How much does an illegal insider trade?

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Abstract

Much research in the area of insider trading finds that illegal insiders do not trade large quantities of shares despite their informational advantage. We investigate the determinants of insider volume and provide evidence that illegal insiders trade off the returns to be gained against the expected costs of utilising their non-public information. In particular, the results indicate that while there is positive correlation between the subsequent return and the volume traded by insiders, the imposition of material sanctions, the approach of the information announcement day and having a direct connection to the information through employment all serve to significantly temper the volume traded by insiders. This study provides insight into why insiders do not trade large volumes of shares.

1. Introduction

Few situations in financial markets better epitomise the interplay between the opposing emotions of fear and greed as the choice faced by corporate insiders who illegally trade on their information. The larger the position an insider takes, the more profit he/she will make. However, it is not unreasonable to expect that trading larger volumes increases both the probability of detection and the penalty levelled against the insider if successfully prosecuted. Given these opposing considerations, how much then does an illegal insider trade?

Through an analysis of a sample of 247 illegal insider trades executed during the period 1996 to 2004, we can provide a short answer to this question: the typical insider trades only a modest amount of shares. The median position taken by insiders in our sample is 4,430 shares. Furthermore, approximately 64% of the observations denote instances where insiders traded less than 9900 shares, the threshold for 'medium-sized' trades as defined by Barclay and Warner (1993). This finding of moderate trading activity by insiders is consistent with prior studies of illegal insider trading activity. For example, Meulbroek (1992) finds in her sample of illegal insider trades executed during the period 1974 to 1988 that transgressors trade on average 9819 shares before information announcements. Cornell and Sirri (1992), analysing the behaviour of 38 individuals who traded before the announcement of the acquisition of Campbell-Taggart by Anheuser-Busch in 1982, document an average position of 6989 shares per individual.[1] And finally Fishe and Robe (2005), examining trades made by five brokers who obtained copies of an influential *Business*

[1] This figure is calculated by taking the total volume transacted by insiders before the announcement, provided in the Appendix of that paper as 265,600 shares, and dividing by 38, the number of insiders who transacted before the announcement.

Week article in advance of its public release, find the combined position for all five brokers averaged 6720 per stock traded (with a median of 5000 shares).

This consistency in insider trading behaviour across studies and time provides the base for which to further examine the behaviour of illegal insiders. In particular we examine the factors which explain the (modest) volume traded by insiders, including how volume is influenced by the expected profit to be made (greed) and the costs associated with getting caught (fear). We also examine the role other factors such as concurrent market conditions, characteristics of the insider, and timing of the trades have in determining the volume traded by individuals. Our results indicate that greater price changes are correlated with larger positions by insiders, while larger imposed penalties coincide with lower holdings, all other things equal. We find that insiders trade 0.49% more shares for each 1% increase in the absolute dollar price change (between the insider's trade and the announcement date), but trade 0.79% less shares for each 1% increase in the dollar penalty per share. This result provides an explanation as to why illegal insiders tend to trade only modest amounts of stock. While this appears to be an intuitive result, very few studies explicitly study and quantify the interplay between these two competing factors.

An exception to this is Seyhun (1992) who examines how insiders respond to increased expected penalties and whether this alters the profitability of their trades. His study examines legal insider trades reported to the SEC over the period January 1975 to December 1989, which coincides with several increases in the level of enforcement of insider trading regulations. He finds a positive correlation between profitability and insider trading volume over his sample period, suggesting that insiders tend to trade more as the returns from their trades increase. Our study is consistent with this result. His findings with respect to how increased penalties affect the volume traded by insiders are not as definitive. The paper reports that insider volume is *positively* correlated with an increase in insider trading penalties enacted under statute. However, he also finds that insider volume *immediately prior to earnings and merger announcements* decreases substantially over his sample, a phenomenon he attributes to the effectiveness of case law in curtailing insider trading. The primary difference between our paper and Seyhun's (1992) is that we examine illegal rather legal insider trades. This represents an important distinction since the very fact that reported insider trades are lodged with the regulatory body implies that they are less likely to be motivated by information and the magnitude of the volume traded is less likely to be as sensitive to potential penalties compared to covert insider trades.

Our work complements existing theoretical literature which models the volume decision facing insider or informed traders as a trade-off between expected return and penalty. DeMarzo, Fishman and Hagerty (1998) develop a model which describes the optimal enforcement policy of insider trading regulations subject to certain assumptions regarding the regulator's budget and the behaviour of market participants (market maker, insider and non-insiders). While the focus of their research is on regulator policy they also consider the appropriate trading strategy of the insider. In their model, the insider trades when the information is expected to have only a moderate effect on prices. Large price movements attract more attention from the regulator and increase the probability of investigation substantially while small price movements do not provide enough return relative to the penalty associated with getting caught. The model of Seyhun (1992; p177) predicts that insiders trade greater volumes when their information is more valuable (i.e. when the expected price movement is greater). His model also predicts that larger penalties lead to less insider trading and a weaker relationship between information and volume. Our findings support the predictions of his model (if not his empirical results). Our work is also related to the some of the literature that models the volume traded by informed participants in securities markets. While the costs associated with being 'discovered' are fundamentally different between informed and insider traders[2], there is nevertheless comparability in the behaviour between these two groups. Models such as Easley and O'Hara (1987) and Kyle (1985) predict that informed traders attempt to maximise profits through trading as many shares as possible, but also temper their trading so as to conceal their status as an informed trader.

