 (0.006)
Interest Coverage		-0.005* (0.003)	-0.004 (0.003)		-0.001 (0.003)	-0.001 (0.003)
Dividend Payout		-0.013 (0.019)	-0.011 (0.019)		-0.026 (0.022)	-0.022 (0.030)
Ln (Total Assets)		-0.002 (0.004)	-0.004 (0.004)		-0.002 (0.005)	-0.006 (0.007)
Number of Analysts		0.001 (0.001)	0.001 (0.001)		-0.001 (0.001)	-0.000 (0.001)
Institutional Ownership		0.000 (0.041)	0.003 (0.043)		-0.046 (0.042)	-0.029 (0.044)
Constant	0.008*** (0.003)	-0.052 (0.181)	0.048 (0.185)	-0.001 (0.004)	-0.178 (0.206)	-0.048 (0.255)
Industry FE	No	No	Yes	No	No	Yes
Year FE	No	No	Yes	No	No	Yes
N	5,988	1,559	1,559	982	386	386
Adjusted R^2	0.010	0.042	0.051	0.028	0.207	0.220

Market Reactions to Connected Directors' Transactions in Traded and Close Firms (by Event Window)

TABLE 6

This table presents OLS regressions that display the relations between the market reactions in the traded and close firms around connected directors' transactions in the traded firm. The dependent variable is the CARs of the traded firm over different event windows around the announcement day of the transaction. The primary independent variable is the CARs of the close firm over the same event window. We control for transaction value and timing, connected director traits, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Purchases						Sales					
	(1) CARs traded [-20,-1]	(2) CARs traded [0,1]	(3) CARs traded [0,5]	(4) CARs traded [0,10]	(5) CARs traded [-1,1]	(6) CARs traded [-5,5]	(8) CARs traded [-20,-1]	(9) CARs traded [0,1]	(10) CARs traded [0,5]	(11) CARs traded [0,10]	(12) CARs traded [-1,1]	(13) CARs traded [-5,5]
CARs_close [-20,-1]	0.268***						0.288					
	(0.049)						(0.179)					
CARs_close [0,1]		0.100*						0.066				
		(0.056)						(0.046)				
CARs_close [0,5]			0.141***						0.116***			
			(0.046)						(0.044)			
CARs_close [0,10]				0.048						0.082**		
				(0.051)						(0.039)		
CARs_close [-1,1]					0.197***						0.069*	
					(0.057)						(0.036)	
CARs_close [-5,5]						0.300***						0.204*
						(0.071)						(0.105)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,699	1,643	1,552	1,382	1,649	1,552	428	413	381	341	417	381
Adjusted R^2	0.081	0.033	0.039	0.017	0.040	0.078	0.227	0.108	0.121	0.089	0.072	0.134

As we only observe a market reaction if there is an insider trade, we address a possible sample selection bias by controlling for the likelihood to trade via a Heckman (1976) selection model. The selection equation includes indicators stating whether the traded and close firms are comparable in terms of industry and size. If so, the insider information becomes more relevant to the connected firms, which increases the probability of trading. The results from estimating the selection equation are reported in Column 1 of Table 7 for purchases and Column 3 for sales. While controlling for a potential selection bias, the regression equations of Columns 2 and 4 report very similar results to those in Table 5, which implies that our results are not sensitive to sample selection bias. Moreover, note that the inverse Mills ratio is not significant.

In Table 8, we control for the potential effects of concurrent events that could affect the CARs of the insider trades, namely M&A and CEO turnover announcements. As both types of events can create opportunities for insider trading, we include indicator variables to capture whether the insider transactions occur within 30 days before concurrent events that could contaminate the results. The results imply that these concurrent events, which are rare, do not impact our earlier results.

