Inside the Network:
Trading of Inside and Outside Stocks by Corporate Insiders

January 2014

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*Corresponding author. This version is preliminary. Please do not cite without permission. We thank Euroclear and the Office of the Data Protection Ombudsman for recognizing the value of this research project.

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Abstract

Members of corporate boards earn significant abnormal returns, both when they trade as an insider in their company's own stock, and when they trade as an outsider in other stocks for which they are not classified as an insider. As outsiders, corporate directors earn larger abnormal returns when they buy stocks for which they have an interlock board connection, and when they have higher status within the network of corporate boards. We also find similar trading inclinations and performance for the family members of these directors, indicating that the benefits of access to the corporate network spill over to the family networks of directors.

Key words: Informed trading, insider trading, information asymmetry, market efficiency, board of directors, corporate director network, family network, social network analysis

JEL classification: G14, G19

I. Introduction

We find significant mean abnormal returns when corporate directors trade, either as an insider in their own company's stock, or as an outsider in other stocks. The likelihood of trading in any particular outside stock, and the performance of such trading, are especially high when the director has a connection to the company through interlocking directorships.[1] When there is no such interlock connection, abnormal returns for director purchases of outside stocks are smaller, but still significantly positive, and the degree of this outperformance is positively associated with the status of the director within the corporate network.

We also find that the family members of corporate directors outperform when they buy shares of the company for which their related director is an insider, or when they buy outside stocks with which their related director has an interlock connection. Family trades in unconnected stocks also outperform, but not by as much as their trades in inside or interlock stocks.. This evidence indicates that the benefits of access to information through the corporate network spill over to the family networks of board members.

Our data on stock trading by board members are obtained from three sources. The first source is publicly available data on transactions by insiders of firms listed on the Finnish Stock Exchange. The second source is the Euroclear Finland Ltd database, which contains daily changes in the shareholdings of all registered Finnish investors. We match the publicly available data on insider trades to accounts in the Euroclear database, to identify 466 corporate insider accounts in Finland. The third source is the Virre database of the National Board of Patents and Registration of Finland, which provides membership lists of the Board of Directors for each

[1] Trades are classified as having an interlock connection when directors trade in the stock of a company where they are not registered as insider, but for which a current co-board member is an insider.

listed firm in Finland. This database enables construction of the network of corporate board members every year.

In addition, we identify investors who are likely to have a family relationship with the directors in our sample. For all individual accounts in the Euroclear database, we have an identification number that represents the surnames of the accountholders, without revealing those surnames. With this information, we link trades by each director to accounts with the same surname that make similar trades, to identify the accounts of likely family members.[2]

Given this information, we construct a dataset that contains all trades by the director accounts that we identify, as well as the accounts of their family members, over the period 1997 - 2011. We then classify all trades by directors or their family members into five categories, according to the scheme illustrated in Figure 1. First, we sort trades according to the connection of the director to the stock traded, as insider trades in the director's own company or trades in outside stocks. We then classify all trades in outside stocks into those with an interlock connection and those with no connection. Finally, we further classify the category of unconnected trades according to the status of the director within the network of corporate boards. The resulting five categories of trades are: (i) insider trades, (ii) interlock trades, (iii) unconnected trades when the board member has high status, (iv) unconnected trades when the director has moderate status, and (v) unconnected trades made when the director was not serving as a board member.

We find that purchases by directors are consistently followed by significant positive cumulative abnormal returns (CARs) over the following weeks and months. This superior stock-picking skill is not limited to stocks for which the director is an insider. For example, purchases

[2] Subsequent to this identification procedure, we prevent the identification of individual investors in our database by dropping the names and retaining only an identification number. In addition, we present only aggregate statistics so that it is impossible to attribute any specific behavior or performance to particular investors.

of outside stocks where directors have interlocking directorships generate an average CAR of 0.7% after two weeks, which grows to 3.0% after three months and 4.8% after one year. We also find that, for outside stocks where there is no insider or interlock connection, directors perform better on the buy side if they have higher status within the corporate network. Sales by directors also tend to be followed by negative abnormal returns, but the average post-sale abnormal return is smaller in magnitude and less significant. The family members of insiders display similar trading performance when they buy inside stocks and interlocking outside stocks.

We further investigate whether the outperformance of directors is due to superior private information that is about to become public, by examining whether this outperformance is concentrated around major information events such as earnings announcements, takeover announcements, or large price changes. We find that these information events do not contribute significantly to the overall performance of directors. Instead, the outperformance of corporate directors appears to derive from access to information about the longer term prospects of the stocks they trade, obtained through access to the corporate network.

Our research contributes to three strands in the literature. First, this study contributes to the extensive literature on insider trading. Most work in this area examines the cross-sectional return forecasting ability of insider trades.[3] Similar to these studies, we find that board members outperform on the buy-side when they trade in their own company's stock, but not on the sell-side. Our analysis provides four novel contributions to this literature indicating that: i) directors are good at picking stocks in general, ii) directors perform especially well when there are interlocking directorships, and iii) directors perform especially well when they have higher status within the network of board members.

[3] For example, see Jaffe (1974), Lakonishk and Lee (2001), Lorie and Niederhoffer (1968), Rozeff and Zaman (1988), and Seyhun (1986, 1998).

Our research also contributes to the growing number of studies which document that some categories of individual investors are more informed than others. For example, Ivkovic and Weisbenner (2005) find that individuals who invest in local companies outperform other individual investors. Grinblatt et al. (2010) document that high-IQ investors in the Finnish stock market have superior stock-picking skills, and Berkman et al. (2014) show that Finnish guardians who trade through underaged accountholders are exceptionally successful at picking stocks. Our study extends these results by offering evidence suggesting that the corporate director network is one of the channels through which high IQ investors and adult guardians obtain access to valuable information.

Finally, we contribute to the growing literature on how information is diffused through social networks to influence trading behavior and stock returns.[4] For example, several studies document that the managers of financial institutions trade based on communication through their network of peers.[5] Other work demonstrates that word-of-mouth effects are an important factor underlying the similarity of trades by investors located in the same geographic neighborhood.[6] Cohen, Frazzini, and Malloy (2008, 2010) show that professional investors enjoy an advantage in obtaining value-relevant information through access to social networks based on their educational affiliation. Based on a measure used to estimate the rate of transmission of diseases through social contact, Shive (2010) shows that socially motivated trades predict returns. Ozsoylev et al. (2014) identify traders with similar trading behavior on the Istanbul Stock Exchange as being linked in an 'empirical investor network.' They find that investors who are

[4] Several studies analyze the impact of social networks on firm value and corporate decisions. For example, Cai and Sevilir (2012) find that acquirers obtain higher announcement returns in transactions when the acquirer and target share a common director. Larcker, So, and Wang (2013) show that firms that are more central in the corporate director network earn higher returns than non-central firms. Fracassi (2012) shows that the corporate investments of companies are more similar when there are stronger social connections.

[5] See Das and Sisk (2005), Hong, Kubik, and Stein (2004), Shiller and Pound (1989), and Pareek (2012).

[6] See Brown et al. (2008), Ivkovic and Weisbenner (2005, 2007), and Feng and Seasholes (2004).

centrally placed in this network earn higher profits and trade prior to peripheral investors around information events. This body of evidence is consistent with theoretical models indicating that information diffusion through social networks influences trading behavior and stock returns.[7]

Our study provides evidence that the network of interlocking directorships represents a significant channel through which firm-specific information spreads across individual investors, and that directors with a higher status in the director network obtain more valuable firm-specific information. We also confirm the findings in Berkman, Koch, and Westerholm (2014) that family connections should be added to the list of social networks that function as a conduit of information flow, and we show that their results extend to the adult family members of insiders, in addition to underage children.

This study proceeds as follows. Section II describes the institutional features of Finnish markets, discusses the data, and summarizes the attributes of the five categories of trades by directors. Section III analyzes the likelihood of directors or family members making different types of trades. Section IV examines the performance of director trades, while section V investigates family trades. Section VI analyzes director trading before major events. A final section concludes.

II. Institutional Background, Data, and Sample Characteristics

II.A. Institutional Background

Insider trading laws in Finland were passed in 1989 and first enforced in 1993 (see Bhattacharya and Daouk, 2002). Like most other countries in the EU and elsewhere, these regulations are modelled after U.S. insider trading laws. In addition to the formal laws, insiders

[7] For example, see Colla and Mele (2010), Han and Yang (2011), and Ozsoylev and Walden (2011). For recent surveys of the use of social network analysis in economics and finance, see Allen and Babus (2009), Easley and Kleinberg (2010), and Jackson (2008, 2010).

are restricted in their trading by "Guidelines for Insiders" published by Nasdaq OMX Helsinki, and by "Guidelines for Insiders" issued by the Finnish Association of Securities Dealers (FASD). Moreover, most publicly listed companies in Finland have adopted internal insider guidelines, which are often stricter than the guidelines of Nasdaq OMX Helsinki and the FASD. We provide more details about the Finnish regulations in Appendix A.

II.B. Data Sources and Classification of Trades

II.B.1. Data Sources

This study is concerned with the trading activity of corporate directors and the share price performance following their trades, conditioned on the level of their connection to the stocks they trade. We use three main data sources to conduct this analysis. Our first source is the set of all publicly available transactions made by insiders in Finnish listed firms during the period, July 2005 through December 2010. In Finland, information about trading by corporate insiders in the previous five years is made available in a public register.

Our second source is the Euroclear database, which documents daily changes in the shareholdings for each registered investor in Finland.[8] There have been a total of 183 Finnish stocks listed on the Nasdaq OMX Helsinki exchange during our sample period covering 1997 – 2011. To trade on this exchange, investors must register with Euroclear. Each investor is given a unique Euroclear account, even if he or she trades through multiple brokers.

Our final main data source is the Virre database of the National Board of Patents and Registration of Finland. This database contains (among other things) information on the composition of the Board of Directors for each listed firm in Finland. The entries record the date when people commence or end their respective roles as insiders, enabling us to create a reliable

[8] Grinblatt and Keloharju (2000) provide a detailed description of the Euroclear database.

annual dataset that contains the names and birth years of the members of the board of directors for each listed company.[9]

We identify our sample of insiders by matching known trades by insiders from the public register with accountholders in the Euroclear database who have the same birth year and make identical trades. This merge is described in more detail in Appendix B, and allows us to identify 466 corporate insiders in Finland within the Euroclear database. After we identify this group of director accounts, we use the Euroclear database to analyze all trades in the accounts of these directors during the sample period. This analysis includes all insider trades, as well as all trades in outside stocks for which the director is not classified as an insider.

II.B.2. Classification of Trades

Each year we split the sample of all trades by directors into the five groups listed above, based on the classification scheme illustrated in Figure 1. First, we consider the connection between the director who makes the trade and the stock traded. Trades by directors in the stock of a company where they are registered as an insider are classified as having an *Insider* connection. Trades by directors in the stock of a company where they are not registered as insider, but for which a current co-board member is an insider, are classified as having an *Interlock* connection. Trades by directors in stocks for which they are not classified as an insider and have no interlock connection are classified as unconnected. When we determine these annual classifications, we assume that directors are insiders of a firm if they are on the board at any time during the year. As a result, our procedure will tend to over-classify directors as having an

[9] Our sample of insiders includes the managing director and all members of the board of directors for each firm. We require the birth year of every director in the public register to match with the birthyear of the accountholder in the Euroclear database. To ensure that the birth year of these insiders is available in the Virre database, we begin the sample period in January 1997 instead of January 1995 (the starting date of the Euroclear database).

insider or interlock connection, since it uses annual data even though a director might have changed status during the year.[10]

Our classification scheme also considers the status of the director within the network of corporate board members each year. For each director in the network, we calculate four measures of centrality that are standard in network theory.[11] These measures capture different dimensions in which a node (director) can be important within a network. The first measure is *Degree Centrality*, which is defined as the number of first-degree links to other nodes. For each director, degree centrality is the number of other unique directors with whom a director shares a board position. *Betweenness Centrality* is the number of shortest paths in the network that pass through a given node, divided by the sum of all shortest paths in the network. If a director is on many of the shortest paths connecting directors, then that director may have an informational advantage. *Closeness Centrality* is defined as the inverse of the sum of the distances from a given node to all other nodes. Finally, *Eigenvector Centrality* measures a node's importance in terms of the significance of the nodes to which it is connected. A node with a higher eigenvector centrality is connected to other nodes with higher eigenvector centrality.