Finally our work is also related to studies which examine aggregate volume changes prior to events which are known to involve or are likely to involve illegal insider trading. Many studies document abnormal volume in either stock or options markets prior to information announcements (e.g. Cao, Chen and Griffin, 2005; Jayaraman, Frye and Sabherwal 2001; Keown and Pinkerton, 1981). In particular Meulbroek (1992), analysing prosecuted insider trading cases, finds that almost all 'abnormal' volume prior to an information announcement can be attributed to illegal insider activity. Our study extends the analysis contained in these studies by investigating the determinants of insider trading volume before information announcements.

[2] If discovered, informed investors face a reduction in the size of their profits, whereas illegal insiders face significant pecuniary and other sanctions.

Apart from identifying a positive (negative) relationship between volume and price change (penalty) this paper also finds that insiders tend to trade less stock when transacting with a specialist as opposed to multiple dealers. Illegal insider also trade less stock as the announcement day approaches. Finally illegal insiders trade less stock if they are more proximate to the information – that is, employees, consultants or legal advisors to the firms in our sample trade less than their tippees. Following the recommendation of Chakravaty and McConnell (1999), we re-run our initial analysis so as to compare insider trades to non-insider trades, rather than to a null of zero. Our results are generally strengthened when undertaking this methodology – with the exception that there is some evidence that the negative relationship between insider volume and trading with a specialist is weaker in a comparison to randomly selected trades.

The rest of this paper is organised as follows. Section 2 develops a model which explains the volume traded (illegally) by an insider in possession of inside information. Section 3 describes the data used to test the model, while section 4 presents our results and robustness tests. Section 5 concludes.

2. Theory

The purpose of this section is to describe a model that predicts the optimal volume to be traded by an individual that has access to non-public price sensitive information ("the insider").We denote the traded volume by s. Our model is a generalisation of Sehyun (1992) that allows for risk-averse investors and arbitrary probability density functions.

Let *z* be the event that crime is committed. Let *h* be the event that it is detected. Both *z* and *h* are Bernoulli variables.

In looking at transgressions, we are conditioning upon *z = 1*. In the case of *h*, *Prob (h = 1) = P(s)*. The transgressor has a utility function *U(sr)* where *r* is the return of the risky asset. Transgressing implies that $r \,|\, z = 1 \sim N(\mu + \Delta, \sigma^2)$ whilst $r \,|\, z = 0 \sim N(\mu, \sigma^2); \Delta > 0$. We may endogenise *z* by letting the investor choose the maximum of $E(U(sr)/z=1)$ *versus* $E(U(sr/z=0)$. However, since our data are for transgressors, we shall not pursue this further and shall suppress the conditioning on *z = 1*. Thus our investor chooses *s* to maximise expected utility;

$$\max E(U(sr) = E(U(sr)/h=1)P(s) \\ +E(U(sr)/h=0)(1-P(s)). \qquad (1)$$

Denoting the left hand side of (1) by *V(s)*, we need to solve for $V'(s) = 0$.

$$\begin{aligned} V'(s) &= P'(s)(E(U(sr)/h=1) - E(U(sr)/h=0)) \\ &\quad +P(s)(E(U'(sr)r/h=1)) + (1-P(s))E(U'(sr)r/h=0) \\ &= P'(s)[E(U(sr)/h=1) - E(U(sr)/h=0)] \\ &\quad +E(U'(sr)r) = 0 \end{aligned}$$

We expect *P(s)* to be increasing in *s*, $P'(s) > 0$. Also the term $\phi(s) = E(U(sr)/h=1) - E(U(sr)/h=0)$ should be negative since the utility of the investor of detection should be smaller than the utility associated with non-detection. This proves that for an interior maximum $E(U'(sr)r) > 0$. If we now consider the second derivative $V''(s)$, for this to be negative corresponding to a maximum, we see that

$V''(s) = P''(s)\varphi(s) + P'(s)\varphi'(s) + E(U''(sr)r^2).$

Sufficient conditions for a maximum are that $P''(s)$ is non-negative, that $U''() < 0$, that is, the investor is risk-averse, and that $\varphi'(s) \leq 0.$ This implies that

$$E(U'(sr)r / h = 1) \leq E(U'(sr)r / h = 0).$$

This means that the “marginal utility” from increasing *s* under detection must be less than the marginal utility of increasing *s* under non-detection.

It is not implausible to consider a risk-loving transgressor. In this case. different sufficient conditions on $\varphi'(s) \leq 0.$ and *P(s)* need to apply.

Particular choices of functional form for *U(sr)* and *P(s)* leads to particular solutions. Seiyun’s empirical work is motivated by $U(w) = w$ (risk-neutrality),where *w* is more generally wealth and $P(s) = \lambda s$ (a linear probability model in s). We can compute more complex forms but these in turn lead to complex first-order conditions that can only be solved by non-linear methods or approximation.

As an example, suppose that $P(s) = P(0)\exp(sv)$. We need to examine an upper bound $\bar{s}$ such that $P(\bar{s}) = P(0)\exp(\bar{s}v) \leq 1$ and $P(0) > 0$. *P(0)* could be interpreted as the probability of detection of “insider trading” without the actual purchase/sale of the asset. Other specifications such as $P(s) = s^{\alpha}P(0)$ have similar properties. For $\alpha > 0,$ $P(0) = 0$ so there is no probability of detection without trade, $P(\bar{s}) = \bar{s}^{\alpha}P(0) \leq 1$ and $P'(s) = \alpha s^{\alpha-1}P(0) > 0$ and $P''(s) = \alpha(\alpha-1)s^{\alpha-2}P(0).$ If we require $P''(s) \geq 0,$ then $\alpha \geq 1$.

