ILLEGAL INSIDER TRADING:

Price Discovery Through the Prism of Private Information

Lina Obolevica

Sophie Schayah

Stockholm Business School

Stockholm University

Acknowledgements

Abstract

This study investigates the effect of illegal insider trading on price discovery in stocks. The rationale of the research lies in the debate over whether insider trading creates more informative stock prices and the intention to provide a better basis for regulating financial markets. The research design is comprised of three regression models. The models assess the topic both in terms of abnormal returns earned by illegal insider on the days they trade prior to public news announcements and in terms of a possible causality between illegal insider activity and stock price movements. We find that illegal insiders earn abnormal returns but do not contribute to improved price discovery. Rather than being the cause of gradual price fluctuations, insiders are affected by past price movements.

Abstract

1. Introduction

The notion of insider trading is central for financial markets. In the European Union, the Market Abuse Regulation (596/2014/EU), often abbreviated to MAR, is the main framework regulating various types of market abuse, including but not limited to market manipulation, insider dealing and unlawful disclosure of inside information. The framework defines insider information as "information of a precise nature, which has not been made public, relating, directly or indirectly, to one or more issuers [...], and which, if it were made public, would be likely to have a significant effect on the prices of those financial instruments" (European Parliament and Council Regulation 596/2014/EU, p. 24). When in possession of insider information, buying or selling financial instruments to which the information relates is considered to be an illegal act of insider trading (European Parliament and Council Regulation 596/2014/EU). In Sweden, insider trading is legal if the insider does not trade in relation to an upcoming news announcement and reports her trades to the Financial Supervisory Authority (Finansinspektionen, 2018). The purpose of the legal framework and the extensive reporting procedures is to achieve a fair and transparent financial market by eliminating any informational advantages obtained by insiders. But is insider trading solely harmful to the market quality? Or do insiders contribute to increased informativeness of prices?

Traditional theoretical models acknowledge an adverse effect of informed trading on the market quality (Bagehot, 1971; Glosten and Milgrom, 1985; Kyle, 1985; Leland, 1992). An increased density of informed traders leads to a suppressed market depth and wider spreads, while it is expected to increase price discovery. There tends to be a trade-off between the two important market functions: liquidity and price discovery. In fact, both concepts can influence asset prices in the presence of asymmetric information and better understanding of one can lead to improved insight regarding the other (O'Hara, 2003).

Though insider trading is widely discussed in academia, there is no uniform approach for assessing its market impact. Previous empirical research use either legal or illegal insider trading to address the subject. The former perspective results in findings that insiders do not alter their trading patterns around news and cause no significant market reaction, suggesting that the prices do not become more informative (Elliott et al., 1984; Lakonishok and Lee, 2001). Simultaneously, stocks with a history of more frequent insider trading demonstrate wider spreads and hence decreased liquidity (Chung and Charoenwong, 1998). The fact that legal insider trading is self-reported corporate transactions poses a question whether it is the

most appropriate type of data to base the analysis on. This particular type of trading is by definition not allowed to be based on private information not yet released to the public. Hence, it should not be informative.

Investigating illegal insider trading yields a consensus regarding immediate price movements in connection to insider activity and the insiders' ability to earn abnormal returns (Meulbroek, 1992; Cornell and Sirri, 1992; Chakravarty and McConnell, 1997; Fishe and Robe, 2004; Ahern, 2017). Despite insiders facilitating price discovery, there is no support for assuming that their trades contribute more to price discovery than those of non-insiders (Chakravarty and McConnell, 1999). At the same time, inspecting the effect of illegal insider activity on liquidity yields conflicting results. It either causes no market response (Cornell and Sirri, 1992; Chakravarty and McConnell, 1997) or leads to declining depth (Fishe and Robe, 2004).

Though there are studies focusing on confirmed observations of illegal trading, research on actions of multiple insiders is limited to Meulbroek (1992). The remaining part of academia on this subject is based on one insider's activity in one stock. We intend to contribute with additional empirical insights, using a large sample of confirmed illegal insider trading instances. Hence, we examine if the findings of previous research are valid for insider trading in general. Additionally, the previous research lack complete understanding of whether actions of insiders are the cause of large price movements or vice versa. The only authors focusing on the matter are Chakravarty and McConnell (1997;1999), using hourly data in their analysis. By applying our analysis on a more granular data of 15-minute intervals, we intend to conduct a more thorough study on the role of insider trading in the price discovery process.

The rationale of our research is based upon the academic debate over whether or not illegal insider trading is harmful to the market efficiency at a microstructural level. The debate can be considered from two perspectives: the aspect of fairness surrounding trading when investors are differentially informed and the aspect of market efficiency in terms of price informativeness. Since there is a lack of consensus regarding a common interpretation of a fair market, we do not address the first aspect and focus solely on measuring the impact of illegal insider trading on price discovery.

There are three major factors creating a space for further research. First, the amount of research using direct observations of illegal insider trading is limited. Second, these studies tend to focus on actions of one insider on one stock. Third, they are unable to distinguish the causality between illegal insider activity and price movements. Our study aims to isolate

the effect illegal insider trading has on price discovery and draw inferences on the causality between information-motivated transactions and fluctuations in prices. By doing so, we intend to contribute with new findings regarding illegal insider trading and its impact on the process of incorporating additional information into stock prices. The main question we address is:

"Does illegal insider trading facilitate price discovery?"

The market of choice is Sweden due to two key reasons. First, the overwhelming majority of prevailing research is concentrated around the US stock market. It raises a question whether the conclusions drawn on the effects of illegal insider trading on stock prices are applicable across global markets or relevant exclusively for the American market. As a member of the European Union, Sweden is obliged to comply with MAR. Since the US is not covered by the EU regulation, examining the Swedish financial market allows for analysis of illegal insider trading in a different legislative setting. Second, the Public Access to Information and Secrecy Act (Offentlighets- och sekretesslagen, 2009) provides an opportunity to obtain transaction data on multiple prosecuted instances of illegal insider trading. By focusing on Sweden, scope of the preceding studies is expanded further in order to gain a more nuanced understanding of the matter.

The methodology of our research consists of two different approaches to assess the effect illegal insider trading has on price discovery. The first approach examines whether abnormal returns are earned on the days illegal insiders trade prior to public news announcements, following the method suggested in Meulbroek (1992). The second approach investigates the connection between confirmed illegal insider trades and price movements and follows the procedures presented in Chakravarty and McConnell (1997).

Our findings suggest that on the days when illegal insiders execute their trades, the opportunity to earn abnormal returns is present. On average, those days yield an abnormal return that exceeds the expected return by 1.82%. The analysis further implies that the presence of abnormal returns does not confirm any improvement in price discovery from insider trading. The prices fail to become more informative when insiders use private information to conduct their trades. Additionally, there seems to be no sign of illegal insiders' ability to create gradual price movements. Their investment decisions affect stock prices in the subsequent 15-minute interval after the trade but do not have any lasting impact. A reverse effect is found to be

statistically significant, where fluctuations in stock prices trigger insiders to act within 45 minutes.

This paper consists of six sections. Section two reviews the prevailing body of research on insider trading from both a theoretical and empirical point of view. Section three contains data collection and description as well as outlines the methodology used for empirical analysis. Section four comprises the empirical findings and provides an analysis regarding the relation between illegal insider trading and price discovery. In section five, our results are discussed and compared to the previous empirical findings. Finally, we provide concluding remarks in section six.

2. Literature review

2.1 Theoretical Framework

In academia, Bagehot (1971) is considered to be the pioneer within the field of informed trading. His research discusses the economics of market making by distinguishing three key categories of market participants. The first category consists of transactors in possession of private information. Transactors lacking an informational advantage and trading merely to fulfill their liquidity needs form the second group. The final category describes transactors who engage in market transactions being convinced they are in possession of information which has not yet been included in the market price, while in reality the market already accounts for it. According to Bagehot (1971), the market maker is at a disadvantage when trading with the first category of transactors. The losses that occur in this particular kind of transaction are reimbursed by gains acquired from trading with the second category of transactors. The issue arising from trading with the first two categories of transactors is that it is not known which particular category the market maker has to deal with. To secure that the losses do not exceed the gains, the market maker sets a bid-ask spread, which affects the liquidity-motivated transactors and the information-motivated transactors equally.