To obtain a measure of the status in the corporate network of directors for each year in the sample period, we aggregate the four social network measures, after standardizing each measure by dividing the score for every director by the cross-sectional standard deviation of that measure across all directors during any given year. We then classify the top tercile of directors every year by this aggregate score as directors with "High Status." The bottom two terciles are labelled as having "Moderate Status." Finally, in addition to the trades while these directors served on corporate boards, our sample also contains trades by these same individuals that

[10] It is likely that some beneficial network connection exists before a director enters a board, and fades out slowly after a director leaves a board. Our procedure results in a maximum lead-in and fade-out period of 12 months.
[11] See, for example, http://en.wikipedia.org/wiki/Centrality#Betweenness_centrality.

occurred before they became a director or after they left the corporate network. These trades are labelled as being associated with directors who have "No Status."

We also identify investors who are likely to have a family relationship to the directors in our sample. For each individual Finnish account, we have an identification number that represents the surname of the accountholder, without revealing the surname. With this information, we link trades by each director account to possible family accounts in two different ways. The first rule identifies a family accountholder if they have: (i) the same surname, (ii) the same postcode, and (iii) at least two trades in the same security on the same day with the same sign (buy/sell). The second rule identifies a family accountholder without the same postcode requirement, but this rule requires four matching trades. Thus, the second rule identifies a family accountholder with: (i) the same surname and (ii) at least four trades in the same security on the same day with the same sign.

Finally, we obtain earnings announcement dates from Bloomberg. Merger and acquisition announcement dates are from SDC Platinum. Daily share prices and the number of shares outstanding are taken from Compustat Global. The market-to-book ratios for all Finnish firms are obtained from Worldscope. We only include stock-years if a stock has more than 200 days on which it is traded within that year.

II.C. Descriptive Statistics for Different Types of Trades

II.C.1. Frequency and Attributes of Trades

Panel A, of Table 1 provides information about the relative frequency and attributes of the different categories of trades by directors and their family members. The first five rows in Panel A provide the descriptive statistics for these categories of trades by corporate directors. The second five rows present the analogous results for trades by family members. The latter

sample includes 241 accounts of family members that can be matched to 106 of the 466 directors in our sample. Note that we use the same classification labels for the different groups of trades by both directors and family members, even though this classification scheme is based on the position of the director to which the family member is matched. The last row of Panel A summarizes the behavior of all remaining trading activity conducted by all other individual Finnish investors who are not identified as directors or their family members.

The first column of Panel A in Table 1 reports the total number of trading days across all stocks and accountholders for every group of trades, while the second column gives the percentage of total trading days in the sample due to every group. Insider trades by directors account for 0.02% of the total number of stock trading days across all individual accounts, while interlock trades comprise another 0.02%. Unconnected trades made by directors with high status make up 0.06% of all stock trading days, those by directors with moderate status comprise another 0.13%, and those by directors with no status make up 0.11% of all stock trading days. Family members make relatively fewer insider trades and more interlock trades, as well as more unconnected trades, especially when the related director has higher status.

Note that there are only 466 directors in our sample and 241 related family accounts, whereas there are roughly 0.5 million retail accounts in Finland that trade at least once during our sample period. The directors in our sample are about three times more active in the stock market than retail investors, with about 122 stock-trading days per director account versus 34 trades per retail account. In comparison, there are around 329 stock trading days per family member account, making them roughly ten times more active than the average retail investor.[12]

[12] These figures are obtained from the 17,111,000 stock trading days across the roughly 0.5 million retail accounts, the total of 57,243 stock trading days across the 466 director accounts, and the total of 79,378 stock trading days across the 241 family accounts.

The third column in Panel A shows the percent of trading days in which the accountholder was a net buyer, while the fourth and fifth columns present the average number of shares bought and sold, respectively. When directors trade as an insider, they tend to buy more frequently than they sell, but the average size of their sales is more than 5 times larger than the average size of their purchases.[13] For the other categories of trades by directors or family members, the percent of trading days for which the accountholder is a net buyer ranges from 54% to 57%, while it is 58% for all other retail investors. The average size of outside trades by directors is two to three times larger than similar trades by family members, and three to six times larger than trades by retail investors. For both directors and family members, the average trade size tends to be largest for insider trades and smallest for unconnected trades.

The sixth column in Panel A gives the percentage of all trades made by female accountholders within every trade category. The proportion of stock trading days by female *directors* ranges from 6% to 7% across the different trade categories. These numbers are low relative to the 17% of stock trading days that originate from female retail accountholders, which is probably due to a paucity of female directors. The proportion of all trades made in outside stocks by female *family members* is larger, ranging from 14% to 24%, whereas 47% of all family insider trades are by females. This latter result indicates that female family members of directors (e.g., wives and daughters) tend to concentrate their trading in insider stocks.

The seventh column in Panel A presents the mean age of the accountholders for each category of trades. The mean age for directors that are actively trading is slightly above 50 years, while the average age of all other retail investors is slightly below 50.[14] The trade category with

[13] The median size of sales for insiders is approximately 3 times larger than the median size of their purchases.
[14] The mean age for individual US accountholders is 51 years for women and 50 years for men (see Barber and Odean, 2001, Table 1), and the mean age for individual accountholders in Norway is 48 years (see Doskeland and Hvide, 2014, Table 1).

the lowest average age is for family members that trade inside stocks. This result suggests that the children of directors, or directors trading through the accounts of their children, tend to concentrate their trading in inside stocks.

The last column in Panel A presents the median value (in euros) of the stock portfolios for accountholders in every trade category, as of January 5, 2005. The median wealth of directors is more than ten times larger than that of retail investors. Likewise, the median account size of family members is substantially larger than that of other retail investors. Furthermore, family members who concentrate their trading in inside stocks tend to have more wealth. Finally, the median portfolio value of board members with moderate or high status is roughly twice as much as the median portfolio value of directors that are not in the network.[15]

II.C.2. Characteristics of the Stocks Sold and Bought for Each Type of Trade

Panels B and C of Table 1 report descriptive statistics for the attributes of the firms sold and bought, respectively, for each category of trades by directors.[16] This information is important to determine whether directors follow certain investment styles or focus on stocks with certain characteristics, which could lead to superior performance. Similar to Grinblatt, Keloharju, and Linnainma (2012), we report the mean adjusted decile ranks of the firm's beta (*BETA*), market-to-book ratio (*M/B*), and market capitalization (*Size*), as well as variables that capture the stock's return over the past year excluding the last month (*RYear*), the past month excluding the last week (*RMonth*), the past week excluding the last day (*RWeek*), and yesterday (*RDay*). These ranks are adjusted to range from -0.5 to 0.5, and serve to attenuate the influence of outliers. Appendix C further describes the construction of these variables.

[15] Note that the values in the eighth column of Panel A in Table 1 do not represent the median wealth *per account*, since each director's (or family member's) account may make no trades or multiple trades in different categories. As a result, accounts that make multiple trades (which likely have more wealth) count for more.
[16] Similar results are obtained for trades by family members of directors (not reported).

First consider the attributes of firms bought and sold in all categories of trades other than insider trades. Panels B and C reveal that directors trade outside stocks with relatively high betas, high market-to-book ratios, and large size. They also tend to be contrarian, selling after stocks have increased in value and buying after they have decreased. For each attribute, however, the difference in the mean scaled ranks between every category of director trades and all other retail trades (reported in the last row of each panel) is small in magnitude. For example, the maximum difference in the average ranks across these trade categories is only 0.07 (i.e., the difference in the mean rank for beta between retail sales and interlock sales in Panel B). This difference is relatively small, given that the change in scaled ranks between any pair of adjacent deciles is 0.1.

Next consider insider trades. As expected, the characteristics of the insider's own company are generally closer to the median firm. Similar to other retail investors, insiders tend to be contrarian when they trade their own company's stock. In general, Table 1 reveals no evidence to indicate that the average stock traded by directors is substantially different from the average stock traded by retail investors.

III. The Likelihood of Directors or Family Members Making Different Types of Trades

If network connections provide directors with a comparative information advantage about either inside or outside stocks, then we hypothesize that directors are more likely to trade stocks for which they have a stronger connection. Furthermore, if the information obtained through these network connections is valuable, then we expect these trades to generate positive abnormal returns.

An alternative view is that directors with interlock connections and directors with moderate or high status may place too much value on information obtained through the corporate network, or they may be overconfident in their own competence in interpreting such information.

Doskeland and Hvide (2011) analyze the investment performance of individual investors when they trade in professionally close stocks, defined as firms within the two-digit industry of their own employment. They find that individual investors overweight their holdings in such stocks, and experience mean abnormal returns that are either zero or negative. Their evidence points to overconfidence as an explanation for the tendency of individuals to trade such stocks, as well as the resulting underperformance.

We investigate these issues by analyzing the trading tendencies and performance of directors, with regard to stocks for which they have a connection through the corporate network. In this section we examine how the likelihood of directors and family members making trades depends on their connection to the traded stock and their position in the network of directors. In the next section we examine the abnormal returns generated from this trading activity.

III.A. Likelihood of Trading by Directors in Stocks They Are More or Less Connected To

We wish to examine how the level of a director's connection to a company affects the probability of trading the shares of that company during any given year. As a first approximation, we find that the probability of a director trading as an insider during any given year is 38 percent. This probability is calculated as the number of times a director trades as insider at least once during the year they are classified as insiders (1,404 times) divided by the total number of stock-year pairs for which a director is classified as insider and was active in the stock market (3,677 stock-years in our sample). The probability of trading an interlock stock is similarly computed as 8.1 percent (1,255 / 15,306), and the probability of trading an unconnected stock is 5.0 percent (=20,428 / 405,269).[17]

[17] This last number, 405,269, is approximately equal to the number of directors (466) times the annual average number of stocks in our database (100) times the number of years the average director is active in the stock market during our 14-year sample period (9).

In order to control for the attributes of a trade or an individual that might affect the probability of trading, we estimate the following panel logit model:

$$\begin{aligned}\text{Log}\{(\text{Trade}_{i,e,y} = 1)/(\text{Trade}_{i,e,y} = 0)\} &= a_0 + a_1\,\text{Insider}_{i,e,y} + a_2\,\text{Interlock}_{i,e,y} \\ &+ a_3\,\text{Unconnected\_High}_{e,y} + a_4\,\text{Unconnected\_Moderate}_{e,y} \\ &+ a_5\,\text{Same\_PostCode}_{i,e,y} + a_6\,\text{Industry}_{i,e,y} + a_7\,\text{Wealth}_{e,y} \\ &+ \text{Age Dummies} \\ &+ \text{Director Fixed Effects} + \text{Firm Fixed Effects} + \text{Year Fixed Effects}, \qquad (1)\end{aligned}$$

where $\text{Trade}_{i,e,y,}$ = 1 if stock *i* is traded by director *e* during year *y*, and 0 otherwise;

Insider = 1 for insider stocks, and 0 otherwise;

Interlock = 1 for interlock stocks, and 0 otherwise;

Unconnected_High = 1 for directors with high status;

Unconnected_Moderate = 1 for directors with moderate status;

Same_PostCode = 1 if the accountholder lives in same postcode as firm headquarters;

Industry = 1 if the stock is in the same industry as the director's firm(s);

and Wealth = percentile rank of director's account value as of June 30th in year y.

Note that the fifth category of unconnected trades made by directors with no status is the omitted group in equation (1). In addition, we include the following age dummies: Age30 = 1 if the director is younger than 31 years; Age3140 = 1 if the director is between 31 and 40; Age4150 = 1 if the director is between 41 and 50; Age5160 = 1 if the director is between 51 and 60; and Age61 = 1 if the director is older than 60 (the omitted age dummy). Inclusion of director, firm, and year fixed effects accounts for differences in the average probability of trading across different directors, stocks, and years, respectively.

Our prior expectations are that the coefficients, a_1 and a_2, in equation (1) should be positive. That is, we hypothesize that the probability of a director (*e*) trading a stock (*i*) during any year (*y*) should be greater if the director has an insider or interlock connection to that stock.

Based on previous research, we also expect positive coefficients for a_5, a_6 and a_7, to reflect a greater probability of a director trading a stock during any year if: (i) the postcode of the company's headquarters is the same as that of the director, (ii) the stock is in the same 2-digit SIC code as the industries for which the director has expertise (proxied by the 2-digit SIC code(s) of the firm(s) where the director is on the board(s)), or (iii) the accountholder has greater wealth.[18]

The relation between the director's status in the network and the probability of trading an unconnected stock is more complicated. We expect that moderate or high status within the corporate network may result in superior information about specific unconnected stocks. As a result, directors with higher status may engage in relatively high trading activity which is focused on only a few such unconnected stocks. This relatively high trading activity might result in positive coefficients, a_3 and a_4. On the other hand, if directors focus on just a few unconnected stocks means that they are less likely to trade any other unconnected stocks, which should lead to negative coefficients, a_3 and a_4.