If we assume $r \mid z = 1 \sim N(\mu + \Delta, \sigma^2)$ and $U(rz) = -\exp(-\lambda rz); \lambda > 0$ then

$$V(s) = \quad -\exp(-\lambda s(\mu+\Delta-c)+\frac{\lambda^2}{2}s^2\sigma^2)P(0)\exp(sv)$$

$$-\exp(-\lambda(\mu+\Delta)+\frac{\lambda^2}{2}s^2\sigma^2)(1-P(0)\exp(sv))$$

$$V(s) = \quad -\exp(\frac{\lambda^2}{2}s^2\sigma^2-\lambda s(\mu+\Delta))$$

$$(\exp(c\lambda s)P(0)\exp(sv))+(1-P(0))\exp(sv)$$

maximising this with respect to s is equivalent to minimising –V(s) or $\ln(-V(s))$ or maximising $-\ln(-V(s))$ so

$$-\ln(-V(s)) = \lambda s(\mu+\Delta)-\frac{\lambda^2}{2}(s^2\sigma^2)$$

$$-\ln(\exp((c\lambda+v)sP(0)+(1-P(0))\exp(sv))$$

This is clearly non-linear in s but we can approximate the last term by Taylor's series first on exp(x) and then on $\ln(1+x)$

$$\ln((1-P(0))(1+sv+½s^2v^2)$$

$$+P(0)(1+(c\lambda+v)s+½(c\lambda+v)^2s^2)$$

$$=\ln(1+P(0)(c\lambda s)+½\mathrm{P}(0)(c^2\lambda^2+2\lambda cv)s^2).$$

Using

$$\ln(1+x)\approx x-\frac{x^2}{2}$$

$$\approx P(0)c\lambda s+½\mathrm{P}(0)(c^2\lambda^2+2\lambda cv)s^2$$

$$-½\mathrm{P}(0)c^2\lambda^2s^2$$

$$=P(0)sc\lambda+P(0)\lambda cvs^2.$$

Thus we get

$$-\frac{1}{\lambda}\ln(-V(s)) = s(\mu+\Delta) - \frac{\lambda}{2}s^2\sigma^2$$

$$-P(0)cs = P(0)cvs^2$$

$$= s\lambda(\mu+\Delta-P(0)c) - \frac{\lambda^2}{2}s^2(\sigma^2 + \frac{2P(0)cv}{\lambda})$$

This leads to $s = \frac{(\mu+\Delta-P(0)c)}{\lambda\left(\sigma^2 + \frac{2P(0)cv}{\lambda}\right)}$

It is apparent that *s* is reduced by an increase in *c* not just through the mean effect (numerator) but also via the variance effect (denominator). Furthermore an increase in λ (absolute risk aversion) will decrease *s* as well. An increase in Δ will increase s as will an increase in μ. An increase in *v* will decrease s as will an increase in *P(0).* The last two parameters correspond to shifts in the probability of detection function *P(s).* As expected, an increase in the variability of the asset (σ^2) will also decrease s.

The implications of this model, over and above existing models, is that the volatility of the investment will decrease the amount invested in an insider trade. This is driven by the model and the independence of *P(s)* from σ^2. It would be straightforward to extend the above analysis to make σ^2 a parameter of *P(s)* which decreases the probability of detection. This would then have a countervailing effect on the magnitude of s so that, in an extended model at least the impact of volatility could be ambiguous. Other factors which might influence the probability of detection and are considered in our empirical analysis of insider trading in Section 4 include:

1. *Specialist versus dealer markets* – Several empirical studies examine whether specialist market makers are better at detecting informed trading than dealers in a multiple market maker environment. In an analysis of repeated illegal insider trading in 116 stocks, Fishe and Robe (2004) show that specialists on exchange-listed securities reduce depth and increase bid-ask spreads after illegal insiders begin trading. In contrast, for NASDAQ listed securities quoted depth decreases, but less so than for NYSE-listed stocks, and there is no appreciable reduction in bid-ask spreads. Garfinkel and Nimalendran (2003) show that effective bid-ask spreads for NYSE-listed stocks, are larger *vis-à-vis* NASDAQ-listed stocks on days when registered (legal) insiders trade. Rather than analyse particular incidences of informed trading, Heidle and Huang (2002) examine how the probability of informed trading in general differs as stocks transfer from dealer to specialist markets, and vice versa. Their results indicate a move to a multiple dealer environment coincides with a higher likelihood of informed trading overall, suggestive of the fact that this market structure is less able to constrain informed investors. Theoretical work also predicts that specialists might be better able to avoid informed trading.[3] Given the results of these studies, insiders wishing to conceal the fact they are trading illegally may choose to be less aggressive when trading in a specialist market such as the NYSE.

2. *Days between trade and information announcement* – the probability of being sanctioned may be a function of the time between the trade by the insider and

[3] For example, Benveniste, Marcus and Wilhelm (1992) model the repeated interactions between brokers and specialists on the floor of the exchange. Their model predicts that floor brokers have an incentive to signal to specialists when they suspect their client is informed, in order to avoid subsequent sanctions from the specialist and to reduce overall costs for their clients.

the date of the announcement. If insiders believe that trading immediately before an information announcement is more likely to attract a penalty then a rational insider will trade as far away from the information event as possible.[4] Park, Jang and Loeb (1995) provide a simple model of how insiders time their trades with respect to forthcoming earnings announcements. Their model predicts that insider trading decreases substantially as the earnings day approaches to the point where immediately before the announcement insiders trade less than they 'normally' would. If the predictions of their model are correct there should exist a positive relationship between the days to announcement and insider volume.

