Personal Attributes and Corporate Insider Trading[*]

David Hillier[†], Adriana Korczak[‡] and Piotr Korczak[§]

This version: January 2014

ABSTRACT

We analyze whether corporate insiders' attributes have an impact on insider trading performance. While prior literature has focused on observable firm and trade characteristics, no effort has been made to understand whether and to what extent individual attributes, such as skills, expertise, or personality, matter in explaining insider trading performance. We capture those unobservable time-invariant characteristics using individual fixed effects and find that they explain a significant proportion of the variability in insider trading performance. Our analysis sheds also new light on the role of insider seniority in explaining insider trading performance and on the impact of regulation.

JEL classification: G12, G14

Keywords: Insider Trading; Abnormal Returns; Fixed Effects

[†] Strathclyde Business School, University of Strathclyde, 100 Cathedral Street, Glasgow G4 0LN, UK, email: david.hillier@strath.ac.uk

[‡] School of Economics, Finance and Management, University of Bristol, 8 Woodland Road, Bristol BS8 1TN, UK, email: adriana.korczak@bristol.ac.uk

[§] *Corresponding author,* School of Economics, Finance and Management, University of Bristol, 8 Woodland Road, Bristol BS8 1TN, UK, email: p.korczak@bristol.ac.uk

1. Introduction

Do corporate insiders' attributes have an impact on insider trading performance? Given that insider trading decisions are individually made by insiders, it is surprising that we still know little about whether and to what extent personal characteristics of corporate insiders affect returns following insider trades. Earlier studies focus predominantly on firm-level characteristics and it is now widely accepted that insider trading patterns and performance differ with the firm's size and book-to-market ratio (e.g. Seyhun, 1986; Rozeff and Zaman, 1998; Lakonishok and Lee, 2001; Jenter, 2005). Finance and accounting literature also documents that profitability of insider transactions depends on such firm-level characteristics as analyst coverage (Frankel and Li, 2004), ownership structure (Fidrmuc et al., 2006), antitakeover provisions (Ravina and Sapienza, 2010), the role of general counsel (Jagolinzer et al., 2011), the quality of internal control over financial reporting (Skaife et al., 2013), or antishareholder mechanisms (Cziraki et al., 2013).[1] So far the importance of insiders' individual, personal characteristics for the performance of their trading has been largely neglected and in this paper we aim to fill this gap.

We argue that insider trading decisions and performance are to a large extent driven by insiders' skills and abilities to acquire and process information, including any biases such as overconfidence or optimism, attitude to risk and willingness to trade on private information. Those personal characteristics have two main features. First, earlier behavioral economics, psychology and genetics literature suggests that many of them are fixed or slow-moving over time. Second, they are unobservable to the econometrician. Given those features, we propose to capture the individual heterogeneity using insider fixed effects. We ask a question of how much of the variability of abnormal returns following insider transactions is explained by insider fixed effects after controlling for known firm and transaction-level determinants of insider trading profitability. Our approach builds on earlier studies in which individual fixed effects are used in various contexts to identify managerial styles (e.g. Bertrand and Schoar, 2003; Coles and Li, 2011a, 2011b; Graham et al., 2012).

Our study is motivated by earlier literature on investment performance of individuals which provides persuasive evidence that innate individual characteristics have a very significant impact on financial

---

[1] The power of the proposed explanatory variables in capturing the variability of insider trading abnormal returns is rather poor which suggests that we still know little about what drives insider trading performance. Although observable firm and transaction-level variables have been shown to be statistically and economically significant in past empirical research, they explain only a small fraction of the variability of abnormal returns following insider transactions. For example, the adjusted R-square in Fidrmuc et al. (2006) is less than 5 percent. Cross-sectional regressions without firm fixed effects presented in Ravina and Sapienza (2010) have an R-square statistic of less than 1 percent.

decision making. For example, Barnea et al. (2010) find that the genetic factor explains about a third of the variability in stock market participation and asset allocation, and Cesarini et al. (2010) document that genetic variation explains about a quarter of individual variation in portfolio risk. Barber and Odean (2001) show different portfolio turnover and performance of men and women and building on the psychology literature attribute it to gender-specific different levels of overconfidence. Similarly, Bharath et al. (2009) and Gregory et al. (2013) document different abnormal returns following trades by male and female insiders. Grinblatt et al. (2012) find that stock trading decisions and performance are related to intelligence (IQ score). Davidson et al. (2013) compile a dataset of law violations and ownership of luxury goods by CEOs and show that executives who reveal lower respect for rules and higher materialism are more likely to trade on profitable information. In a similar vein, Bhattacharya and Marshall (2012) argue that the decision to trade on inside information may be explained by unobservable psychological factors, such as hubris. While genetic variation is by nature fixed, many psychological traits that affect decision making are also fixed or slow-moving over time. For example, Landier and Thesmar (2008) find that biases in beliefs (e.g. optimism) tend to persist over time. The argument on the impact of fixed person-specific effects on the performance of insider trades is also underpinned by a study by Cohen et al. (2012). They split insiders into routine and opportunistic traders based on the pattern of initial trades and using that fixed classification over time show that opportunistic traders persistently outperform routine traders.

Bertrand and Schoar (2003), Coles and Li (2011a, 2011b), Graham et al. (2012) and others show that there is an important unobserved managerial style component in a number of corporate finance choices, spanning the firm's investment, financial, payout and compensation policies.[2] Similarly, Bamber et al. (2010), Dyreng et al. (2010) and Ge et al. (2011) document the impact of executive-specific effects on firms' accounting choices, including voluntary disclosure and tax avoidance. There is also a strand of the management literature that shows a strong impact of managers' personal attributes on corporate-level strategic choices and firm performance. For example, Chatterjee and Hambrick (2007) show that companies run by narcissist CEOs tend to generate more volatile accounting performance and that narcissistic CEOs are much more likely to engage in strategic changes such as merger and acquisition than their less narcissistic peers. Considering that mangers reveal specific styles in firm policies, one can expect that they also reveal individual fixed styles in share trading in own account as there is evidence of correlation between personal and firm choices. For example, Malmendier and Tate (2005) and Kolasinski and Li (2013) document that managers who

---

[2] In a recent study, Fee et al. (2013) use exogenous features of managerial turnover to provide a fuller picture of the impact of managerial-styles on firms' investment and financial decisions. They reject the hypothesis that managerial styles are idiosyncratic and unanticipated by the board. In contrast, they document that boards select CEOs with certain perceived styles that have a causal role in the selection of firm policies.

manifest overconfidence in their personal portfolio decisions also show overconfidence in corporate investment. Lee et al. (1992) document a strong relation between insiders' trading in their own accounts and share repurchases announced by their firms, and Cronqvist et al. (2012) show a link between CEO's personal and firm-level leverage choices. All of this evidence is in line with the psychology literature that points to the consistency in behavior across situations (Epstein, 1979). Taken together, earlier evidence gives a strong support to our proposition that unobservable time-invariant individual attributes captured by insider fixed effects are likely to be important in explaining the performance of corporate insider trading.

The counterargument to that view is that insider-specific characteristics play only a minor role in explaining variability in trading performance since individual behaviors are constrained by the effective enforcement of insider trading regulation. There is also the possibility that voluntary firm-level insider trading restrictions have an important role in shaping insider trading choices (Bettis et al., 2000; Lee et al., 2012). If firm-level insider trading restrictions are endogenously linked to the risk culture within a firm, cross-sectional differences in insider trading performance are captured by firm-specific effects. The findings of Ravina and Sapienza (2010) support this perspective as their regression R-square increases from less than 1 percent to about 20 percent when firm fixed effects are included.

When we turn to data to test our proposition of the importance of insider time-invariant unobservable characteristics, we show that fixed manager traits are indeed a significant determinant of insider trading performance. Similarly to other studies we find that the factors usually considered in the insider trading literature (firm size, book-to-market ratio, transaction size) explain a very small proportion of the variation in insider trading performance, and adding insider fixed effects to the regressions substantially improves their explanatory power. Depending on the return horizon and the transaction type (purchases or sales), insider fixed effects increase the adjusted R-square of the regression from less than 3 percent to between 19 and 39 percent, several percentage points more than firm fixed effects alone. Because firms and insiders do not match randomly, insider and firm effects are likely to be correlated. To make sure that insider effects do not pick up firm-level fixed effects, we draw on the method proposed by Abowd et al. (1999) which allows for identification of both insider and firm fixed effects. We confirm that insider fixed effects have up to three times greater explanatory power than firm fixed effects. The effect of individual heterogeneity is also economically very large. All else constant, replacing an insider at the 25th percentile of the distribution of fixed effects with one at the 75th percentile changes the post-trade buy-and-hold abnormal return by between 15 and 51 percentage points, depending on the model.

The fixed-effect approach sheds light on how much of the variability in insider trading performance is explained by individual characteristics but not what those characteristics are. We address this issue in supplementary tests. By linking estimated insider fixed effects to observable time-invariant personal characteristics on which we have large-sample information, we show that individual fixed effects are related to the year in which the insider was born and to the insider's gender, with better performance found for younger male insiders. Still, the vast majority of the variability in insider fixed effects is attributable to individual factors which are impossible to observe or measure.