Panel A of Table 2 provides the results of this panel logit regression analysis for all director trades. We find that a_1 and a_2 are significantly positive, supporting the hypothesis that directors are more likely to trade stocks for which they have an insider or interlock connection. In addition, we find that a_3 and a_4 are significantly negative, indicating that directors with high or moderate status in the corporate network are *less* likely to trade the typical unconnected stock. These results suggest that board members tend to focus on trading a small number of

[18] See Doskeland and Hvide (2011), Ivkovic and Weisbenner (2005), Grinblatt and Keloharju (2000), and Grinblatt, Keloharju, and Linnainma (2011).

unconnected stocks where they have a comparative information advantage, and are thus less likely to trade the typical unconnected stock. [19]

In addition, consistent with previous research, we find that directors are more likely to trade local stocks, and stocks where the director has industry experience. We also find that directors are more active in the stock market when they have more wealth, and when they are younger (below age 50 years).

III.B. Likelihood of Trading by Family Members

Panel B of Table 2 repeats the logit analysis for family trades.[20] We extend model (1) and also include age dummies for the family member and the percentile rank of family member's account value as of June 30th in each year (relative to the other 240 family account holders). We also include an additional same postcode dummy that equals 1 if the family accountholder lives in same postcode area as the firm's headquarters, and replace the director fixed effects by family member fixed effects.

The coefficients, a_1 and a_2, are significantly positive, indicating that family members are more likely to trade in stocks where the matching director is an insider or has an interlock connection. The coefficients, a_3 and a_4 are negative, indicating that family members are less likely to trade the typical unconnected stock if the related director has higher status in the network. The coefficient, a_5 is insignificant, indicating no tendency for family members to trade more or less in local stocks when local is defined based on the director's postcode. Family

[19] This interpretation is reinforced in unreported analysis where we analyse the decision to participate in the stock market depends on the director's status in the network. Using a model similar to (1), where the dependent variable equals 1 if the director trades at any time during the year and 0 otherwise, we find strong evidence that directors with a high status are more likely to participate in the stock market than directors with moderate status and that directors with moderate status are more likely to participate than directors with no status.

[20] DROP THIS FN ? As a rough approximation, we find that the probability of a family member trading a stock in any given year where the related director is classified as an insider is around 11 percent (calculated as 320 / 2,930). Similarly, the probability of a family member trading a stock where the related director has an interlock connection during a year is 8.4 percent (= 1,185 / 14,102). Both of these probabilities are high compared to the analogous probability of a family member trading an unconnected stock, which is only 4.1 percent (= 13,946 / 340,166).

members are less likely to trade if their related director has more wealth invested in the share market, but are more likely to trade stocks in which the related director might have industry expertise. Consistent with the results in Panel A, the family member's own wealth is positively correlated with the likelihood of trading a stock, and family members are more likely to trade stocks headquartered in their own postcode area. The age dummies suggest that the likelihood of trading decreases with the age of the related director, and is relatively low when family members are in their forties.

To summarize, the results in Table 2 are consistent with the idea that directors actively seek to benefit from their comparative information advantage: they are more likely to trade stocks for are an insider; they are more likely to trade stocks for which they have an interlocking director connection; and they concentrate their trading on fewer unconnected stocks if they have higher status in the director network. In addition, consistent with the notion that relevant stock market information is shared within the family network, we find that the trading activity of family members also reflects the relative information advantage of the corporate director they are related to.

IV. Performance of Trading Activity by Directors

In this section we examine how a director's connection to a traded stock is associated with the director's stock performance. We analyze this performance in two ways: an event study approach, and a calendar time-series regression approach.

IV.A. Event Study Approach: When Director is More or Less Connected to the Stock Traded

In the event study approach, we consider every trade by a given director as a separate event, and we analyze size-adjusted cumulative abnormal returns over the subsequent 1 week, 2 weeks, 1 month, 3 months, 6 months and 1 year periods. The size-adjusted abnormal return for

any given stock is the actual return minus the equally-weighted return across all Finnish firms in the same size-quintile (but excluding the stock in question).

We separately examine purchases and sales by each director. We further partition all director trades into the five categories depending on the connection level. For each group of trades, we first compute the mean CAR for every director, and then calculate the average of these mean CARs across all directors.

IV.A.1. Director Trades in Insider, Interlock, and Unconnected Stocks

Table 3 presents the results for insider trades, interlock trades, and unconnected trades. The t-statistics in Table 3 are based on the standard deviation of the mean CARs averaged across all directors, for each trade category. Table 3 also presents the median CARs and the number of different directors that have at least one trade, for each trade category.

First consider the results for insider trades by directors, in Panel A of Table 3. There are 214 different director accounts that make insider sales in our sample, while 349 director accounts have at least 1 insider purchase.[21] For insider sales, for all horizons, the mean CAR is close to 0 and never statistically significant. In contrast, the mean CAR following insider purchases is positive and significant over longer horizons, accumulating to 0.8% (t-ratio = 2.5) after one month, and 6.9% (t-ratio = 4.8) after one year. This evidence is similar to prior research on insider trading.[22]

Second consider the performance of interlock trades by directors, in Panel B of Table 3. From the total of 466 director accounts, 194 accounts sell interlock stocks at least once during our sample period, while 205 accounts buy interlock stocks. After selling interlock stocks, the

[21] For this analysis we exclude trades where several board members buy shares on the same day, since these transactions are likely to be part of a managerial compensation plan, and are thus unlikely to be motivated by superior information. Inclusion of these trades does not materially alter the results.

[22] For example, see Lorie and Niederhoffer (1968), Jaffe (1974), Seyhun (1986, 1998), Rozeff and Zaman (1988), and Lakonishok and Lee (2001).

mean CAR accumulates to -1.7% (t-ratio = -1.4) after six months, before diminishing in magnitude and significance over the next six months. The performance is much stronger and more robust after buying interlock stocks, with a mean CAR of 3.0% (t-ratio = 3.4) after three months, growing to 4.8% (t-ratio = 2.9) after one year.

The performance of all trades by directors in unconnected stocks is reported in Panel C of Table 3. There are 418 director accounts with unconnected sales, while 405 directors make unconnected purchases. Directors do not display significant stock-picking skills when they sell stocks for which they have no connection through the corporate network. However, when they buy unconnected stocks, these directors again perform significantly better than the portfolio of benchmark stocks in the same size-quintile. After one month, the mean CAR is 0.6% (t-ratio = 3.0), and after 3 months this mean CAR grows to 1.1% (t-ratio = 3.1). However, when the event window is increased to one year, the CAR declines and is no longer significant.

IV.A.2. Director Trades in Interlock Stocks versus Unconnected Stocks

In this subsection we examine whether directors' trades in interlock stocks outperform their own trades in unconnected stocks. We first isolate the subset of director accounts that make both interlock trades and unconnected trades of the same sign (i.e., purchases or sales). There are 188 director accounts with both interlock and unconnected sales, while 200 accounts have both interlock and unconnected purchases. We then estimate the following regression model that analyzes variation in the average CAR per director, across the two kinds of purchases or sales made by each director, including fixed effects for all directors:

$$CAR_{e,i} = \alpha_0 + \alpha_1 \text{ Interlock}_e + \text{ Director Fixed Effects}_e + \varepsilon_{e,i}, \qquad (2)$$

where $\text{Interlock}_e = 1$ if $CAR_{e,i}$ is based on interlock trades by director *e*, and 0 otherwise.

The intercept (α_0) in this regression represents the mean CAR following unconnected trades, averaged across all directors. The coefficient, α_1, indicates the difference in the mean CAR per director between their interlock trades versus their own unconnected trades. This model is estimated separately for the samples of director sales and purchases, respectively, and for the different windows.

The results are presented in Panel D of Table 3. First consider the difference in mean CARs across interlock sales versus unconnected sales, on the left side of Panel D. The coefficient, α_1, is negative for all horizons up to six months, and significantly different from zero at -1.7% (t-ratio = -1.9) after three months. Over longer windows the coefficient (α_1) becomes less significant, and even becomes positive, at 1.4% (t-ratio = 0.7) after one year.

For purchases, on the right side of Panel D, the differential performance (α_1) is positive for all windows, and it grows monotonically in magnitude and significance for longer windows. This evidence indicates that interlock purchases tend outperform unconnected purchases, especially for longer windows. After one year, the mean outperformance of interlock purchases is 5.5% (t-ratio = 2.9).[23]

Overall, the results in Panel D show that individual directors tend to make better decisions when they buy stocks for which they have an interlock connection, relative to stocks with no connection.

IV.B. Event Study Approach: When Director has Higher or Lower Status

In this section we further examine the performance of all trades by directors in unconnected stocks, partitioned into those made by directors with high, moderate, or no status.

[23] Note that the difference of mean CARs (α_1) in Panel D is not identical to the difference across the mean CARs provided in Panel B versus Panel C, because the analysis in Panel D is limited to the subset of directors who make trades of the same sign in *both* interlock stocks and unconnected stocks. A t-test of the difference in the mean CAR for the 205 accounts in Panel B and the 405 director accounts in Panel C shows the CAR after interlock purchases is significantly different at the 5% level or better for the 3 months, 6 months and 1 year windows.

The results are presented in Panels A - C of Table 4, respectively. Similar to the analysis in Table 3, we first compute the mean CAR for every director in each subgroup, and then calculate the average of these mean CARs across all directors in the subgroup.

On the left side of Panel A in Table 4, there is no indication that sales in unconnected stocks are followed by lower CARs for the subset of directors with high status. The right side of Panel A, however, indicates that purchases by directors with high status tend to be followed by higher mean CARs, which accumulate to 4.6% (t-ratio = 3.3) after one year.

Panels B and C again show no evidence of significant outperformance for sales in unconnected stocks, made by directors with moderate or no status in the corporate network. On the buy side, however, these two groups of directors display outperformance for windows up to three months. For example, in Panel B the mean CAR is 1.2% (t-ratio = 2.6) after three months, for directors with moderate status, while Panel C reveals a mean CAR of 1.0% (t-ratio = 1.9) over the same time frame, for directors with no status. When the window is extended beyond three months, this outperformance diminishes in size and significance.

Next, we analyze how the variation in the mean CAR for unconnected trades depends on the status of the director, by estimating the following panel regression model with fixed effects for all directors:

$$CAR_{e,i} = \alpha_0 + \alpha_1 \text{ Unconnected\_ Moderate}_e + \alpha_2 \text{ Unconnected\_ High}_e + \text{ Director Fixed Effects}_e + \varepsilon_{e,i}, \quad (3)$$

where Unconnected_Moderate = 1 if $CAR_{e,i}$ is based on unconnected trades by directors with moderate status.

Unconnected_High = 1 if $CAR_{e,i}$ is based on unconnected trades by directors with high status;

Note that the omitted group captured by the intercept in equation (3) is the set of unconnected trades made by directors with no status (i.e., while they were not part of the corporate director network). Thus, the coefficient, α_1 (or α_2), indicates the difference in the mean CAR following unconnected trades made by directors when they had moderate (or high) status versus the mean CAR following their unconnected trades when they were not part of the director network.

Results are presented in Panel D of Table 4. As before, this model is estimated separately for the samples of director sales and purchases in unconnected stocks. On the left side of Panel D, the coefficient estimates (α_1 and α_2) are small in magnitude and insignificant. Thus, there is no significant difference in the mean CARs subsequent to sales made by directors when they had high or moderate status relative to when they had no status. In contrast, the right side of Panel D reveals significant differences (α_2) in the mean performance following purchases by directors when they had high status. For example, after six months the mean CAR for purchases made by directors with high status is 3.1% (t-ratio = 2.2) higher than the mean CAR for purchases made by directors when they had no status, and this difference grows to 4.9% (t-ratio = 2.2) after one year.

IV.C. Calendar Time Portfolio Approach: Analysis of Director Trades

In this section we analyze the relative investment skills of directors across the five categories of trades, using a calendar time portfolio approach. The calendar time portfolios are designed to mimic the trading behavior of the different groups of director trades. For example, a stock is included in the '1-quarter calendar time buy portfolio for insider trades' if, over the previous quarter, the number of insiders who were net purchasers of this stock exceeds the number of insiders who were net sellers of the stock.

Specifically, our portfolio construction proceeds as follows. First, for each trading day (*t*) in the sample period, we identify all director accounts (*e*) that trade in any given stock (*i*) during the preceding twelve months, covering calendar days, *t-90 to t-1*. Second, for each director account (*e*), we aggregate the trading activity across all trades in the stock (*i*) during this period, to determine whether the account was a net buyer or net seller of the stock. Third, we partition all director trades into the five categories, as: i) insider trades; ii) interlock trades, and unconnected trades by directors with (iii) high status, iv) moderate status, and v) no status. Fourth, for every trade category, on each day (*t*) we allocate a given stock (*i*) into the 'director buy portfolio' if more directors are net purchasers than net sellers of that stock, or into the 'director sell portfolio' if more directors are net sellers. Finally, we calculate the equally weighted portfolio return on day *t* ($R_{p,t}$) for each of the ten director portfolios (*p* = 1-10, representing a buy portfolio and a sell portfolio for each category of director trades).