3. *The proximity to the non-public information* – the degrees of separation between the trader and any individual who has access to non-public information might determine the volume they trade. To successfully prosecute an individual for illegal insider trading, the regulator must establish possession of material non-public information. If it is easier to establish possession of information for employees of the company in question than those that are separated from that information, then direct insiders will trade less, if at all, because their probability of sanction is higher.

4. *Normal trading volume of security* – if the volume traded by the insider is significant relative to the usual volume traded in the security then the regulator may be more likely to investigate those particular trades. If this is the case, then the insider will trade fewer shares in illiquid securities.

[4] An alternative explanation, unrelated to the probability of sanction but with the same expected outcome, is that insiders will trade larger amounts as early as possible to maximise expected profit before the information is impounded into the price by other informed traders.

3. Data and Sample Selection

Insider trading data are drawn from litigation reports made available on the SEC website (http://www.sec.gov/litigation/litreleases.shtml) when the SEC formally brings an action against an individual. We examine all cases where illegal insider transactions occur between 1996 and 2004. The focus of this study is exclusively on trades in common stock before mergers or earnings announcements.[5] Furthermore we constrain our sample to include only those stocks that are publicly listed, that is, we do not consider stocks that trade in the over the counter market. The litigation reports provide varying levels of detail about the insider's trades. The name of the defendant, the volume traded, the price of the transaction, the date of trade, the date the insider's information became public, the security being traded and the penalty levelled against the insider are collected.

Using this information, trade packages are constructed by aggregating all volume traded by an individual before a given news announcement in a given security. Aggregation of insider volume occurs because our model is relevant for describing the total volume traded by an insider before a given announcement, and not how the insider chooses to break up orders across time before the announcement. Therefore trade 'packages' rather than individual trades are the unit of observation in this study.

While it is possible for individuals to trade in more than one listed company or for several different individuals to trade shares in the same company, each observation in

[5] Cases involving solely options or derivatives trading were not examined. Cases where the insider(s) traded both options and common stock are included but only the common stock trades are analysed.

our sample represents a unique insider-company combination.[6] For each trade package, the closing and opening prices surrounding the first trading day in the package and the date of the news announcement are collected. Total market volume on the 30 days preceding the first trade in the package is also collected. All price and volume data is sourced from Bloomberg. Finally, we consult the annual report corresponding to the financial year of the insider's trade to determine which exchange the stock was listed on at the time of the illegal trading activity.

The litigation reports are not standardised and therefore, many observations are lost due to incomplete case data. Table 1 describes the proportion of observations that are included in our sample compared to the population of all trade packages over the sample period. The sample consists of 247 trade packages out of a possible 457 (earnings and merger announcements for publicly listed companies only), representing 54.05% of the population. As a point of comparison, Meulbroek 1992 who uses publicly available litigation reports and confidential case files to build her sample, is only able to analyse data that captures 69% of defendants charged with insider trading between the years 1980 to 1989.[7] While this unit of observation – 'defendants' – is not the same as the unit analysed in this study – 'trade packages' – it nevertheless highlights the fact that significant data loss occurs when attempting to extract information from non-standardised litigation reports.

Table 2 depicts the sample selection criteria. There are 457 observations available over the sample period. Sixty nine observations are lost because the litigation reports

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[6] In one case an individual traded the same security before two different news announcements pertaining to the same company. This was defined as two separate trade packages and so technically each observation in our sample represents a unique insider-company-news announcement combination.
[7] Our sample selection criteria are similar to Meulbroek's (1992) except that her analysis does not require data on the penalty levelled against the insider.

do not provide the amount of shares traded by the insider. A further 133 observations are removed from the sample because the litigation reports do not mention the penalty imposed upon the illegal insider. Finally eight observations are lost because the date on which the insider performed the trade is unavailable. The final sample is 247 packages which represents the trading of 166 defendants across 143 stocks, prosecuted in 131 cases (see Table 3). Two hundred and eleven observations in our sample involve prior knowledge of mergers or tender offers, while 36 observations relate to earnings announcements.

Descriptive statistics for the sample are presented in Table 4. Table 4 documents significant skewness to the right in almost all the variables. The median amount of stock traded by insiders is 4430 shares per package with a value of approximately $88,000. This amount of stock is within the range designated by Barclay and Warner (1993) as 'medium sized' trades (500 – 9,999), the amount most likely to be used by informed traders to 'stealth trade'.[8] The volume traded by insiders represents 4.43% (median) of the average daily trading volume in the security over the previous thirty days, indicating that insiders have a reasonably significant presence in the market during their trading window. Insiders trade around seven days before the announcement and use between one to two trades to implement their strategy.

Table 4 also presents the imputed profit or loss avoided by the insiders. This value is calculated by first determining the absolute price change between the closing price the day before the first trade in the package and the last trade on the day of the news

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[8] Barclay and Warner (1993) analyse individual trades rather than trade packages as is the case in this study. The median individual trade size of our sample is 2000, which also fits within the 'medium sized' category of Barclay and Warner.

announcement.[9] This is then multiplied by the number of shares in the package to calculate the imputed profit or loss avoided. The median profit reaped by insiders per security they traded is $27,750.

