

# Getting the inside track: The effect of CEO ownership and wealth on insider trading returns

Julian GREILICH<sup>a</sup>

Nils HÄRTEL<sup>b</sup>

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## Abstract

This paper analyzes the market reaction to insider transactions by CEOs in Swedish companies and if a CEO's ownership in her company, wealth and magnitude of change in shareholding have an effect on the market reaction. Moreover, we analyze how outside investors can benefit from mimicking CEOs' insider transactions. We present five major findings. First, CEOs trade on superior information and earn average abnormal returns of 1.46% and 1.35% for purchases and sales respectively over the first five days following the transaction. Second, a higher change in shareholding due to the transaction leads to higher abnormal returns. Third, a higher ownership stake reduces the magnitude of abnormal returns. Fourth, a CEO's affected wealth has no significant effect on the magnitude of abnormal returns for CEOs in the short-term, but in the long-term. Finally, outside investors can benefit from mimicking CEO insider transactions in Sweden. In particular, mimicking CEO purchases in which at least 10% of a CEO's wealth is affected leads to abnormal returns of 81 basis points per month, when controlling for size, market-to-book and momentum.

*Keywords:* Insider trading, market efficiency, trading strategy, managerial ownership, personal wealth

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<sup>a</sup>40385@student.hhs.se

<sup>b</sup>40365@student.hhs.se

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# 1 Introduction

One of the central questions in financial economics is whether financial markets are efficient or if it is possible to consistently beat the market. Fama (1970) leads the group of those arguing that markets are efficient and perfectly rational, postulating three forms of the Efficient Market Hypothesis. The strong form assumes that prices always reflect all available information, both public and private. Under the semi-strong form, prices reflect all publicly available information at any time. The weak form of the Efficient Market Hypothesis assumes that prices reflect all past publicly available information. Some scientists and practitioners, who make a living from beating the market, naturally disagree with the Efficient Market Hypothesis, especially the semi-strong and strong form.

The debate on whether financial markets are efficient or not has recently been fuelled again, when Eugene Fama and Robert Shiller were awarded the Nobel prize in Economics in 2013. It might seem puzzling that Fama, who developed the Efficient Market Hypothesis, and Shiller, who is known for outlining housing and equity bubbles and thus market inefficiencies, can be honored for their work at the same time. One potential explanation is the difference between short-term trading and long-term reversion to the mean, i.e. that there can be small market inefficiencies which are corrected quickly (The Economist, 2014). Hence, both Fama's and Shiller's standpoint can have merit at the same time.

One area that has received a lot of attention in the quest for testing market efficiency is insider trading. According to Seyhun (1998), insider trading refers to stock transactions of officers, directors, and large shareholders of the firm. This study looks at Chief Executive Officers' (CEOs) insider transactions in Sweden for the time period 2004-2013. Finansinspektionen, the Swedish Financial Supervisory Authority, outlines that insider trading includes both legal and illegal conduct. When carried out in a legal way corporate insiders buy and sell shares in their own companies and report these transactions to Finansinspektionen. In our study, insider trading refers to CEOs buying and selling shares in their own company. Abnormal returns would mark a violation of the strong form of market efficiency as CEOs have access to non-public, i.e. private, information. This has been documented in several studies on insider trading in different countries, such as the U.S. and the U.K. (e.g., Lakonishok and Lee, 2001; Fidrmuc et al., 2006). Our study also analyzes whether CEOs' success is based on luck and CEOs just manage to occasionally beat the market or if they are consistently able to utilize their information about

the prospects of their firm. However, what is of more interest for this study is whether outside investors can beat the market by mimicking the transactions of CEOs. If this is the case, the semi-strong form of the Efficient Market Hypothesis would be violated, giving support to the group of people who argue that markets are not efficient and irrational. Research on insider trading has a long history. Yet, whether outside investors can also benefit from insider trading has not been analyzed in a published paper with regard to the Swedish market. Moreover, various factors such as a CEO's change in shareholding due to the insider transaction, ownership stake in the company, and wealth have not been taken into account in detail in previous studies when analyzing how outside investors can benefit from mimicking insider transactions. In particular, an insider's wealth has (to the best of our knowledge) not been used at all when analyzing potential trading strategies by which outside investors can benefit from insider trading. This study is the first to take this into account.

The proceeding sections of this paper are organized as follows. The next section summarizes the previous literature on insider trading from different angles. Section 3 develops and outlines the hypotheses based on existing literature. In the fourth section, the sample, databases and data sources used, and the methodology applied for the analyses are described. Section 5 analyzes the results and Section 6 concludes and gives an outlook on potential further research in this area.

## **2 Literature Review**

### **2.1 Information asymmetries**

Berle and Means (1932) laid the ground for agency theory with their seminal work on managers' interests not being perfectly aligned with shareholders' interests in publicly traded firms. While managers run the firm, they generally do not have a large financial stake in the company. This misalignment of interests has since been a topic for prevalent critique and discussion. In their seminal papers, Akerlof (1970), Spence (1973), and Rothschild and Stiglitz (1976) developed the discussion further by outlining and analyzing information asymmetries. One main asymmetry pointed out in several studies (e.g., Fama, 1970; Myers and Majluf, 1984) is that a company's management may have information about the company's prospects that are not yet publicly available and known. Hence, managers may have superior information compared to outside investors which raises the question of whether managers (can) exploit their information advantage by trading on inside information.

### **2.2 Insider trading**

Insider trading has been analyzed from several different angles. These studies can be categorized along various dimensions. According to Jeng et al. (2003), there are three important motives to analyze insider trading: science, policy and profit. Studies focusing on scientific aspects analyze what implications their findings have for market efficiency. Policy studies examine the effectiveness of insider trading regulation and whether regulation is appropriate. Finally, studies focusing on profit try to implement trading strategies which allow outsiders to earn abnormal returns by following insider trades. Many studies analyze aspects relevant to more than one of the three categories.