In an attempt to quantify the theory outlined by Bagehot (1971), Kyle (1985) and Glosten and Milgrom (1985) design two models incorporating informed trading. Similarly to Bagehot (1971), the authors acknowledge the inability to distinguish the transactors driven by liquidity needs from the transactors trading on superior information. Kyle (1985) investigates

the rate at which new information becomes reflected in the market price and concludes that a greater proportion of liquidity-motivated transactors contributes to an improved market depth. Thus, it can be said that market depth is inversely proportional to the amount of transactors in possession of private information. Glosten and Milgrom (1985) concentrate on how the presence of information-motivated transactors affect the spread. In the designed model, the market maker chooses to set regret free quotes. The regret free quotes ensure that the market maker does not regret any trade she is obliged to make and are dependent on the presumed proportion of the information-motivated transactors. When information-motivated transactors constitute a greater portion of all transactors, the market maker's quotes are set further apart.

Leland (1992) combines the insights provided by Kyle (1985) and Glosten and Milgrom (1985) in his development of a model that includes differentially informed investors, which are based on the transactors distinguished by Bagehot (1971). The author evaluates the validity of arguments that informed trading is entirely harmful or beneficial for financial markets. Rather than reaching a conclusive verdict, Leland (1992) emphasises that whether informed trading harms or helps markets depends on the characteristics exhibited by those markets. In markets where informed trading is not prohibited, stock prices are expected to reflect information more accurately. Simultaneously, the same regulatory environment contributes to decreased levels of liquidity. In markets where informed trading is restricted, the market dynamics are expected to be opposite.

Similarly to Leland (1992), O'Hara (2003) focuses on the two main functions of financial markets - liquidity and price discovery. Her research explores implications of market microstructure in terms of these functions for the process of price formation. O'Hara (2003) emphasises that asset prices evolve in markets and that both liquidity and price discovery play an essential role in explaining the dynamics of price movements. Particularly in the presence of differentially informed transactors, the impact of the two concepts on the pricing of assets cannot be ignored. According to O'Hara (2003), liquidity affects the price formation through transaction costs arising from a wider bid-ask spread as the market maker attempts to protect herself from losses to information-motivated transactors. Price discovery influences asset price behaviour through a risk which liquidity-motivated transactors become exposed to. The risk occurs due to information asymmetry being present between the liquidity-motivated transactors and the information-motivated transactors as the latter attempt to realise their profits at the expense of the former. O'Hara (2003) advocates strongly for transaction costs of liquidity and risks of price discovery being accounted for when analysing prices.

2.2 Prevailing Empirical Findings

In research regarding informational advantage, insider traders are a common proxy used to capture the concept of information-motivated transactors. The majority of the prevailing studies on illegal insider trading is primarily concerned with the effects on market liquidity while there is little to no attention paid to its effect on price discovery. As O'Hara (2003) emphasises, both liquidity and price discovery affect formation of stock prices. Combining her statement with the insights from Leland (1992), this paper aims to inspect the empirical findings on insider trading both in terms of price discovery and liquidity.

2.2.1 Price Discovery

The speed and accuracy at which new information is incorporated into the transaction price is the main principle behind the price discovery mechanism (Hasbrouck, 1995). The research focusing on the impact of insider trading on stock prices is examined from two perspectives - inferred and confirmed instances of insider trading. Inferences about insider trading tend to be made based on the existence of abnormal returns prior to public news announcements. To name a few, Keown and Pinkerton (1981), Jarrell and Poulsen (1989), Christophe et al. (2010) as well as Baruch et al. (2017) take this approach. The confirmed instances can be further divided into observations associated with either legal or illegal insider trading activity. While the former approach appears to be more frequently used, the latter seems to be more appropriate for assessing the effects of insider trading. This is due to legal insider trading being self-reported corporate transactions, which by definition is not based on material, private information. Since trading on information of this type is prohibited by law, it is more likely that corporate insiders will avoid reporting such trades to the authorities. However, investigating the effect of insider trades on price discovery through self-reported insider trades can still lead to valuable insights, as access to data on illegal insider trading activities is often limited or even non-existent.

Two research papers based on legal insider trading are Elliott et al. (1984) and Lakonishok and Lee (2001). Elliott et al. (1984) examine the distributional characteristics of legal insider trading, comparing the trading patterns around news announcements to the patterns during periods when no public information is disclosed. The main finding suggests that insiders are generally placing their trading orders in a profitable manner, indicating that some use of private information is present. However, when mapping insider trading around public announcement days, the authors find no evidence of significantly altered trading strategies.

6

Hence, it is reasonable to assume that no additional information is incorporated into prices preceding public information releases. When examining the market reaction to legal insider trading, Lakonishok and Lee (2001) anticipate observing a significant market response on the days legal insiders trade and/or the days their trades are disclosed. Instead, their results demonstrate no substantial change in stock prices around trading and reporting days. Despite the market remaining unresponsive in the short term, the authors conclude that the aggregated activity of legal insiders possess a certain predictive power for future price movements.

Though Elliott et al. (1984) and Lakonishok and Lee (2001) provide informative insights on the relation between insider trading and price efficiency, there is a main drawback to their research design. Since the authors focus primarily on legal insider trading, the fact that the market does not incorporate additional information into stock prices may not come as a surprise. As per definition, legal insider trading is not allowed to be conducted using material information not yet available to the general public. Considering this essential aspect, legal insider activity should not contribute to an increased informativeness of prices, which is also confirmed by the findings in Elliott et al. (1984) and Lakonishok and Lee (2001).

In contrast to legal insider trading, illegal trading is related to subsequent news announcements. Hence, it is more appropriate to use confirmed observations of illegal insider trading to assess the effect of informational advantage on price discovery. Due to limited disclosure of details surrounding illegal insider trading, there is a scarcity of academic articles addressing the matter.

One of the most influential works on illegal insider trading is written by Meulbroek (1992). The author investigates whether insider trading contributes to a greater accuracy of stock prices. By examining a group of individuals charged with insider trading violations, she conducts an event study to measure abnormal returns both on the days when insiders trade and on the days when the private information becomes publicly announced. When the abnormal returns on both days have the same sign, the author interprets it as insider trading improving accuracy of stock prices. The research concludes that significant price movements caused by insider trading leads to greater accuracy of stock prices. On insider trading days, the abnormal price movements range between 40% and 50% of the price response on public announcement days. The result of Meulbroek (1992) implies that insider trading is related to immediate price movements, which is a consequence of the stock market's ability to identify insider trading and incorporate inside information in the stock prices prior to its release to all

market participants. Subsequently, insider trades trigger quick price reactions and thus improved price discovery.

Ahern (2017) obtains findings consistent with those of Meulbroek (1992). The author observes that illegal insider trading impose a significant effect on stock prices. Increased density of illegal trades pushes prices closer to their fundamental values at a higher rate. A comparison between stock returns on the day of the public announcement and stock returns realised by illegal insiders reveals that the latter are significantly greater. This indicates that a substantial portion of the returns in total is earned prior to the news and that insiders are capable of correctly predicting the direction of stock prices on the day of the announcement. Therefore, Ahern (2017) arrives at a conclusion that trading activity by illegal insiders significantly improves informativeness of stock prices, making them more accurate. The result in Ahern (2017) is further supported by similar evidence presented in Cornell and Sirri (1992) as well as Fishe and Robe (2004).

Chakravarty and McConnell (1997; 1999) joins the discussion on price discovery in relation to actions of illegal insiders. Their earlier findings suggest that the presence of illegal insiders introduces a lack of response in liquidity but facilitates price discovery. Chakravarty and McConnell (1997) specify that trading actions of the illegal insider led to a subsequent increase in stock price rather than the rise in stock price being the reason behind the insider trading activity. For this reason, it is appropriate to draw the inference that trading actions of illegal insiders make incorporation of private information into stock prices more efficient. However, their later study finds no evidence that the effect caused by the illegal insider is significantly distinguishable from the impact made by any other trader. Nevertheless, Chakravarty and McConnell (1999) continue to emphasise that a positive correlation between the insider's trades and the stock price undeniably exists. The authors identify no significant difference between how the insider and the non-insiders contribute to price discovery. Hence, illegal insider trading has no superior role in creating more accurate prices than uninformed trading. Chakravarty and McConnell (1999) do not entirely contradict the findings of Meulbroek (1992), Ahern (2017), Cornell and Sirri (1992) as well as Fishe and Robe (2004). All presented research agrees on illegal insider trading having an impact on informativeness of prices. Simultaneously, Chakravarty and McConnell (1999) also take into account non-insider trading and add that there is no detectable difference between these two categories in their contribution to price discovery in stocks.