We analyze the return performance of these ten portfolios (*p*), using the Fama-French 3-factor model.[24] The dependent variable is the excess return on day t for each portfolio, *p*:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_1 (R_{m,t} - R_{f,t}) + \beta_2 HML_t + \beta_3 SMB_t + \varepsilon_{p,t}. \quad (4)$$

The regression results are provided in Panels A and B of Table 5, for the five sell portfolios and the five buy portfolios, respectively. These results are based on a 1 quarter portfolio formation period. Table 5, Panels C and D provide results for different portfolio formation periods.

Table 5, Panel A reveals no outperformance for the director sell portfolios based on these five trade categories, since no alphas are significantly negative. In contrast, the director buy portfolios in Panel B have positive alphas for all five types of trades, which are larger in magnitude and significance for the first three trade categories. In particular, the daily alpha for

[24] Using daily data for all Finnish stocks, we follow the procedures in Fama and French (1993) to calculate their three factors.

the director buy portfolio of insider trades is 5.3 basis points (bp) per day (t-ratio = 2.7). This performance corresponds to 13.3% per annum. Likewise, the alpha is 5.9 bp per day (14.8% p.a.) and 5.4 bp (13.5% p.a.) for interlock trades and unconnected trades by directors with high status (t-ratios = 2.6 and 4.1), respectively. For the buy portfolios for unconnected stocks by directors with moderate status or no status, we also find positive and significant alphas of 2.6 and 2.2 bp per day.

We further examine the relative performance across these director portfolios, to investigate whether a director's network connections provide valuable information. First, we form a daily hedge portfolio that is long the director sell (buy) portfolio of interlock stocks and short the sell (buy) portfolio of unconnected stocks by directors with no status. The daily alphas for this zero-cost hedge portfolio are presented near the bottom of Panels A and B, for the director sell hedge portfolios and the director buy hedge portfolios, respectively. On the sell side in Panel A, the alpha for the hedge portfolio is positive at 0.6 bp per day (t = 0.3), indicating that directors do not perform substantially better when they sell interlock stocks, relative to their sales of unconnected stocks while they are not a member of the corporate network. On the buy side in Panel B, the alpha for this hedge portfolio is 3.6 bp per day (t = 1.9), indicating that directors tend to outperform when they buy interlock stocks relative to their purchases of unconnected stocks while they are not a board member.

We perform a similar analysis by generating a second daily hedge portfolio that is long the portfolio of unconnected stocks traded by directors with high status, and again short the portfolio of unconnected stocks traded by directors with no status. Panel A indicates that, when directors sell unconnected stocks, those with high status do not substantially outperform those with no status, since the alpha is only -0.1 bp per day (t-ratio = -0.4). On the buy side, Panel B

indicates significant outperformance by directors with high status, by 3.3 bp per day (t-ratio = 2.6).

In Panels C and D of Table 5 we present the analogous one-day alphas for the director sell portfolios and buy portfolios, respectively, using several different portfolio formation periods that range from 7 calendar days to 365 calendar days. In Panel C there are no significant negative alphas for any of the sell portfolios, regardless of the portfolio formation period. However, Panel D reveals that the portfolios of interlock trades and unconnected trades by directors with high status consistently have the greatest degree of outperformance, with significant alphas that range from 4.1 bp per day (t-ratio = 3.8) to 11.7 bp per day (t-ratio = 2.4). In contrast, the alpha for the insider buy portfolio is not significant for shorter term windows up to 30 calendar days, although this one-day alpha is significant for longer windows, ranging from 2.4 bp per day (t-ratio = 1.7) to 5.3 bp per day (t-ratio = 2.6). Finally, portfolios based on purchases by directors with moderate or no status tend to have significant positive alphas, but they are smaller than the analogous one-day alphas for portfolios based on interlock purchases and purchases by directors with high status.

Overall, the results in Table 5 confirm our earlier conclusion that directors display significant stock picking skills on the buy side. These skills are particularly evident when directors trade stocks with which they have an interlock connection, and for directors with a prominent position within the network of directors.

V. Performance of Trading Activity by the Family Members of Directors

In this section we conduct similar analyses to examine the performance following trades by family members of the directors in our sample.

V.A. Event Study Approach: Family Trades When Director Is More or Less Connected

For each category of family trades, we first compute the mean CARs across all family accounts associated with every director, since several family members related to the same director may engage in identical trades. We then average these mean family CARs across the directors that have matched family members. The results are provided in Table 6.

V.A.1. Family Trades in Insider, Interlock, and Unconnected Stocks

The performance of family trades in inside stocks is documented in Panel A of Table 6. We identify 43 (45) director accounts for which one or more family member accounts sell (buy) a stock at least once where the related director is an insider.[25] These family accounts perform exceptionally well when they make inside trades. On the sell side, the mean CARs for inside family trades are consistently negative over the different windows, accumulating to -5.1% (t-ratio = -1.9) after six months. On the buy side, the mean CARs for inside family trades are significantly positive and even larger in magnitude, accumulating to 10.0% after six months (t-ratio = 2.8), and 14.0% after twelve months (t-ratio = 2.5).

Next consider the performance of interlock family trades, in Panel B of Table 6. For interlock sales, the mean CARs are mostly positive and large but insignificant. In contrast, the mean CARs following interlock family purchases are positive with magnitudes and significance that grows monotonically over longer windows. These mean CARs accumulate to 5.9% after three months (t-ratio = 3.7), and 12.6% after twelve months (t-ratio = 3.8).

Finally, consider the performance of unconnected family trades in Panel C. Once again, for unconnected family sales there is little evidence of significant stock picking skills by family members. On the other hand, family members significantly outperform on the buy side over the

[25] Underage children and spouses of insiders are required to report their trading in the related insider's own company, whereas other family members are not required to report these inside trades. Therefore, we further split all inside family trades into trades by family members who must report, and trades by all other family members. In analysis not reported here, we find that reporting family members tend to outperform other family members on both the buy side and the sell side, but this outperformance is never significant.

next month, with a mean CAR of 1.0% after one month (t-ratio = 2.5). For the three, six and twelve month holding periods, however, the mean CAR is insignificant.

The performance of all unconnected trades by family members, in Panel C of Table 6, is similar in magnitude and significance to that by the directors themselves, in Panel C of Table 3.

V.A.2. Family Trades in Interlock versus Unconnected Stocks

In this section we examine the benefits of access to the corporate network, by testing whether the interlock trades of family members outperform their own trades in unconnected stocks. As before, we first isolate the subset of director accounts for which family members make both interlock trades and unconnected trades of the same sign (i.e., purchases or sales). There are 50 director accounts with family members that make both interlock sales and unconnected sales, while 56 accounts have both interlock purchases and unconnected purchases by family members. We then re-estimate the panel regression model specified in equation (2) above, and reproduced here:

$$CAR_{e,i} = \alpha_0 + \alpha_1 \text{ Interlock}_e + \text{ Director Fixed Effects}_e + \varepsilon_{e,i}, \qquad (2)$$

where $\text{Interlock}_e = 1$ if $CAR_{e,i}$ is based on family interlock trades matched to director *e*, and zero otherwise.

This model analyzes the difference in the mean CARs across family members associated with this sample of directors, for the two kinds of trades made by these family members, including fixed effects for all directors. The omitted group is the set of family trades in unconnected stocks. Thus, the coefficient, α_1, indicates the difference in the mean CARs across family trades in interlock stocks versus their own trades in unconnected stocks.

The results appear in Panel D of Table 6. The evidence for sales on the left hand sde of panel D, indicates that interlock family sales do not outperform unconnected family sales.

However, for windows of one month and longer, interlock family purchases significantly outperform unconnected family purchases, and the outperformance grows in size and significance for longer windows. After three months, the difference in mean CARs is 5.0% (t-ratio = 2.8); after six months, 8.8% (t-ratio = 3.1), and after one year, 14.5% (t-ratio = 4.0). This evidence indicates that the benefits of access to the corporate network extend to the family members of directors, on the buy side.

In unreported analysis we split the samples of unconnected family sales and purchases into trades where the matched directors have: i) high status, ii) moderate status and iii) no status. The average CARs for the 3 groups are similar and the differences across these groups are never significant. A possible reason for the stronger similarity in outperformance between directors and their family members subsequent to purchases of insider stocks and interlock stocks is that stock purchases by family members from the much larger group of unconnected stocks are less likely to be based on information obtained from the family network.

V.B. Calendar Time Portfolio Approach: Family Trades

In this section we analyze the relative investment skills of family members across the five categories of trades, using the calendar time portfolio approach. In this case, we generate daily time series that identify the composition of ten family portfolios (a buy portfolio and a sell portfolio for each category of family trades). As before, we consider several portfolio formation periods that range from the previous 7 calendar days to the prior 365 calendar days. For each portfolio formation period, we then analyze the return performance of the resulting ten portfolios (*p*), using the Fama-French 3-factor model. The dependent variable is the excess return on day t for each family portfolio, ($R_{p,t}$ - $R_{f,t}$).

The one-day alphas from the Fama French regressions for the different portfolio formation windows are provided in Panels A and B of Table 7, for the five family sell portfolios and the five family buy portfolios, respectively. In Panel A, the one-day alpha is significantly negative for family sales in inside stocks for the portfolio formation window of one month. The daily alpha of -15.1 bp (t-ratio is -2.8) corresponds to a very high annualized return of -37.8%. However, for all other formation periods, the daily alphas are not significant. Similarly, for the interlocking sales portfolio and the portfolios of unconnected sales, the daily alphas are never significant.

Panel B of Table 7 reveals one-day alphas that are positive and significant for several portfolios based on family purchases in all five trade categories. For example, for family purchases of inside stocks, the daily alpha is large and significantly positive when we use portfolio formation periods of one month or three months. Portfolios based on family purchases of interlock stocks generate daily alphas that are large and significant for all formation periods. Likewise, family purchases of unconnected stocks when the related director has high or moderate status in the network generate consistently positive and significant one-day alphas, although these results are somewhat smaller than the analogous alphas for interlock stocks.

In further tests, we form a daily hedge portfolio that is long the director sell (buy) portfolio of interlock stocks and short the sell (buy) portfolio of unconnected stocks by directors with no status. The estimated daily alphas of this hedge portfolio are significantly positive for portfolio-formation periods of 3, 6 and 12 months.[26]

[26] The alpha of a hedge portfolio that is short family interlock sales and long family unconnected sales by directors with no status is never significant. We also generate a daily family hedge portfolio that is long the portfolio of unconnected stocks traded by the family members of directors with high status, and short the portfolio of unconnected stocks traded by the family members of directors with no status. These alphas are mostly insignificantly different from zero on both the sell side and the buy side.

Overall, Tables 6 and 7 provide evidence that the benefits of access to information in the corporate network spill over to directors' family members. These results indicate strong support for the value of family network connections, as well as the value of access to the corporate network.

VI. Performance of Trades by Directors Around Major Information Events

This section uses an event study approach to focus on trades made during the 3 weeks prior to takeover and earnings announcements. In addition, we examine trades before large price changes, which presumably reflect the arrival of substantive value-relevant information. We focus on the mean size-adjusted cumulative abnormal return on the day of and the day after each type of event (*CAR(0,+1)*).

Our sample of earnings announcements is obtained from Bloomberg and consists of 5,479 quarterly announcements made by Finnish firms over the period, 1999 - 2011. Data on mergers and acquisitions are obtained from SDC Platinum, and include 213 merger announcements for our sample of Finnish firms. Our third sample includes large price changes, which we generate by selecting the two days each year with the largest and smallest market-adjusted abnormal returns for every stock. We exclude all such major price change events if they occur within five days of an earnings or acquisition announcement, or if they occur within one month of another large price change event for the same stock. This sample includes 3,677 large price events.

For each event, we compute the stock's size-adjusted cumulative abnormal return on the event day and the next day, *CAR(0,+1)*. We then "sign" this *CAR* for each stock for every accountholder, depending on whether that account was a net buyer or seller in the first (or second or third) week before the event. If an account was a net purchaser (i.e., shares bought exceed

shares sold during the week), then the event period return for that account equals the stock's *CAR(0,+1)*. Alternatively, if an account was a net seller (i.e., shares sold exceed shares bought), then the event period return for that account equals the stock's *CAR(0,+1)* multiplied by -1.

For each event, and for every category of trades, we calculate the mean signed *CAR(0,+1)* across all director accounts that were net buyers or sellers of the stock during week -1, -2, or -3. We then average these mean signed *CARs* across all events. The standard error of this mean signed *CAR* across all events is used to construct a t-test of the null hypothesis that the mean *CAR(0,+1)* is zero.