#### **2.2.1 Scientific literature on insider trading**

A plethora of research on insider trading has focused on scientific aspects, in particular market efficiency and abnormal returns. Potential abnormal returns from insider trading have been analyzed in various studies using different statistical methodologies, sample periods, and sample selection criteria. In general, one can differentiate between two approaches to measure the effect of insider trading on share prices. The first approach is to assume that price reaction to

insider trading occurs over time and thus measures the cumulative abnormal returns that result from insider trading over a longer time period. The second approach makes the assumption that information from insider transactions are quickly reflected in the security prices, i.e. that markets are informationally efficient (Fidrmuc et al., 2006).

As a forerunner of the first approach, Rogoff (1964) finds that stocks which are intensively bought by insiders outperform the market by 9.5% in the six months following insider purchases.<sup>1</sup> Similarly, Lorie and Niederhoffer (1968) conclude that intensively bought (sold) securities are more likely to outperform (underperform) than underperform (outperform) the market in the six months following insider trades.<sup>2</sup>

Unlike the previous studies, Jaffe (1974b) explicitly takes market risk into account by using the Capital Asset Pricing Model (CAPM) as the benchmark. He estimates that if there is intensive insider trading, which he defines as at least three more buyers than sellers or vice versa in a company for a given month, insider transactions allow insiders to earn abnormal returns of three percent (net of transaction costs) in the subsequent eight months. Finnerty (1976) corroborates these results, also using the CAPM. Similar to earlier studies, Finnerty constructs insider buy and sell portfolios for each month, with the portfolios comprising all securities which are bought (sold) by any insider in that respective month. He documents abnormal returns in the eleven months following insider trades, with the greatest above average return for purchases occurring in the first month, indicating that insider information is quickly reflected in the price. For the sell portfolios price effects occur gradually.

As the CAPM has been shown not to hold empirically (e.g., Banz, 1981; Reinganum, 1981; Capaul et al., 1993), later studies use different models to estimate benchmark returns. Seyhun (1986) uses the market-model for estimating expected returns and finds that insiders can earn abnormal returns of approximately 3% on average over a period of 300 days following insider transactions. Abnormal returns for purchases are slightly higher (4.3%), but overall Seyhun's estimates are lower than results from previous studies, indicating that using the CAPM overestimates abnormal returns. A similar conclusion is reached by Rozeff and Zaman (1988), who find that insiders' abnormal returns (neglecting transaction costs) decrease from 8.64% to 5.16% annually over a 12-month holding period when controlling for size and earnings/price

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<sup>1</sup>Rogoff (1964) looks at abnormal returns in the six months following insider purchases by at least three insiders in one company in the same month (and no insider sales in that company).

<sup>2</sup>Lorie and Niederhoffer (1968) analyze stock performance for months in which there are at least two more insider buyers than sellers or vice versa.

ratio. While the aforementioned studies analyze U.S. samples, Gregory et al. (1997) document abnormal returns for up to 24 months following insider purchases in the U.K. On the contrary, Eckbo and Smith (1998) analyze insider transactions on the Oslo Stock Exchange and conclude that insiders earn zero or negative abnormal returns for the six months after the insider transaction. A potential explanation given by Eckbo and Smith is that insiders on the Oslo Stock Exchange do not or only rarely possess insider information.<sup>3</sup>

Lakonishok and Lee (2001) also document abnormal returns for insiders for a U.S. sample. They conclude that insiders are contrarian investors and can earn abnormal returns for a one-year holding period, even after controlling for size and book-to-market ratio. The documented abnormal returns are four times larger for insider purchases than sales and are also larger in smaller firms. Jeng et al. (2003) further support these findings. They estimate that insider purchases generate abnormal returns of more than six percent per year whereas insider sales do not lead to significant abnormal returns when controlling for various factors such as size.

A few studies have focused on the short-term effects of insider trading. Jaffe (1974b) does not only look at long-term holding periods, but also estimates abnormal returns for 1- and 2-month holding periods and concludes that insiders can earn abnormal returns in the short-term if transaction costs are not taken into account. With transaction costs, the gains from holding securities are outweighed by these costs. Rozeff and Zaman (1988) are one of the first who explicitly analyze abnormal returns in the month of the actual transaction, instead of building a portfolio at the end of the month in which insider transactions occurred and then computing subsequent returns. They document abnormal returns of 0.4% within the month of the respective insider transactions.

Lakonishok and Lee (2001) analyze abnormal returns for a five-day period starting on either the transaction or the reporting date. They find that the abnormal returns for the reporting date are not economically meaningful, but abnormal returns are slightly larger for the transaction date. In total, the combined abnormal returns of the two events amount to around one percent for small firms and close to zero for large firms. Friederich et al. (2002) focus on short-term abnormal returns for smaller firms when analyzing insider transactions by directors on the London Stock Exchange. They conclude that insiders are able to time the market. Insider purchases lead to average abnormal returns of 1.9% over the 20-day period following the insider trade and

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<sup>3</sup>Additional reasons are brought forward by Kallunki et al. (2009). For example, most firms on the Oslo Stock Exchange are either state-owned, with the state potentially limiting insider trading, or family-owned, with insiders mainly wanting to maintain corporate control benefits.



insider sales generate average abnormal returns of 1.5%. Transaction costs remove these abnormal returns for the most part. Friederich et al. also point out that previous studies underestimate abnormal returns as the offsetting pattern of stock price movements around insider trades is not captured if portfolios are formed at the end of the month.

When analyzing long-term abnormal returns to insiders, Jeng et al. (2003) find that one quarter of insiders' abnormal returns amass in the first five days after the insider transaction, and one half of the abnormal returns is generated within the first month. Fidrmuc et al. (2006) conclude for a U.K. sample that insiders can time the market and that the two-day cumulated average abnormal returns around the announcement day of insider transactions are significantly positive for insider purchases and negative for insider sales. Moreover, abnormal returns are of higher magnitude for purchases than sales and are of greater scale for larger trades. Finally, Fidrmuc et al. find that abnormal returns in the U.K. are higher than in the U.S., which is most likely due to regulation and faster reporting of insider transactions.