Heckman Sample Selection Model TABLE 7

This table displays the results of the Heckman sample selection models. Columns 1 and 3 contain the selection equation. In Column 1 (Column 3), the dependent variable is equal to 1 if there is at least one purchase (sale) by a connected director during the close period and 0 otherwise. The independent variables indicate whether the traded and close firms belong to the same sector and are of a comparable size. Columns 2 and 4 contain the regression equation with the CARs of the traded firm from day -10 to day +10 around the announcement day for the transaction as the dependent variable. The main independent variable is the CARs of the close firm over the same event window. We control for transaction value and timing, the characteristics of the connected director, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	(1) Purchases = 1	(2) CARs traded [-10,10]	(3) Sales = 1	(4) CARs traded [-10,10]
Same Industry	-0.047		-0.039	
	(0.056)		(0.099)	
Similar Size	0.001***		-0.000	
	(0.000)		(0.001)	
CARs_close		0.211***		0.111***
[-10,10]		(0.077)		(0.041)
Trade Value (% Market		4.498*		-2.251**
cap)		(2.372)		(0.989)
Routine		-0.001		-0.011
		(0.010)		(0.008)
Clustered		-0.002		-0.013
		(0.009)		(0.009)
Female	-0.083	0.022	-0.274*	0.015
	(0.063)	(0.015)	(0.147)	(0.014)
Age	-0.415**	0.050	-0.852***	0.079
	(0.193)	(0.045)	(0.241)	(0.048)
CEO	0.313***	0.004	1.040***	0.017
	(0.081)	(0.013)	(0.083)	(0.028)
Chairman	0.191***	0.006	0.100	-0.021
	(0.050)	(0.012)	(0.089)	(0.019)
Executive Director	0.233***	0.003	1.010***	0.016
	(0.062)	(0.013)	(0.087)	(0.029)
CEO–Chair Duality	0.143	-0.032	-0.336	-0.054***
	(0.171)	(0.021)	(0.222)	(0.018)
ROA	0.002***	0.074*	0.001	0.006
	(0.001)	(0.040)	(0.001)	(0.090)
Debt/Total Assets	-0.000	-0.055*	0.000*	0.018
	(0.000)	(0.032)	(0.000)	(0.035)
Fixed/Total Equity	0.000	0.002	-0.000	-0.003
	(0.000)	(0.004)	(0.000)	(0.004)
Interest Coverage	-0.000	-0.002	0.000**	0.005***
	(0.000)	(0.002)	(0.000)	(0.002)
Dividend Payout	0.002***	0.029	0.001	-0.009
	(0.001)	(0.018)	(0.001)	(0.023)
Ln (Total Assets)	0.000	0.001	-0.000	0.002
	(0.000)	(0.004)	(0.000)	(0.004)
Number of Analysts	0.013***	-0.000	0.015***	-0.001
	(0.003)	(0.001)	(0.004)	(0.001)
Institutional Ownership	0.001	0.046	-0.000	-0.004
	(0.001)	(0.041)	(0.002)	(0.035)
Constant	-4.869**	-0.140	0.299	-0.332*
	(2.001)	(0.207)	(1.003)	(0.180)
Inverse Mills Ratio		-0.024		0.020
		(0.026)		(0.029)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	100,624	100,624	102,825	102,825

Concurrent Events of M&As and CEO Turnover

TABLE 8

This table shows regressions analyzing the market reactions to connected transactions in both the traded and close firms, with additional controls, including indicator variables for concurrent corporate events, such as M&A announcements and CEO turnover. In Column 1, we introduce two binary variables, M&A Event Traded as Acquirer (or M&A Acquirer) and M&A Event Traded as Target (or M&A Target), which equals 1 if the traded firm is involved in an M&A as an acquirer or a target shortly after the insider transaction. In Column 2, the binary variable CEO Turnover Traded equals 1 if CEO turnover in the traded firm is announced shortly after the insider transaction. Columns 1 and 2 are based on the sample of purchase transactions. Columns 3 and 4 focus on the sales subsample. We control for transaction value and timing, connected director traits, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Purchases		Sales	
	(1) CARs_ traded [-10,10]	(2) CARs_ traded [-10,10]	(3) CARs_ traded [-10,10]	(4) CARs_ traded [-10,10]
CARs_close [-10,10]	0.178***	0.181***	0.131**	0.133**
	(0.046)	(0.046)	(0.053)	(0.051)
M&A Event Traded as Acquirer	-0.008		-0.002	
	(0.010)		(0.016)	
M&A Event Traded as Target	0.097		-0.008	
	(0.091)		(0.025)	
CARs_close [-10,10] x M&A Acquirer	0.231		0.401	
	(0.154)		(0.258)	
CARs_close [-10,10] x M&A Target	-0.254		-0.173	
	(0.268)		(0.426)	
CEO Turnover Traded		-0.006		0.035
		(0.013)		(0.033)
CARs_close [-10,10] x CEO Turnover Traded		0.164		0.968
		(0.152)		(0.560)
Controls	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	1,559	1,559	386	386
Adjusted R^2	0.057	0.050	0.214	0.222