The median penalty is $63,997 and the median penalty per dollar of (imputed) profit is 2.00. In civil cases the penalty assessment is the sum of all monies that the defendant is forced to pay. This usually involves full disgorgement of profits, some civil penalty and interest assessments. If a defendant is given a criminal sanction beyond a civil penalty, this is added to the total penalty levelled against the individual. In litigation reports sanctions are often reported *per individual*. When determining the penalty *per trade package*, penalty assessments for individuals are scaled by the profit made per trade package for the individual in question. For example, if a defendant makes a profit of $10,000 in one trade package and $40,000 in another trade package, the penalty for that individual is split across those packages using a ratio of 1:4. Legislation restricts civil penalties to three times the profit made, implying an upper limit of this variable to 4 times (assuming full disgorgement). However, it is possible for the penalty per dollar profit ratio to exceed 4 times. This can occur if insiders are ordered to pay the disgorgement of tippees as well as their own penalties. The ratio can also exceed theoretical statutory limits if there is a significant period between the trade and the imposition of sanction, leading to very large interest assessments. Finally, the penalty per profit ratio can exceed four if significant criminal sanctions are imposed.

[9] Where the last trade on the day prior to the first trade of the package is not available, the price documented in the litigation report is used, if available.

4.1 Empirical Results

In order to test the determinants of volume traded by insiders we estimate several different specifications of the model outlined in Section 2. The regressions contain the following variables which are designed to proxy for the theoretical determinants mentioned previously. The dependant variable, *ln*(*volume)* is the natural log of total volume transacted by the insider in the trade package standardised by the average daily traded volume in the security over the previous thirty days. As is apparent from the specification of the dependant variable, we do not explicitly consider the effect that 'normal' liquidity of the security has on insider volume by incorporating it on the right hand side of the equation. Rather insider volume is scaled by extant liquidity. This produces a more appropriate measure of the dependant variable in a cross-sectional regression where traded volumes can differ substantially simply due to variations in liquidity. Furthermore, scaling insider volume by some measure of broader liquidity is common in papers on insider trading.[10]

The variable *ln(price change)* is the natural log of the absolute dollar return between the last trade on the day before the first trade in the package and the last trade on the day of the information announcement. When the information announcement occurs after the market close, the opening price on the next day is used to calculate the price change. In order to ensure comparability across stocks and time, the price change is net of the market return over the insiders' holding period. The variable, *ln(penalty)* is equal to the natural log of the penalty per trade package (described earlier) scaled by volume of the trade package. *Specialist* is a dummy variable which equals one if the insider traded on the New York Stock Exchange or American Stock Exchange and

[10] See for example Seyhun, (1992 p. 168); Cornell and Sirri, (1992 p.1045); Chakravaty and McConnel, (1997, p26); Fishe and Robe (2005 p479).

zero otherwise (NASDAQ). The variable *ln*(*days)* is equal to the natural log of one plus the volume weighted average number of calendar days before the information announcement that the insider performed the trades.[11] *Direct insider* captures the proximity of the illegal trader to the inside information. It equals one if the individual is an employee, legal advisor or consultant to the company about to make the information announcement, or in the case of a merger an employee, consultant or legal advisor to the target or acquiring firm. It is equal to zero otherwise.

The regression results are presented in Table 5. Model 1 denotes the most parsimonious representation of our theoretical model – containing only the price change and penalty determinants. The results of Models 2, 3 and 4 depict how the model changes as an extra determinant is added to this base specification. Models 5, 6, 7 represent the basic specification plus two additional determinants, while Model 8 represents the full specification. As indicated by the respective F-statistics, the variables are jointly significant at the 1% level across all specifications. The models describe between 17.8% (Model 1) to 26.6% (Model 8) of the variation in the dependant variable. As for individual coefficients the results are generally consistent regardless of the specification. We will refer to the results from all models but focus primarily on the results from the fully specified model (Model 8).

The coefficient on the price change variable is positive across all models, ranging from 0.15 (Model 7) to 0.26 (Model 2). The value of the coefficient in the full model

[11] $Days = \sum_{i=1}^{n} \frac{d_i * v_i}{V_n}$ where *n* is the number of trades in the package, d_i is the number of calendar days before the information announcement that the insider performed trade *i*, v_i is the volume for trade *i*, and V_n is the total volume traded in the package.

(Model 8), 0.21, indicates that for every one percent increase in dollar return (net of market), insiders will trade 0.21% more shares relative to the underlying volume in the security. This is consistent with models of informed and insider trading, where individuals trade larger volumes when there are greater rents to be made (e.g. Seyhun, 1992, Easley and O'Hara, 1987). As indicated by the respective t-stats, there is weak evidence that the variable is significantly different from zero, moving between significance and non-significance at conventional levels depending on the exact model specification. In the full model the variable is marginally significant with a p-value of 13%.

The coefficient on the natural log of scaled penalty is negative and significant at the 1% level across all models. The parameter coefficient is robust to the exact model specification ranging from -0.72 to -0.74. This suggests that insiders respond significantly to greater penalties by lowering their traded volume. For every one percent increase in penalty per share an insider will trade 0.74% less volume. The finding of penalty effect is supported empirically by Garfinkel (1997) who examines the effect of increased sanctions under the *Insider Trading and Securities Fraud Enforcement Act (1988)* (ITSFEA) on insider trading before earnings announcements. In the post-ITSFEA environment, the paper documents significantly less (legal) insider trading before announcements as well as larger price movements after the date of the earnings announcement. Both of these findings are consistent with the notion that insiders respond to the possibility of harsher sanctions by reducing their traded volume.

The coefficient on *specialist,* -1.08 (Model 8), is negative and significant at the 1% level indicating that insiders are more likely to trade greater volumes in a multiple dealer environment than with a specialist on the NYSE or AMEX. This is consistent with previous studies that show NYSE specialists are more easily able to detect informed trading and adjust their quotes or spreads accordingly (Fishe and Robe, 2001; Garfinkel and Nimalendran, 2003). Insiders appear to have their volume constrained when trading with specialists compared to other market structures.