### **2.2.2 Policy literature on insider trading**

Studies looking at insider trading regulation analyze whether these regulations are appropriate and effective. As Bhattacharya and Daouk (2002) point out, insider trading laws have become widespread around the globe since 1990. Hence, regulators now consider insider trading laws as appropriate. Academic opinion on the matter is divided.<sup>4</sup>

Manne (1966), as a front runner of the academic literature analyzing insider trading regulation, compares a situation where no insider trading is allowed to a situation of free trading by insiders. Manne outlines that no good argument can be made for prohibiting insider trading and argues that insider trading allows information to be quickly reflected in security prices. Hence, insider trading increases the efficiency of capital markets. This is supported by Garfinkel (1997), who observes lower insider trading frequency and slower price discovery after insider trading regulation is introduced.<sup>5</sup> In contrast, Bettis et al. (2000) find that liquidity is greater, indicated by narrower bid-ask spreads for a sample of U.S. firms, when insider trading is prohibited by company policies.

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<sup>4</sup>We focus on the main aspects discussed in the academic literature as regulation is not the main scope of our study. For a comprehensive and detailed overview of the literature on insider trading policies see for example Bainbridge (2000) and Leland (1992), who analyzes several advantages and disadvantages of insider trading.

<sup>5</sup>While the volume per transaction did not change significantly, the number of trades, i.e. the frequency, declined following the introduction of new regulation. Other studies, such as Jaffe (1974a) did not find any effect on the volume of trading following the introduction of new insider trading regulation.

Fishman and Hagerty (1992) find that instead of increasing price efficiency – as outlined by Manne (1966) – insider trading can actually decrease price efficiency. They show that insider trading might discourage market professionals from acquiring information and trading. While insiders have costless access to valuable information, market professionals need to spend resources to obtain valuable information and thus might refrain from doing so if insiders' information is too good and used in trading. Hence, the total amount of information captured in the stock price is reduced.

Besides the outlined potential reduction in price efficiency and reduced liquidity, a few authors argue against insider trading from a fairness perspective. Schotland (1967) strongly disagrees with Manne's (1966) findings and outlines that uninformed investors might feel at a disadvantage to insiders. Thus, public confidence in the stock markets is undermined which will deter uninformed investors from participating in the stock markets and in turn reduce liquidity. This is supported by Brudney (1979), who argues that other investors cannot obtain the information that insiders have, rendering financial markets unfair. He states that regulation can foster stability and fairness and lead to greater liquidity as more investors are willing to transact.

While both Schotland (1967) and Brudney (1979) argue that outside investors do not benefit from insider trading, Carlton and Fischel (1983) follow up on Manne's (1966) arguments and outline that insider trading conveys information which is consequently impounded in the price of the security. This increases price efficiency and reduces investor uncertainty as insiders can produce this information at lower costs than investors.

In a more recent study, Bhattacharya and Daouk (2002) find that insider trading laws improve liquidity in a market and that this effect is even stronger if the laws are actually enforced. Moreover, the enforcement of insider trading laws reduces the cost of equity for firms, indicating that shareholders demand a premium if insiders can trade freely. Finally, Jeng et al. (2003) quantify the costs of legal insider trading for non-insiders as 10 cents on a \$10,000 sale to an insider and no significant disadvantage at all for non-insiders when buying securities and therefore argue that public confidence in stock markets should not be diminished given the current insider trading regulations.<sup>6</sup>

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<sup>6</sup>Note that these results are based on then existing SEC rules. Most studies on insider trading focus on the U.S. due to data availability. Results for other countries with different regulations might differ. Jeng et al. (2003) estimate the costs from insider trading to outsiders by computing the abnormal returns earned from insider trades (by insiders) and then calculate this as a percentage of all trades.

### **2.2.3 Profit for outsiders from insider trading**

Several studies have attempted to analyze how outsiders can profit from insider trading by mimicking insider trades. Jaffe (1974b) finds that in most cases, net of transaction costs, outsiders do not manage to earn abnormal returns. However, Jaffe also analyzes an intensive trading sample in which a month is only included if there are at least three more sellers than buyers and vice versa. For this sample, Jaffe estimates abnormal returns of 2.5% over an 8-month holding period for outside investors. Hence, by only following the most intensive trading sample, outsiders can earn a profit net of transaction costs.

Later studies, such as Seyhun (1986), also corroborate these findings. Seyhun, using the market-model to measure the expected returns of securities, finds that net of transaction costs outsiders do not earn abnormal profits. Based on these findings, Seyhun concludes that the semi-strong form of market efficiency is not violated as outsiders cannot earn abnormal profits by using publicly available information about insider trading. Rozeff and Zaman (1988) find similar results for outsiders but take the analysis one step further. Outsiders can earn abnormal returns by mimicking insider transactions, however, these returns disappear when controlling for size and earnings/price ratio and assuming transaction costs of 2%. Hence, Rozeff and Zaman argue that the abnormal returns are not a result of the informative content of insider trades but due to size and earnings/price ratio effects.

While the aforementioned studies argue that outsiders cannot earn abnormal returns, Bettis et al. (1997) reach a different conclusion. By focusing on large-volume trades by high-ranking insiders, they find that outsiders can earn significant abnormal returns. One potential reason is the shorter reporting delay between the insider transaction and the day the information becomes public in comparison to earlier studies. In his comprehensive work, Seyhun (1998) corroborates the findings of Bettis et al. (1997). Seyhun (1998) analyzes five indicators regarding the quality of insiders' information: i) identity of the trader (e.g., officer, large shareholder), ii) number of shares traded, iii) firm size, iv) sales and purchases, and v) the existence of consensus among insiders. Based on these indicators, outsiders can earn abnormal returns which are higher for insider transactions by top executives, in small firms, and transactions that exceed 1,000 shares in all firms.<sup>7</sup> These results also hold when including transaction costs, but outside investors need to hold on to their shares for a few months in order to make a profit. Several studies

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<sup>7</sup>In Seyhun's (1998) analysis abnormal returns are defined as beating an equally weighted index of New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and National Association of Securities Dealers Automated Quotations (NASDAQ) stocks.

confirm Seyhun's indicators (e.g., Lakonishok and Lee, 2001; Jeng et al., 2003) but in a recent study, Merikas et al. (2011) conclude that outside investors do not earn abnormal returns by mimicking insider transactions on the Athens Stock Exchange in Greece in 1999. Yet, they note that the time period for the analysis might be too short for general conclusions.