Furthermore, we consider the role of executive seniority in post-trade performance and investigate the impact of unobservable insider and firm heterogeneity on the significance of CEO and CFO dummies. The inclusion of insider fixed effects captures an individual's unobservable skills and expertise, while the CEO and CFO dummies encapsulate access to preferential information and the risk of higher scrutiny. We find a remarkable change in the significance of the CEO and CFO dummy coefficients across model specifications. It appears that, in general, the underperformance of CEOs is driven by higher scrutiny associated with the position, while CFO outperformance is determined by superior financial acumen.

We also document that insider characteristics matter most in smaller firms where insiders have the largest information advantage. Furthermore, our results, which hold solely for purchase transactions though, show that after the Sarbanes-Oxley Act was enacted in 2002, the role of differences across firms in explaining insider trading performance sharply declined, while the role of individual heterogeneity increased. Individual trading behaviors thus seem to be deeply rooted in personalities, and do not appear to be affected by broad-brush regulation.

The importance of individual heterogeneity in insider trading performance can be explained in a number of ways. One interpretation is that trading performance is closely aligned to the abilities and character of individual directors, irrespective of corporate governance. Formal structures that enhance the independence of boards or improve reporting transparency or disclosure do little to constrain the opportunistic behavior of individuals who choose to exploit misvaluation in the company's equity. Alternatively, and consistent with a signaling hypothesis, it may also be the case that corporate insiders with certain characteristics choose to personally signal that their firm's stock price is abnormally high or low. The market thus responds proportionately to the degree to which the insider is respected in the market.

The paper is structured as follows. Section 2 outlines the empirical framework that is used in this study and Section 3 describes the data. Section 4 presents empirical results and Section 5 concludes the paper.

2. Empirical Framework

The aim of empirical tests in this paper is to determine whether and to what extent personal, individual attributes of corporate insiders are important in explaining post-trade buy-and-hold abnormal returns. Our testing strategy is to first identify the explanatory power of observable firm, trade and insider characteristics, known from previous literature to determine the performance of insider trading. Then, we test the incremental explanatory power of time-invariant unobservable personal attributes captured by insider fixed effects, controlling for the observable characteristics. Because unobserved insider and firm characteristics can be correlated, we then move on to a series of tests that aim to check and disentangle the explanatory power of insider and firm fixed effects.

We start with estimating the following baseline model separately for sale and purchase transactions:

$$BHAR_{ijt} = X_{ijt}\beta + \varepsilon_{itj}, \tag{1}$$

where $BHAR_{ij}$ is the buy-and-hold abnormal return following a trade by insider i in company j on day t. X_{ijt} is a vector of time-varying firm, trade and insider observable characteristics and year dummies. The firm-level characteristics we include are the firm size, book-to-market ratio and past return. Earlier studies document that insider trading profits are larger in small firms (e.g., Seyhun, 1986, Lakonishok and Lee, 2001) and the book-to-market ratio and past return control for contrarian trading by corporate insiders (e.g., Rozeff and Zaman, 1998; Jenter, 2005). The trade-level characteristic included is the size of the trade since larger trades have arguably greater information content and are associated with higher abnormal returns.[3] The insider-level observable characteristics are two dummy variables to capture the insider's role in the company (CEO or CFO). Although top executives have better access to information (Seyhun, 1986; Ravina and Sapienza, 2010), they are also subject to higher scrutiny (Jeng et al., 2003; Fidrmuc et al., 2006). All regressions include year dummies to control for possible time trends in the profitability of insider trades driven by changing regulations and firm governance cultures (Lee et al., 2012). Note that the inclusion of year dummies does not add the standard time dimension in a panel setting as there can be more than one trade per firm and insider in a unit of time (year).

We then add insider fixed effects, γ_i, to the baseline regressions and estimate the following model:

$$BHAR_{ijt} = X_{ijt}\beta + \gamma_i + \varepsilon_{ijt}, \tag{2}$$

with an interest in the change in the adjusted R-squared of the regression compared to the baseline model (1). $BHAR_{ijt}$ and X_{ijt} are defined as above. Vector X_{ijt} still includes the CEO and CFO dummies

---

[3] See Seyhun (1986) and Fidrmuc et al. (2006) for competing perspectives on trade size metrics.

and the estimation with insider fixed effects allows us to shed light on whether the observed link between position and trading performance debated in the earlier literature is driven by executive position *per se*, or whether it captures unobservable time-invariant insider characteristics correlated with an individual being in the role. Note that we are able to jointly identify the executive position dummies and insider fixed effects as we can have an individual's trades in the same or other companies before she takes the CEO or CFO position, trades after the individual stops being the CEO or CFO, or concurrent trades in other firms if the CEO or CFO holds multiple board appointments.

The change in the adjusted R-squared between models (1) and (2) provides direct evidence on the importance of unobserved, fixed insider characteristics in explaining post-trade abnormal returns. However, an important caveat is in order. Insiders and firms do not match randomly and insiders with specific characteristics are likely to choose to work in or are likely to be sought by firms with particular profiles. In the context of our tests it means that estimated insider fixed effects can be capturing unobserved firm characteristics. To test this possibility we perform three tests. First, we estimate model (2) replacing insider fixed effects, γ_i, with firm fixed effects, μ_j:

$$BHAR_{ijt} = X_{ijt}\beta + \mu_j + \varepsilon_{ijt}, \tag{3}$$

where $BHAR_{ijt}$ and X_{ijt} are defined as before. We compare the adjusted R-squared of models (3) and (2) to provide initial evidence on which of insider and fixed effects have a greater incremental explanatory power. Second, we estimate the baseline model with fixed effects for every insider-firm combination (spell), ν_{ij}:

$$BHAR_{ijt} = X_{ijt}\beta + \nu_{ij} + \varepsilon_{ijt}. \tag{4}$$

The adjusted R-squared of model (4) compared with the statistic for models (2) and (3) will indicate whether controlling jointly for unobserved insider and firm heterogeneity increases the explanatory power of the regression. The drawback of the spell method is that it does not allow for the separation of insider and firm effects if there is at least one firm with insiders who do not trade in any other firm throughout the whole sample period. In such a case, that firm's fixed effects and its insiders' fixed effects are perfectly collinear. We address this drawback in the third test which aims to explain insider trading performance by disentangling the effects of time-invariant unobservable individual and firm effects in the 'connectedness' sample.

The concept of 'connectedness' was originally proposed by Abowd et al. (1999) and recently applied in a finance context by Coles and Li (2011a, 2011b) and Graham et al. (2012).[4] Insider and firm fixed

---

[4] See Appendix 2 in Graham et al. (2012) for a detailed methodological and econometric discussion of the estimation procedure.

effects can be separately estimated for all trades linked by a single insider's trading in multiple firms - that is, trading by an individual who moves between firms or who holds multiple insider (e.g. board) appointments.[5] Specifically, insider and firm fixed effects can be separately estimated for transactions by all insiders who trade in firms with at least one multi-firm insider, no matter in how many firms they trade themselves. To illustrate, if an insider trades in firms A and B, her multi-firm transactions are a necessary and sufficient condition to identify insider and firm fixed effects for trades by all insiders in firms A and B.[6]

In principle, we estimate the following model:

$$\text{BHAR}_{ijt} = X_{ijt}\beta + \gamma_i + \mu_j + \varepsilon_{ijt}, \tag{5}$$

with all notation as before. To understand the relative importance of unobserved fixed insider and firm characteristics in explaining the post-trade buy-and-hold returns, the R-square of the estimated models with insider and firm fixed effects is decomposed following the method proposed by Graham et al. (2012). The model R-square can be presented as

$$R^2 = \frac{\text{cov}\left(\text{BHAR}_{ij}, \overline{\text{BHAR}}_{ij}\right)}{\text{var}\left(\text{BHAR}_{ij}\right)} = \frac{\text{cov}\left(\text{BHAR}_{ij}, X_{ij}\hat{\beta}+\hat{\gamma}_i+\hat{\mu}_j\right)}{\text{var}\left(\text{BHAR}_{ij}\right)} = \frac{\text{cov}\left(\text{BHAR}_{ij}, X_{ij}\hat{\beta}\right)}{\text{var}\left(\text{BHAR}_{ij}\right)} + \frac{\text{cov}\left(\text{BHAR}_{ij},\hat{\gamma}_i\right)}{\text{var}\left(\text{BHAR}_{ij}\right)} + \frac{\text{cov}\left(\text{BHAR}_{ij},\hat{\mu}_j\right)}{\text{var}\left(\text{BHAR}_{ij}\right)}. \tag{6}$$

The normalized covariances measure the proportion of each model's sum of squares attributable to individual observable characteristics, insider fixed effects and firm fixed effects, respectively.