In our opinion, the primary weakness of the presented research on illegal insider trading is the assumption that all trading activity not conducted by prosecuted insiders is attributable to those lacking any informational advantage. It may be rather unrealistic to presume that all illegal trading actions are detected and lead to legal prosecution. Despite being an apparent weakness, the assumption can be necessary to analyse illegal insiders' impact on stock price dynamics.

2.2.2 Liquidity

As the theoretical framework states, the presence of information-motivated traders reduces market depth and contributes to a wider spread, which is associated with suppressed liquidity (O'Hara, 2003). When it comes to empirical findings, there are various views on whether the theories hold. Fishe and Robe (2004) agree with Kyle (1985) and find evidence that insider trading leads to a diminished market depth. The authors focus on five stock brokers who were able to acquire information ahead of other market participants. Fishe and Robe (2004) find that only ask depth is affected significantly. It is observed that the brokers engaged solely in purchases, which may explain why the bid depth remains unaffected. In comparison to the average quoted depth the day before, ask depth declines by 38% for NYSE and AMEX stocks during the intervals when the insiders trade. For Nasdaq stocks, ask depth drops by 3%. Hence, the theory defined by Kyle (1985) is supported.

Similarly to Fishe and Robe (2004), Chung and Charoenwong (1998) attempt to find empirical evidence for the conclusions drawn in the theoretical framework. The latter concentrate on the dynamics of spreads and investigate whether spreads are affected significantly on the days of insider trading. The authors examine insider trading both cross-sectionally over stocks and through time, yielding different results. The cross-sectional analysis reveals that the stocks with a higher density of insider trading demonstrate wider spreads than the stocks with less frequent insider trading activities. However, the time-series analysis shows no indication of changes in spreads on insider trading days. The results imply that market makers are not able to know exactly when an insider trade is taking place. Nevertheless, the previous patterns of insider trading allow market makers to infer which stocks are more likely to be exposed to insider trading activities. Due to this knowledge, market makers are prone to set wider spreads for stocks with greater extent of insider trading. The finding is consistent with the theory outlined in Glosten and Milgrom (1985).

Both Fishe and Robe (2004) and Chung and Charoenwong (1998) identify an effect of insider trading on the market dynamics. However, they base their research on different types of insiders. The former study investigates illegal trading activities by insiders lacking any corporate connection to the stocks they trade in. The informational advantage they obtain originates from a subjective analysis presented in a newspaper column. As opposed to that, the latter study uses legal insider trades voluntarily disclosed to the regulatory authorities. These legal trading activities are performed by individuals with corporate connections to the companies in which stock they trade in. It may suggest that no matter the means used to acquire informational advantage, the effect can still be significant.

In addition, it is crucial to point out that the time-series analysis performed by Chung and Charoenwong (1998) may fail to provide any evidence of insider trading effect due to a restricted research design. Since the intraday spread is aggregated into average daily spreads, important information may be lost. The authors are not able to estimate the effect of a particular insider trade on the spread. Unlike Chung and Charoenwong (1998), Fishe and Robe (2004) succeed to provide precise measurements of the impact. The estimation procedure presented by the latter appears to be applicable to a greater extent as the authors focus on shorter intraday intervals rather than inspecting the total daily insider transactions.

Two studies finding contradicting results to those presented in the work of Fishe and Robe (2004) and Chung and Charoenwong (1998) are Cornell and Sirri (1992) and Chakravarty and McConnell (1997). Cornell and Sirri (1992) centre their attention around a tender offer. One of the directors in the acquiring company leaked the information regarding the upcoming acquisition to a small group of individuals, who subsequently purchased the acquired company's stock in large amounts. The authors find that the illegal insider trades do not result in a wider spread. The rise in the adverse selection component of the spread predicted by Glosten and Milgrom (1985) is absent. In fact, the trades contribute to a tighter effective spread. The illegal trading activity attracted liquidity-motivated traders. Besides providing market makers with additional earnings, they relieved the market makers from the burden of engaging in insider trading by trading with the insiders directly. Thus, the market maker was able to compensate the losses incurred in trades with insider traders with the profits obtained in trades with liquidity-motivated traders without widening the spread. The result contradicts the models described in the work of Bagehot (1971), Kyle (1985) and Glosten and Milgrom (1985). In a similar manner, the empirical findings of Chakravarty and McConnell (1997) suggest that the trading activity of one particular insider caused no significant impact on either quoted or

effective spread. Furthermore, the authors detect no effect on the bid depth or the ask depth. Thus, Chakravarty and McConnell (1997) argue that spread and depth are rather unresponsive to the presence of insiders.

A feature that the works of both Cornell and Sirri (1992) and Chakravarty and McConnell (1997) have in common is an analysis based on instances of illegal trading. The non-public information the insiders had access to was of substantial importance for the value of the companies in question and subsequently their stock. However, while Cornell and Sirri (1992) concentrate on trading activities of numerous insiders, Chakravarty and McConnell (1997) choose to take into account trading of one particular corporate insider. Focusing on only one insider introduces a certain level of concern as to whether the results of Chakravarty and McConnell (1997) can be applied to a larger population and a different time interval. Cornell and Sirri (1992) encounter a research design issue similar to that of Chung and Charoenwong (1998). When the data is aggregated over longer time intervals, crucial information may be lost. Since the former study aggregates its spread estimates by month, the effect of insider trading may become more difficult to trace.

2.3 Hypotheses

The presented body of research concerned with the effects of insider trading on the market quality provides us with a fundamental understanding of the market dynamics in the presence of differentially informed traders. If the postulated hypotheses presented below are true, illegal insider trading facilitates price discovery in stocks.

H1: Illegal insider transactions coincide with abnormal returns.
Taking into consideration the results in Meulbroek (1992) and Ahern (2017), we expect abnormal returns to be earned on the days of illegal insider trading. We predict that the returns on the days when illegal insiders trade in a stock will significantly exceed the average returns for that stock.

H2: Stocks move in the direction of their post-announcement price on the day of illegal insider activity.
Similarly to the first hypothesis, we rely on the results in Meulbroek (1992) and Ahern (2017) when examining whether improved price discovery is present. We anticipate a price run-up on

the days illegal insiders trade. If confirmed, stock prices move closer to their post-announcement value on the days of illegal insider trading.

H3: Illegal insider transactions cause immediate and gradual price movements.

There is a lack of consensus in terms of identifying the causality between illegal insider transactions and stock price movements. There is an uncertainty as to whether trades placed by illegal insiders trigger immediate and gradual price movements or vice versa. Chakravarty and McConnell (1997; 1999) provide the only evidence regarding the matter. In light of their research, we expect that illegal insiders cause immediate and subsequent movement in stock prices rather than the other way around. If the hypothesis is supported, illegal insider trades are the reason why the stock price moves closer to its post-announcement value on the days when the insider transactions are executed.

3. Empirical Setting and Research Design

3.1 Philosophy of Social Science and Research Ethics

We apply a deductive approach on our investigation of the relationship between theory and empirical evidence, as suggested by Bryman and Bell (2010). Our hypotheses are derived based on the existing theoretical and empirical knowledge, which is further followed by a research design aimed to test them. Epistemologically, the study takes on a positivist approach, arguing that research in social sciences exhibit equivalent scientific level of objectivity to that of natural sciences. We make inferences based entirely on logic and value-free reasoning. Methodologically, our research is of a quantitative nature, as it emphasises data quantification at all stages. The validity of our results is established through a detailed description of our methodology and accessibility of databases, which makes the study replicable.

A central ethical aspect of our research is our cooperation with Scila. The fact that we are funded by the company to conduct the study may raise concerns regarding its independency. However, our research has not been angled in any way to benefit Scila, as they pursue a purely academic interest in examining the relation between insider trading and price discovery. Therefore, we claim that the support and funding provided by the company do not

harm the unbiasedness of our research. We remain independent in our attempt to obtain new empirical evidence on the relation between illegal insider trading and price discovery.

3.2 Empirical setting

Our data consists of individuals prosecuted by the Swedish Economic Crime Authority for illegal insider trading at Stockholm District Court. The starting point of our research is a list of all cases of illegal insider trading in the time period between 2010 and 2018, which is provided by the Stockholm District Court. From this list, we are able to get access to both preliminary hearing protocols and court rulings for the cases that have proceeded to criminal trial. The Public Access to Information and Secrecy Act (Offentlighets- och sekretesslagen, 2009) grants us access to this documentation. The documents contain detailed descriptive and trading information surrounding each illegal insider crime. We extract descriptive data for each separate case of insider activity, including the traded volume, profit earned for each defendant and the number of days between the insider trade and the public news announcement. Appendix I contains the type of data collected for each defendant. We exclude cases where the defendants trade only in derivatives or on the day of the public news announcement as well as cases where the placed order is not executed.