## **2.3 Motivation for our study**

As outlined above, insider trading has already been analyzed in great depth. However, with the exception of a study by Kallunki et al. (2009), an insider's wealth has not been taken into account when analyzing insider trading. Kallunki et al. (2009) focus on insiders' motivations to trade and conclude that insider selling by insiders who have the greatest proportion of wealth allocated to their stocks is more informative. Yet, they do not analyze in detail if the magnitude of abnormal returns is affected by CEOs' wealth and if outsiders can make use of knowledge about CEOs' wealth.

In this study, we test the effect of CEOs' ownership and wealth on abnormal returns in insider transactions carried out by CEOs in Sweden. We add to the academic research in two ways. First, we explicitly take CEOs' wealth into account when looking at abnormal returns resulting from insider transactions. Second, we analyze if outside investors can benefit from knowing about CEOs' ownership and wealth when mimicking insider transactions by CEOs. Most previous studies which look at potential profits for outside investors analyze a vast amount of strategies, with some being more profitable than others. By looking at a large number of possible strategies it is statistically likely that some of these strategies are profitable. In order to not fall prey to data mining, we focus our study on a selective number of strategies and make use of a unique dataset which includes CEOs' wealth data. Bettis et al. (1997) and Seyhun (1998) conclude that insider transactions by top executives and high-volume transactions are the most profitable transactions that outside investors should mimic. We use these results as a starting point and add the wealth component. The strategies are thus built around CEO's ownership (in percent), shareholding (in terms of number of shares owned) and wealth, as CEOs are the top executive in a company.

In a nutshell, our study is the first to consider CEOs' wealth when analyzing potential trading strategies for outside investors. By also looking at abnormal returns for CEOs in Sweden, our study adds to both the scientific and profit literature on insider trading.

## 3 Hypotheses

### 3.1 Abnormal returns from insider transactions

Our analysis is based on the benchmark hypothesis that CEOs trade on superior information due to information asymmetries between CEOs and outside investors. CEOs who buy shares in their own company forego diversification. Hence, when buying shares in their own company, CEOs entail additional costs on themselves by not having optimally diversified investment portfolios (e.g., Lambert et al., 1991). A purchase by a CEO can therefore be seen as a positive signal about the firm's future value. Contrarily, a CEO who sells shares sends a negative signal to the market. However, this signal tends to be weaker and less informative as there are other reasons why CEOs sell their shares, such as liquidity needs. Hence, a sale does not have to be caused by changed expectations about the firm's future cash flows and thus the firm's value (e.g., Ke et al., 2003; Huddart et al., 2007).<sup>8</sup>

**Hypothesis 1a:** *The market reaction to insider purchases by CEOs is positive, i.e. CEOs can earn abnormal returns on their purchases.*

**Hypothesis 1b:** *The market reaction to insider sales by CEOs is negative, i.e. CEOs can earn abnormal returns on their sales.*

**Hypothesis 1c:** *The market reaction to insider purchases by CEOs is larger than that to insider sales.*

We proceed by taking a CEO's shareholding in their company into account. While a few studies document that large volume insider trades have more information content (e.g., Bettis et al., 1997; Seyhun, 1998), most studies do not consider the actual shareholding of insiders. Scott and Xu (2004), who analyze a U.S. sample, are an exception and they conclude that the shares traded as a percentage of shares held is a good predictor of future returns. CEOs who buy a large amount of shares in relation to their shareholding show a commitment to their firm and signal that they value their company highly. The aforementioned foregone diversification argument also applies in this case. Thus, a large increase in shareholding should lead to a

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<sup>8</sup>Huddart et al. (2007) also mention other reasons why insiders might trade, such as an actual desire to diversify.

stronger market reaction. As outlined by Scott and Xu (2004), CEOs who only sell a small part of their shares might do so because of liquidity needs, while still having a positive view on the firm's future performance. Hence, they try to sell as few shares as possible. Similarly, CEOs who sell a large part of their shareholdings are likely to have negative information and expectations about their firm's prospects. Therefore, selling a larger part of their shareholding should trigger a stronger market reaction.

**Hypothesis 2:** *A higher change in CEOs' shareholdings leads to higher abnormal returns.*

Next, we test the effect of a high CEO ownership stake in the company prior to insider transactions. As pointed out by Lambert et al. (1991), heavy investments in their own company entail a large cost for CEOs as they are less diversified.<sup>9</sup> One could argue that CEOs, who hold a large portion of their company and buy further shares, signal to the market that they expect the company to perform (even) better in the future. In that case, abnormal returns should be of a higher magnitude. Moreover, CEOs' interests and incentives are more likely to be aligned with other shareholders' interests if CEOs hold shares in their company and an increase in ownership can be seen as a commitment to shareholder value creation (Jensen and Meckling, 1976; Fidrmuc et al., 2006). Therefore, CEO purchases (sales) should lead to a stronger market reaction, as the market observes the (reduced) commitment.