We are also interested in the significance of observable characteristics, conditional on unobservable insider and firm characteristics. It is likely that unobservable effects are correlated with observable factors. For example, latent skills and abilities will be related to the probability of an individual being in a top executive position (such as CEO or CFO), and these characteristics are also likely to influence insider trading performance. If unobservable insider and firm effects are correlated with observable characteristics, the coefficients of observable factors are estimated with bias if there is no control for the unobservable effects. Hence, our empirical approach allows us to reinterpret the impact of observable factors traditionally considered in the insider trading literature.

---

[5] Abowd et al. (1999), Coles and Li (2011a, 2011b) and Graham et al. (2012) call individuals with observations in more than one company 'movers', and the related sample, the 'mobility' sample. In our study, mobility between firms is not a necessary condition as we can observe an individual's trades in more than one firm even without the executive moving jobs. This is because individuals can hold multiple appointments at the same time.

[6] Because we analyze purchases and sales separately, the discussion only applies to same-type trades by an insider in more than one firm. That is, an insider's purchase transaction in firm A and a sale in firm B does not allow for the estimation.

3. Data and Variable Definitions

The primary data source is Thomson Reuters Insider Filing Data Feed (IFDF). The database contains information on reported share transactions by corporate insiders, defined as officers, directors and beneficial owners of more than 10 percent of shares outstanding. The information includes the type of transaction (buy/sell), transaction date, volume, price, identifiers of the security involved, and identifiers of the specific insider who traded. The sample period spans all trades executed between January 1986 and December 2010. As the focus of this paper is on individual insider characteristics, we exclude trades by beneficiary owners who are not officers or directors. The excluded beneficial owners are mainly financial institutions. We further select and filter the transactions following the standard approach in the literature. We limit our sample to open market or private purchases and sales (IFDF codes P and S) of common stock (CRSP share codes 10 and 11). Any trade where the reported volume is higher than the trading volume on the transaction day reported in CRSP or the transaction day closing price is lower than USD 2.00 is dropped from the sample. We also exclude trades in firms with a negative book-to-market ratio on the trading day.

Multiple trading by one insider on the same day in the same direction (buy or sell) is cumulated to give a single daily buy or sell trade. We do so for two reasons. First, same-day trades are likely to be executed on the basis of the same information. Second, treating multiple trades as separate observations could increase the correlation of post-trade abnormal returns for a given insider and firm, which would influence the statistical relationship between unobservable individual/firm characteristics and insider abnormal returns.

Firm-level stock market and accounting data are sourced from CRSP/Compustat. Individual insider characteristics (age, gender, education) come from BoardEx. BoardEx spans a number of countries and contains detailed biographical information on officers and directors, together with compensation data (see, e.g. Fernandes et al., 2012). Insiders in the Thomson Reuter IFDF and BoardEx databases are manually matched on surname, given name, middle name, and the names of companies in which they serve. The BoardEx database begins in the late 1990s, and even though we focus on time-invariant insider characteristics, the information on insiders in the earlier years of our sample period is likely to be patchy.

The variables in our regression models are defined and calculated as follows. The abnormal return estimation method follows Ravina and Sapienza (2010). For each transaction in our sample we estimate buy-and-hold abnormal returns (BHAR) over 30, 90 and 180 trading days following the transaction, with the CRSP value-weighted index used as the benchmark. Firm size is proxied by the

natural logarithm of market capitalization (measured on the trade date as the number of shares outstanding multiplied by the closing price) and expressed in USD millions. Book-to-market ratio is calculated as book value of common equity at the end of most recent fiscal quarter divided by market capitalization on the trading day. Past return is defined as the buy-and-hold abnormal return over 90 trading days preceding the transaction date. Trade size is measured as shares traded divided by the number of shares outstanding. The CEO (CFO) dummy variable is equal to one if a trade is executed by the CEO (CFO), and zero otherwise. We rely on the IFDF database for the position classifications.

Information on the sample, as well as descriptive statistics of the dependent and independent variables is presented in Table 1. Our final sample includes over 310,000 purchases and over 823,000 sales. The average number of transactions per insider, important from the viewpoint of estimating insider fixed effects, is 4.3 and 7.9 in the purchase and sale samples, respectively. At the firm level, there are an average of 28.5 purchase transactions and 76.6 sales transactions per firm. Consistent with prior literature, we find that the mean abnormal return for purchases is larger in absolute value than for sales, suggesting that sales are more likely to be for liquidity and diversification reasons and less driven by private information.

Over the 180-day horizon, purchases generate average abnormal returns of 5.95%, while for sales the respective number is -0.19%. The distribution of returns is skewed and medians are below means for both purchases and sales making the differences in average trading performance for purchases and sales difficult to interpret. Looking at independent variables, the results again confirm trends observed in previous studies. We find that sales have higher monetary value and are executed in larger firms; insiders are contrarians and time the market by buying (selling) after stock price decreases (increases); and purchase transactions tend to be in firms with higher book-to-market ratios. For both purchases and sales, about 10% of trades are executed by CEOs and about 5% by CFOs.

4. Unobservable Heterogeneity in Insider Trading Performance

4.1. The Role of Insider and Firm Heterogeneity

We explore the role and the magnitude of unobservable insider and firm attributes in explaining insider trading performance by running a set of regressions reported in Table 2 (purchases) and Table 3 (sales). All regressions include observable firm, trade and insider characteristics normally used in the empirical insider trading literature, as well as year dummies. In the first step of our analysis we measure the change in regression explanatory power when insider and firm fixed effects capture unobserved insider and firm heterogeneity, respectively. In the second step we further extend our empirical test to use the connectedness sample to be able to disentangle and quantify the relative

importance of unobservable insider, unobservable firm and a set of observable characteristics we control for.

Similar to earlier insider trading studies (e.g. Fidrmuc et al., 2006; Ravina and Sapienza, 2010), our pooled-sample test results for both purchase and sale transactions reveal very low explanatory power when firm and individual fixed effects are omitted. The adjusted R-square is, depending on the return horizon, no bigger than 3.3% for purchases (Table 2, col 1-3) and 1.9% for sales (Table 3, col 1-3). When we add insider fixed effects alone to control for the unobserved individual insider characteristics the R-square raises substantially. The R-square for models that account for insider effects is between 25.3% and 39.1% for purchases (Table 2, col 4-6), and between 19.1% and 34.2% for sales (Table 3, col 4-6), depending on the return horizon. The results point to the very important role of latent insider characteristics in explaining abnormal trading performance.

When we add firm fixed effects alone to capture the unobservable firm attributes and characteristics the explanatory power of the models raises compared to the baseline pooled regressions but the increase is smaller compared to the effect of unobservable insider characteristics. The R-square of regressions with firm fixed effects only is a few percentage points lower than for regressions with insider fixed effects only. For purchases, the R-square ranges between 17.0% and 32.8% (Table 2, col 7-9) in comparison with 25.3% and 39.1% (Table 2, col 4-6) for insider fixed effects, depending on the return horizon. For sales the R-square ranges between 11.8% and 28.5% (Table 3, col 7-9) in comparison with 19.1% and 34.2% (Table 3, col 4-6) for regressions with insider effects only. However, both insider-level and firm-level fixed effects have incremental explanatory power as documented by the results for the *spell* method reported in columns 10-12 of Tables 2 and 3. Controlling for all insider-firm spells shows a further increase in the adjusted R-square up to 49.5% in the longest return window of 181 days for purchases (Table 2 col 10-12) and up to 43.2% in the longest return window of 181 days for sales (Table col 10-12).

The results discussed above give an indication of the large importance of individual heterogeneity for explaining insider trading performance and show that individual heterogeneity is more important than firm heterogeneity. However, any far reaching conclusions cannot be drawn at this stage since it is possible that both dimensions of fixed effects are overlapping. For example, individual fixed effects may reflect firm-level insider trading constraints, or firm effects could capture average insider characteristics within a firm. We now sharpen our analysis to separately identify insider and firm effects by decomposing their relative explanatory importance in cross-sectional abnormal return regressions.

As discussed in Section 2, the connectedness created by insiders who trade in multiple firms is a necessary condition to separately estimate insider and firm fixed effects. Table 4 presents information on the number of multi-firm insiders and the connectedness they create. Altogether, 14.6% of insiders in the purchase sample and 11.2% of insiders in the sale sample have trades in more than one firm, with the majority trading in two different firms. As can be seen from the table, the relatively small number of multiple-firm insiders creates large connectedness. The connectedness sample includes around 85% of all insiders for both purchases and sales, and they execute 86.6% of all purchases and as many as 90.3% of all sale transactions. The percentage of all firms included in the connectedness sample is smaller, standing at 71.3% for purchases and 67.1% for sales.