An alternative explanation for our results may be that the correlation between the CARs in the traded and close firms is triggered by macroeconomic news and hence is not unique to the connected firms. For instance, a change in monetary policy by the Bank of England may trigger market selloffs, which may in turn lead to concurrent negative returns for most equities. However, it is unlikely that such events would explain the observed correlation between the CARs. First, our sample covers a long time series spanning 20 years. It is therefore unlikely that rare market events would dominate our sample period and drive the positive correlation. Second, to test the validity of this alternative explanation, we develop a falsification test whereby a traded firm is paired with a randomly selected unconnected firm. This sample, consisting of

pairs of traded firms and unconnected firms, is the placebo group. If the alternative explanation of a market-wide shock simultaneously affecting the returns of the traded and close firms were true, we would also observe such a positive correlation for the placebo group. While for the traded firms paired with their truly connected firms, we observe a positive correlation between their CARs (Column 1 of Table 9), the regression based on the placebo group (Column 2) shows that the CARs of the traded firms are not significantly correlated with the CARs of the paired unconnected firms.

Next, in Column 3, we merge the actual subsample of traded firms and their connected firms used in Column 1 and the placebo group used in Column 2 into a single sample. We include an indicator variable equal to 1 if the traded firm is paired with an actual connected firm and 0 if it is paired with a random, unconnected firm. Again, the correlation between the traded and "connected" firms is only observed if both firms are genuinely connected. These results imply that the positive correlations between CARs are not driven by macroeconomic or market-wide news.

However, as reported by Ben-David et al. (2019), firms within the same industry may experience correlated share price movements due to being influenced by the same news. Note that such firms are also more likely to form connections, as a director's talent and experience are often highly valued across firms from the same industry. However, in Column 4, we demonstrate that merely being in the same industry does not result in correlated market reactions. In an untabulated analysis, we also find that industry familiarity does not enhance the correlation between CARs in the placebo sample. In Column 5, we investigate whether industrial familiarity enhances the correlation between the CARs for the truly connected pairs, but do not find supporting evidence. Using the subsample of sale transactions, we repeat the above tests and confirm our earlier findings (see Columns 6 to 8 of Table 9). Therefore, the traded and close firms have correlated market reactions during the close periods if and only if they are truly connected.

Falsification Test with Unconnected Firms

TABLE 9

This table presents regressions based on a constructed sample that examines market reactions following connected directors' transactions (truly connected) and market reactions in unconnected firms (Placebo). In Column 1, the correlation between the CARs of the traded and close firms is shown for a sample of pairs of (truly connected) traded and close firms. In Column 2, the dependent variable remains the CARs of the traded firm, while the independent variable is the CARs for the same event window taken from a randomly selected firm that is not connected to the traded firm. In Column 3, the sample includes both truly connected and placebo observations for close firms. The indicator variable Truly Connected equals 1 if the firms are truly connected and 0 if they are placebo firms. In Column 5, we use the indicator variable Same Industry, which equals 1 if the traded firm and the paired "close" firm belong to the same industry (same 2-digit SIC code), and 0 otherwise. Column 6 is based on the sample of truly connected traded and close firms. Columns 6 to 8 replicate the analysis of the sale transactions. We control for transaction value and timing, the characteristics of the connected director, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Purchases					Sales		
For close firms:	(1) CARs_ traded [-10,10] Truly Connected	(2) CARs_ traded [-10,10] Placebo	(3) CARs_ traded [-10,10] Truly Connected and Placebo	(4) CARs_ traded [-10,10] Truly Connected and Placebo	(5) CARs_ traded [-10,10] Truly Connected	(6) CARs_ traded [-10,10] Truly Connected	(7) CARs_ traded [-10,10] Placebo	(8) CARs_ traded [-10,10] Truly Connected and Placebo
CARs_"close" [-10,10]	0.204***	0.019	0.019	0.020	0.189**	0.193***	0.011	0.011
	(0.066)	(0.016)	(0.016)	(0.017)	(0.077)	(0.058)	(0.008)	(0.008)
Truly Connected			0.001				0.066	
			(0.005)				(0.046)	
Truly Connected x CARs_"close"			0.177***					0.143**
			(0.064)					(0.057)
Same Industry				-0.012	-0.013			
				(0.006)	(0.014)			
Same Industry x CARs_"close"				0.051	0.079			
				(0.044)	(0.115)			
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,049	13,579	14,628	14,628	1,049	292	3,906	4,198
Adjusted R^2	0.035	0.042	0.042	0.044	0.078	0.148	0.062	0.059