However, CEOs' ownership is a double-edged sword. By further increasing their ownership CEOs might entrench themselves, eventually allowing themselves to consume private benefits of control (e.g., Grossman and Hart, 1980; Morck et al., 1988). Such consumption is not in the interest of other shareholders and a purchase by a CEO who already owns a substantial stake will therefore lead to a negative reaction by the market which might outweigh the positive effect outlined above.<sup>10</sup> Furthermore, insider purchases by CEOs might be due to overconfidence (Malmendier and Tate, 2005). CEOs might overestimate their ability to increase firm value and thus invest in their own firm.<sup>11</sup> By engaging in projects which yield a negative net present value, they do not act in the interest of shareholders. When analyzing a U.K. sample, Fidrmuc

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<sup>9</sup>CEOs who are heavily invested in their own company put "all their eggs in one basket" as they not only receive a salary from the company, but also their investment returns depend on the company's performance.

<sup>10</sup>Entrenchment refers to the observed phenomenon that CEOs have too much voting power in a company so that they cannot be held accountable and replaced even if their company is performing poorly, as described by Fidrmuc et al. (2006).

<sup>11</sup>Anderson (2007), when analyzing online investors, summarizes the suboptimal diversification and (excessive) risk-taking but not achieving the desired returns with the fitting catchphrase "all guts, no glory" (in our case: CEOs show guts in taking risk, but do not necessarily glory in it).

et al. (2006) find that these negative implications lead to a smaller positive impact of insider purchases when the previous ownership stake is already high. Using similar reasoning, the market might react positively if it considers a sale by a CEO and a corresponding reduction of her ownership as better than the negative signal coming from her sale of shares. Fidrmuc et al. (2006) document that the negative market response to sales by insiders, who own a substantial fraction of the company, is smaller.

**Hypothesis 3:** *Insider transactions by CEOs who hold a large portion of their company lead to a smaller market reaction.*

The final test with regard to insiders' abnormal returns is the effect of CEOs' wealth on CEOs' abnormal returns from insider transactions. CEOs who have a large proportion of their wealth allocated to their company are not optimally diversified, as discussed above. Hence, purchases by CEOs, who already have a large part of their wealth invested in their company, can be seen as a strong signal to the market that the CEOs have positive expectations about their firm's future success. Having a significant proportion of their wealth allocated to their company does not necessarily mean that such CEOs are entrenched, as the ownership stake could still be rather low, especially in large firms. Hence, the negative impact from potential entrenchment should not outweigh the positive signal resulting from further increasing the part of CEOs' wealth in their company. With regard to sales, CEOs whose wealth is allocated mostly to their company have more incentives to time the market than CEOs whose wealth is not heavily invested in their company. However, CEOs might also sell their shares for liquidity or diversification reasons (Kallunki et al., 2009). Thus, insider sales by CEOs who have a large proportion of their wealth invested in their company could lead to a lower market reaction, as CEOs might trade for personal reasons which are not related to expectations about the firm's future. However, Kallunki et al. (2009) find that insiders who have more wealth allocated to their company are better at timing their sales and that these sales are more informative.

**Hypothesis 4:** *Insider transactions by CEOs who hold a larger portion of their wealth in the company lead to abnormal returns of larger magnitude.*

### 3.2 Trading strategy for outside investors

Academic opinion on whether outside investors can earn abnormal returns when mimicking insider trades is divided. While Seyhun (1986) and Rozeff and Zaman (1988) conclude that net of transaction costs, outsiders do not earn abnormal returns when mimicking insider trades, other studies challenge these results by focusing on certain types of trades. As outlined above, Bettis et al. (1997) argue that outsiders should focus on large-volume trades by high-ranking executives in order to earn significant abnormal returns. This argument is supported by Seyhun (1998), who shows that outsiders can earn the highest abnormal returns when mimicking insider transactions by top executives, in small firms, and transactions with more than 1,000 shares independent of firm size. In a recent study, Tavakoli et al. (2012) further corroborate these findings as they find that among all insiders only senior management's insider transactions have predictive power.<sup>12</sup> In addition to these outlined factors, our study is the first to include CEOs' wealth when analyzing whether outside investors can profitably mimic insider transactions.

**Hypothesis 5a:** *Outside investors can realize abnormal returns when mimicking insider trades by CEOs, who trade a significant number of their held shares.*

**Hypothesis 5b:** *Outside investors can realize abnormal returns when mimicking insider trades by CEOs, who have a low stake in their company.*

**Hypothesis 5c:** *Outside investors can realize abnormal returns when mimicking insider trades by CEOs, who have a large proportion of their wealth allocated to the company.*

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<sup>12</sup>Tavakoli et al. (2012) also find that officers' insider transactions only have predictive power in small firms whereas directors' insider transactions have predictive power irrespective of firm size.



## 4 Data sources, descriptive statistics and methodology

### 4.1 Data sources

Our sample covers data on CEOs' insider transactions, CEOs' ownership (in percent), CEOs' shareholding (in number of shares), CEOs' wealth, and companies' daily stock returns, market capitalization, and market-to-book ratio.

Companies included in the sample have been listed on either the Stockholm Stock Exchange or the Nordic Growth Market (NGM) Stock Exchange. CEOs' insider transactions cover the period from 2004 to 2013 and are obtained from Finansinspektionen (Swedish Financial Supervisory Authority). The original file contains 95,513 insider transactions as insider transactions by all types of insiders, i.e. not limited to CEOs, are covered. This file includes information on companies' registration numbers,<sup>13</sup> company names, insiders' names and position in the company, for whom the shares were traded (e.g. own account, spouse, legal person, etc.), types of transaction, transaction and announcement dates, security types, number of shares traded, and number of shares held after the transaction.