Regression results in the connectedness sample are reported in Tables 5, Panel A, and the relative importance of different factors is presented in Table 5, Panel B. As mentioned above, the connectedness requirement reduces the sample size, and the adjusted R-square in the connectedness sample is slightly lower compared to the R-square for the *spell* method regressions. As reported in Table 5, Panel B with the exception of sales transactions for the 180-day return horizon, we find that unobservable insider characteristics are up to 3 times more important in determining post-trade abnormal returns than unobservable firm characteristics. For example, for the 30-day horizon for share purchases (Table 5, Panel B, col (1)), the observable characteristics including year dummies, insider fixed effects and firm fixed effects explain a fraction of 0.05, 0.32 and 0.10, respectively of the variation of abnormal returns following an insider trade. The remaining variation (0.53) is unexplained and captured by the model residual. Scaling the contributions by total variability explained by all components (= 1 − 0.53), we find that unobservable insider and firm characteristics contribute 68.1% and 21.6%, respectively, to the explained variation in insider trading performance. The observable characteristics account for only 10.4% of post-trade returns explained by all components of the model.

For purchase transactions (Table 5, Panel B, col 1-3), we find that unobservable insider characteristics account for at least half of the model R-square, with the contribution from unobservable firm characteristics no greater than a third. In tests of sale transactions (Table 5, Panel B, col 4-6), the impact of firm fixed effects is higher than for purchase transactions but still insider fixed effects play the dominant role in explaining trading performance in two of the three models. Firm fixed effects capture, among other factors, firm-level policies and practices related to insider trades. The greater importance of firm fixed effects for sales relative to purchases is consistent with earlier evidence on the impact of firm policies on insider trading. Bettis et al. (2000) and Lee et al. (2012) find that firm-level insider trading rules tend to limit price-sensitive selling rather than buying, and it is consistent with higher litigation risks associated with insider sales (Cheng and Lo, 2006). Consequently, we show that unobservable firm characteristics matter more for sales than purchases.

We restrict our discussion and inferences to the analysis of the variation in post-trade abnormal returns explained by insider fixed effect and do not formally test the joint significance of estimated fixed effects. As documented by Fee et al. (2013), the traditional F-test is highly problematic in settings like ours and there is no information content in the test in many cases.

Overall, our results indicate that latent individual characteristics are a key driver of insider trading abnormal returns, which vary between individuals irrespective of the culture or corporate governance of the firm. A large fraction of post-trade return variability is explained by insiders' unobservable attributes that are not captured by observable characteristics commonly considered in insider trading research. It is possible that corporate insiders with certain characteristics choose to signal their views on share mispricing. In light of the importance of individual characteristics one can argue that formal regulatory steps aimed at enhancing firm-level corporate governance or transparency will have little impact on the behavior of individuals who choose to trade on private information.

4.2. Magnitude of Individual Effects

The evidence presented so far reveals that unobservable insider characteristics captured by our models explain a large fraction of post-trade abnormal return variability. In this section we aim to understand the economic significance of our results. Towards this end, we analyze the distribution of insider fixed effects estimated in the connectedness sample to show the magnitude by which performance of individual insiders vary, controlling for unobserved firm effects and a set of observable characteristics. Note that the mean and location of fixed effects depend on the benchmark relative to which they are estimated and are therefore not meaningful in isolation. We focus instead on the dispersion of estimated fixed effects, where large dispersion indicates substantial variability in the person-specific component of trading performance. For clearer presentation, we normalize the insider fixed effects so that their mean is zero.

The Abowd et al. (1999) estimation method divides the connectedness sample into distinct groupings. Firms within each group are connected by insiders trading in multiple firms with no connection across groups. Firm and insider fixed effects are estimated relative to a benchmark for each group and hence are directly comparable within groups and not between groups. We present estimated insider fixed effects in only one, the largest group, which includes the vast majority of corporate insiders. There are 57,878 insiders with purchases and 85,605 insiders with sales in that group, which is 96.4% and 96.2% of the total connectedness sample, respectively.

Descriptive statistics of the estimated fixed effects are presented in Table 6. There is substantial variation in the magnitude of fixed effects, which suggests an economically significant difference in the effect of unobservable individual characteristics on insider trading performance. The interquartile range for the 30-day investment horizon is 18.8% for purchases and 14.8% for sales, widening to 51.1% for purchases and 43.1% for sales in the longest, 180-day, return window. The interquartile range provides an estimate of the difference in trading performance of insiders on the 25th and 75th percentile of the distribution, after controlling for the impact of unobservable firm characteristics, executive position and observable firm and trade characteristics.

To shed further light on our findings, we estimate whether insider-specific characteristics are related to time-invariant observable factors, such as education, birth cohort or gender, for which we have large-sample data. We run a set of regressions with the estimated insider fixed effects as the dependent variable, and three independent variables sourced from the BoardEx database: number of qualifications, year of birth and a gender dummy. The biographical data is available for about 32% of individuals with purchase regression fixed effects and 22% of individuals with sale regression fixed effects. The results are reported in Table 7.

We find that younger generations of insiders outperform older generations. There is also weak evidence that female insiders underperform male insiders. Overall, the regression R-squares are very low indicating that observable time-invariant personal characteristics explain only a very small fraction of the variability of individual effects in insider trading performance. Nearly all of the variability in fixed effects is attributable to personal characteristics that are very difficult or impossible to measure.

4.3. Executive Position and Insider Trading Performance

So far our focus has been on estimating and disentangling the role of unobservable heterogeneity and observable characteristics. As mentioned in Section 2, our empirical framework allows us to explore the problem of omitted variables in the insider trading literature. If unobservable time-invariant characteristics of firms and insiders are correlated with observable factors, failing to account for latent heterogeneity can bias observable characteristic coefficients.

In this subsection we focus on the significance and interpretation of CEO and CFO dummy variables. We do so for two main reasons. First, CEO and CFO dummies are most likely to suffer from omitted variable bias. This is because latent skills, knowledge and personal characteristics are linked to top positions in the corporation, leading to correlation between unobserved insider heterogeneity, trading performance and the position dummies. Second, the literature investigating the role of position in the

13

performance of insider trading presents mixed results and competing explanations. Our tests, which explicitly control for unobservable insider characteristics, can shed more light on what drives the trading performance of different insider groups.

Seyhun (1986) and Ravina and Sapienza (2010) find that top executives outperform other groups of insiders in share trading. Both papers argue that the difference is caused by the privileged position of executives with respect to the corporate information set as a result of day-to-day involvement in the firm. Nevertheless, this information hierarchy hypothesis is not supported by Jeng et al. (2003), who fail to find any abnormal trading performance of top executives. They provide a competing explanation based on regulatory and adverse attention risks, and claim that top executives (especially CEOs), who are much more closely scrutinized by regulators and investors, avoid trading on valuable private information. In line with the risk arguments, Fidrmuc et al. (2006) document that purchase transactions by CEOs generate significantly lower abnormal returns than trades of any other insider group. More recently, Wang et al. (2011) find that share purchases by CFOs significantly outperform those by the CEOs. They argue that the differences can be driven by CFOs' better insight into the financial standing of the firm but also by lower scrutiny compared to CEOs. Knewtson and Nofsinger (2012) explore the two competing explanations and conclude that the regulatory scrutiny hypothesis appears to be most appropriate.

We compare the estimated coefficients of the CEO and CFO dummies in pooled OLS models without any fixed effects and in models that control for insider and firm fixed effects using the *spell* method (col 1-3 vs. col 10-12 of Tables 2 for purchases and Table 3 for sales). The insider position dummies capture access to information and exposure to higher scrutiny on the one hand, and superior skills, and expertise, on the other. Inclusion of fixed effects captures the role of unobservable time-invariant skills and expertise, while the position dummy captures access to preferential information and regulatory scrutiny risk.

There is a remarkable change in the significance of the CEO and CFO dummy coefficients across model specifications. For purchases reported in Table 2, the coefficient of the CEO dummy is positive but insignificant in the pooled-sample tests and this becomes significantly negative when we control for unobservable insider and firm characteristics. The change indicates that executive seniority leads to less information trading and is not related to personal characteristics (e.g. risk aversion). The results are supportive of the regulatory scrutiny hypothesis (Jeng et al., 2003; Fidrmuc et al., 2006) and also indicate that the superior performance of top executives found in earlier studies may be driven by their unobserved personal traits.

The coefficient of the CFO dummy in our tests for purchases is positive and highly significant, in line with findings by Wang et al. (2011), when fixed effects are not included. This becomes negative but insignificant when we account for unobserved insider and firm heterogeneities. The result indicates that superior trading performance is not driven by executive position and associated access to financial information, but rather personal characteristics such as skills and expertise. We complement Knewtson and Nofsinger (2012) by providing direct evidence that the weaker performance of CEOs is driven by higher scrutiny associated with the position, while CFOs' abnormal trading performance is determined by their superior financial acumen.

For sale transactions reported in Table 3, CFOs trading performance does not differ significantly from the performance of other insiders, irrespective of controlling for unobserved heterogeneities. However, the results for CEOs are sensitive to the inclusion of fixed effects. For the horizon of 30 and 90 days, CEOs significantly outperform other insiders in pooled regressions where we find significantly lower (i.e. more negative) post-trade returns. However, the superior performance is driven by CEOs' unobservable skills and abilities to process information, and not their superior access to information associated with the position. Once fixed effects are included, the sign of the CEO dummy reverses, and for the 90 and 180-day horizon we find significant underperformance of CEOs. As for purchases, the finding suggests that CEOs respond to higher scrutiny risks by avoiding informed trading.