Stocks exposed to confirmed cases of illegal insider trading performed by the defendants described above construct the sample used for analysis. There are 20 stocks, representing a variety of industries as defined in Refinitiv Eikon: communications, consumables, defence, entertainment, electronics, finance, healthcare, pharmaceuticals, pulp and paper and software. According to the sample, companies operating in electronics industry appear to be more prone to trading activity of illegal insiders. The stocks in the sample are listed on four exchanges in Sweden. There are nine (45%) stocks listed on Nasdaq Stockholm, five stocks (25%) listed on Spotlight, five stocks (25%) listed on Nasdaq First North and one stock (5%) listed on NGM Nordic MTF. In regards to market capitalisation, 6 (30%) companies have a value below 100 million SEK, 10 (50%) companies' value lie in the range between 100 million SEK and 1 billion SEK and 4 (20%) companies exceed the market capitalisation value of 1 billion SEK. Appendix II lists all stocks included in the sample and details their main characteristics. Data on daily returns is collected from Refinitiv Eikon and data on 15-minute returns as well as 15-minute trading volume is sourced from Refinitiv Tick History. Dates for

interim news and formal news announcements are primarily collected from preliminary hearing protocols and controlled against Refinitiv Eikon database.

To illustrate the incidents of illegal insider trading that our sample consists of, we describe two of the prosecuted cases. The first case concerns the take-over bid on Axis Communications (Axis) in February 2015. Before the take-over bid was revealed to the public, a group of relatives related to a corporate insider at Axis bought shares in the company. The five relatives started investing in the company two months before the news announcement, on the day after the corporate insider was notified of the take-over bid. In total, the relatives acquired stocks for a worth of 4 060 673 SEK and made a profit of 3 500 671 SEK. The court ruling stated that it was more likely than not that the relatives had access to insider information at the time of trading. However, the prosecution failed to provide evidence to prove their guilt beyond a reasonable doubt. The persons involved were not convicted.

The second case illustrates repetitive instances of insider crime in Fingerprint Cards stock during the period of 2012-2014, which is considered to be the expansion phase of the biometrics technology firm. During this time interval, two former board members at Fingerprint Cards were accused of trading on private information regarding the future prospects of the company on multiple occasions in connection to a variety of material news. In total, the two defendants realised profits of 1 819 322 SEK and deferred losses of 3 128 607 SEK. Both were found guilty of crime and faced charges both in form of prison sentence and fines. In addition, the illegal insiders were banned from conducting any business for five years.

In total, we base our research on 21 prosecuted cases of insider crime, which are the only cases available for the general public. These cases provide us with information on 33 defendants involved in illegal insider trading actions. Among these 33 defendants, 30 (91%) are male and 3 (9%) are female. It is possible for defendants to receive multiple verdicts if they have traded in several stocks. One of the defendants has not received a verdict yet as the trial is still ongoing. Another defendant has traded in two different stocks and thus received two verdicts. This results in 33 verdicts. Nine verdicts (27%) led to conviction. Table I details summary statistics on the insiders' trading activities.

Table I provides an insight into trading tendencies of illegal insiders included in the sample. The measures appear to be scattered due to every prosecuted case of insider crime varying considerably in terms of the summarised metrics. Illegal insider trading occurs 17 (median = 11) days prior formal public news announcement on average. Trades can be made as close as one day and as far as 61 days before the private information insiders trade on is

officially released to the public. On average, illegal insiders trade 20.30% (median = 7.88%) of a stock's daily trading volume. However, the amount of stocks purchased or sold by insiders during one trading day can range from as little as 0.09% to as much as 99.94% of daily trading volume. The highest profit of approximately 2.5 million SEK was obtained by one of the insiders trading in Cefour Wine and Beverage Partihandel.

TABLE I

Descriptive Overview of the Trading Activity of Illegal Insiders

The table contains a descriptive overview of the trading activity of the defendants in terms of the amount of days between a trade and the public news announcement, the profit gained and the loss deferred as well as the value traded and the volume traded. The volume traded is described in terms of total volume acquired or sold by a defendant, fraction of the daily volume and average volume per transaction.

	Mean	Std. Deviation	Median	Min	Max
Days Prior to Public Announcement	17	17	11	1	61
Profit Gained, SEK	392 228	588 631	155 778	500	2 483 173
Trading Value, SEK	1 638 522	3 509 080	367 250	10 750	18 872 530
Volume					
Volume Traded	493 356	2 548 754	25 139	1 000	16 557 960
Average Volume Per Transaction	9 668	22 136	4 000	775	110 386
Fraction of Daily Volume	0.2030	0.2623	0.0788	0.0009	0.9994

Table II clarifies the type of information the defendants in our sample traded on, classified in accordance with the market reaction after the announcement. The table highlights that a majority of the news (87%) is related to a positive stock price reaction, indicating that most illegal insiders trade to make profits rather than defer losses. The most frequent type of information associated with illegal insider trading is when a new agreement or partnership is announced (30%). Take-over bids are also common (23%).

TABLE II

Type of News Announcement Exploited by the Illegal Insiders

The table depicts the type of information the defendants exploit. The type of information is separated in two - positive and negative news. Positive news are announcements that initiated a positive stock price reaction, whereas negative news initiated a negative stock price reaction.

Type of Information	Total	Percentage
Positive News		
Agreement/Partnership	9	30
Take-over Bid	7	23
Financial Report	3	10
Receive Order	4	13
Merger	1	3
Launch of New Fund	1	3
Successful Medical Trial	1	3
Total Positive News	26	87
Negative News		
Delayed Agreement	1	3
Financial Report	3	10
Total Negative News	4	13
Total News	30	100

3.3 Research Design

The section outlines the methodology used to assess the impact of illegal insider trading on stock price accuracy. The research design is divided into two parts. Each part presents an approach to examine each of the three hypotheses.

3.3.1 Abnormal Returns

In order to investigate whether abnormal returns are earned on the days when illegal insiders trade prior to public news, we follow the model presented in Meulbroek (1992).

   The regression model presented in Meulbroek (1992) is a modified market model designed to evaluate the stock price impact of illegal insider trading. It is an extension of the traditional capital asset pricing model (CAPM) outlined in Sharpe (1964) and Lintner (1965). The model is fully applicable on the data sample constructed to assess the topic of our research.

The model can be specified as follows:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \gamma_i \times News_{it} + \delta_i \times Insider_{it} + \sum_{j=1}^{J} \mu_{ij} \times Interim_{ijt} + \varepsilon_{it} \quad (1)$$

As in Meulbroek (1992), the dependent variable R_{it} is the return on day t for stock i and the independent variables are $News_{it}$, $Insider_{it}$ and $Interim_{ijt}$. $News_{it}$ is a dummy variable, which takes on value 1 if the insider information regarding stock i is announced at day t and 0 otherwise. $Insider_{it}$ is a dummy variable which equals 1 for stock i on days t of illegal insider trading and zero otherwise. $Interim_{ijt}$ are J dummy variables, controlling for any confounding news announcements and varying depending on the how many interim news announcements regarding stock i were made prior to the formal news announcement. This is done to isolate the effect of insider trading when news announcements coincide with days illegal insiders trade. The j-th interim dummy takes on value 1 on the day of the j-th interim news release and 0 otherwise.

As in Sharpe (1964) and Lintner (1965), R_{mt} represents the market return. OMX Stockholm 30 (OMXS30) is commonly used as a proxy for market performance in Sweden and is comprised of the 30 most actively traded stocks on the Stockholm Stock Exchange. Due to all of the companies included in the sample being listed in Sweden, OMXS30 is a reasonable and appropriate choice as the market proxy in our research. In order to estimate the market model parameters α_i and β_i, we incorporate 150 trading days prior the first day of insider trading in each episode in our analysis.

A separate OLS regression is estimated for each illegal insider trading episode. An episode is defined as the time period between the date of the first illegal trade and the date when the formal announcement is made.