After excluding non-CEO transactions the number of observations is reduced to 12,827. Furthermore, we only include voluntary stock purchases and sales, i.e. transactions such as exercise of options, reverse splits, rights issues, and holding notifications are not considered as a CEO insider transaction. Following Lakonishok and Lee (2001), transactions by spouses and minor children are accounted for as if the CEO trades the shares indirectly in her own account. We aggregate multiple purchases (or sales) by the same CEO on the same day.<sup>14</sup> Moreover, we net transactions, i.e. if a CEO both sold and purchased shares on the same day only the resulting combined effect is taken into account.<sup>15</sup> We also exclude transactions if the trade observation was inconsistent, i.e. the file said purchase, but the number of shares held decreased or if the trade is stated to have taken place on a non-trading day, e.g. a Sunday. Moreover, we remove insider transactions from the sample if no sufficient daily price data is available. Finally, we also do not include a handful of transactions which only consist of one or two shares, as these transactions are not considered as meaningful. After these adjustments, our sample covers

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<sup>13</sup>Each company in Sweden has a so called "Organisationsnummer", which provides information on the company, e.g. the first digit gives information about the type of company, such as a limited company.

<sup>14</sup>For example, a purchase of 2,000 shares and another purchase of 4,000 shares on the same day are viewed as one purchase of 6,000 shares.

<sup>15</sup>For example, a purchase of 3,000 shares and a sale of 2,000 shares are considered as a net purchase of 1,000 shares on that day.

2,820 CEO insider transactions from 495 CEOs in 305 companies. Besides this full sample, we also use a smaller sample, called the unique sample, in which all transactions, which interfere with another transaction's event window, are excluded. If, for example, a CEO buys shares on subsequent days, only the first transaction is included in the unique sample. This unique sample consists of 2,025 insider transactions, of which 1,556 are purchases and 469 are sales, when excluding overlapping trades for a five-day window around the transaction day.

Company name changes are traced through Skatteverket (Swedish Tax Agency), which also provides information on companies' delistings or terminations.

Ownership data is obtained via several sources. Annual ownership data is collected from 'Ägarna och Makten' by Fristedt and Sundqvist (2009). Their publications contain ownership data on the 25 biggest owners for all Swedish companies whose shares are listed on the Stockholm Stock Exchange and NGM Stock Exchange. In order to gather monthly ownership data, SIS Ägarservice's database is used. It offers semi-annual data from 1999 onwards and quarterly or even monthly ownership data on the 200 biggest shareholders of each company for years after 2004.<sup>16</sup> These figures are cross-checked with Finansinspektionen's insider register. In case of inconsistencies we further include a company's annual reports to verify a CEO's ownership in her company. Shareholdings via other companies or legal persons are also included in our ownership data. While the ownership data collection is cumbersome, it provides for a database of both very good coverage and high quality.<sup>17</sup>

Wealth data is obtained from Skatteverket. This data is reported on an annual basis and includes real estate, mutual funds, shareholdings, bank holdings and investments in debt securities. As no data was available for several CEOs, the analysis on wealth is carried out with a sample of 782 CEO insider transactions.<sup>18</sup> Finally, we obtain adjusted daily prices and thus daily returns as well as market capitalizations and market-to-book ratios from Datastream.

Overall, we have a final dataset with remarkably detailed information on CEO's wealth and ownership, which allows for a plethora of analyses with regard to insider transactions carried out by CEOs in Swedish companies.

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<sup>16</sup>It could happen that a CEO is not among the 200 biggest shareholders. This equals an ownership of 0.0% in all companies in our sample. The main reason why we do not only use SIS Ägarservice to obtain ownership data is that it only includes companies which are still listed.

<sup>17</sup>As outlined by Lilienfeld-Toal and Ruenzi (2014), "high data quality and at the same time a long time series and broad cross-section is strongly preferable."

<sup>18</sup>Sweden abolished its wealth tax in 2007. Hence, 2006 data was used in subsequent years. While this might lead to slightly wrong wealth estimates it avoids an endogeneity bias. As debt is deducted with regard to wealth, for many CEOs no positive wealth is reported by Skatteverket. Transactions from these CEOs are excluded.

## 4.2 Descriptive statistics

In Table 1 and 2 the summary statistics of our insider transaction sample is reported. Table 1 gives an overview of all trades, separately for purchases and sales with respect to CEO's ownership, change in shareholdings and wealth. Panel A of Table 1 shows the number of purchase and sales insider transactions by CEOs on an annual basis. According to Panel A, CEOs in Swedish companies have been net buyers based on the number of transactions.<sup>19</sup> While the discrepancy between the number of CEO insider purchases and sales is particularly high before the financial crisis, this changes strongly in 2009, with sales transactions increasing and purchase transactions almost cut in half. Hence, CEOs seemed to be rather cautious during the crisis and not willing to invest in their own company as much as before the crisis. Several other studies in other countries document more insider sales transactions than purchases and argue that this is mainly due to stock options granted to insiders. These options do not show up as a purchase while sales are accounted for when shares are liquidated (e.g., Seyhun, 1998; Jeng et al., 2003). Goergen and Renneboog (2011) document that option grants as part of CEO compensation is much lower in Sweden than in other countries, such as the U.S. and the U.K., giving an explanation as to why the number of sales transactions is not higher than the number of purchase transactions by CEOs in Swedish companies.

In Panel B, CEOs' insider transactions with regard to the fraction of the overall shareholding that stems from the respective insider transaction are shown. CEOs tend to trade a significant proportion of their shareholdings when engaging in insider trading. More than half of all purchase transactions account for a change of more than 5% in the CEO's shareholding. This fraction is even higher for sales transactions, with almost two-thirds of all sales resulting in a change of more than 5% in the CEO's shareholding. Panel C summarizes the number of trades carried out with respect to ownership. More than one-third of all purchases are made by CEOs who hold more than 5% of their company. The percentage for sales is slightly smaller which indicates that CEOs are unwilling to sell shares if this could lead to falling below an ownership stake of 5%. Finally, Panel D shows the number of CEO insider transactions with regard to a CEO's wealth that is affected by the respective transaction. The overall number of transactions for Panel D is smaller than for the other Panels, as outlined above. For almost three quarters of all sales transactions more than 10% of a CEO's wealth is affected by the transaction, while for

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<sup>19</sup>This is also true in terms of value per transaction (not displayed here), but the results are distorted by one or two commodity companies with very volatile stock prices.