The coefficient on *ln(days)* (0.29) is significantly positive at the 10% level, indicating that insiders trade less as the announcement day approaches, consistent with detection minimization behavior and the model proposed by Park, Jang and Loeb, (1995). Finally, as indicated by the coefficient on *direct insider*, direct insiders of companies – employees, legal advisors and consultants – trade 63% less volume than those tipped off by direct insiders. This coefficient is significant at the 10% level for Model 8. This is consistent with the hypothesis that those closer to the information will trade less (assuming they choose to trade at all) because it is easier for the regulator to establish a connection between the insider and the information.

Overall the results suggest that illegal insiders are forced to curb their trading significantly as they engage in detection and cost minimisation behaviour. For a stock trading at $20 (the approximate median trade price in our sample), an expected return of 25 percent – not atypical for merger announcements – would correlate with insider volume equal to 32% of day's average trading volume in the security, *assuming all other determinants have zero net effect on trading.* Summary statistics and prior research indicate that insiders rarely trade this amount of shares. Instead the threat of penalties, the actions of specialists and the desire to avoid detection significantly reduce the volume traded by insiders.

4.2 Additional Tests

The results of the preceding section are not completely conclusive insofar as they may just reflect normal trading behaviour of which insider trading behaviour is a subset. For example, the results show that insiders trade less when engaging with specialists. It is unclear whether this is a general phenomenon of all trading or unique to insiders. Essentially, our initial results are not able to distinguish between insider and normal trading behaviour, and therefore any implications drawn from these results may not be useful. [12]

To overcome this problem we repeat our analysis using a sample of trades which are matched to trade packages. For each package, a suitable information announcement is found which mostly closely corresponds to the announcement associated with that package. Matching is based on (in order of importance) announcement type (merger or earnings), the date of the announcement, the market capitalisation of the firm undertaking the announcement (four weeks prior to the information release) and the exchange on which the security is listed. Once a suitable announcement is found, all trading days from the announcement day to (x+15) days prior to the announcement are sourced from the Securities Research Centre for the Asia Pacific (SIRCA), where x corresponds to the (closest integer) value for the *days* variable of the particular

[12] One of the first papers to incorporate non-insider trades into their analysis of insider trading behaviour was Park, Jang and Loeb (1995), p600. This issue was also raised by Chakravaty and McConnell (1999).

package.[13] Over the relevant period a trade is drawn at random as a match to the insider's trades, with each trade in the sampling window having an equal probability of selection. For each matched trade, the dependant variable and the covariates ln(*price change), ln(days), specialist* and *direct insider* are constructed in the same manner as for the original (hereafter treatment) sample. The variable *ln(penalty)* is not applicable for the matched control sample.

Table 6 provides descriptive statistics for the treatment and control samples. Consistent with our matching criteria, there is little difference in either the mean or median market capitalisation between the treatment and control samples. The mean (median) market capitalisation of the firms in the treatment sample is $2238.82 million ($314.79 million), while for the control it is $2164.44 million ($337.77 million). The average absolute announcement day return for the treatment sample (0.29) is larger than for the control sample (0.16). Given that there are greater incentives for insiders to trade before announcements that have larger returns, the treatment sample is more likely to be skewed towards those announcements with larger returns *vis-à-vis* a random sample of announcements. The fact that the random sample has lower announcement date returns is important in the setting of our controlled analysis, since we naturally assume that, on average, the randomly drawn trades represent normal, non-insider trading.

[13] Two competing factors require consideration when choosing the appropriate window from which to draw the random trade. Since trading conditions change significantly as the day of the announcement approaches, to ensure appropriateness of the match some degree of similarity is required between the sampling window from which we draw the trade and the trading window facing the insider. However, matching too closely on days to announcement dampens the power of this variable to distinguish between insider and non-insider trades. Our approach is a compromise between these two considerations.

We estimate the following cross-sectional regression on the combined sample of treatment and control observations:

$$\begin{aligned}\ln(volume_i) = \alpha + \beta_1 \ln(|price\ change_i|) + \beta_2 specialist_i + \beta_3 \ln(days_i) + \beta_4 D \\ + \beta_5 \ln(|price\ change_i|) * D + \beta_6 specialist_i * D + \beta_7 \ln(days_i) * D \\ + \beta_8 \ln(penalty) * D + \beta_9 direct\ insider * D + \varepsilon\end{aligned} \quad (7)$$

Where *D* is a dummy variable which equals 1 if the trade is part of the treatment sample and zero otherwise. Effectively these coefficients identify the incremental effect that a covariate has on volume if the trade is an illegal insider trade. The results are presented in column one of Table 6. The results highlight the importance of comparing insider trades to non-insider trades rather than to a null of zero. There are two differences between the results presented in Table 5 versus the results presented here. Firstly, the coefficient on *ln(price change) * D* is positive, 0.49, and significant at the 1% level, whereas previously the results were only marginally significant. This outcome stems from the fact that randomly selected trades exhibit a significant negative relationship between trade size and absolute price change following the announcement. This is to be expected given that there is likely to be a positive relationship between absolute price change and share price and, in the course of normal trading, there is a negative relationship between share price and trade size. The net effect is that for our treatment sample, the positive correlation between volume and price change previously considered only weakly significant (when tested against a null of zero) is now abnormally significant when tested against a selection a random trades. This confirms the predictions of the model that illegal insiders trade larger quantities if the value of their information is greater.