Table III illustrates the distributional characteristics of the variables *Insider* and *Interim*, as well as the number of insiders. The entire sample consists of 107 days of insider trading, 5 days of interim news and 2 days when both insider trading and interim news occur. Per episode, insiders trade on 3.57 days on average (median = 2), interim news are announced on 0.17 days (median = 0) and they both occur on the same day on 0.07 days (median = 0). Interim news events are not frequently observed in the sample but must still be included in the analysis to isolate the effect of illegal insider trading. The table also highlights the density of illegal insiders per episode. On average, 1.47 insiders (median = 1) trade in connection to an impending news announcement. The amount of insider trading days peaks at 22, describing the illegal insider trading activity in the Axis stock in 2015.

17

TABLE III

Distributional Characteristics of the Variables in Regression (1)

The table contains an overview of the distributional characteristics of the variables "Insider" and "Interim", as well as the number of insiders. "Insider Trading Days" is the number of days insiders traded on per episode. "Interim News Days" is the number of days with interim news per episode. "Insider Trading and Interim News Days" is the number of days when both insider trading and interim news occurred per episode. "Number of Insiders" is the number of insiders active per episode.

	Insider Trading Days	Interim News Days	Insider Trading and Interim News Days	Number of Insiders
Mean	3.57	0.17	0.07	1.47
Std. Deviation	4.78	0.46	0.25	1.07
Median	2	0	0	1
Min	1	0	0	1
Max	22	2	1	6
Total Sample	107	5	2	33

For each of the 30 insider trading episodes, we compute the average abnormal return (AAR) on an insider trading day as well as the cumulative abnormal return (CAR) across all insider trading days in the episode. The AAR on an insider trading day in the i-th insider trading episode is given directly by the estimate of the coefficient δ_i in the regression model (1). The CAR for that same insider trading episode is the product of the estimate of the δ_i coefficient and the number of illegal insider trading days, defined as N_i. Additionally, the AAR on days when insider trading occurs and the CAR are calculated for the sample as a whole by calculating an average for all 30 episodes. In order to consolidate the results across the sample, the abnormal returns are multiplied by -1 in the trading episodes when the news are negative.

We perform a t-statistic test on the consolidated estimates for the whole sample to evaluate whether the AAR and the CAR on days insiders trade are significantly different from zero. Taking into account the obtained p-value, we draw conclusions on the statistical significance of the estimates.

Proceeding with the approach presented in Meulbroek (1992), run-up (Ω_i) is defined as the quota between CAR on insider trading days and the abnormal return on the news

18

announcement day. It is used to examine whether stock price accuracy improves on days of insider trading activity. Formally, the equation is given as:

$$\Omega_i = \frac{\delta_i \times N_i}{\gamma_i} \qquad (2)$$

We calculate the run-up for each insider trading episode and aggregate the results to draw conclusions from the mean. The measure captures both the direction and the size of the abnormal returns on days of illegal insider trading. A positive run-up measure means that the abnormal return on insider trading days have the same sign as the abnormal return on the day of the public news announcement. This implies that insider trading facilitates price discovery as it moves the stock price closer to the stock price realised after the public release of the insider information. The larger the run-up, the larger impact insider trading has on the price movements in relation to the public news announcement. If the stock price on insider trading days moves past its realised value on the day of the public announcement, the stock price accuracy is not considered to be improved.

To evaluate whether accuracy of stock prices increases on days of insider trading, we use a binomial sign test. When the CAR across insider trading days and the abnormal return on the day of public news announcement share the same sign, the run-up is positive. The binomial sign test assists to either confirm or deny whether the run-up is significantly different from zero.

3.3.2 Insider Trading vs. Price Movements

If the first hypothesis holds and the regression (1) demonstrates a significant relationship between abnormal returns and insider trading, we proceed to investigate the third hypothesis. The third postulated hypothesis concerning whether illegal insider transactions is at least partly responsible for immediate and subsequent price movements is examined by applying the methodology outlined in Chakravarty and McConnell (1997). The previously presented regression (1) fails to distinguish whether illegal insider activity is the cause for price run-ups or vice versa. To investigate the causality further, a regression is formulated as follows:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \sum_{j=0}^{4} \psi_{ij} \times d_{i,t-j} \times InsiderFraction_{i,t-j} + \varepsilon_{it} \qquad (3)$$

The dependent variable, R_{it} is the 15-minute rate of return for stock i at time t. The first independent variable, R_{mt}, is the 15-minute rate of return on the market, represented by the

returns of OMXS30. To handle overnight returns, we consider the closing price of the previous trading day in comparison to the opening price of the next trading day. The second independent variable, $InsiderFraction_{i,t-j}$, is used to capture the magnitude of insider trading activity expressed as the insider's 15-min trading volume at time t in proportion to the total 15-min traded volume at time t of the stock i. An indicator variable adjusting for the direction of the trade, $d_{i,t-j}$, is added to the model. Among the 30 illegal insider trading episodes, the exact transaction time for illegal insider trades is available for 13 episodes. The regression (3) is estimated for each of those 13 illegal insider episodes and consolidated over the whole sample. Following this approach enables us to examine whether trades made by illegal insiders precede the stock price movements, which would be an indication of causality. Formally, if the coefficient ψ_{ij} is significantly different from zero for $j > 0$, we interpret it as proof of causality.

To control whether stock price changes result in illegal insider trading, a reversed regression is performed:

$$d_{it} \times InsiderFraction_{it} = \alpha_i + \sum_{j=0}^{4} \nu_{ij} \times R_{i,t-j} + u_{it} \qquad (4)$$

As previously, the regression (4) is repeated for each of the 13 illegal insider trading episodes and consolidated over the whole sample. The variable $InsiderFraction_{it}$ becomes the independent variable in the reverse version of the regression. Similarly to regression (3), an adjustment for the direction of trade is made. The independent variables are 15-min returns on stock i at time t and the four preceding quarters. The reversed causality is assessed by examining the statistical significance of the coefficient ν_{ij} for $j > 0$. If it is significant, we interpret it as a reversed causality is present. By looking at regression (3) and (4), we are able to assess the connection between stock price movements and illegal insider trading.

When examining the distributional features of the variable *InsiderFraction* we find that illegal insiders have been trading over 178 intervals of 15 minutes. For every separate episode, insiders trade over 13.69 15-minute intervals (median = 4). The minimum amount of quarters with insider trading activity occurred in the CybAero stock in 2014, when the insider was trading during only one 15-minute interval. The maximum amount of 15-minute trading intervals is 50, describing illegal insider activity in the Scandinavian Enviro Systems stock in 2017.

3.4 Bias

Using confirmed cases of illegal insider trading instead of inferring such trading or considering legal insider trades provides an opportunity for a more appropriate analysis of the effects on the market dynamics. An obvious limitation of using prosecuted cases is sample bias. The bias arises when the focus is entirely on insiders who were prosecuted, neglecting the insiders whose actions were reported but did not face any legal consequences. In accordance with the Public Access to Information and Secrecy Act, it is possible to obtain data solely on the cases of illegal insider trading that faced legal prosecution (Offentlighets- och sekretesslagen, 2009). Hence, the instances of illegal insider trading which were reported but did not proceed through the court system are omitted. It is uncertain whether the suspected but not prosecuted insiders are innocent of the insider crime or the current legislative framework fails to hold them accountable. Our research does not intend to evaluate the efficiency of insider regulation, leaving the matter open for discussion.

The exact reason why the particular instances of illegal insider trading included in the sample have proceeded to legal prosecution is not known. It can be due to a variety of reasons. An apparent reason can be that the particular instances caused a significant market response. If the Swedish Economic Crime Authority decides to pursue an insider trading case based upon an abnormal price movement prior to the announcement day, the sample consists exclusively of insider trades which caused a large market response. These cases can be easier to detect as the insiders fail to successfully conceal their actions. It may imply that sophisticated illegal insiders possess a greater ability to conceal their actions and remain unidentified. Since the actions of the sophisticated insiders can not be included in the analysis, focusing merely on the confirmed instances may lead to overestimation of the impact illegal insider trading has on stock prices.

Despite the presence of a selection bias, it is important to acknowledge the fact that this issue is inherent in this type of academic studies. In an attempt to deal with the bias, we use a cross-section of cases in comparison to the rest of the studies focusing on case studies. Thus, our research approach results in findings demonstrating weaker signs of bias. As the sample size is increased, the risk of outliers affecting the results is diminished.

4. Findings and Analysis

4.1 Insider Trading and Abnormal Returns

In this subsection, we examine whether returns on the days with confirmed cases of illegal insider trading significantly exceed the average returns for the stock in question. Table IV presents the estimates of the 30 OLS regressions, consolidated over the whole sample. For analysis regarding abnormal returns and insider trading, we only consider estimates listed in the first three columns of the table. The first column outlines abnormal return on the day of news announcement, represented by γ_i in regression (1). The next column demonstrates the average abnormal return on days of insider trading activity, denoted by δ_i. The third column gives a statistical overview of the cumulative abnormal return on the days of insider trading.