**Table 1: CEO insider purchases and sales on annual basis**

This table shows the summary statistics for insider purchases and sales carried out each year. Panel A describes the actual number of sales and purchases in each respective year. The Purchases/Sales Ratio is computed by dividing the number of purchases by the number of sales in that year. Panel B summarizes CEO insider transactions with respect to what fraction of the resulting shareholding comes from the insider transaction, i.e. if a CEO buys 50 shares and the resulting shareholding is 100 shares, the recorded fraction is 50%. In Panel C insider transactions are shown with respect to how large a CEO's ownership stake was prior to carrying out an insider transaction. Finally, Panel D shows insider transactions by CEOs in Sweden with regard to the fraction of a CEO's wealth that is affected by the respective insider transaction.

| <b>Panel A: CEO insider purchases and sales with respect to number of transactions in respective year</b> |              |           |          |                       |
|-----------------------------------------------------------------------------------------------------------|--------------|-----------|----------|-----------------------|
| Year                                                                                                      | Total Trades | Purchases | Sales    | Purchases/Sales Ratio |
| 2004                                                                                                      | 264          | 178       | 86       | 2.07                  |
| 2005                                                                                                      | 242          | 171       | 71       | 2.41                  |
| 2006                                                                                                      | 236          | 169       | 67       | 2.52                  |
| 2007                                                                                                      | 357          | 285       | 72       | 3.96                  |
| 2008                                                                                                      | 454          | 388       | 66       | 5.88                  |
| 2009                                                                                                      | 308          | 204       | 104      | 1.96                  |
| 2010                                                                                                      | 289          | 234       | 55       | 4.25                  |
| 2011                                                                                                      | 231          | 167       | 64       | 2.61                  |
| 2012                                                                                                      | 221          | 184       | 37       | 4.97                  |
| 2013                                                                                                      | 218          | 174       | 44       | 3.95                  |
| Total                                                                                                     | 2 820        | 2 154     | 666      | 3.24                  |
| <b>Panel B: CEO insider transactions with respect to changes in CEO's shareholdings</b>                   |              |           |          |                       |
| Change                                                                                                    | $\geq 0\%$   | $> 5\%$   | $> 10\%$ | $> 20\%$              |
| Purchases                                                                                                 | 2 154        | 1 164     | 944      | 691                   |
| % of Purchases                                                                                            | 100.0%       | 54.0%     | 43.8%    | 32.1%                 |
| Sales                                                                                                     | 666          | 424       | 341      | 268                   |
| % of Sales                                                                                                | 100.0%       | 63.7%     | 51.2%    | 40.2%                 |
| <b>Panel C: CEO insider transactions with respect to CEO's ownership in her company</b>                   |              |           |          |                       |
| Ownership                                                                                                 | $\geq 0\%$   | $> 5\%$   | $> 10\%$ | $> 20\%$              |
| Purchases                                                                                                 | 2 154        | 786       | 670      | 395                   |
| % of Purchases                                                                                            | 100.0%       | 36.5%     | 31.1%    | 18.3%                 |
| Sales                                                                                                     | 666          | 180       | 131      | 93                    |
| % of Sales                                                                                                | 100.0%       | 27.0%     | 19.7%    | 14.0%                 |
| <b>Panel D: CEO insider transactions with respect to CEO's wealth</b>                                     |              |           |          |                       |
| Fraction of wealth                                                                                        | $\geq 0\%$   | $> 2\%$   | $> 5\%$  | $> 10\%$              |
| Purchases                                                                                                 | 577          | 366       | 282      | 192                   |
| % of Purchases                                                                                            | 100.0%       | 63.4%     | 48.9%    | 33.3%                 |
| Sales                                                                                                     | 186          | 170       | 152      | 137                   |
| % of Sales                                                                                                | 100.0%       | 91.4%     | 81.7%    | 73.7%                 |

almost half of all purchase transactions in Panel D more than five percent of a CEO's wealth is affected by the respective transaction. Hence, most CEOs in our sample seem to have a substantial fraction of their wealth invested in the company which they run.

**Table 2: Reporting delay**

This table shows the number of days it takes for each CEO insider transaction to be announced to the public, i.e. the delay from the transaction date to the reporting date. The reporting date is the date at which the insider trade was registered with Skatteverket (Swedish Financial Supervisory Authority).

| <b>Transaction date vs. announcement date</b> |      |       |       |       |       |       |       |        |
|-----------------------------------------------|------|-------|-------|-------|-------|-------|-------|--------|
| Delay (in days)                               | 0    | 1     | 2     | 3     | 4     | 5     | 6-10  | >10    |
| Frequency                                     | 134  | 510   | 286   | 321   | 349   | 238   | 583   | 399*   |
| Percentage                                    | 4.8% | 18.1% | 10.1% | 11.4% | 12.4% | 8.4%  | 20.7% | 14.1%  |
| Cum. Percentage                               | 4.8% | 22.8% | 33.0% | 44.4% | 56.7% | 65.2% | 85.9% | 100.0% |

\*Of these trades which have been reported more than 10 days after the actual transaction around 75% can be attributed to one company, in which the CEO has purchased new shares each day, while all trades have been registered with the Swedish Financial Supervisory Authority on the same day, some more than three years late.

Table 2 shows the number of days that it takes until a CEO insider transaction is registered with the Swedish Financial Supervisory Authority, i.e. how long it takes until information about a transaction becomes publicly available. Almost two-thirds of all CEO insider transactions have been reported within five calendar days as required by Swedish insider trading regulations.<sup>20</sup> More than 85% of all trades are reported within ten days. The median reporting delay is four days. Hence, outside investors who want to mimic insider transactions have access to information about CEO insider transactions in Sweden relatively quickly. This becomes particularly important when implementing trading strategies. In order to be able to mimic insider transactions as closely as possible, each transaction has to be reported very soon after the actual transaction date.