The changing signs, magnitudes and significance of the executive position dummies, together with changing coefficients of other observable characteristics (e.g. the effect of firm size and book-to-market ratio in regressions for sale transactions reported in Table 3) highlight the potential omitted-variable problem in empirical tests when there are no controls for unobserved heterogeneity at the individual or firm level.

4.4. Information Asymmetry

If the insider fixed effects reflect unobservable person characteristics that determine trading performance, we expect them to matter more when insiders have a larger information advantage over outside investors. The information advantage creates more opportunities for profitable trading, which is expected to amplify the role of individual characteristics in trading decisions.

We use firm size as a proxy for information asymmetry and split our sample into three size groups using the 30th and 70th NYSE market capitalization percentiles available from Ken French's website. The breakpoints are updated annually. The results of regressions of buy-and-hold returns over 90 days following the trade are reported in Table 8. Consistent with our prediction, we find that insider fixed effects contribute most to the model R-square in the sample of small capitalization (high information

asymmetry) firms. The difference in the contribution between small and large cap groups exceeds 10 percentage points for sales but is more modest for purchases. The size of the gap persists for unreported 30- and 180-day return horizons.

4.5. Subsample of Multiple-Firm Insiders

The tests presented so far separate insider and firm effects in the connectedness sample – the sample of trades by insiders connected by insider trading in multiple firms. The insiders included in the sample are not required to have trades in more than one firm as long as they trade in a firm that has at least one multiple-firm insider. In this section we introduce a stricter requirement and re-run the baseline tests in a sample of multiple-firm insiders only.

The results are presented in Table 9. To save space we report results for BHAR(0,90) only but the findings also hold for the 30 and 180 day windows. The sample considered is much smaller than the connectedness sample with the number of observations equal to 32.5% and 23.8% of the number of observations in the connectedness sample for purchases and sales, respectively. By and large, the signs and significance of estimated coefficients are similar to the results in the connectedness sample. However, we do find some systematic differences between the restricted sample and the connectedness sample in the decomposition of R-square. For example, the contribution of firm fixed effects to the model's R-square in purchases regression goes up from 28.9% (Model (10) in Table 3) to 51.2% (Table 9), and the contribution of insider effects decreases from 58.2% to 32.3%. Overall, in the sample of multiple-firm insiders we find that the firm effects dominate individual effects but still the importance of individual heterogeneities is not negligible.

There are a number of possible reasons for the observed differences. First, the sample of multiple-firm insiders can suffer from selectivity bias. Insiders with trades in multiple firms are either individuals who have changed jobs and moved between firms, or who hold multiple board appointments. As such, they are likely to differ from the whole population of insiders with respect to expertise, skills and other personal attributes. Restricting the sample to those individuals wipes out a lot of individual heterogeneity in the sample and hence diminishes the importance of individual unobservable characteristics in explaining trading performance. Second, the restricted sample is only about a third of the connectedness sample for purchases and a quarter of the connectedness sample for sales. The smaller sample size leads not only to the problem of selectivity, but also reduces the precision with which coefficients of the model can be estimated. Lastly, as noted by Graham et al. (2012), increasing the percentage of multiple-firm insiders in a sample may raise the role of firm effects in explaining the dependent variable, since the firm fixed effects contribute to between-firm and not within-firm

variation in the dependent variable. Consequently, they play a more significant role in explaining trading performance for multiple-firm insiders rather than for single-firm insiders.

Overall, the differences in results between the connectedness sample and the sample of multiple-firm insiders indicate that a disaggregated analysis of insider and firm effects can be noisy and should be interpreted with caution. The connectedness sampling methodology relies on insiders trading in more than one firm and when the number of multiple-firm insiders is relatively small, the idiosyncratic component of multiple-firm trading may have a large impact on the estimation (Graham et al., 2012). Nevertheless, we find that both insider and firm effects play sizeable roles in explaining insider trading performance and should be considered in empirical tests in the literature in the field.

4.6. Regulations and Insider Trading

In this section we aim to shed more light on the impact of regulations on insider trading. In particular, we analyze whether the Sarbanes-Oxley Act (SOX) had an impact on the role of unobservable insider and firm characteristics in explaining insider trading returns. The Sarbanes Oxley Act of 2002 is a wide-reaching federal law that changed the corporate landscape with the key objective to improve corporate governance and enhance disclosure practices. SOX mandated stronger firm-level internal control mechanisms, but also enhanced the individual responsibilities of top executives with increased penalties for white-collar crime. Another aspect of SOX was the requirement of more timely disclosure of insider trade activity. Brochet (2010) documents that after SOX the short-term stock price reaction in response to insider trading was stronger, indicating greater information content under the new reporting regime. He also reports that, after SOX, insiders were less likely to trade on negative private information, in line with the increased scrutiny of insider behavior introduced by regulation. Consistent with less trading on private information, Lee et al. (2012) find that long-horizon insider trading profitability fell in the post-SOX period. We provide further evidence on whether SOX had any impact on the factors driving insider trading performance.

It is an open question how SOX might affect the relative role of insider and firm characteristics in explaining post-trade abnormal returns. On the one hand, enhanced scrutiny and tighter regulations in the post-SOX period may curb opportunistic insider behavior, which could reduce the role of individual heterogeneity in explaining insider trading. Whereas pre-SOX insiders' incentives and disincentives to trade on information may be more person-specific, after SOX, with the more stringent regulatory requirement, they could potentially be homogenous, with little contribution towards explaining the variability of post-trade abnormal returns. A contrasting view is centered on the role of SOX in shaping firm-level practices. If SOX successfully strengthens firm-level internal control and

oversight mechanisms, there would be greater homogeneity across firms, with the result that latent firm-level factors would have lower power in explaining insider returns.

To analyze the impact of SOX, we re-run baseline regressions in two subperiods: 1991-2002 ('pre-SOX') and 2003-2010 ('post-SOX'). In 1990 the Securities Enforcement Remedies and Penny Stock Reform Act (SERPSRA) changed SEC enforcement powers and increased penalties for insider trading (Lee et al., 2012) and hence we include only the post-1990 period in our analysis to limit the impact of other regulatory changes. The results are presented in Table 10.

For brevity we do not report the estimated coefficients and focus only on the role of individual factors in explaining insider trading performance, which is the main interest of the analysis. We also report results for regressions of BHAR(0,90) only, since the results do not differ materially for BHAR(0,30) and BHAR(0,180) return windows. Overall, we find a differential impact of SOX on purchases and sales. For purchase transactions, we record a large increase in the role of insider fixed effects accompanied by a drop in the importance of firm fixed effects. The contribution of individual fixed effects to the R-square of the model increases from 48.8% to 75.5%, and the contribution of firm fixed effects goes down from 34.8% to only 12.3%. For sales, the effect is much more modest and the contributions from insider and firm fixed effects remain fairly stable around the enactment of SOX.

Table 10 provides convincing evidence that market wide regulations, in our case SOX, homogenize the corporate landscape but have a limited impact on individual behavior once firm-level factors are included. Our results may indicate that individual trading behaviors are deeply rooted in personalities, and regulations do not alter individual heterogeneities, although they could influence average behavior, as found by Brochet (2010) and Lee et al. (2012). The asymmetric effect of regulations on stock buying and selling behavior is somewhat puzzling and may be driven by the confounding influence of firm-level and individual-level responses, if both firm-level and insider-level factors become more homogenous.

5. Summary and Conclusions

In this paper we analyze the impact of unobservable time-invariant individual characteristics on the performance of insider trades. Our results strongly suggest that latent individual personality traits have a sizeable impact on insider trading performance and the impact is greater than the influence of the firm environment or observable characteristics. The evidence points to an important influential factor that has not been examined in this literature before, namely that corporate insiders systematically vary in ways that are not captured by position or firm characteristics. The differences

in individual effects are economically large, and the role of unobservable individual factors is most prominent where insiders have the largest informational advantage over outside investors.

Our tests explore the importance of executive roles in insider trading performance. We find that the recorded superior return performance of top executives (CEOs and CFOs) can be attributed to their better expertise and skills and not preferential access to firm information. Once we control for those unobservable individual characteristics, we find that their trading behavior is actually hampered by higher regulatory scrutiny and adverse attention associated with the top position. Our research also shows that regulations (in our case, the Sarbanes-Oxley Act) homogenize the corporate landscape, but do little to influence individual behaviors.

The findings presented in this paper have important implications. First, they highlight the need to control for individual effects in empirical tests of insider trading performance. Unobservable insider characteristics explain a large fraction of the variability of post-trade abnormal returns, and a failure to control for them can lead to biased coefficients and incorrect inferences on the determinants of trading performance. Second, the significance of insider fixed effects should be considered by investors who want to exploit information on insider transactions in their own trading decisions. Our results indicate that there is persistence in the trading performance of individual insiders driven by their skills or other personal characteristics. Importantly, this is not captured by firm effects or observable characteristics.