A second difference is that the coefficient on *ln(days)*, while still positive, is not as significant as in Table 5. The coefficient is now significant only at the 10% level. This finding suggests a weak positive relationship between trade size and days to announcement for the control sample of trades. While, few studies, if any, examine the relationship between trade size and days to announcement,[14] a large body of literature documents significant price increases before mergers and earnings announcements (e.g. Keown and Pinkerton, 1981; Dennis and McConnell, 1986; Jarrell and Poulsen, 1989; Morse, 1981). The slight positive relationship between trade size and days to announcement, therefore, might be explained by a general negative relationship between trade size and share price, and an increase in share price prior to the announcement. The net effect is that the significance of our initial finding is weaker given that randomly selected trades also exhibit a similar positive relationship between the size of trades and days to announcement. For the remaining variables the results of the robustness test confirm or strengthen our initial findings. Results indicate significant (at the 5% level) negative coefficients for interaction terms on *specialist*, *ln(penalty)* and *direct insider* variables.

For the preceding robustness test, only one trade is matched to each insider trade package. There is potential for inappropriate matching since each trade package might represent more than one trade[15]. Therefore, it is possible that the dependent variable for treatment sample observations is biased upwards for reasons unrelated to inherent differences between insider trading and normal trading. To some extent the single

[14] However, many studies examine the changes in total volume prior to merger announcements and typically find significant increases in volume as the announcement day approaches (e.g. Jarrell and Poulsen, 1989; Pound and Zeckhauser, 1990; Schwert, 1996; Jayaraman, Frye and Sabherwal, 2001; Cao, Chen and Griffin; 2005).

[15] However, 162 observations, or approximately 65% of the treatment sample involve only one trade and 210 observations or 85% of the sample involve one or two trades.

dummy variable (coefficient four) in equation 7 controls for this bias, but to further ensure the robustness of our results we match each package that involves more than one trade to a number of randomly selected trades corresponding to the number of trades performed by the illegal insider. For example, if an insider's trade package is the aggregation of four trades, then we match to this a random selection of four trades and aggregate these trades into a 'trade package'. As previously, we construct the independent variables *ln(price change), ln(days)* and *specialist* and re-run the analysis. The results are presented in column two of Table 7. The results of this analysis are not materially different from that discussed previously, with the exception of the *specialist* dummy variable. While still negative, the coefficient is no longer significant at conventional levels.

5. Summary and Conclusion

This paper empirically analyses the determinants of insider trading volume executed by illegal insiders. We find that there is a positive relationship between subsequent price change in a security and the volume traded by insiders. The results also indicate that there is a negative relationship between imposed sanction and volume. This suggests that insiders trade off the costs and benefits associated with utilising their illegal information. The analysis also indicates that insiders trade less as the announcement day approaches and if they have a close connection through employment to the firm undertaking the information announcement. Our initial results provide evidence that insiders tend to trade less when engaging with a specialist but the results of our final robustness test did not validate this finding.

The results of this study have implications for regulators seeking to detect and prosecute insider trading. In particular, our results show that, *prima facie*, illegal insiders do not trade large amounts of stock. However, insiders do trade substantially prior to information announcements at times when 'normal traders' would be relatively inactive, that is, *not* immediately before the announcement. They then trade much less than normal traders immediately prior to the announcement. Our findings suggest that greater nuance should be added to the notion that the mark of illegal insider activity is in general, 'large price changes on large volumes' (Harris, 2003; p588).

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Tables

Table 1 – Trade packages: January 1996 to December 2004

This table reports the total population of trade packages in all litigation reports filed between January 1997 and December 2007. The population of trade packages consists of all trades in common stock before merger and earnings announcements. The year corresponds to the year in which the insider trade occurred and not the year of prosecution. This table also reports the number of trade packages remaining in the sample once all filters have been applied.

Year	Trade packages in population	Trade packages in sample	Percent in sample
1996	36	22	61.11%
1997	53	31	58.49%
1998	59	29	49.15%
1999	69	38	55.07%
2000	101	53	52.48%
2001	38	22	57.89%
2002	28	12	42.86%
2003	49	30	61.22%
2004	24	10	41.67%
Total	457	247	54.27%

Table 2 – Sample Selection Criteria

Filter	Observations Lost	Observations Available
All insider trade packages	0	457
No data on volume traded by insider	69	388
No data on penalty	133	255
No data on date of trade	8	247
Total Available trade packages		247
Percentage of total		54.05%

Table 3 – Distribution of sample across years

This table reports the distribution of the sample across years, by trade packages, defendants, stocks and cases. The value in the 'All years' field does not necessarily equal the sum of the individual years because several defendants / stocks / cases are present in the sample in more than one year.

Year	Trade Packages	Defendants	Stocks	Cases
1996	22	22	13	17
1997	31	19	21	15
1998	29	27	16	19
1999	38	34	22	23
2000	54	45	29	27
2001	22	21	10	12
2002	12	12	9	8
2003	30	27	12	13
2004	10	10	8	9
All years	247	166	143	131

Table 4 – Descriptive Statistics

This table provides mean, median, maximum and minimum values for our sample of trade packages across several variables. *Volume* represents the amount of stock traded by the insider per package. *Volume / Liquidity* represents the total insider volume divided by the average daily market volume on the 30 days prior to the day in which the insider traded. *Dollar Value* is equal to the volume of the trade package multiplied by the closing price on the day before the first trade in the package. *Price Change* is the absolute percentage price change between the closing price on the day of the announcement and the day before the first trade in the package (net of market). *Days* represents the volume weighted average number of calendar days before the information announcement that the insider performed the trades. *Number of trades* is the number of trades per trade package executed by the insider. *Imputed Profit (Loss Avoided)* is the dollar value of profit made or losses avoided by the insider. This value is calculated by first determining the absolute price change between the closing price the day before the first trade in the package and the last trade on the day of the news announcement. This is then multiplied by the number of shares in the package to calculate the imputed profit or loss avoided. *Dollar penalty* is equal to the dollar value of the penalty imposed by the SEC. The penalty is the total sum of disgorgement, civil penalties, criminal sanctions and interest and is on a per trade package basis. The penalty is also scaled by the profit of the insider and reported below.