5.4 Relationship between Traded and Close Firms

The above analysis focuses on the relationship between traded and close firms that are connected to one another. Borgatti and Li (2009) study the mutual embeddedness of director connections and supply-chain relationships. They conclude that director connections are more likely among firms with supply-chain relationships. Conversely, when two firms are rivals, potential conflicts of interest make it risky for directors to serve on both boards (again, in the United Kingdom, the CMA discourages directors from sitting on the boards of competing firms). We therefore expect that virtually all of the traded and close firms have friendly or neutral relationships (rather than relations based on rivalry). In the analysis that follows, we investigate whether the correlation of the market reactions becomes stronger if the traded and close firms are in a friendly relationship.

We identify 352 pairs of traded and close firms that are in a friendly relationship according to FactSet. For the pairs of traded and close firms not covered by FactSet but operating in the same industry, we assess their mutual relationship based on their industry's HHI. This results in an additional 153 pairs of traded and close firms. Table 10 focuses on the possible moderation effect of a friendly relationship between traded and close firms. Column 1 suggests that the correlation between the CARs of the traded firm and those of the close firm is stronger if the two firms are in a friendly relationship – as captured by the interaction terms in Columns 1 to 3. Compared to firms in a neutral or rival relationship, the correlation of the stock market reactions for firms in a friendly relationship is nearly twice as strong. This result confirms the validity of C4. By contrast, for a much smaller number of sale transactions, we do not observe such evidence (Columns 4 to 6).

Relationship between Traded and Close Firms TABLE 10

This table shows regressions analyzing the market reactions for both traded and close firms, taking into account the relationship between the traded and close firms. The indicator variable Friendly Relationship equals 1 if a) the traded and close firms are identified as partners in FactSet and b) the two firms are in a sector with a Herfindahl–Hirschman index in the top tercile among all sectors in the given year and 0 otherwise. We control for transaction value and timing, connected director traits, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Purchases			Sales		
	(1) CARs_ traded [-10,10]	(2) CARs_ traded [-10,10]	(3) CARs_ traded [-10,10]	(4) CARs_ traded [-10,10]	(5) CARs_ traded [-10,10]	(6) CARs_ traded [-10,10]
CARs_close [-10,10]	0.112*** (0.015)	0.098*** (0.028)	0.112*** (0.015)	0.145*** (0.029)	0.102*** (0.035)	0.079** (0.036)
Friendly Relationship	0.001 (0.007)	0.019* (0.011)	0.001 (0.007)	0.003 (0.011)	-0.014 (0.015)	-0.020 (0.016)
Friendly Relationship x CARs_close [-10,10]	0.108*** (0.041)	0.149** (0.060)	0.108*** (0.041)	-0.045 (0.097)	0.010 (0.141)	0.009 (0.142)
Controls	No	Yes	Yes	No	Yes	Yes
Industry	No	No	Yes	No	No	Yes
Year	No	No	Yes	No	No	Yes
N	7,391	2,142	2,142	1,227	508	508
Adjusted R^2	0.011	0.042	0.052	0.019	0.132	0.159

5.5 Channel Analysis

In this section, we investigate potential channels that may be responsible for the observed positive correlation between the CARs of traded and close firms. One such channel may be institutional investors. Such investors may possess superior knowledge, experience, and sophistication compared to retail investors. Gu et al. (2021) report that institutional investors closely monitor insider transactions and actively exploit trading opportunities. Compared to retail investors, institutional investors are more likely to be aware of the connections between firms.