TABLE IV

Regression Output for Regression (1): Abnormal Returns and Run-Up

The table presents the means and standard errors of the performed OLS regressions consolidated over the whole sample. The dependent variable is the daily return of stocks with confirmed presence of insider trading. "AR on Day of News Announcement" is the abnormal return on the day when the public news announcement is made. "AAR on Days of Insider Trading" is the average abnormal return on the insider trading days. "CAR on Days of Insider Trading" is the cumulative abnormal return over all insider trading days in a given episode. "Run-Up" is the quota between "CAR on Days of Insider Trading" and "AR on Days of News Announcement".

	AR on Day of News Announcement (γ_i)	AAR on Days of Insider Trading (δ_i)	CAR on Days of Insider Trading	Run-Up
Mean	45.44%	1.82%	6.03%	7.65%
Standard Error	1.08	0.06	0.13	1.76
t-statistic	2.31	1.76	2.58	-
p-value	0.03	0.09	0.02	0.11

Table IV illustrates that the abnormal return on the days of public news announcements is 45.44%, a significant result with a p-value below the 0.05 threshold. Similarly, the abnormal return on days when insiders trade exceeds the expected return by 1.82% on average. The estimate yields a t-statistic of 1.76 and is significantly different from zero at the 10 percent significance level. The average cumulative abnormal return for an insider

trading yields a significant estimate of 6.03% at the 5 percent significance level (t-statistic = 2.58).

The findings imply that the trading activities of illegal insiders in possession of private information not yet disclosed to all market participants are associated with abnormal returns significantly different from zero. On average, insiders exercising their informational advantage earn almost 2 percent in excess of the expected return per day. In a similar manner, the abnormal return the illegal insiders accumulate over all insider trading days in an episode is about 6 percent. This indicates that illegal insider trades coincide with abnormal price movements.

As the first postulated hypothesis states, we anticipate illegal insider trading on days before the news is made public to be accompanied by abnormal market fluctuations. In terms of average abnormal returns and average cumulative abnormal returns, it is hypothesised that illegal insider trades are associated with stock prices exhibiting these effects. The obtained result is consistent with the stated hypothesis and confirms the ability of illegal insiders to acquire abnormal returns on the days they trade. Hence, the first hypothesis cannot be rejected. This is an indication of illegal insider trading activity coinciding with abnormal returns, not evidence of causality.

4.2 Insider Trading and Price Discovery

The following subsection concentrates on investigating whether illegal insider trades make stock prices move closer to their fundamental values and thus facilitate price discovery. As stated by equation (2), run-up measures the accuracy of stock prices on days of illegal insider trading activity in relation to their post-announcement values. For analysis regarding insider trading and price discovery, we use the estimates outlined in the fourth column of Table IV, which shows the consolidated estimate of run-up for the sample as a whole.

Table IV reveals that run-up is estimated to 7.65%. However, the result is not considered to be significantly different from zero as the binomial sign test provides a p-value above the threshold of 10 percent. This implies that illegal insider trading activity does not contribute to increased accuracy of stock prices. Although it has been previously confirmed that illegal insiders are able to obtain abnormal returns on days of trading prior public news release, their trading actions do not contribute to improved price discovery. Hence, it is suggested that

illegal insider trading lacks any possible spillover effect in terms of increased informativeness of stock prices.

The second postulated hypothesis states that we expect stock prices to fluctuate in the direction of their post-news values on the days when illegal insiders trade. To be confirmed, a large and significant estimate for run-up is required. Our result do not exhibit either of these two characteristics. As a consequence, we are able to reject the second postulated hypothesis, implying that stock prices do not move significantly closer to their post-announcement value on the days when illegal insiders exercise their informational advantage.

4.3 Insider Trading and Market Impact

The current part sheds light on the relation between illegal insider trading and stock price movements. Since the first hypothesis holds and a significant relationship between abnormal returns and insider trading is found, we proceed to investigate the true nature of this relationship, based on the 13 episodes we were able to obtain intraday data for. In order to distinguish whether illegal insider activity is the cause for abnormal returns or vice versa, we begin with presenting descriptive statistics of intraday illegal insider trading patterns. Table V presents the intraday data in terms of time of trade, number of shares traded and number of trades distributed over daily trading hours.

The total number of shares traded amounts to approximately 21 million over 980 executed trades. Considering the distributional characteristics of traded volume over daily trading hours, it is clear to see that approximately one third of total shares traded are purchased or sold during the first hour of the trading day. The rest of the transactions are rather evenly distributed throughout the trading day. An exception is the time interval between 15:00 and 16:00, when the illegal insider trading activity gains momentum again. Presumably, the explanation of this behaviour is the opening of the US stock market, when the overall trading activity increases. Hence, it increases chances for illegal insiders to conceal their actions in the market order flow and lessen their potential market impact.

To draw more definitive inferences, illegal insiders' traded volume is compared to price movements. Table VI provides a detailed overview of the estimates for regression (3), which inspects the impact of insiders' trading volume on stock returns. Insiders' trading volume is defined as a fraction of the total volume traded over a given 15-minute interval. The third

row represents the contemporaneous impact illegal insiders have on return of stocks, while the remaining rows depict estimates for the impact during the preceding hour.

TABLE V

Illegal Insider Trading Summarised by Trading Hour

The table illustrates an overview of illegal insider trades summarized by hour of the trading day based on the 13 episodes with intraday data available.

Time of Day	Number of Shares Traded	Number of Trades
09:00 – 10:00	8 243 921	347
10:00 – 11:00	741 867	88
11:00 – 12:00	2 798 448	74
12:00 – 13:00	232 143	85
13:00 – 14:00	3 756 282	71
14:00 – 15:00	186 059	56
15:00 – 16:00	4 810 257	120
16:00 – 17:00	131 156	68
17:00 – 17:30	95 410	71
Total	20 995 543	980

The regression (3) addressing the correlation between stock price movements and prior trades by illegal insiders provides a positive and significant ($p = 0.0467$) coefficient for the contemporaneous measure of insiders' trading volume. Additionally, the coefficient of the market return defined as return of OMXS30 is positive and demonstrates a statistical significance ($p = 0.0024$). None of the four lagged measures of insiders' trading volume appears to be statistically different from zero. Hence, the regression results do not provide any evidence that the trading activity of illegal insiders influence subsequent stock price fluctuations. However, a relationship between illegal insider trades and contemporaneous price changes is found. Stock prices exhibit a contemporaneous response to the informational advantage of illegal insiders embedded in their trades. Simultaneously, a lag in the reaction of the stock price to illegal insiders' trades seem not to be present.

TABLE VI

Regression Output for Regression (3): Insider Trades' Impact on Stock Prices

The table reveals the means and standard errors of the performed OLS regressions consolidated over the 13 episodes with intraday data available. The dependent variable is the return of stocks over 15-minute intervals. The independent variables are the return of OMXS30 over 15-minute intervals and the contemporaneous and four lagged measure of insiders' trading volume.

	Mean	Standard Error	t-statistic	p-value
Intercept	0.0004	0.0009	1.60	0.136
R_m	0.8889	0.8381	3.82	0.002
$InsiderFraction_t$	0.0170	0.0277	2.22	0.047
$InsiderFraction_{t-1}$	-0.0013	0.0120	-0.38	0.712
$InsiderFraction_{t-2}$	-0.0022	0.0060	-1.36	0.2
$InsiderFraction_{t-3}$	-0.0022	0.0109	-0.73	0.477
$InsiderFraction_{t-4}$	-0.0094	0.0281	-1.21	0.251

To address the question of whether stock price fluctuations give rise to illegal insider trading, the reverse regression (4) is performed and the estimates are presented in Table VII. The dependent variable defines the density of illegal insider trading during a specific 15-minute time interval as a fraction of the total volume traded. The independent variable is the 15-minute rate of return on stocks with a confirmed presence of illegal insiders at the moment of trade and during the preceding hour.

TABLE VII

Regression Output for Regression (4): Stock Prices' Impact on Insider Trading

The table illustrates the means and standard errors of the performed OLS regressions consolidated over the 13 episodes with available intraday data. The dependent variable is the number of shares traded by illegal insiders during 15-minute intervals divided by the total number of shares traded during that time interval. The independent variable is the contemporaneous and four lagged 15-minute intervals of stock returns.