Future research can proceed in a number of directions. First, considering that insider fixed effects capture the stock trading ability of executives and directors, it is relevant whether corporate insiders utilize their transaction skills in firm-level stock market activities such as share repurchases or share issues, and whether outside investors recognize this in their market response. Second, taking into account that observable time-invariant insider characteristics do poorly in explaining the variability of insider fixed-effects, further work is needed to explore what drives the large dispersion in individual trading performance. Attention may converge on slow-moving characteristics, such as experience or the centrality of the insider within business and social networks. We leave these issues for further research.

References

Abowd, John M., Francis Kramarz, and David N. Margolis, 1999, High Wage Workers and High Wage Firms, *Econometrica* 67, 251-333.

Bamber, Linda S., John X. Jiang, and Isabel Y. Wang, 2010, What's My Style? The Influence of Top Mangers on Voluntary Corporate Financial Disclosure, *Accounting Review* 85, 1131-1162.

Barber, Brad M., and Terrance Odean, 2001, Boys Will be Boys: Gender, Overconfidence, and Common Stock Investment, *Quarterly Journal of Economics* 116, 261-292.

Barnea, Amir, Henrik Cronqvist, and Stephan Siegel, 2010, Nature or nurture: What determines investor behavior? *Journal of Financial Economics* 98, 583-604.

Bertrand, Marianne, and Antoinette Schoar, 2003, Managing with Style: The Effect of Managers on Firm Policies, *Quarterly Journal of Economics* 118, 1169-1208.

Bettis, J. Carr, Jeffrey L. Coles, and Michael L. Lemmon, 2000, Corporate Policies Restricting Trading by Insiders, *Journal of Financial Economics* 57, 191-220.

Bharath, Sreedhar T., M.P. Narayanan, and H. Nejat Seyhun, 2009, Are Woman Executives Disadvantaged?, University of Michigan Working Paper.

Bhattacharya, Utpal, and Cassandra D. Marshall, 2012, Do they do it for money? *Journal of Corporate Finance* 18, 92-104.

Brochet, Francois, 2010, Information Content of Insider Trades before and after the Sarbanes-Oxley Act, *Accounting Review* 85, 419-446.

Chatterjee, Arijit, and Donald C. Hambrick, 2007, It's All about Me: Narcissistic Chief Executive Officers and Their Effects on Company Strategy and Performance, *Administrative Science Quarterly,* 52, 351-386.

Cheng, Qiang, and Kin Lo, 2006, Insider trading and voluntary disclosures, *Journal of Accounting Research* 44, 815-848.

Cohen, Lauren, Christopher Malloy, and Lukasz Pomorski, 2012, Decoding Inside Information, *Journal of Finance* 67, 1009-1043.

Coles, Jeffrey L., and Zhichuan Frank Li, 2011a, Managerial Attributes, Incentives and Performance, Arizona State University Working Paper.

Coles, Jeffrey L., and Zhichuan Frank Li, 2011b, An Empirical Assessment of Empirical Corporate Finance, Arizona State University Working Paper.

Cziraki, Peter, Peter De Goeij, and Luc Renneboog, 2013, Corporate Governance Rules and Insider Trading Profits, *Review of Finance*, forthcoming.

Davidson, Robert, Aiyesha Dey, and Abbie J. Smith, 2013, Executives' Legal Records, Lavish Lifestyles and Insider Trading Activities, Georgetown University Working Paper.

Dyreng, Scott D., Michelle Hanlon, and Edward L. Maydew, 2010, The Effects of Executives on Corporate Tax Avoidance, *Accounting Review* 85, 1163-1189.

Epstein, Seymour, 1979, The Stability of Behavior: On Predicting Most of the People Much of the Time, *Journal of Personality and Social Psychology* 37, 1097-1126.

Fernandes, Nuno, Miguel A. Ferreira, Pedro Matos, and Kevin J. Murphy, 2012, Are US CEOs Paid More? New International Evidence, *Review of Financial Studies*, forthcoming.

Fidrmuc, Jana P., Marc Goergen, and Luc Renneboog, 2006, Insider trading, new releases and ownership concentration, *Journal of Finance* 61, 2931-2973.

Frankel, Richard, and Xu Li, 2004, Characteristics of a firm's information environment and the information asymmetry between insiders and outsiders, *Journal of Accounting and Economics* 37, 229-259.

Ge, Weili, Dawn Matsumoto, and Jenny L. Zhang, 2011, Do CFOs Have Style? An Empirical Investigation of the Effect of Individual CFOs on Accounting Practices, *Contemporary Accounting Research* 28, 1141-1179.

Graham, John R., Si Li, and Jiaping Qiu, 2012, Managerial Attributes and Executive Compensation, *Review of Financial Studies* 25, 144-186.

Gregory, Alan, Emma Jeans, Rajesh Tharyan, and Ian Tonks, 2013, Does the Stock Market Gender Stereotype Corporate Boards? Evidence from the Market's Reaction to Directors' Trades, *British Journal of Management 24*, 174-190.

Grinblatt, Mark, Matti Keloharju, and Juhani T. Linnainmaa, 2012, IQ, trading behavior, and performance, *Journal of Financial Economics* 104, 339-362.

Jagolinzer, Alan D., David F. Larcker, and Daniel J. Taylor, 2011, Corporate Governance and the Information Content of Insider Trades, *Journal of Accounting Research* 49, 1249-1274.

Jeng, Leslie A., Andrew Metrick, and Richard Zeckhauser, 2003, Estimating the returns to insider trading: a performance-evaluation perspective, *Review of Economics and Statistics* 85, 453-471.

Jenter, Dirk, 2005, Market timing and managerial portfolio decisions, *Journal of Finance* 60, 1903-1949.

Knewtson, Heather S., and John R. Nofsinger, 2012, CEOs, CFOs, and COOs: Why Are Certain Insiders' Trades More Informative? Working Paper.

Lakonishok, Josef, and Inmoo Lee, 2001, Are Insider Trades Informative? *Review of Financial Studies* 14, 79-111.

Landier, Augustin, and David Thesmar, 2009, Financial Contracting with Optimistic Entrepreneurs, *Review of Financial Studies* 22, 117-150.

Lee, D. Scott, Wayne H. Mikkelson, and M. Megan Partch, 1992, Managers' Trading Around Stock Repurchases, *Journal of Finance* 47, 1947-1961.

Lee, Inmoo, Michael Lemmon, Yan Li, and John M. Sequeira, 2012, Do Voluntary Corporate Restrictions on Insider Trading Eliminate Informed Insider Trading? Working Paper.

Ravina, Enrichetta, and Paola Sapienza, 2010, What Do Independent Directors Know? Evidence from Their Trading, *Review of Financial Studies* 23, 962-1003.

Rozeff, Michael S., and Mir A. Zaman, 1998, Overreaction and Insider Trading: Evidence from Growth and Value Portfolios, *Journal of Finance* 53, 701-716.

Seyhun, H. Nejat, 1986, Insiders' Profits, Costs of Trading, and Market Efficiency, *Journal of Financial Economics* 16, 189-212.

Skaife, Hollis A., David Veenman, and Daniel Wangerin, 2013, Internal control over financial reporting and managerial rent extraction: Evidence from profitability of insider trading, *Journal of Accounting and Economics* 55, 91-110.

Wang, Weimin, Yong-Chul Shin, and Bill B. Francis, 2012, Are CFOs' Trades More Informative than CEOs' Trades? *Journal of Financial and Quantitative Analysis 47*, 743-762.

Table 1. Summary statistics – whole sample

The table presents descriptive statistics of dependent and independent variables used in main regression tests. BHAR(0,30) ((0,90), (0,180)) is the stock buy-and-hold abnormal return over 30 (90, 180) trading days following the transaction. The abnormal returns are calculated relative to the CRSP value-weighted index. Ln (mcap) is the natural logarithm of market capitalization on the transaction day expressed in USD millions. Book-to-market ratio is book value of common equity at the end of most recent fiscal quarter divided by market capitalization on the trading day. Past return is the buy-and-hold abnormal return over 90 trading days preceding the transaction day. Trade size is shares traded divided by the number of shares outstanding. CEO (CFO) dummy variable takes the value of one if the trade is executed by the CEO (CFO), and zero otherwise. The sample includes open market purchases and sales by corporate insiders in the period 1986-2010. Same-day, same-direction, same-insider and same-firm trades are cumulated and treated as one observation. Data are sourced from Thomson Reuters Insider Filing Data Feed, CRSP and Compustat.