The results are presented in Table 8. The analysis of earnings announcements appears in Panel A, merger and acquisition announcements are in Panel B, and large price changes are in Panel C. Every Panel provides three sets of results, for the director trades made during each of the 3 weeks before the event date. Each set of results presents the analysis for the three types of trades in insider, interlock, and all unconnected stocks.

First consider the analysis of earnings announcements in Panel A of Table 8. The only results that are marginally significant for this event are for insider trades one week and three weeks before the earnings announcement. For the 24 earnings announcements where at least one director traded as an insider during the prior week, the average signed CAR(0,+1) is 2.0% (t-ratio = 1.7), and for the 70 earnings announcements where at least one director traded as an insider in the third week before earnings announcements, the average signed CAR(0,+1) is 1.1% (t-ratio = 1.9). The remainder of Panel A reveals mean signed CARs that are small in magnitude and not significant at the .10 level.

Second, the results for merger and acquisitions in Panel B of Table 8 do not provide convincing evidence that directors exploit private information about upcoming merger or

acquisition announcements. While the mean signed CAR is large in magnitude for insider trades made during each of the three weeks before a takeover announcement, this statistic is based on only a small number of observations in each case, and thus cannot be relied upon to make reasonable inferences.

Finally, Panel C of Table 8 presents the analysis of large price change events. The only significant result in this Panel applies to directors who trade unconnected stocks during the first week before a large price change. There are 671 such events where at least one director trades an unconnected stock during the week before a large price change, and the average signed CAR across these events is 0.8% (t-ratio = 1.7).

Together, this analysis provides only weak evidence that directors tend to outperform when they trade just before major information events. The resulting CARs are typically small and insignificant.[27] This result, combined with the evidence from earlier sections that the exceptional performance of directors extends over horizons up to one year, suggests that directors' outperformance is primarily due to network connections that provide access to valuation information that is longer term in nature, rather than to private information that is about to become public in the next one to three weeks.

VIII. Conclusions

We find that directors and their family members enjoy superior performance when they trade in either the inside stock of the director's own company, or in outside stocks where the director has an interlocking board connection. We also find a similar, although smaller, degree of outperformance for director trades made in other outside stocks with no such connection through the corporate board network. For directors this performance in unconnected stocks tends to be

[27] We have also analyzed trades by family members during the three weeks before earnings announcements, takeovers, and large price changes. The only marginally significant outperformance found is for family members trading unconnected stocks during the week before earnings announcements (CAR = 2.7%, t-ratio = 1.6).

greater when the director has higher status within the network of corporate board members. These results are especially evident on the buy side, and over longer horizons that extend up to one year following the trades. This evidence establishes that one source of the trading profits of corporate insiders is access to valuable information through the network of corporate boards.

We also demonstrate the value of family networks. We show that the family members of insiders display exceptional trading performance that is similar to that of their related director, when they buy inside stocks. In addition, when family members trade interlocking stocks, they perform even better than the related director. This evidence helps to establish that family connections should be added to the list of social networks that function as a conduit of information flow.

We also analyze the performance of trades made by directors in the few weeks before major information events, and find little evidence of significant profits based on these trades. Together, this analysis indicates that the superior performance of directors and their family members over longer horizons is due to access to valuable information about the longer term prospects of the firms traded, rather than to private information that is about to become public.

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Appendix A. Institutional Features of Insider Trading in Finland

A.1. Insider Trading Regulation in Finland

The first regulation of insider trading in Finland was introduced in the 1989 Securities Market Act (SMA). It was designed to deter corporate insiders, security issuers and other parties from using insider information they might possess. According to the SMA, inside information refers any "information of a precise nature relating to a security subject to public trading or to multilateral trading which has not been made public or which otherwise has not been available in the markets and which is likely to have a material effect on the value of the security."

The sanctions against the abuse of insider information in Finland are regulated in the SMA and the Penal Code. According to the Penal Code, abuse of inside information is prohibited and possible sanctions vary from a fine to an imprisonment of four years. The sanctions in the SMA are lower than those in the Penal Code, but according to the SMA not only intentional but also unintentional use of insider information is prohibited.

In addition to the formal laws against insider trading, insiders are restricted in their trading by the: "Guidelines for Insiders," published by Nasdaq OMX Helsinki, and the "Guidelines for Insiders," issued by the Finnish Association of Securities Dealers (FASD). In addition, most publicly listed companies in Finland have adopted internal guidelines regarding insider trading, which are often more strict than the guidelines of Nasdaq OMX Helsinki and the FASD.

A.2. Insiders of Finnish Listed Companies

According to the SMA, the ownership of publicly traded securities in Finnish listed companies and information concerning trade executions must be made public if the owner is:

1) a member or deputy member of the board of directors or supervisory board of the company, managing director or deputy managing director, or deputy director, or an employee of an audit organization with main responsibility for the audit of the accounts of the company;

2) any other person belonging to the senior management of the company, who regularly obtains inside information and who has the right to make decisions on the future development and the arrangement of business operations of the company;

3) the spouse of a person referred in paragraphs 1 and 2 above, or a minor whose guardian is the person referred to in paragraph 1 or 2, or another family member of the person referred to in paragraph 1 or 2 who has lived for at least one year in the same household with the person subject to the duty to declare;

4) an organization or foundation in which a person referred to in the paragraphs above, either alone or together with the members of his family, or with another person referred to in the above paragraphs, exercises control directly or indirectly.

A.3. Registration of Trades

According to the SMA (Chapter 5, Section 7), the issuers of securities that are traded on a Finnish stock exchange must maintain a public insider register that presents the holdings and trades of persons subject to the disclosure requirements. These companies may choose where to keep the public register, but this site must be approved by the Financial Supervisory Authority, be open for public inspection, and be kept in its entirety at a single place (FIN-FSA Standard 5.3). Most firms employ Euroclear Finland to keep their register. Euroclear publishes these registers through its EFI SIRE system.[28] The SIRE system is directly linked to a book entry

[28] Before 2008, Euroclear Finland Ltd. was known as the Finnish Central Securities Depository. The Finnish companies that currently do not subscribe to the EFI SIRE system include: Interavanti Oyj, Pohjois-Karjalan Kirjapaino Oyj, Julius Tallberg-Kiinteistöt Oyj, Outokumpu Oyj, QPR Software Oyj, SSK Suomen Säästäjien

system, so that changes in insider holdings are updated automatically without any delay. In general, trades are available to the public between four and seven days after the transaction.[29]

The public register of insider holdings includes personal information (including name) about the insider subject to the disclosure requirement, and information on their holdings of the issuer's securities, as well as all transactions in these securities. Similar information (excluding names) is disclosed for selected other people and organizations related to these company insiders, as discussed above. According to FSA Standard 5.3, the public information about insider trades must be available to the public for at least 5 years after the trade has taken place.

Since July 2006, all Finnish listed companies are also obligated to publish their insider registers on the internet (see SMA 5:7 (13.5.2005/297)). However, these trades must be available online for only 12 months. These online registers contain the same information as the public register, and they are available on companies' own web site or on Euroclear's NetSire webpage.

A.4. Supervision of Insider Trading: The Roles of the FSA, Exchange, and the Company

In Finland the supervision of insider trading is executed by three different parties: the Financial Supervisory Authority (FSA), the Nasdaq OMX Helsinki Stock Exchange and the listed companies themselves. The FSA is responsible for regulating and monitoring the Finnish financial and insurance sector, as well as the parties operating in this sector. The FSA seeks to prevent the abuse of insider information, first by regulation, and then by ex-post monitoring and supervision of insider trading activities.

Kiinteistöt Oyj, Tekla Oyj, Telia Sonera Oyj and Vaahto Group Plc Oyj. If a company does not use the SIRE system, the location of its public register is typically its head office.

[29] The most common 4-day delay includes the trade date and the three-day settlement period, since most insider trades are entered into the book-entry system on the next trading day after the trade has settled. Under the rules of Nasdaq OMX Helsinki, it is also possible to publish trades within the three days following a trade. In all cases, changes in ownership by insiders must be made public within seven days following the trade.

Similar to most other national markets, the supervision of insider trading in Finland focuses on suspected cases of abuse of inside information. Information about potential market abuse is obtained from the automated monitoring system or from other market participants.[30]

The Nasdaq OMX Helsinki Stock Exchange also has its own Insider Guidelines for monitoring insider trading in its listed companies. These guidelines set minimum requirements for the insider trading restrictions in listed companies. According to the guidelines, permanent insiders shall schedule their trading of securities issued by the company so that their trading will not undermine the public confidence in the securities market. It is recommended that insiders should only trade when the market has all the relevant information about the company, e.g. after the publication of interim reports. Insiders are also subject to binding trading restrictions with regard to their own companies stock, during the period from at least 14 days prior to an interim report until publication of such a report. The company itself also has the discretion to define a longer window for such trading by its insiders (see Guidelines for Insiders, Section 6).

Appendix B. Identification of Insiders

We identify directors in the Euroclear database by first collecting data on "public insider" trades in shares of companies listed on the Nasdaq Omx Helsinki over the period, July 2005 through February 2010. The data were hand collected from the EFI Sire register, which is available at the customer service point of Euroclear Finland's head office in Helsinki. The EFI Sire register reports insider holdings and transaction data for almost all listed Finnish companies, and, at any point in time has historical data for the past 5 years. The insider register is directly linked to the Euroclear book entry system. The Euroclear database should thus include all transactions made by insiders.

[30] Other market participants could be, for example, a stock broker, a corporate lawyer, or other employee, who are responsible for reporting all suspicious activity to the FSA.

The collected data include the insider's name and position in the company, the transaction date and settlement date, and the number of shares bought or sold. These data also specify whether the trade is done by the insider, or by a company where the insider exercises controlling power, or by the insider's spouse or underaged children. Multiple trades made by an insider on the same day are netted. For example, if an insider buys 1000 shares and sells 2000 shares on the same day, this day's activity is recorded as a single sale of 1000 shares.

The database makes a distinction between several types of changes in ownership: e*xchange transaction or other transaction, account transfer,* and *other*. We include only the entries marked as *exchange transaction or other transaction*, since these trades reflect on-market trades that are instigated by the insider, which can be matched with trades from the Euroclear database. In contrast, an *account transfer* is not a trade and the *other* category includes transfers resulting from gifts or inheritance, and therefore includes transfers that are not instigated by the insider. The register also distinguishes between different types of assets, and includes stock and derivative instruments. We only include trades in common and preferred stocks, because these trades can be matched with trades from the Euroclear database.

We restrict our selection of insider trades to those made by members of the Board of Directors and by the managing directors for all Finnish listed companies. For these insiders, we have detailed records from the Virre database of the National Board of Patents and Registration of Finland. These data include the name, birth date, beginning date, and ending date for each person's tenure as director. After applying this restriction, we have a total of 2,616 trades made by 510 different insiders. For each trade, we have the date, the stock name, and the net number of shares traded.[31] In addition, we know the identity of the insider and the insider's year of birth.

[31] Several companies have more than one class of stock listed on the OMX Helsinki exchange (each class with a unique stock identifier, ISIN). In these cases, we search each of the stock classes for the matching transaction.

We match insider trades from the public register to similar trades made by an account from the Euroclear database, based on the stock, the trade date, and the net number of shares traded. We also have the year of birth for each accountholder in the Euroclear database, which enables an additional screen to match trades made by insiders.

We are able to match 2,337 (89%) of the total of 2,616 insider transactions in our dataset, based on net daily volume, trade date, stock code, and year of birth of the accountholder.[32] These trades originate from 475 different insider accounts. We drop 9 of these matched insider accounts for which the proportion of matched trades is less than 50%. This final screen results in 466 unique insider accountholders that held a position as board member or managing director in a company listed on the Finnish stock exchange sometime during the period, 2005 - 2010.

For each of these indisers, and for every year in the sample, we know from the Virre database: (i) whether the accountholder was classified as member of the board of directors for a given company, (ii) the companies for which the insider had interlocking directorships, and (iii) the insider's position in the network of directors, based on the social network measures discussed in section 2.

[32] Our inability to match 10% of the trades could be due to data entry errors on our side (e.g. spelling of name, volume data, or dates). In addition, some insider trades appear to have an irregular settlement period of 1 or 2 trading days, rather than the typical 3-day settlement period.