	Mean	Standard Error	t-statistic	p-value
Intercept	0.0335	0.0488	2.47	0.029
R_t	0.6766	1.3022	1.87	0.086
R_{t-1}	0.1578	0.4898	0.80	0.442
R_{t-2}	0.3911	0.0060	2.88	0.014
R_{t-3}	0.5755	1.1193	1.85	0.089
R_{t-4}	-0.1815	0.9529	-0.69	0.505

As observed, the coefficient of the contemporaneous stock return and its second and third lagged values are positive. All three coefficients are significantly different from zero, as their p-values do not exceed the threshold of 0.10 (p = 0.086, p = 0.014, and p = 0.089 respectively). It can be interpreted as illegal insiders being responsive to stock price changes. According to the regression (4) output, stock price movements can have an impact on illegal insiders' trading activity for as long as 45 minutes after occurring. In other words, price fluctuations upwards (downwards) can potentially trigger investors in possession of private information to purchase (sell) the stock. The p-values for the remaining coefficients, representing the first and the fourth lagged values, are greater than the conventional level of significance and are thus not considered to be statistically different from zero.

The third formulated hypothesis predicts that illegal insider trades are responsible for stock price fluctuations. In accordance with our results, the statement is rejected. Instead, our findings may imply a reverse effect being present. As previously highlighted in Table V, the trading density for illegal insiders is most concentrated during trading hours when the overall trading activity of the market peaks. A possible explanation is that illegal insiders attempt to camouflage their informed trades behind other market activity and consequently lessen their impact on stock returns. Further justifying this point of view is the obtained estimates for the contemporaneous and lagged values of the illegal insider density and stock returns. A pattern of stock prices leaving an impact on illegal insiders' trading decisions emerges. It is observed that the past stock returns trigger the insiders to trade on their informational advantage, perhaps out of fear of missing out on a better opportunity. Illegal insider trades affect the contemporaneous stock returns, leaving the following returns uninfluenced. Rather than observing an increase in the subsequent stock performance, our research indicates that the immediate price effect associated with informed trades is subject to reversal. Thus, the third and final postulated hypothesis is rejected.

5. Discussion

Insider trading involves utilising asymmetric information in an attempt to create gains. From a fairness and market morality perspective, actions of this kind are opposed by financial market regulators. If the ethical side of the notion is omitted from the discussion, our question is

whether is illegal insider trading in fact strictly harmful to the market or can it have positive effects? The rationale of our research is to shed light on the effect illegal insiders have on the market and price discovery in particular. The results have direct significance for policy makers in the ongoing debate regarding the strictness of regulatory framework all market participants are subjected to. Regardless of whether in favour or against rigorous regulation, it is vital to understand the implications of such regulation when striving for a more fair and efficient financial market.

Consistent with the majority of studies performed on illegal insiders, our findings strengthen the paradigm of illegal insider trading coinciding with abnormal returns. On days of illegal insider activity, the market exhibits a clear tendency to award investors with additional profit. This may suggest either that the market is able to detect the presence of informed traders and reacts accordingly, or that insiders receive incentives to hurry up and exercise their informational advantage after observing uncommon price movements.

Despite our previous finding, we do not obtain any evidence confirming that the actions of illegal insiders facilitate speed and accuracy at which private information becomes incorporated into prices. Hence, it cannot be stated that price discovery improves in the presence of illegal insiders. This contradicts the findings of Meulbroek (1992), Cornell and Sirri (1992), Fishe and Robe (2004) and Ahern (2017), whose research comes to a consensus regarding insider trading pushing prices closer to their fundamental values. The discrepancies may be explained by differences in interpretation of contribution to the price discovery process. All authors except Meulbroek (1992) infer price discovery merely by the market's tendency to create opportunities for abnormal profits. We attempt to conduct a more thorough analysis and take a closer look at the true nature of the relationship. Although we find that abnormal returns are generated on the days when insiders trade prior to the formal public news announcement, we do not obtain statistically significant results proving insiders' trading actions contribute to improved price discovery. Hence, one should be cautious when drawing conclusions solely from the presence of abnormal market returns. Despite fully adopting the methodology outlined in Meulbroek (1992), we do not acquire equivalent results. A reasonable explanation for this may be the dataset used for the analysis reflecting different behavioural tendencies. While Meulbroek (1992) focuses on American illegal insiders, we base our analysis on their Swedish counterparts, whose investment decision-making may deviate due to a variety of unobserved reasons.

Similarly, our results regarding whether illegal insiders cause price movements or vice versa contradict those of Chakravarty and McConnell (1997), who find evidence for illegal insiders' ability to move stock prices while remaining unaffected by price fluctuations. In our case, the market influences the illegal insiders, while the opposite is true for Chakravarty and McConnell (1997). The empirical findings may differ due to our analysis being based on a larger sample of confirmed illegal insider trading instances, whereas they focus on trading activity of only one insider. The authors themselves question whether their results can be generalised to a larger population. Our evidence indicates that the actions of one insider should not be interpreted as applicable to a larger population.

The attempt to assess the relation between illegal insider trades and price movements microscopically yields a result suggesting that insiders cause immediate price fluctuations, but do not lead to gradual changes in stock prices. The market response lasts during the first 15-minute interval after the executed trade and ceases afterwards. Simultaneously, a reverse relation is found to be statistically significant. Past price fluctuations appear to have an impact on investment decisions of illegal insiders and encourage them to act on their superior information. As prices start to move rapidly in the same direction as the private information predicts, insiders may perceive it as an opportunity to act on their informational advantage while diminishing the risk of being detected. Perhaps the illegal insiders believe that since they are not the origin of the shift in the price behaviour, their activity may have no to slight impact on the stock prices and thus have a greater chance of remaining unexposed. It may also be reasonable to assume that when the insiders observe a major change in the market dynamics, they are likely to utilise the private information they possess out of fear of losing an opportunity to use it at a later stage. The longer the insiders wait, the higher the risk of the magnitude of their financial gains decreasing.

In section three, we mentioned a potential selection bias affecting the sample. The bias suggests that the sample consists exclusively of illegal insiders who impacted the market the most. If that is the case, the findings overestimate the impact of illegal insider activity on price informativeness. Our results imply that the illegal insiders investigated have no impact on stock price movements. Taking into consideration that the investigated sample may consist of insiders causing the largest market response, the bias strengthens our results. If no relation is found in the most prominent cases of illegal insider trading, the connection may not be present at all.

6. Conclusions

Using not yet investigated data on confirmed illegal insider trading instances in Sweden, we attempt to answer the question whether illegal insider trading promotes price discovery in stocks. We find that on the days when illegal insiders execute their trades, the opportunity to earn abnormal returns is present. On average, those days yield an abnormal return that exceeds the expected return by 1.82%. The analysis further suggests that despite abnormal returns being present, price discovery does not benefit from insider trading. The prices do not become more informative when insiders act on private information not yet disclosed to all market participants.

We also investigate the relation between illegal insider trading and price fluctuations in terms of causality. The empirical evidence suggests that the ability of illegal insiders to impact stock prices stretches only as far as to cause immediate price fluctuations, but does not prevail longer than the first 15 minutes past the executed trades. Instead a reverse effect seems to be present, where stock price movements affect the investment decisions of illegal insiders for as long as 45 minutes after occurring. Further justifying this reasoning is the time of day at which illegal insider trading activity reaches its peak. Insider trading is observed to be most intense during trading hours with the highest overall market activity.

The findings have direct public policy implications, as they give valuable insights about the impact of illegal insider trading and contribute to the discussion of whether such trading makes stock prices more informative. Previously, the opponents of insider trading regulation advocated that insider trading facilitates price discovery and thus stimulates market efficiency. On the basis of our findings, rigorous insider trading regulation does not impede price discovery and thus does not harm the financial market quality.

From an academic point of view, the findings of our research validate existing evidence regarding abnormal returns but does not authenticate the conclusions stating that actions of illegal insiders push stock prices closer to their fundamental values. In addition, we cannot verify the previous claims concerning insider trading being the main force behind immediate and gradual price movements.

Future research can take on a direction where social networks are taken into consideration. A full mapping of how private information disseminates through social relationships can reveal the best way to detect transactions executed by illegal insiders. If regulatory authorities have an understanding of how information flows through social channels,

they may become more efficient at unravelling major cases of insider crime. This can reduce information asymmetry among market participants and secure a fairer financial market.