When institutional investors observe close period transactions, they may identify a trading opportunity in the close firm. As a result, institutional investors might trade in both the close firm and the traded firm, which could explain the correlated CARs. Furthermore, we expect investors' trades and subsequent market reactions in the close firm to happen shortly after those in the traded firm. In Table 11, we explain the subsequent market reaction in the close firm once the purchase (and the market reaction) has been observed in the traded firm. In support of our argument, Columns 1 to 4 suggest that the market reaction in the close firm over an event window shortly after the announcement of the transaction in the traded firm – i.e., [1,2] or [1,5] – is explained by the immediate market reaction in the traded firm over the window of [0,1]. By contrast, we do not find evidence that the market reaction in the traded firm occurs after that in the close firm (Columns 5 and 6).

To account for potential information leakage in the close firm, we examine the market reaction immediately before the transaction in the close firm (Columns 7 and 8), and do not find evidence to support such leakage. The above results imply that the market reaction in the traded firm precedes that in the close firm; the presence of institutional investors in the traded or close firms may then explain the positively correlated CARs between the traded and close firms.

Furthermore, if institutional investors were driving the correlated market reactions to insider transactions between connected firms, we would expect traded and close firms with high institutional ownership to exhibit a more positive correlation. Table 12 suggests that high institutional ownership, defined as the sum of institutional ownership in both the traded and close firms being in the 50th (or 75th) percentile, increases the positive correlation between the CARs of the traded and close firms. We also conduct a split sample analysis[26] (untabulated) based on institutional ownership and find that the correlation between the CARs is more significant in the high institutional ownership subsample.

Finally, we consider the possibility that the positive correlation between the CARs may be attributed to information leakage (Berkman et al., 2023). If insider information is leaked during the close period, investors may act upon it by trading and generating a positive stock market reaction in the close firm. This positive market reaction in the close firm resonates with the positive market reaction observed in the traded firm, leading to positively correlated CARs. However, we believe that this explanation is unlikely to be valid. First, information leakage is rare,[27] and large investors are exposed to significant litigation risks when attempting to exploit it. Second, in an untabulated analysis, we control for the quality of corporate governance (captured by CEO duality and the percentage of independent directors on the board), as information leakage is more likely to occur when corporate governance is weak. However, we do not find a significant moderating effect for corporate governance quality. Third, following information leakage, the market reaction in the close firm would precede the transaction and the subsequent market reaction in the traded firm. However, this is not the case (Table 11, Columns 5 to 8). Therefore, information leakage is unlikely to be the underlying cause of the observed correlation between CARs.

Timing of the Market Reaction in the Trade and Close Firms TABLE 11

Columns 1 to 4 of this table report the regressions explaining the stock market reactions for the close firms by the market reactions for the traded firms following a connected insider transaction. The close firm event windows (i.e., [1,2] and [1,5]) are timed after the traded firm event windows (i.e., [0,1]). In Columns 5 to 8, the market reactions of the traded firms are explained by market reactions of the close firms, in event windows timed shortly before ([0,1] and [-1,0]). We control for transaction value and timing, the characteristics of the connected director, close firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

26 We split the sample at the median and alternatively at the 75th percentile.

27 A cross-country study conducted by Aitken et al. (2015) reports that the average (median) number of cases of suspected information leaks per month is only 3.42 (0.17) per one million transactions per stock exchange.

	(1) CARs_ close [1,2]	(2) CARs_ close [1,5]	(3) CARs_ close [1,2]	(4) CARs_ close [1,5]	(5) CARs_ traded [1,2]	(6) CARs_ traded [1,5]	(7) CARs_ traded [1,2]	(8) CARs_ traded [1,5]
CARs_traded [0,1]	0.032***	0.041***	0.050*	0.048*				
	(0.008)	(0.011)	(0.026)	(0.027)				
CARs_close [0,1]					0.037	0.029		
					(0.039)	(0.046)		
CARs_close [-1,0]							-0.015	-0.015
							(0.023)	(0.023)
Controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year	No	No	Yes	Yes	Yes	Yes	Yes	Yes
N	5,017	6,367	2,010	2,549	2,099	2,655	2070	2626
Adjusted R^2	0.003	0.002	0.006	0.006	0.016	0.007	0.018	0.007