Figure 1. Classification Schemes based on Connection of Director to Stock and Status of Director in Network

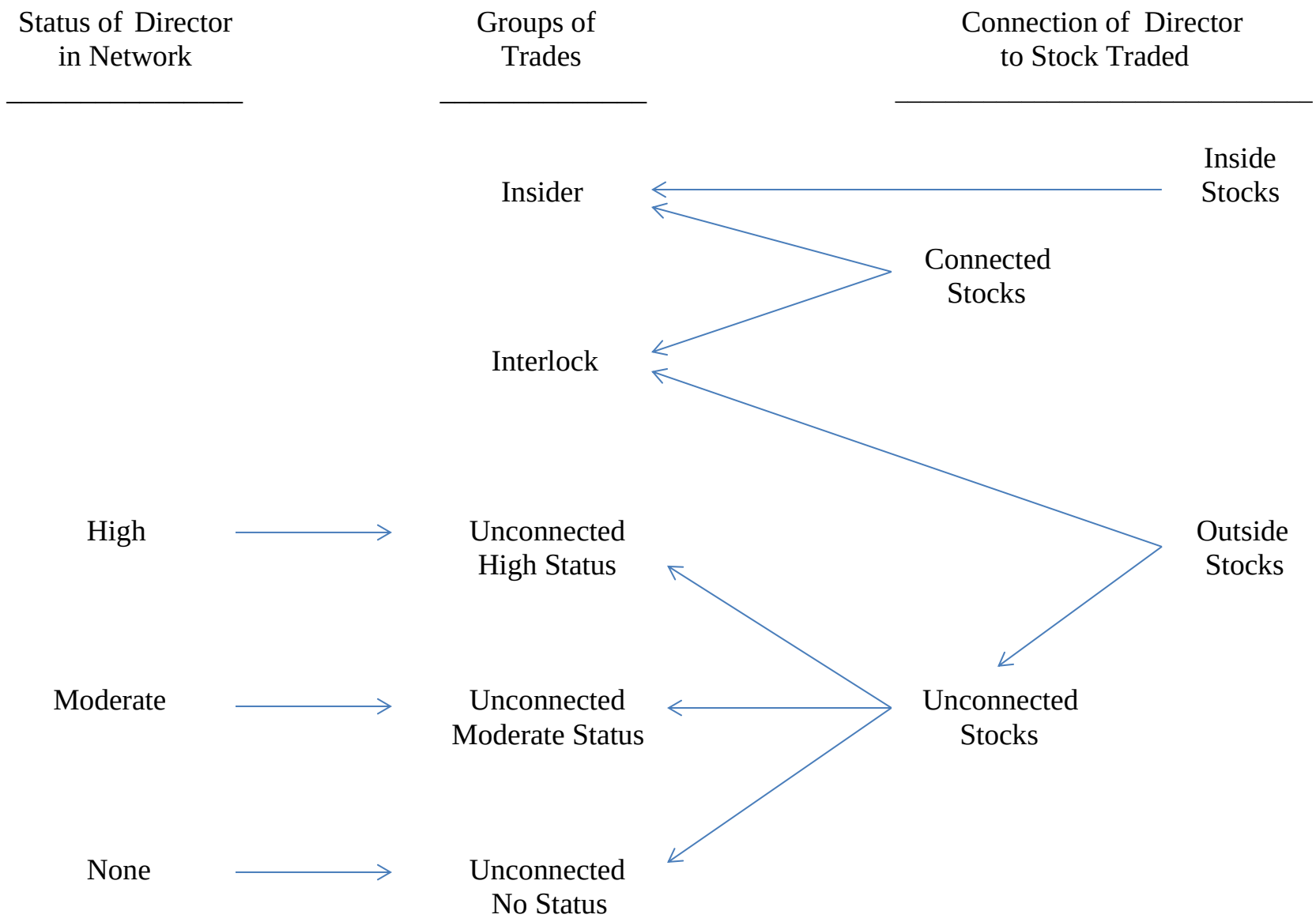

Table 1. Sample Characteristics for Different Types of Trades by Directors or Their Family Members

This table summarizes the characteristics of different types of trades by directors or their family members. The different types of trades include: (i) insider trades in the director's own company, (ii) trades in the company of a fellow director with an interlock board connection, (iii) unconnected trades when the director has high status, (iv) unconnected trades when the director has moderate status, and (v) unconnected trades when the director has no status in the corporate network. The first column of Panel A reports the total number of trading days across all stocks and individual accountholders for every group of trades. . The second column gives the percent of total trading days by all accountholders that are attributable to every group of trades. The third column shows the percent of stock trading days in each group for which the accountholder was a net buyer. Columns 4 and 5 report the average number of shares bought and sold, respectively, in the average trade from every group. Column 6 provides the percent of stock trading days in each group for female accountholders. The last two columns give the mean age and the median wealth (i.e., account size in € as of Jan. 5, 2005) of the accountholders who trade in every category.

Panel B reports the mean adjusted ranks of the control variables for the subset of sales in every group of trades. Panel C gives the analogous results for purchases in every trade category. Control variables include the firm's beta, market-to-book ratio, size, and previous returns taken over four time frames including the past year excluding the last month, the past month excluding the last week, the past week excluding the last day, and the most recent day. Mean adjusted ranks are computed by first transforming each variable into decile ranks every day in the sample, and then adjusting these daily ranks to range from -0.5 (for the lowest decile) to +0.5 (for the highest decile). The adjusted daily ranks for each group are then averaged across all days in the sample period.

Panel A. Frequency and Attributes of Different Types of Trades

trade category (i)	(1) # Trades (n_i)	(2) % Trades (n_i / N)*100	(3) % $buys_i$ (#$buys_i$ / n_i)*100	(4) avg vol. bought # shares traded	(5) avg volume sold # shares traded	(6) % of Trades by Females	(7) Mean Age	(8) Median Wealth (€)
Director Trades								
Insider	3,614	0.02%	58.74%	11,339	63,862	6.70%	53	259,455
Interlock	2,802	0.02%	56.03%	4,413	6,946	6.25%	55	315,588
Unconnected High	9,832	0.06%	54.54%	5,339	7,449	7.35%	53	353,811
Unconnected Moderate	22,415	0.13%	57.19%	3,678	5,507	5.67%	54	356,397
Unconnected No Status	18,580	0.11%	54.21%	3,316	5,504	6.95%	50	199,037
Family Trades								
Insider	999	0.01%	54.75%	3,821	6,993	47.29%	43	173,979
Interlock	5,416	0.03%	54.12%	1,926	2,063	14.00%	48	33,009
Unconnected High	14,111	0.08%	55.48%	1,875	2,194	16.05%	46	27,790
Unconnected Moderate	31,998	0.19%	54.97%	1,779	2,030	17.10%	53	112,024
Unconnected No Status	26,854	0.16%	53.44%	1,335	1,555	24.23%	59	135,661
All Retail Trades	17,111,000	99.21%	58.12%	978	1,267	17.34%	49	22,998
Total Trades (N)	17,247,621							

Table 1, continued

Panel B. Attributes of Firms Sold in Every Category of Trades by Directors, versus All Retail Trades

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
trade category (i)	Rank(β)	Rank(M/B)	Rank(Size)	Rank(Ryear)	Rank(Rmonth)	Rank(Rweek)	Rank(Rday)
Insider	-0.07	0.07	-0.06	0.04	0.03	0.04	0.02
Interlock	0.15	0.07	0.26	0.04	0.04	0.03	0.04
Unconnected High	0.19	0.06	0.31	0.00	0.03	0.02	0.03
Unconnected Moderate	0.20	0.05	0.30	0.00	0.03	0.02	0.05
Unconnected No Status	0.17	0.08	0.26	0.01	0.04	0.03	0.04
All Retail Trades	0.22	0.09	0.29	0.01	0.02	0.02	0.04

Panel C . Attributes of Firms Purchased in Every Category of Trades by Directors, versus All Retail Trades

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
trade category (i)	Rank(β)	Rank(M/B)	Rank(Size)	Rank(Ryear)	Rank(Rmonth)	Rank(Rweek)	Rank(Rday)
Insider	0.04	-0.01	0.06	-0.02	-0.03	-0.01	-0.01
Interlock	0.21	0.07	0.33	0.00	-0.03	-0.01	-0.02
Unconnected High	0.20	0.07	0.33	-0.02	-0.02	-0.02	-0.02
Unconnected Moderate	0.21	0.05	0.31	-0.03	-0.03	-0.03	-0.04
Unconnected No Status	0.20	0.08	0.29	-0.03	-0.04	-0.02	-0.02
All Retail Trades	0.24	0.11	0.31	-0.03	-0.03	-0.02	-0.03

Table 2. Likelihood of Directors or Family Members making Different Types of Trades

This Table presents the results of estimating the following panel logit model:

$$\text{Log}\{(\text{Trade}_{i,e,y} = 1)/(\text{Trade}_{i,e,y} = 0)\} = a_0 + a_1\,\text{Insider}_{i,e,y} + a_2\,\text{Interlock}_{i,e,y} + a_3\,\text{Unconnected\_High}_{e,y} + a_4\,\text{Unconnected\_Moderate}_{e,y} + a_5\,\text{Same\_PostCode}_{i,e,y} + a_6\,\text{Industry}_{i,e,y} + a_7\,\text{Wealth}_{e,y}. \quad (1)$$

The variables are described in the text. The subscript, *i*, refers to the stock traded, while *e* points to the director associated with the trade, and *y* represents the year of the trade. This analysis reveals how the level of a director's connection to a company affects the probability of the director or his family members trading the shares of that company in any given year. This model also controls for: (i) the status of the director within the corporate network, (ii) whether company headquarters are located in the same postcode as the accountholder, (iii) whether the industry of the stock traded is an area of expertise of the director, and (iv) the wealth of the accountholder. This model is estimated separately for the two samples of trades by directors and by their family members, and the results are presented in Panels A and B, respectively. We also include age dummies and fixed effects for the director or family member, the firm, and the year.

Panel A. Trades by Directors

		Coefficient	p-value
Intercept	a_0	-2.826	0.00
Insider	a_1	1.460	0.00
Interlock	a_2	0.061	0.00
Unconnected_High	a_3	-0.123	0.00
Unconnected_Moderate	a_4	-0.102	0.00
Same_Postcode Director	a_5	0.057	0.00
Industry Director	a_6	0.029	0.02
Wealth Director	a_7	0.007	0.00
Age30 Director		0.217	0.00
Age3140 Director		0.137	0.00
Age4150 Director		0.061	0.03
Age5160 Director		0.009	0.62
Director Fixed Effects		Yes	
Firm Fixed Effects		Yes	
Year Fixed Effects		Yes	
% Concordant		86%	

Panel B. Trades by Family Members

		Coefficient	p-value
Intercept	a_0	-2.529	0.00
Insider	a_1	0.746	0.00
Interlock	a_2	0.048	0.03
Unconnected_High	a_3	-0.025	0.13
Unconnected_Moderate	a_4	-0.090	0.00
Same_Postcode Director	a_5	-0.040	0.12
Industry Director	a_6	0.852	0.00
Wealth Director	a_7	-0.002	0.00
Age30 Director		0.153	0.05
Age3140 Director		0.074	0.12
Age4150 Director		0.027	0.44
Age5160 Director		-0.001	0.97
Same_Postcode Family		0.061	0.00
Wealth Family		0.005	0.00
Age30 Family		0.025	0.69
Age3140 Family		-0.020	0.67
Age4150 Family		-0.090	0.01
Age5160 Family		0.026	0.25
Family member Fixed Effects		Yes	
Firm Fixed Effects		Yes	
Year Fixed Effects		Yes	
% Concordant		87%	

Table 3. Event Study Approach: Performance by Directors Who Are More or Less Connected to the Stock Traded

Panels A - C of this Table present the mean and median cumulative abnormal returns (CARs) following different types of trades by directors. First we define the daily size-adjusted abnormal return for every stock as the actual return minus the equally-weighted mean return across all Finnish firms in the same size quintile (but excluding the stock in question). Then, for each director we calculate the mean CARs following all trades over several different windows covering the next 5, 10, 20, 60, 120 and 250 trading days, respectively. We separately examine sales and purchases by each director, for three categories of trades: (i) insider trades, (ii) interlock trades, and (iii) all unconnected trades. For each group of trades, we first compute the mean CAR for every director, and then calculate the average of these mean CARs across all directors. The t-statistics are based on the standard deviation of these average CARs for each trade category N is the number of different directors that have at least one trade, for each trade category.

Panel D provides the differential performance of interlock trades versus unconnected trades made by the same director. We first isolate the subset of director accounts that make both interlock trades and unconnected trades. We then estimate the panel regression model specified below in equation (2), that analyzes the mean CAR per director across the two types of sales or purchases made by each director.