	Purchases (N = 310,014)			Sales (N = 823,707)		
	mean	std dev	median	mean	std dev	median
Dependent variables						
BHAR(0,30)	0.025	0.186	0.007	0.003	0.178	-0.004
BHAR(0,90)	0.041	0.350	0.003	-0.002	0.324	-0.023
BHAR(0,180)	0.060	0.554	-0.012	-0.002	0.478	-0.044
Independent variables						
Ln (mcap)	5.295	1.795	5.065	6.654	1.844	6.540
Book-to-market	0.817	0.793	0.643	0.413	0.374	0.329
Past return	-0.059	0.331	-0.077	0.169	0.524	0.084
Trade size ($\times$ 100)	0.043	0.173	0.009	0.070	0.268	0.021
CEO dummy	0.101	0.301	0.000	0.108	0.310	0.000
CFO dummy	0.048	0.213	0.000	0.055	0.227	0.000

	Purchases	Sales
# of insiders	71,276	103,817
Avg # of trades per insider	4.3	7.9
# of firms	10,873	10,757
Avg # of trades per firm	28.5	76.6

Table 2. Determinants of BHARs - purchases

The table presents regression results on the determinants of buy-and-hold abnormal returns following insider purchases. The variables are as defined in Table 1. Constant is included but not reported. The *spell* method assigns a fixed effect for each insider-firm combination. T-stats of standard errors adjusted for clustering within firms are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10 per cent level, respectively. The sample covers the period 1986-2010.

	Pooled (no FE)			Insider FE (no firm FE)			Firm FE (no insider FE)			Insider and firm FE (spell method)		
	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ln (mcap)	-0.002***	-0.006***	-0.009***	-0.015***	-0.042***	-0.085***	-0.038***	-0.118***	-0.244***	-0.059***	-0.178***	-0.361***
	(-5.08)	(-5.77)	(-4.92)	(-12.16)	(-14.21)	(-15.08)	(-19.04)	(-25.32)	(-25.88)	(-14.79)	(-19.19)	(-22.61)
Book-to-market	0.011***	0.013***	0.024***	0.022***	0.034***	0.053***	0.012***	0.001	-0.016*	0.013***	-0.004	-0.033***
	(5.08)	(3.45)	(3.29)	(5.64)	(4.78)	(4.55)	(3.52)	(0.26)	(-1.80)	(2.61)	(-0.54)	(-2.66)
Past return	-0.020***	0.020**	0.083***	-0.037***	-0.032**	-0.013	-0.021***	0.010	0.060***	-0.038***	-0.032**	-0.008
	(-5.33)	(2.44)	(4.99)	(-9.13)	(-2.34)	(-0.58)	(-6.13)	(1.14)	(3.79)	(-8.69)	(-2.39)	(-0.34)
Trade size	3.916***	3.989***	3.085***	2.459***	2.141***	1.131	2.835***	2.362***	1.156	2.265***	1.612**	1.045
	(8.52)	(5.37)	(3.11)	(4.83)	(2.60)	(1.11)	(6.99)	(3.67)	(1.31)	(4.34)	(2.04)	(1.07)
CEO dummy	0.003	0.005	0.006	-0.010***	-0.019**	-0.031**	-0.003*	-0.005	-0.010	-0.012**	-0.022**	-0.044**
	(1.19)	(0.91)	(0.72)	(-2.62)	(-2.31)	(-2.02)	(-1.69)	(-1.20)	(-1.42)	(-2.26)	(-2.07)	(-2.31)
CFO dummy	0.016***	0.025***	0.042***	0.002	0.005	0.023	0.008***	0.014***	0.022***	-0.011	-0.022	-0.013
	(6.35)	(4.24)	(4.20)	(0.36)	(0.46)	(0.00)	(3.98)	(3.34)	(0.00)	(-1.32)	(-1.30)	(-0.46)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-sq	1.9%	2.7%	3.3%	25.3%	32.6%	39.1%	17.0%	24.9%	32.8%	30.7%	40.3%	49.5%
# of observations	310,014	310,014	310,014	310,014	310,014	310,014	310,014	310,014	310,014	310,014	310,014	310,014

Table 3. Determinants of BHARs - sales

The table presents regression results on the determinants of buy-and-hold abnormal returns following insider sales. The variables are as defined in Table 1. Constant is included but not reported. The *spell* method assigns a fixed effect for each insider-firm combination. T-stats of standard errors adjusted for clustering within firms are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10 per cent level, respectively. The sample covers the period 1986-2010.

	Pooled (no FE)			Insider FE (no firm FE)			Firm FE (no insider FE)			Insider and firm FE (spell method)		
	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ln (mcap)	-0.001**	0.002**	0.003*	-0.026***	-0.082***	-0.160***	-0.040***	-0.129***	-0.261***	-0.059***	-0.190***	-0.377***
	(-2.06)	(2.03)	(1.84)	(-21.56)	(-23.78)	(-23.42)	(-21.79)	(-26.14)	(-28.48)	(-23.71)	(-26.36)	(-26.96)
Book-to-market	-0.006***	0.004	0.026***	-0.002	0.013	0.041***	-0.021***	-0.042***	-0.066***	-0.020***	-0.047***	-0.080***
	(-3.08)	(0.77)	(2.69)	(-0.68)	(1.43)	(2.69)	(-5.59)	(-4.09)	(-3.74)	(-3.92)	(-3.38)	(-3.48)
Past return	0.002	0.006	0.017**	-0.018***	-0.022***	-0.004	-0.009***	-0.006	0.017***	-0.019***	-0.018***	0.011
	(0.57)	(1.42)	(2.30)	(-5.87)	(-4.28)	(-0.49)	(-2.85)	(-1.38)	(2.69)	(-5.58)	(-3.28)	(1.41)
Trade size	1.057***	0.867***	0.653	0.815***	0.602*	-0.323	1.154***	1.452***	1.616***	1.359***	1.646***	1.136*
	(4.95)	(2.73)	(1.30)	(3.32)	(1.72)	(-0.64)	(5.73)	(5.01)	(3.87)	(4.68)	(3.97)	(1.94)
CEO dummy	-0.004***	-0.007*	-0.008	0.001	0.000	0.003	-0.002*	-0.003	-0.006	0.005	0.011*	0.025**
	(-2.64)	(-1.83)	(-1.21)	(0.34)	(0.01)	(0.39)	(-1.80)	(-1.21)	(-1.45)	(1.60)	(1.71)	(2.33)
CFO dummy	-0.002	-0.005	-0.010	0.005	0.003	0.006	-0.001	-0.005*	0.010**	0.003	-0.001	-0.001
	(-1.36)	(-1.49)	(-1.62)	(1.39)	(0.45)	(0.67)	(-0.78)	(-1.71)	(-2.20)	(0.69)	(-0.11)	(-0.06)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-sq	0.5%	1.9%	1.8%	19.1%	27.9%	34.2%	11.8%	20.7%	28.5%	22.7%	34.3%	43.2%
# of observations	823,707	823,707	823,707	823,707	823,707	823,707	823,707	823,707	823,707	823,707	823,707	823,707

Table 4. Insiders with trades in multiple firms and connectedness sample

The table presents information on the number of insiders with trades in more than one firm (Panel A) and the size of the connectedness sample (Panel B). The connectedness sample includes trades by insiders in firms that have at least one insider with trades in at least one other firm.

	Purchases		Sales	
Panel A. Insiders with trades in more than one firm				
	N	% of all	N	% of all
Total	10,430	14.6%	11,612	11.2%
Insiders with trades in two firms	7,195	10.1%	8,800	8.5%
Insiders with trades in three firms	1,930	2.7%	1,885	1.8%
Insiders with trades in four or more firms	1,305	1.8%	927	0.9%
Panel B. Connectedness sample				
	N	% of all	N	% of all
Trades	268,421	86.6%	744,064	90.3%
Insiders	60,041	84.2%	88,968	85.7%
Firms	7,756	71.3%	7,222	67.1%

Table 5. Relative importance of components in determining BHAR

Panel A of the table presents regression results on the determinants of buy-and-hold abnormal returns following insider transactions. The variables are as defined in Table 1. Constant is included but not reported. The sample (connectedness sample) includes trades by insiders in firms that have at least one insider with trades in at least one other firm, and allows for separate identification of insider and firm fixed effects. T-stats of standard errors adjusted for clustering within firms are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10 per cent level, respectively. Panel B presents the analysis of the relative importance of individual factors (observable characteristics, insider fixed effects and firm fixed effects) in explaining the variability of post-trade buy-and-hold returns. The sample covers the period 1986-2010.