Institutional Ownership TABLE 12

This table shows regressions that explain the stock market reactions for the close firms by the market reactions for the traded firm around a connected insider transaction, controlling for the ownership of institutional investors. Institutional Ownership is the combined shareholding percentage of both the traded and close firm by institutional investors. The binary variable High Institution Ownership equals 1 if the institutional ownership of both the traded and close firms is above the industry median or the 75th percentile in the year of the transaction. We control for transaction value and timing, connected directors' traits, traded firm characteristics, and industry and time fixed effects. Standard errors are clustered at the firm level and reported in parentheses. Detailed variable definitions are provided in the Appendix. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Purchases			Sales		
	(1) CARs_ traded [-10,10]	(2) CARs_ traded [-10,10]	(3) CARs_ traded [-10,10]	(5) CARs_ traded [-10,10]	(6) CARs_ traded [-10,10]	(7) CARs_ traded [-10,10]
CARs_close [-10,10]	0.104***	0.144***	0.182***	0.019	0.106*	0.155**
	(0.033)	(0.044)	(0.046)	(0.018)	(0.061)	(0.072)
CARs_close [-10,10] x Institutional Ownership	0.980***			0.936***		
	(0.036)			(0.019)		
Institutional Ownership	0.010			0.005		
	(0.007)			(0.006)		
CARs_close [-10,10] x High Institutional Ownership (50^{th})		0.951***			1.009***	
		(0.023)			(0.065)	
High Institutional Ownership (50th)		0.007			-0.004	
		(0.008)			(0.010)	
CARs_close [-10,10] x High Institutional Ownership (75^{th})			0.941***			0.953***
			(0.051)			(0.119)
High Institutional Ownership (75th)			-0.004			-0.016
			(0.012)			(0.016)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	1,426	1,559	1,559	364	386	386
Adjusted R^2	0.638	0.197	0.078	0.835	0.337	0.254

6 Conclusion

We demonstrated that when facing trading bans in the form of a close period prior to an earnings announcement, executive and nonexecutive directors actively trade in their connected firms (the so-called traded firms) to capitalize on their insider information. Furthermore, directors' trading decisions (i.e., whether they make purchases or sales) in the traded firm are determined by whether the insider information in the close firm is positive or negative, provided that the two firms are connected. More specifically, a connected director is 23.9% more likely to purchase shares given positive insider information in the close firm (in which a director is not allowed to trade because of the trading ban) and 15.0% less likely to do so given negative insider information. Subsequently, we observed a market reaction in the close firm, which suggests that investors observe directors' trades in the traded firm during the close period. Importantly, the market reaction in the close firm exhibits a positive correlation with that in the traded firm, suggesting that both market reactions are driven by the same insider information.

We further examined the positive correlation between the CARs while controlling for potential sample selection bias and concurrent events (i.e., M&A and CEO turnover announcements), and the results are consistent. The positive correlation is further strengthened if the traded and close firms are in a friendly relationship. This makes intuitive sense because when the operations of such firms are closely intertwined (e.g., through their supply chain), insider information in one firm is also likely to be relevant to the other one.

We considered two mechanisms that may drive the positive correlation between market reactions: institutional investors and information leakage. First, we argued that close period transactions are monitored by institutional investors, who adjust their trading strategies accordingly in close firms (in which they can trade contrary to the directors), resulting in correlated market reactions. We found that the correlation of market reactions is stronger if institutional ownership is high in both connected firms. The fact that the market reaction in the close firm occurs shortly after that in the traded firm supports this explanation. Second, in the event of insider information leakage in a close firm, investors might engage in trading during the close period, leading to positively correlated market reactions. However, this alternative explanation is not plausible for the following three reasons: 1) trading on leaked information creates a legal risk; 2) such trading counters the aforementioned evidence that abnormal market returns occur earlier in the traded firm than in the close firm; and 3) when using corporate governance quality as a proxy for the likelihood of information leakage, we do not find support for the argument that close firms with worse governance – and hence a higher likelihood of information leakage – are associated with greater market reactions to close period transactions.

Our study contributes to the existing literature by providing evidence that insider information has broader value beyond the firm to which it relates. Insiders may evade trading bans by trading shares in their connected firms, thereby still capitalizing on their insider information. Therefore, regulations on insider trading should not be limited to individual firms; they should be extended to insider trading in connected firms. Note that the SEC in the United States has already taken a step in this direction via its enforcement action against "shadow trading." Last but not least, investors may find it beneficial to track insider transactions across connected firms. Our evidence suggests that institutional investors are already following insider trades across connected firms and formulating strategies based on directors' trading activities in all their firms.