Panel A. Performance of Insider Trades by Directors

CARs after Insider Sales

Window	Mean	t-stat	Median	N
(1,5)	0.0%	0.2	-0.3%	214
(1,10)	0.3%	0.8	0.0%	214
(1,20)	0.6%	1.3	0.5%	214
(1,60)	0.4%	0.4	0.2%	214
(1,120)	0.3%	0.2	0.4%	213
(1,250)	1.0%	0.5	1.8%	212

CARs after Insider Purchases

Window	Mean	t-stat	Median	N
(1,5)	0.1%	0.6	-0.1%	349
(1,10)	0.2%	0.7	0.1%	349
(1,20)	0.8%	2.5	0.4%	349
(1,60)	2.5%	4.1	1.7%	349
(1,120)	4.0%	4.2	3.5%	349
(1,250)	6.9%	4.8	5.7%	349

Panel B. Performance of Interlock Trades by Directors

CARs after Sales of Interlocks

Window	Mean	t-stat	Median	N
(1,5)	-0.2%	-0.8	-0.1%	194
(1,10)	-0.1%	-0.4	-0.1%	194
(1,20)	-0.3%	-0.7	0.5%	194
(1,60)	-1.4%	-1.7	-0.8%	194
(1,120)	-1.7%	-1.4	-0.6%	192
(1,250)	1.0%	0.6	0.0%	191

CARs after Purchases of Interlocks

Window	Mean	t-stat	Median	N
(1,5)	0.6%	2.6	0.4%	205
(1,10)	0.7%	2.5	0.3%	205
(1,20)	0.7%	1.6	0.5%	205
(1,60)	3.0%	3.4	1.3%	205
(1,120)	3.1%	2.6	2.5%	205
(1,250)	4.8%	2.9	4.3%	205

Panel C. Performance of All Unconnected Trades by Directors

CARs after Unconnected Sales

Window	Mean	t-stat	Median	N
(1,5)	-0.1%	-0.7	-0.2%	418
(1,10)	-0.1%	-0.7	-0.1%	418
(1,20)	0.0%	-0.2	-0.1%	418
(1,60)	0.0%	0.0	0.1%	415
(1,120)	-0.1%	-0.1	-0.3%	414
(1,250)	0.1%	0.1	-0.5%	414

CARs after Unconnected Purchases

Window	Mean	t-stat	Median	N
(1,5)	0.3%	4.1	0.2%	405
(1,10)	0.4%	3.6	0.3%	405
(1,20)	0.6%	3.0	0.5%	405
(1,60)	1.1%	3.1	1.0%	405
(1,120)	0.9%	1.9	1.0%	405
(1,250)	-0.6%	-0.7	-0.1%	405

Table 3, continued

Panel D. Differential Performance of Interlock Trades versus Unconnected Trades

This Panel presents the estimates of α_1 from the following panel regression model:

$$CAR_{e,i} = \alpha_0 + \alpha_1 \text{ Interlock}_e + \text{Director Fixed Effects} + \varepsilon_{e,i}, \quad (2)$$

applied to the subsample of all director accounts that make both interlock trades and unconnected trades. The coefficient, α_1, is the difference of the mean CARs across these two types of trades.

Differential Performance after Sales

Window	α_1	t-stat	N
(1,5)	-0.1%	-0.5	188
(1,10)	-0.1%	-0.2	
(1,20)	-0.5%	-0.9	
(1,60)	-1.7%	-1.9	
(1,120)	-1.8%	-1.4	
(1,250)	1.4%	0.7	

Differential Performance after Purchases

Window	α_1	t-stat	N
(1,5)	0.3%	0.6	200
(1,10)	0.2%	0.5	
(1,20)	0.3%	0.6	
(1,60)	1.6%	1.7	
(1,120)	2.5%	2.0	
(1,250)	5.5%	2.9	

Table 4. Event Study Approach: Performance of Unconnected Trades by Directors with Higher or Lower Status in the Corporate Network

Panels A - C of this Table present the mean and median CARs following trades by directors in unconnected stocks, partitioned into those made by directors with high, moderate, or no status. We calculate the mean CARs for each category of trades over several different windows covering the next 5, 10, 20, 60, 120, and 250 trading days, respectively. We separately examine sales and purchases by each director. For each group of trades, we first compute the mean CAR for every director, and then calculate the average of these mean CARs across all directors in the group. The t-statistics are based on the standard deviation of these average CARs, for each trade category. N is the number of different directors that have at least one trade, for each category.

Panel D provides the differential performance of unconnected trades made by directors with high or moderate status, relative to those made by directors with no status. We obtain this information by estimating the panel regression model specified below in equation (3), that analyzes the mean CAR per director across unconnected sales or purchases made by directors with different levels of status within the corporate network.

Panel A. Performance of Unconnected Trades by Directors with High Status

CARs after Unconnected Sales

Window	Mean	t-stat	Median	N
(1,5)	0.2%	0.8	0.0%	154
(1,10)	0.0%	-0.1	-0.2%	154
(1,20)	0.5%	0.8	0.1%	154
(1,60)	0.9%	1.1	0.2%	154
(1,120)	0.6%	0.6	0.3%	152
(1,250)	1.1%	0.6	-0.2%	151

CARs after Unconnected Purchases

Window	Mean	t-stat	Median	N
(1,5)	0.3%	1.6	0.1%	154
(1,10)	0.7%	2.3	0.2%	154
(1,20)	0.9%	3.0	0.5%	154
(1,60)	2.7%	4.1	2.1%	154
(1,120)	3.6%	4.1	3.1%	154
(1,250)	4.6%	3.3	3.4%	154

Panel B. Performance of Unconnected Trades by Directors with Moderate Status

CARs after Unconnected Sales

Window	Mean	t-stat	Median	N
(1,5)	0.0%	-0.1	-0.1%	305
(1,10)	-0.1%	-0.5	0.1%	305
(1,20)	0.2%	0.5	0.1%	305
(1,60)	0.5%	0.6	0.3%	304
(1,120)	0.8%	0.7	-0.3%	300
(1,250)	0.4%	0.2	0.2%	296

CARs after Unconnected Purchases

Window	Mean	t-stat	Median	N
(1,5)	0.5%	2.5	0.2%	312
(1,10)	0.7%	2.9	0.4%	312
(1,20)	0.9%	3.2	0.7%	312
(1,60)	1.2%	2.6	1.1%	312
(1,120)	0.9%	1.5	0.9%	312
(1,250)	0.8%	0.7	1.6%	311

Panel C. Performance of Unconnected Trades by Directors with No Status

CARs after Unconnected Sales

Window	Mean	t-stat	Median	N
(1,5)	0.0%	0.2	-0.1%	304
(1,10)	0.2%	1.0	0.0%	304
(1,20)	0.2%	0.7	0.1%	304
(1,60)	0.6%	1.0	0.7%	302
(1,120)	0.5%	0.6	0.9%	299
(1,250)	-0.5%	-0.3	0.4%	298

CARs after Unconnected Purchases

Window	Mean	t-stat	Median	N
(1,5)	0.4%	2.8	0.2%	282
(1,10)	0.3%	1.3	0.2%	282
(1,20)	0.5%	1.5	0.3%	282
(1,60)	1.0%	1.9	1.1%	282
(1,120)	0.2%	0.3	1.6%	282
(1,250)	-0.7%	-0.6	2.0%	282

Table 4, continued

Panel D. Differential Performance of Unconnected Trades Made by Directors with High or Moderate Status versus Those Made By Directors with No Status

This Panel presents the estimates of α_1 and α_2 from the following panel regression model:

$$CAR_{e,i} = \alpha_0 + \alpha_1 \text{Unconnected\_Moderate}_e + \alpha_2 \text{Unconnected\_High}_e + \text{Director Fixed Effects} + \varepsilon_{e,i}, \quad (3)$$

applied to the sample of all unconnected trades by directors. The omitted group captured by the intercept is the set of unconnected trades made by directors with no status. The coefficient, α_1 (or α_2), indicates the difference across the mean CARs between the groups of unconnected trades made by directors with moderate (or high status versus those made by directors with no status.

Differential Performance after Sales					Differential Performance after Purchases				
Window	α_1	t-stat	α_2	t-stat	Window	α_1	t-stat	α_2	t-stat
(1,5)	0.0%	-0.1	0.3%	0.7	(1,5)	0.0%	0.2	-0.3%	-0.8
(1,10)	-0.4%	-1.0	0.0%	0.1	(1,10)	0.3%	0.8	0.2%	0.4
(1,20)	-0.4%	-0.5	0.4%	0.4	(1,20)	0.2%	0.4	0.2%	0.3
(1,60)	-0.4%	-0.4	0.7%	0.5	(1,60)	0.3%	0.4	1.3%	1.3
(1,120)	0.6%	0.4	0.7%	0.3	(1,120)	0.6%	0.6	3.1%	2.2
(1,250)	0.6%	0.2	0.9%	0.3	(1,250)	2.1%	1.2	4.9%	2.2

Table 5. Calendar Time Portfolio Approach: Performance of Different Types of Trades by Directors

We build a set of ten portfolios (*p*) each day that are designed to mimic the recent trading behavior behind the different groups of director trades (i.e., five director buy portfolios and five director sell portfolios). First, each trading day (*t*) we identify all director accounts (*e*) that trade any given stock (*i*) in the preceding year, covering calendar days *t-90 to t-1*. Second, for each director account (*e*), we aggregate all trades in the stock (*i*) during this period, to determine whether that account was a net buyer or net seller. Third, we partition all trades into the five categories: i) insider trades; ii) interlock trades, and unconnected trades made by directors with (iii) high status, iv) moderate status, and v) no status. Fourth, for every trade category, on each day (*t*) we allocate a given stock (*i*) into the 'director buy portfolio' if more directors are net purchasers than net sellers of that stock, or into the 'director sell portfolio' if more directors are net sellers. Finally, we calculate the equally weighted portfolio return on day *t* ($R_{p,t}$) for each of the ten director portfolios (*p* = 1-10, representing a buy portfolio and a sell portfolio for each category of director trades) and analyze the return performance of these ten portfolios (*p*), using the Fama-French 3-factor model. We present these regression results in Panels A and B for the director sell portfolios and the director buy portfolios, respectively. N is the average number of director accounts in each portfolio across all days in the sample period. Panels C and D provide the analogous one-day alphas for the director sell portfolios and buy portfolios, respectively, using different portfolio formation periods that range from 7 calendar days to 365 calendar days.

Panel A. Daily Fama-French Regressions for the Director Sell Portfolios

Dependent Variable: Daily Return on Portfolio of	Portfolio Formation Period = previous 90 calendar days				
	1-day α (%)	RM_RF	SMB	HML	R^2 / N
Insider Sales	0.027	0.763	0.255	-0.262	0.296
	1.0	34.3	7.2	-7.8	3,660
Interlocking Sales	0.012	0.875	0.039	-0.114	0.413
	0.5	41.7	1.2	-3.6	3,428
Unconnected Sales by Directors with High Status	-0.001	0.880	0.108	-0.026	0.622
	-0.1	69.7	5.4	-1.4	3,766
Unconnected Sales by Directors with Moderate Status	0.001	0.821	0.135	-0.038	0.671
	0.1	77.9	8.1	-2.4	3,769
Unconnected Sales by Directors with No Status	0.005	0.795	0.138	-0.090	0.671
	0.4	77.3	8.5	-5.8	3,770
Hedge Portfolio 1: Long Interlock Stocks Sold by Directors, and Short Unconnected Stocks Sold by Directors with No Status					
Return on Hedge Portfolio 1	0.006	0.077	-0.128	-0.014	0.015
	0.3	2.7	-2.5	-0.2	3,429
Hedge Portfolio 2: Long Unconnected Stocks Sold by Directors with High Status and Short Unconnected Stocks Sold by Directors with No Status					
Return on Hedge Portfolio 2	-0.007	0.091	-0.018	0.075	0.017
	-0.4	4.4	-0.6	1.4	3,766

Table 5, continued

Panel B. Daily Fama-French Regressions for the Director Buy Portfolios

Dependent Variable: Daily Return on Portfolio of	Portfolio Formation Period = previous 90 calendar days				
	1-day α (%)	RM_RF	SMB	HML	R^2 / N
Insider Purchases	0.053	0.829	0.197	0.024	0.4449
	2.7	49.1	7.4	0.9	3,624
Interlocking Purchases	0.059	1.063	0.176	-0.142	0.5289
	2.6	55.2	5.8	-4.9	3,540
Unconnected Purchases by Directors with High Status	0.054	0.953	0.026	-0.020	0.7245
	4.1	85.4	1.5	-1.2	3,767
Unconnected Purchases by Directors with Moderate Status	0.026	0.915	0.145	-0.006	0.7728
	2.4	101.1	10.1	-0.4	3,771
Unconnected Purchases by Directors with No Status	0.022	0.877	0.122	-0.007	0.7786
	2.1	102.3	9.0	-0.5	3,771
Hedge Portfolio 1: Long Interlock Stocks Purchased by Directors, and Short Unconnected Stocks Purchased by Directors with No Status					
Return on Hedge Portfolio 1	0.036	0.186	0.057	-0.135	0.044
	1.9	6.8	1.3	-2.7	3,541
Hedge Portfolio 2: Long Unconnected Stocks Purchased by Directors with High Status, and Short Unconnected Stocks Purchased by Directors with No Status					
Return on Hedge Portfolio 2	0.033	0.076	-0.097	-0.014	0.046
	2.6	5.7	-4.4	-0.5	3,767