References

Ahern, K. (2017). "Information Networks: Evidence from Illegal Insider Trading Tips". *Journal of Financial Economics*, vol. 125, no. 1, 2017, pp. 26–47

Bagehot, W. (1971). "The Only Game in Town". *Financial Analysts Journal*, vol. 27, no. 2, 1971, pp. 12-14, 22

Baruch, S., Panayides, M. and Venkataraman, K. (2017). "Informed Trading and Price Discovery Before Corporate Events." *Journal of Financial Economics*, vol. 125, no. 3, 2017, pp. 561–588

Bryman, A. and Bell, E. (2010). *Företagsekonomiska forskningsmetoder* (Första upplagan). Malmö, Liber

Chakravarty, S. and McConnell, J. (1997). "An Analysis of Prices, Bid/Ask Spreads, and Bid and Ask Depths Surrounding Ivan Boesky's Illegal Trading in Carnation's Stock". *Financial Management*, vol. 26, no. 2, 1997, pp. 18 - 34

Chakravarty, S. and McConnell, J. (1999). "Does Insider Trading Really Move Stock Prices?". *The Journal of Financial and Quantitative Analysis*, vol. 34, no. 2, 1999, pp. 191-209

Christophe, S., Ferri, M. and Hsieh, J. (2010). "Informed Trading Before Analyst Downgrades: Evidence from Short Sellers." *Journal of Financial Economics*, vol. 95, no. 1, 2010, pp. 85–106

Chung, K. and Charoenwong, C. (1998). "Insider Trading and the Bid-Ask Spread." *The Financial Review*, vol. 33, no. 3, 1998, pp. 1–20

Cornell, B. and Sirri, E. (1992). "The Reaction of Investors and Stock Prices to Insider Trading". *The Journal of Finance*, vol. 47, no. 3, Papers and Proceedings of the FiftySecond Annual Meeting of the American Finance Association, New Orleans, Louisiana January 3-5, 1992, pp. 1031-1059

Elliott, J., Morse, D. and Richardson, G. (1984). "The Association between Insider Trading and Information Announcements." *The RAND Journal of Economics*, vol. 15, no. 4, 1984, p. 521

European Parliament and Council Regulation (EU) No 596/2014 of 16 April 2014 on market abuse (market abuse regulation) and repealing Directive 2003/6/EC of the European Parliament and of the Council and Commission Directives 2003/124/EC, 2003/125/EC and 2004/72/EC. [Online]. [Accessed 27 February 2019]. Retrieved from: https://eurlex.europa.eu

Finansinspektionen, (2018). *Transaktioner utförda av personer i ledande ställning – insynshandel.* [Online]. [Accessed 27 February 2019]. Retrieved from:
https://www.fi.se/sv/marknad/investerare/transaktioner-utforda-av-personer-i-ledande-stallning--insynshandel/

Fishe, R. and Robe, M. (2004). "The Impact of Illegal Insider Trading in Dealer and Specialist Markets: Evidence from a Natural Experiment." *Journal of Financial Economics*, vol. 71, no. 3, 2004, pp. 461–488

Glosten, L. and Milgrom, P. (1985). "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders". *Journal of Financial Economics,* vol. 14, 1985, pp. 71-100

Hasbrouck, J. (1995). "One Security, Many Markets: Determining the Contributions to Price Discovery." *The Journal of Finance*, vol. 50, no. 4, 1995, pp. 1175

Jarrell, G. and Poulsen, A. (1989). "Stock Trading Before the Announcement of Tender Offers: Insider Trading or Market Anticipation?" *The Journal of Law, Economics, and Organization*, 1989

Keown, A. and Pinkerton, J. (1981). "Merger Announcements and Insider Trading Activity: An Empirical Investigation." *The Journal of Finance*, vol. 36, no. 4, 1981, pp. 855–869

Kyle, A. (1985). "Continuous Auctions and Insider Trading". *Econometrica*, vol. 53, no. 6, 1985, pp. 1315-1335

Lakonishok, J. and Lee, I. (2001). "Are Insider Trades Informative?" *Review of Financial Studies*, vol. 14, no. 1, 2001, pp. 79–111

Leland, H. (1992) "Insider Trading: Should It Be Prohibited?" *Journal of Political Economy*, vol. 100, no. 4, 1992, pp. 859–887

Lintner, J. (1965). "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets". *Review of Economics and Statistics*. vol. 47, no. 1, 1965, pp. 13–37.

Meulbroek, L. (1992). "An Empirical Analysis of Illegal Insider Trading". *The Journal of Finance*, vol. 47, no. 5, 1992, pp. 1661-1699

Offentlighets- och sekretesslagen (2009:400). Sweden. [Online]. [Accessed 10 March 2019]. Retrieved from: http://rkrattsbaser.gov.se/sfst?bet=2009:400

O'Hara, M. (2003). "Presidential Address: Liquidity and Price Discovery." *The Journal of Finance*, vol. 58, no. 4, 2003, pp. 1335–1354

Sharpe, W. F. (1964). "Capital asset prices: A theory of market equilibrium under conditions of risk". *Journal of Finance*. vol. 19, no. 3, 1964, pp. 425–442.

Appendix I - *Data acquired for each defendant*

Name

Occupation

Initial report of suspicious trading activity

Whether criminal case was filed

Number of illegal transactions

Profit earned or loss deferred

Whether securities are traded on personal account or not

Whether defendant traded, tipped private information or both

Whether defendant was the original source of private information

Legal framework applied

Penalty imposed by the court

Personal correspondence (e-mail, texts, phone records)

Records of interrogation procedure

Confiscated belongings

Trading information:

        Name of security

        Type of security

        Exchange traded on

        Day of trading

        Transaction time

        Transaction volume

        Transaction price

        Transaction profit

        Type of information traded on

        Source of information traded on

        Day the private information is announced to the general public

Appendix II - *Stocks included in the sample*

Name	ISIN	RIC	Exchange	Industry	Market Capitalisation
					In million SEK
Avtech Sweden AB	SE0004270445	AVTCHb.ST	Nasdaq First North	Aerospace & Defense	42.93
Axis Communications AB	SE0000672354	AXIS.ST^K18	Nasdaq Stockholm	Communications & Networking	13433.81
BioPhausia AB	SE0001048984	BIOP.ST	Nasdaq Stockholm	Drug Retailers	390.51
Cefour Wine and Beverage Partihandel AB[1]	SE0009190788	UMIDAb.TE	Spotlight	Distillers & Wineries	8.16
Cherry AB	SE0010133256	CHERb.ST	Nasdaq Stockholm	Casinos & Gaming	5969.33
CybAero AB	SE0005188711[2]	CBA.ST^F18	Nasdaq First North	Aerospace & Defense	154.68
Elektronikgruppen BK AB	SE0000101669	ELGRb.ST^I11	Nasdaq Stockholm	Electronic Equipment & Parts	165.12
Fingerprint Cards AB	SE0008374250	FINGb.ST	Nasdaq Stockholm	Electronic Equipment & Parts	118.09
Fortnox AB	SE0001966656	FNOX.NGM	NGM Nordic MTF	Software	1069.04
FX International AB	SE0003787555	FXI.TE	Spotlight	Investment Banking & Brokerage	11.40
G5 Entertainment AB	SE0001824004	G5EN.ST	Nasdaq Stockholm	Software	246.40
Hexatronic Scandinavia AB	SE0002367797	HTRO.ST	Nasdaq Stockholm	Electrical Components & Equipment	40.75
Jojka Communications AB	SE0002017707	JOJK.TE	Spotlight	Software	2.83
Odd Molly International AB	SE0002017657	ODD.ST	Nasdaq Stockholm	Apparel & Accessories	161.06
Oniva Online Group Europe AB[3]	SE0005249570	BINERO.ST	Nasdaq First North	Advertising & Marketing	565.66
Rottneros AB	SE0000112252	RROS.ST	Nasdaq First North	Paper Products	276.11
Scandinavian Enviro Systems AB	SE0005877560	SCENS.ST	Nasdaq First North	Environmental Services & Equipment	315.36
Scandinavian Real Heart AB	SE0008348213	HEART.TE	Spotlight	Medical Equipment	120.21
Starbreeze AB	SE0005992831	STZEb.ST	Nasdaq Stockholm	Online Services	3455.59
Traveas AB[4]	SE0002869719	EVERYa.TE	Spotlight	Advertising & Marketing	13.83

---

[1] Has since changed name to Umida Group AB
[2] Has since changed ISIN to SE0010414250
[3] Has since changed name to Binero Group AB
[4] Has since changed name to Everysport Media Group AB