	Panel A. Regression results					
	Purchases			Sales		
	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)
	(1)	(2)	(3)	(4)	(5)	(6)
Ln (mcap)	-0.053***	-0.160***	-0.327***	-0.055***	-0.179***	-0.358***
	(-15.87)	(-20.95)	(-23.21)	(-23.29)	(-26.04)	(-27.35)
Book-to-market	0.015***	0.001	-0.016	-0.020***	-0.040***	-0.065***
	(3.02)	(0.08)	(-1.31)	(-4.20)	(-2.98)	(-2.92)
Past return	-0.035***	-0.018	0.011	-0.017***	-0.017***	0.011
	(-7.61)	(-1.63)	(0.66)	(-5.02)	(-3.23)	(1.60)
Trade size	2.387***	2.197**	1.144	1.381***	1.683***	1.205**
	(4.12)	(2.44)	(1.06)	(4.92)	(4.20)	(2.12)
CEO dummy	-0.012***	-0.013	-0.028*	0.006*	0.013**	0.026***
	(-2.57)	(-1.45)	(-1.70)	(1.92)	(2.21)	(2.71)
CFO dummy	-0.005	0.000	0.001	0.000	0.000	-0.001
	(-0.68)	(0.00)	(0.04)	(0.01)	(0.03)	(-0.11)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-sq	29.3%	40.0%	47.8%	20.9%	32.0%	41.6%
# of observations	268,421	268,421	268,421	744,064	744,064	744,064

	Panel B. Relative importance of components in determining BHAR					
	Purchases			Sales		
	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)	BHAR(0,30)	BHAR(0,90)	BHAR(0,180)
	(1)	(2)	(3)	(4)	(5)	(6)
	$\frac{cov(BHAR, component)}{var(BHAR)}$					
Observable characteristics incl. year dummies	0.049	0.071	0.088	0.014	0.024	0.035
Insider FE	0.320	0.321	0.319	0.203	0.208	0.205
Firm FE	0.102	0.159	0.202	0.093	0.176	0.251
Residual	0.529	0.449	0.391	0.689	0.593	0.509
	% of R-sq attributable to the component					
Observable characteristics incl. year dummies	10.4%	12.9%	14.4%	4.5%	5.9%	7.1%
Insider FE	68.1%	58.2%	52.4%	65.4%	51.0%	41.8%
Firm FE	21.6%	28.9%	33.2%	30.1%	43.1%	51.1%

Table 6. Estimated insider fixed effects

The table presents descriptive statistics of insider fixed effects estimated in the connectedness sample regressions reported in Table 5. To maintain comparability of fixed-effects, only fixed effects for insiders in the largest group of firms connected by multi-firm insider trading are presented. Fixed effects are normalized so that their mean is zero.

	mean	std dev	p25	median	p75	p75-p25
Panel A. Purchases (N = 57,878)						
BHAR(0,30)	0.000	0.215	-0.096	-0.003	0.092	0.188
BHAR(0,90)	0.000	0.387	-0.179	-0.006	0.167	0.346
BHAR(0,180)	0.000	0.586	-0.265	-0.005	0.246	0.511
Panel B. Sales (N = 85,605)						
BHAR(0,30)	0.000	0.172	-0.075	-0.001	0.073	0.148
BHAR(0,90)	0.000	0.310	-0.147	-0.001	0.139	0.286
BHAR(0,180)	0.000	0.439	-0.217	0.001	0.214	0.431

Table 7. Insider fixed effects and observable time-invariant insider characteristics

The table presents the analysis of the link between estimated insider fixed effects and observable time-invariant insider characteristics: education, birth cohort and gender. Panel A presents descriptive statistics of the observable characteristics. Table B presents regression results. Dependent variables are insider fixed effects estimated in the connectedness sample regressions reported in Tables 3 and 4. T-stats of heterskedasticity consistent standard errors are reported in parentheses. Constant is included but not reported. ***, **, and * denote significance at the 1, 5, and 10 per cent level, respectively.

	Panel A. Descriptive statistics					
	Purchases (N=18,241)			*Sales (N=19,189)*		
	mean	std dev	median	mean	std dev	median
No of qualifications	1.75	1.21	2.00	1.76	1.19	2.00
Year of birth	1946	1946	10.01	1947	1947	10.28
Female dummy	0.08	0.27	0.00	0.07	0.26	0.00
	Panel B. Regression results					
	Purchases			*Sales*		
	(0,30)	(0,90)	(0,180)	(0,30)	(0,90)	(0,180)
No of qualifications	0.0016	-0.0013	-0.0033	-0.0004	-0.0022	-0.0053**
	(1.31)	(-0.59)	(-0.95)	(-0.35)	(-1.39)	(-2.28)
Year of birth	0.0001	0.0005*	0.0012***	-0.0004***	-0.0007***	-0.0005*
	(0.97)	(1.94)	(-0.76)	(-3.68)	(-3.47)	(-1.85)
Female dummy	-0.0079*	-0.0103	-0.0095	0.0055	0.0095	0.0059
	(-1.69)	(-1.23)	(-0.76)	(1.57)	(1.38)	(0.62)
R-sq	0.03%	0.03%	0.05%	0.08%	0.09%	0.05%
# of observations	18,241	18,241	18,241	19,189	19,189	19,189

Table 8. Results across Firm Size Groups

The table presents selected information on regressions of buy-and-hold abnormal returns over 90 days (BHAR(0,90)) following open market insider trades on firm size, book-to-market ratio, past return, trade size, CEO and CFO dummies and year dummies. The variables are as defined in Table 1. The regressions include insider and firm fixed effects. The regressions are estimated in the connectedness sample which includes trades by insiders in firms that have at least one insider with trades in at least one other firm, and which allows for separate identification of insider and firm fixed effects. Small cap (large cap) sample includes trades by firms with market capitalization below (above) the 30th (70th) percentile of market capitalization of NYSE-listed firms. Mid cap sample includes trades by firms with market capitalization between the 30th and 70th percentile. Breakpoints are updated annually. The sample covers the period 1986-2010.

	Purchases			Sales		
	Small cap	*Mid cap*	*Large cap*	*Small cap*	*Mid cap*	*Large cap*
Adjusted R-sq	44.8%	43.5%	29.5%	41.2%	39.3%	29.1%
# of observations	161,883	52,520	30,394	219,038	245,754	183,680
	$\frac{\text{cov(BHAR, component)}}{\text{var(BHAR)}}$					
Observable characteristics incl. year dummies	0.037	0.077	0.071	0.039	0.025	0.064
Insider FE	0.363	0.375	0.302	0.288	0.204	0.178
Firm FE	0.190	0.182	0.150	0.180	0.260	0.156
Residual	0.410	0.366	0.477	0.493	0.512	0.602
	% of R-sq attributable to the component					
Observable characteristics incl. year dummies	6.3%	12.2%	13.5%	7.7%	5.0%	16.1%
Insider FE	61.5%	59.1%	57.8%	56.8%	41.8%	44.8%
Firm FE	32.2%	28.7%	28.6%	35.5%	53.2%	39.1%

Table 9. Insider and firm FE regressions – observations for insiders trading in more than one firm

Panel A of the table presents regression results on the determinants of buy-and-hold abnormal returns over 90 days (BHAR(0,90)) following open market insider trades. The variables are as defined in Table 1. Constant is included but not reported. The sample is restricted to insiders with trades in more than one firm. T-stats of standard errors adjusted for clustering within firms are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10 per cent level, respectively. In Panel B the analysis of the relative importance of individual factors (observable characteristics, insider fixed effects and firm fixed effects) in explaining the variability of post-trade buy-and-hold returns is presented. The sample covers the period 1986-2010.

	Panel A. Regression results	
	Purchases	*Sales*
Ln (mcap)	-0.142***	-0.169***
	(-18.54)	(-15.56)
Book-to-market	0.009	-0.039*
	(0.74)	(-1.93)
Past return	0.006	-0.017**
	(0.50)	(-2.29)
Trade size	3.231***	1.601***
	(3.05)	(3.08)
CEO dummy	-0.014	0.007
	(-1.32)	(0.89)
CFO dummy	0.010	0.011
	(0.66)	(1.17)
Year dummies	Yes	Yes
Adjusted R-sq	36.9%	33.0%
# of observations	100,627	195,670

	Panel B. Relative importance of components in determining BHAR	
	Purchases	*Sales*
	$\frac{\text{cov(BHAR, component)}}{\text{var(BHAR)}}$	
Observable characteristics incl. year dummies	0.080	0.026
Insider FE	0.156	0.124
Firm FE	0.247	0.245
Residual	0.518	0.606
	% of R-sq attributable to the component	
Observable characteristics incl. year dummies	16.5%	6.5%
Insider FE	32.3%	31.4%
Firm FE	51.2%	62.1%

Table 10. Results around Sarbanes-Oxley Act

The table presents selected information on regressions of buy-and-hold abnormal returns over 90 days (BHAR(0,90)) following open market insider trades on firm size, book-to-market ratio, past return, trade size, CEO and CFO dummies and year dummies. The variables are as defined in Table 1. The regressions include insider and firm fixed effects. The regressions are estimated in the connectedness sample which includes trades by insiders in firms that have at least one insider with trades in at least one other firm, and which allows for separate identification of insider and firm fixed effects. Pre-SOX period covers 1991-2002 and post-SOX period covers 2003-2010.

	Purchases		*Sales*	
	Pre-SOX	*Post-SOX*	*Pre-SOX*	*Post-SOX*
Adjusted R-sq	44.5%	45.4%	35.3%	33.3%
# of observations	143,710	52,419	344,429	256,277
	$\frac{\text{cov(BHAR, component)}}{\text{var(BHAR)}}$			
Observable characteristics incl. year dummies	0.098	0.075	0.030	0.051
Insider FE	0.294	0.466	0.201	0.190
Firm FE	0.210	0.076	0.227	0.178
Residual	0.398	0.384	0.541	0.581
	% of R-sq attributable to the component			
Observable characteristics incl. year dummies	16.3%	12.2%	6.6%	12.3%
Insider FE	48.8%	75.5%	43.9%	45.3%
Firm FE	34.8%	12.3%	49.6%	42.5%