Table 5, continued

Panel C. One-Day Alphas for the Director Sell Portfolios: Different Formation Periods

Dependent Variable: Daily Return on Portfolio of	Portfolio Formation Period (number of calendar days)					
	7 days	14 days	30 days	90 days	180 days	365 days
Insider Sales	0.022	-0.004	0.056	0.027	-0.007	0.011
	0.4	-0.1	1.5	1.0	-0.3	0.6
Interlocking Sales	-0.032	0.043	-0.009	0.012	-0.021	0.026
	-0.5	0.8	-0.2	0.5	-1.0	1.3
Unconnected Sales by Directors with High Status	-0.009	0.010	0.008	-0.001	-0.003	0.011
	-0.3	0.4	0.4	-0.1	-0.2	0.8
Unconnected Sales by Directors with Moderate Status	-0.024	-0.012	-0.002	0.001	0.018	0.025
	-1.1	-0.7	-0.1	0.1	1.5	2.1
Unconnected Sales by Directors with No Status	-0.027	-0.024	-0.003	0.005	0.016	0.012
	-1.3	-1.5	-0.2	0.4	1.5	1.1

Panel D. One-Day Alphas for the Director Buy Portfolios: Different Formation Periods

Dependent Variable: Daily Return on Portfolio of	Portfolio Formation Period (number of calendar days)					
	7 days	14 days	30 days	90 days	180 days	365 days
Insider Purchases	0.012	0.052	0.022	0.053	0.033	0.024
	0.3	1.4	0.8	2.6	2.1	1.7
Interlocking Purchases	0.117	0.067	0.076	0.059	0.049	0.042
	2.4	1.8	2.3	2.5	2.4	2.5
Unconnected Sales by Directors with High Status	0.099	0.092	0.065	0.054	0.056	0.041
	3.7	4.2	3.8	4.1	4.8	3.8
Unconnected Sales by Directors with Moderate Status	0.085	0.048	0.036	0.026	0.023	0.014
	4.6	3.3	3.1	2.4	2.2	1.4
Unconnected Sales by Directors with No Status	0.062	0.036	0.035	0.022	0.016	0.014
	3.2	2.5	2.9	2.1	1.7	1.5

Table 6. Event Study Approach: Performance by the Family Members of Directors Who Are More or Less Connected to the Stock Traded

Panels A - C of this Table present the mean and median CARs following different types of trades by the family members of directors. For all family accounts associated with each director, we calculate the mean CARs following all trades over several different windows covering the next 5, 10, 20, 60, 120 and 250 trading days, respectively. We separately examine sales and purchases by the family members of each director, for three categories of trades: (i) insider trades, (ii) interlock trades, and (iii) all unconnected trades. For each group of trades, we first compute the mean CAR for the family members of every director, and then calculate the average of these mean CARs across all directors. The t-statistics are based on the standard deviation of these average CARs, for each trade category. N is the number of different directors that have at least one family member trade, for each trade category.

Panel D provides the differential performance of interlock trades versus unconnected trades made by family members of the same director. We first isolate the subset of director accounts with family members that make both interlock trades and unconnected trades. We then estimate the panel regression model specified below in equation (2), that analyzes the mean CAR for the family members of each director, across the two types of sales or purchases made by the family members of each director.

Panel A. Performance of Insider Trades by the Family Members of Directors

CARs after Insider Sales

Window	Mean	t-stat	Median	N
(1,5)	0.0%	0.0	-0.3%	43
(1,10)	-0.3%	-0.5	-0.1%	43
(1,20)	-1.6%	-1.5	-1.4%	43
(1,60)	-4.0%	-2.0	-5.1%	43
(1,120)	-5.1%	-1.9	-6.7%	43
(1,250)	-1.7%	-0.5	-3.7%	43

CARs after Insider Purchases

Window	Mean	t-stat	Median	N
(1,5)	1.9%	2.9	0.6%	45
(1,10)	2.1%	2.6	1.7%	45
(1,20)	2.8%	2.7	1.7%	45
(1,60)	10.3%	3.5	8.0%	45
(1,120)	10.0%	2.8	10.1%	45
(1,250)	14.0%	2.5	5.4%	45

Panel B. Performance of Interlock Trades by the Family Members of Directors

CARs after Sales of Interlocks

Window	Mean	t-stat	Median	N
(1,5)	-0.2%	-0.3	-0.3%	51
(1,10)	0.5%	1.1	-0.2%	51
(1,20)	1.1%	1.7	0.6%	51
(1,60)	1.9%	1.1	1.9%	51
(1,120)	2.8%	1.3	2.8%	50
(1,250)	5.2%	1.4	6.2%	50

CARs after Purchases of Interlocks

Window	Mean	t-stat	Median	N
(1,5)	0.4%	0.9	-0.1%	59
(1,10)	1.0%	2.1	0.4%	59
(1,20)	1.9%	2.3	0.9%	59
(1,60)	5.9%	3.7	2.3%	59
(1,120)	9.4%	3.5	7.9%	59
(1,250)	12.6%	3.8	11.2%	59

Panel C. Performance of All Unconnected Trades by the Family Members of Directors

CARs after Unconnected Sales

Window	Mean	t-stat	Median	N
(1,5)	0.2%	0.8	-0.1%	103
(1,10)	0.4%	1.1	-0.1%	103
(1,20)	0.7%	1.2	0.0%	103
(1,60)	0.3%	0.3	-0.4%	103
(1,120)	0.6%	0.5	-1.1%	103
(1,250)	-3.4%	-1.4	-2.7%	103

CARs after Unconnected Purchases

Window	Mean	t-stat	Median	N
(1,5)	0.4%	1.8	0.2%	100
(1,10)	0.8%	2.4	0.3%	100
(1,20)	1.0%	2.5	0.6%	100
(1,60)	0.5%	0.9	-0.1%	100
(1,120)	0.2%	0.2	0.0%	100
(1,250)	-0.5%	-0.4	-1.5%	100

Table 6, continued

Panel D. Differential Performance of Interlock Trades versus Unconnected Trades

This Panel presents the estimates of α_1 from the following panel regression model:

$$CAR_{e,i} = \alpha_0 + \alpha_1 \text{ Interlock}_e + \text{Director Fixed Effects} + \varepsilon_{e,i}, \quad (2)$$

applied to the subsample of all director accounts where family members make both interlock trades and unconnected trades. The coefficient, α_1, is the difference of the mean CARs across these two types of trades.

Differential Performance after Sales

Window	α_1	t-stat	N
(1,5)	-0.1%	-0.1	51
(1,10)	0.5%	1.0	
(1,20)	0.9%	1.1	
(1,60)	1.9%	1.0	
(1,120)	2.9%	1.0	
(1,250)	7.7%	1.9	

Differential Performance after Purchases

Window	α_1	t-stat	N
(1,5)	0.0%	-0.1	59
(1,10)	0.4%	0.8	
(1,20)	1.1%	1.3	
(1,60)	5.0%	2.8	
(1,120)	8.8%	3.1	
(1,250)	14.5%	4.0	

Table 7. Calendar Time Portfolio Approach: Trades by Family Members

In this approach, we build a set of ten portfolios (*p*) each day that mimic the recent trading behavior behind the different groups of trades by family members of directors. First each day (*t*) we identify all family accounts associated with each director (*e*) that trade any given stock (*i*) during the preceding days, *t-x to t-1*, where the portfolio formation period (*x*) ranges from 7 to 365 calendar days. Second, for each director (*e*), we aggregate all related family members' trades in the stock (*i*) during this period, to determine whether the families behind that director were net buyers or net sellers. Third, we partition all trades into the five categories: i) insider trades; ii) interlock trades, and unconnected trades made by the family of directors with (iii) high status, iv) moderate status, and v) no status. Fourth, for every trade category, on each day (*t*) we allocate a given stock (*i*) into the 'family buy portfolio' if more family account holders are net purchasers than net sellers of that stock, or into the 'director sell portfolio' if more family accounts are net sellers. Finally, we calculate the equally weighted portfolio return on day *t* ($R_{p,t}$) for each of the ten family portfolios (*p* = 1-10, representing a buy portfolio and a sell portfolio for each category of family trades) and analyze the return performance of these ten portfolios (*p*), using the Fama-French 3-factor model. We present the one-day alphas in Panels A and B for the family sell portfolios and buy portfolios, respectively, using the different portfolio formation periods.

Panel A. One-Day Alphas for the Family Sell Portfolios: Different Formation Periods

Dependent Variable: Daily Return on Portfolio of	Portfolio Formation Period (number of calendar days)					
	7 days	14 days	30 days	90 days	180 days	365 days
Insider Sales	-0.071	-0.088	-0.151	-0.039	-0.017	0.039
	-0.8	-1.2	-2.8	-0.9	-0.5	1.3
Interlocking Sales	-0.066	-0.005	0.011	0.014	-0.008	-0.009
	-1.8	-0.2	0.4	0.6	-0.4	-0.5
Unconnected Sales by Directors with High Status	-0.010	-0.013	0.031	-0.007	-0.005	0.002
	-0.3	-0.5	1.5	-0.4	-0.3	0.1
Unconnected Sales by Directors with Moderate Status	0.002	0.007	0.034	0.018	0.014	0.016
	0.1	0.3	2.0	1.2	1.1	1.3
Unconnected Sales by Directors with No Status	0.004	0.021	0.012	0.016	0.014	0.017
	0.2	1.2	0.8	1.2	1.1	1.4

Panel B. One-Day Alphas for the Family Buy Portfolios: Different Formation Periods

Dependent Variable: Daily Return on Portfolio of	Portfolio Formation Period (number of calendar days)					
	7 days	14 days	30 days	90 days	180 days	365 days
Insider Purchases	0.031	0.062	0.110	0.081	0.054	0.021
	0.3	0.8	1.7	2.0	1.5	0.8
Interlocking Purchases	0.119	0.089	0.071	0.076	0.063	0.055
	3.4	3.0	2.7	3.5	3.4	3.5
Unconnected Purchases by Directors with High Status	0.077	0.061	0.043	0.023	0.021	0.017
	3.4	3.4	3.0	2.0	1.9	1.7
Unconnected Purchases by Directors with Moderate Status	0.087	0.052	0.054	0.033	0.021	0.023
	3.5	2.4	2.9	2.3	1.6	2.1
Unconnected Purchases by Directors with No Status	0.002	-0.004	0.026	0.029	0.027	0.012
	0.1	-0.2	1.4	1.9	1.9	0.9

Table 8. Event Study: The Performance of Different Types of Trades by Directors around Major Information Events

Panels A - C of this Table present event study analysis of the performance of trades made by directors during the three weeks prior to three kinds of events: earnings announcements, takeover announcements, and large price changes. We consider all events where at least one director trades during one of the three weeks before the event. In the text we further discuss the criteria for selecting the sample for each kind of event. We present the mean size-adjusted cumulative abnormal return on the day of and the day after each type of event, CAR(0,+1), for three types of trades by directors: insider trades, interlock trades, and all unconnected trades.

Panel A. Earnings Announcements

		Mean CAR(0,+1)	t-statistic	# of Events with ≥ 1 trade
1 Week Before	Insider Trades	2.0%	1.7	24
	Interlock Trades	0.2%	0.4	148
	Unconnected Trades	0.0%	0.1	1298
2 Weeks Before	Insider Trades	0.6%	0.6	38
	Interlock Trades	-0.2%	-0.4	148
	Unconnected Trades	-0.1%	-0.5	1262
3 Weeks Before	Insider Trades	1.1%	1.9	70
	Interlock Trades	0.0%	-0.1	149
	Unconnected Trades	0.1%	0.6	1284

Panel B. Merger and Acquisition Announcements

1 Week Before	Insider Trades	3.1%	1.0	3
	Interlock Trades	-1.6%	-2.0	3
	Unconnected Trades	1.3%	1.2	31
2 Weeks Before	Insider Trades	6.2%	3.5	2
	Interlock Trades	-1.1%	-1.5	5
	Unconnected Trades	-1.8%	-0.8	34
3 Weeks Before	Insider Trades	24.2%	1.5	2
	Interlock Trades	-6.4%	-1.4	3
	Unconnected Trades	-1.0%	-0.4	39

Panel C. Large price Changes

1 Week Before	Insider Trades	0.0%	0.0	60
	Interlock Trades	0.0%	0.0	62
	Unconnected Trades	0.8%	1.7	671
2 Weeks Before	Insider Trades	1.3%	0.7	57
	Interlock Trades	-1.4%	-0.9	57
	Unconnected Trades	0.3%	0.7	672
3 Weeks Before	Insider Trades	0.8%	0.5	57
	Interlock Trades	-1.1%	-0.8	71
	Unconnected Trades	0.3%	0.7	638