	Mean	Median	Maximum	Minimum
Volume	22903	4430	1400000	50
Volume / Liquidity	47.07%	4.43%	1904.76%	0.02%
Dollar Value	$478,647	$88,369	$29,844,030	$995
Absolute Price Change (dollar value)	$10.95	$7.40	$64.50	$0.063
Absolute Price Change (%)	50.67	42.66	288.20	0.03
Days	17.90	7.43	254.00	0.00
Number of trades	1.69	1.00	40.00	1.00
Imputed Profit (Loss Avoided)	$204,797	$27,750	$15,050,000	$56
Penalty	$327,770	$63,997	$7,819,509	$624
Penalty (scaled by imputed profit)	4.55	2.00	55.20	0.01

Table 5 – Regression Results

Coefficient estimates and corresponding test statistics for several regression specifications. The regressions contain the following variables: the dependant variable, *volume* is equal to the total volume traded by an individual before a given news announcement standardised by the average daily traded volume in the preceding 30 days ; *price change* is the return between the last price on the day preceding the first trade in a package and the last price on the day of the news announcement; *specialist* is a dummy variable equal to one if the stock is traded on the NYSE or AMEX and zero otherwise; *days* is the volume weighted number of days before the information announcement that the insider traded the shares; *penalty* is equal to the penalty levelled against the insider for that particular trade, divided by trade size; and *insider* is a variable equal to one if the individual is an employee, legal advisor or consultant to the company and zero otherwise.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	-1.48 (-5.09)****	-1.05 (-3.61)****	-2.26 (-6.00)****	-1.17 (-3.71)****	-1.64 (-4.16)****	-0.83 (-2.67)****	-1.99 (-5.17)****	-1.47 (-3.70)****
ln(price change)	0.19 (1.31)	0.26 (1.81)**	0.17 (1.17)	0.18 (1.21)	0.23 (1.65)**	0.24 (1.71)**	0.15 (1.03)	0.21 (1.50)
ln(penalty)	-0.72 (-6.37)****	-0.72 (-6.66)****	-0.72 (6.46)****	-0.74 (-6.56)****	-0.72 (-6.70)****	-0.73 (-6.80)****	-0.74 (-6.71)****	-0.74 (-6.88)****
Specialist		-1.32 (-4.89)****			-1.17 (-4.26)****	-1.25 (-4.66)****		-1.08 (-3.90)****
ln(days)			0.37 (3.19)****		0.25 (2.19)***		0.41 (3.56)****	0.29 (2.54)**
Insider				-0.67 (-2.31)****		-0.52 (-1.84)**	-0.80 (-2.79)****	-0.63 (-2.25)**
n	247	247	247	247	247	247	247	247
F-Stat	26.35****	27.18****	21.62****	19.56****	21.90****	21.44****	18.62****	18.82****
Adjusted R^2	0.178	0.242	0.201	0.185	0.254	0.249	0.222	0.266

** - denotes significance at the 10% level

*** - denotes significance at the 5% level

**** - denotes significance at the 1% level

Table 6 – Descriptive Statistics of Treatment and Control Samples

Treatment Sample	n	Mean	Median	Std Dev
Market Capitalisation of Firms	143	2223.82	314.79	6309.09
Return on announcement date	143	0.29	0.21	0.33
NYSE or AMEX listed securities	102			
Control Sample	n	Mean	Median	Std Dev
Market Capitalisation of Firms	144	2164.44	342.34	6215.28
Return on announcement date	144	0.16	0.11	0.18
NYSE or AMEX listed securities	128			

Table 7 – Robustness Test

This table reports the results of several regressions. The first regression specification is:

$$\ln(volume_i) = \alpha + \beta_1 \ln(|price\ change_i|) + \beta_2 specialist_i + \beta_3 \ln(days_i) + \beta_4 D + \beta_5 \ln(|price\ change_i|) * D + \beta_6 specialist_i * D + \beta_7 \ln(days_i) * D + \beta_8 \ln(penalty) * D + \beta_9 direct\ insider * D + \varepsilon$$

which is estimated on a sample representing 247 insider trading packages and a control sample of trades matched on announcement type, market capitalisation of security, date and exchange.

Variable	**All**	**Matched pairs involving only one trade by insider**
Intercept	-1.77 (-0.86)	-4.22 (-5.77)****
ln(price_change)	-0.27 (-3.05)****	-0.14 (-1.36)
Specialist	-0.17 (-0.66)	0.06 (0.18)
ln(days)	-0.53 (-1.18)	-0.09 (-0.43)
D	0.30 (0.15)	2.41 (2.78)****
ln(price_change) * D	0.49 (2.96)****	0.38 (2.11)**
Specialist * D	-0.91 (-2.44)***	-0.85 (-1.81)**
ln(days) * D	0.82 (1.77)**	0.32 (1.24)
ln(penalty) * D	-0.74 (-7.01)****	-0.76 (-5.80)****
Direct insider * D	-0.63 (-2.29)***	-0.24 (-0.69)
n	494	324
F-statistic	20.89****	9.73****
Adj. R^2	0.266	0.196

** - denotes significance at the 10% level
*** - denotes significance at the 5% level
**** - denotes significance at the 1% level