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Appendix. Variable Definitions

Variable	Definition	Original Source
Insider Information		
Earnings Surprise	(actual Earnings Per Share – forecasted EPS) / forecasted EPS	IBES
Positive Information (Earnings Surprise)	= 1 if Earnings Surprise is in the top terciles within an industry-year, = 0 otherwise	IBES
Negative Information (Earnings Surprise)	= 1 if Earnings Surprise is in the bottom terciles within an industry-year, = 0 otherwise	IBES
Positive Information (CARs [-1,1])	= 1 if market reaction (CARs [-1,1]) at the earnings announcement is in the top tercile within an industry-year, = 0 otherwise	Datastream
Negative Information (CARs [-1,1])	= 1 if market reaction (CARs [-1,1]) at the earnings announcement is in the bottom tercile within an industry-year, = 0 otherwise	Datastream
Share Price Reactions		
CARs_traded	Cumulative abnormal returns of connected director's transactions in the traded firm	Datastream
CARs_close	Cumulative abnormal returns of connected director's transactions in the close firm	Datastream
Transaction Characteristics		
Trade Value (% Market Cap)	Transaction value scaled by the market capitalization of the traded firm at the time of the transaction	smartinsider.com
Routine	= 1 if a transaction of the same direction occurs at a similar time (within 30 days) as in previous years, = 0 otherwise	smartinsider.com
Clustered	= 1 if the transaction occurs on the same day as (an)other transaction(s), = 0 otherwise	smartinsider.com
M&A Event Traded as Acquirer	= 1 if the traded firm is involved in an M&A as an acquirer within 30 days after the trade	EIKON
M&A Event Traded as Target	= 1 if the traded firm is involved in an M&A as a target within 30 days after the trade	EIKON
CEO Turnover Traded	= 1 if the traded firm announces CEO turnover within 30 days after the trade	BoardEX
Trading Director Characteristics		
Close Period (Other)	= 1 if the director faces a close period of another of his firms, = 0 otherwise	IBES
Number of Directorships	Number of directorships of a director	BoardEX
Female	= 1 if the trading director is female, = 0 otherwise	BoardEX
Age	Age of the trading director	BoardEX

CEO	= 1 if the trading director is the CEO, = 0 otherwise	BoardEX
Chairman	= 1 if the trading director is the chairman, = 0 otherwise	BoardEX
Executive Director	= 1 if the trading director is an executive director, = 0 otherwise	BoardEX
Mutual Relationships		
Same Industry	= 1 if the traded firm and close firm are in the same industry based on two-digit SIC codes, = 0 otherwise	Datastream
Similar Size	= 1 if the traded firm and close firm are of the same size decile for a given year, = 0 otherwise	Datastream
Friendly Relationship	= 1 if the traded firm and close firm are in a friendly relationship, = 0 otherwise (Friendly Relationship is defined as follows: a) the traded and close firms are identified as partners, customers, or suppliers in FactSet or b) the two firms are in a sector with a Herfindahl–Hirschman index in the top tercile among all sectors in a year)	FactSet
Control Variables		
Board Size	Number of directors on the board	BoardEX
% Nonexecutive	Number of nonexecutive directors / Board Size	BoardEX
% Female	Number of female directors / Board Size	BoardEX
CEO–Chair Duality	= 1 if the CEO and chairman is the same person, = 0 otherwise	BoardEX

Variable	**Definition**	**Original Source**
ROA	Return on assets	Datastream
Debt/Total Assets	Total debt / total assets	Datastream
Fixed/Total Equity	Fixed assets / value of equity	Datastream
Interest Coverage	EBIT / total interest expense	Datastream
Dividend Payout	Dividends per share / earnings per share * 100	Datastream
Ln (Total Assets)	Natural logarithm of total assets in thousands of GBP	Datastream
Number of Analysts	Number of analysts following the traded firm	IBES
Institutional Ownership	Percentage of shares held by institutions including pension funds, investment companies, insurance companies, other companies, and governments	Datastream
High Institutional Ownership	= 1 if Institutional Ownership is in the top terciles within an industry year, = 0 otherwise	Datastream