### 4.3 Methodology

Our analysis consists of two distinct parts. In the first part, we evaluate whether CEOs can earn abnormal returns by engaging in insider transactions. In the second part, we analyze if and how outsiders can potentially mimic insider transactions and thereby gain abnormal returns themselves.

<sup>20</sup>A change in closely related party's holdings needs to be reported by the insider within five business days after gaining knowledge about the change having occurred.

### 4.3.1 Event study

For the first part of our analysis, we employ an event study approach as outlined by MacKinlay (1997). As Fama (1991) states, event studies, especially event studies with daily returns, provide the "cleanest evidence on market efficiency." However, when conducting this kind of analysis, one is faced with two decisions that might change the outcome significantly: treatment of overlapping events and the choice of an appropriate benchmark. When taking a close look at our dataset, we find that some CEOs tend to buy a small number of shares many days in a row, leading to multiple overlapping events. On the one hand, keeping all these trades in our sample would give the returns of a specific company a very high weight in the calculation of average abnormal returns and distort the results. On the other hand, deleting all overlapping results would reduce our sample size, and thus the power of the tests carried out. This becomes even more an issue if a longer event window is chosen. As both solutions have drawbacks, we opt to eliminate as many overlapping events as necessary while keeping as many events in our sample as possible by applying the following heuristic: For a given company  $i$  and an event window of length  $w$ , we find the first insider trade on day  $T_0$ , keep it in our sample and ignore all following trades from  $T_0 + 1$  until  $T_0 + w$  which are in the same direction as the first trade.<sup>21</sup> The results for the full sample are presented in the next section and the results for the unique sample (without overlapping events) are outlined in the Appendix. With respect to the benchmark, we follow Barber and Lyon (1997) and use the equally weighted return of our sample as an approximation for the market return. The Swedish market indices are – even more than in most other developed financial markets – dominated by a few large companies such as Hennes & Mauritz, Nordea and Ericsson. By using an equally weighted index consisting of all companies in the sample, we avoid the possibility that our results are mainly driven by these high-weight companies. Moreover, as our event study analyses mainly look at short-term abnormal returns, we avoid the well-documented sensitivity of long-term abnormal returns to the benchmark used (e.g., Kothari and Warner, 1997; Barber and Lyon, 1997).

To account for different risk profiles amongst companies, we use the market-model to calculate ex ante expected returns:

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t}(RM_t) + \epsilon_{i,t} \quad (1)$$

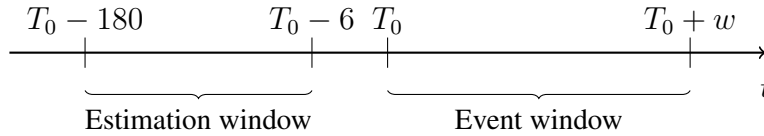
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<sup>21</sup>Since this is done for purchases and sales separately, a purchase on day  $T_0$  and a sale on day  $T_0 + 1$  will both remain in our sample while another sale on day  $T_0 + 2$  would be eliminated from the sample.

where  $R_{i,t}$  is the return on stock  $i$  on day  $t$ ,  $\beta_{i,t}$  measures the sensitivity of insider portfolio  $i$  to non-diversifiable risk at time  $t$ , i.e. market risk,  $RM_t$  is the equally-weighted market return on day  $t$  and  $\epsilon_{i,t}$  denotes the regression residual.<sup>22</sup> As outlined by MacKinlay (1997), adding additional explanatory factors to reduce the abnormal return's variance is possible but the marginal gains with regard to explanatory power are small. This also holds for using multifactor models. Since covariances, and therefore betas, vary over time (Bollerslev et al., 1988), it is necessary to run a separate regression for every recorded event to re-estimate  $\alpha_{i,t}$  and  $\beta_{i,t}$  for every trade day  $T_0$ . As shown in Figure 1, we use the 180 trading days prior to an insider trade as the estimation window, but exclude the five days directly preceding the trade in order to ensure that the parameter estimates are not influenced by the event.

**Figure 1:** Timeline event study

We use the past 180 trading days preceding each trade as the estimation window to calculate  $\alpha$  and  $\beta$  for each company. Trades without a complete estimation period are omitted from the sample to reduce errors due to insufficient data and to minimize the impact of Initial Public Offerings (IPOs) on our results. Days immediately preceding the trade are excluded from the regression to avoid that the event itself influences the parameter estimates.



The estimated factors are then kept constant over the event window to calculate abnormal returns expressed by  $\epsilon_{i,t}$ , which captures the difference between actual observations and predicted outcomes by the model, in the following expression:

$$R_{i,t} = E(R_{i,t}) + \epsilon_{i,t} = \alpha_{i,T_0} + \beta_{i,T_0} RM_t + \epsilon_{i,t} \quad (2)$$

$$E[\epsilon_{i,t}] = 0 \quad Var[\epsilon_{i,t}] = \sigma_\epsilon^2 \quad (3)$$

where  $R_{i,t}$  is the period  $t$  return for security  $i$  and  $RM_t$  is the period  $t$  return for the market portfolio. The error term  $\epsilon_{i,t}$  is assumed to be normally distributed with a mean of zero and constant variance. After calculating abnormal returns for each event separately, we aggregate them by calculating the arithmetic average over all events for each day  $t$  as:

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<sup>22</sup>We generally use the absolute returns  $R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$  instead of the commonly used log returns  $r_t = \ln(1 + R_t)$  since some of the smaller companies have relatively large swings in daily prices and the approximation  $r_t \approx R_t$  does not hold anymore.

$$\overline{AR}_t = \frac{1}{N} \sum_{i=1}^N \epsilon_{i,t} \quad \forall t \in [T_0 - w, T_0 + w] \quad (4)$$

where  $w$  denotes the length of the event window and  $N$  is the number of observations. Consequently, the cumulative average abnormal return (CAAR) from day  $\tau_1$  to  $\tau_2$  is defined as:

$$CAAR(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} \overline{AR}_t \quad (5)$$

In a first analysis,  $\tau_1$  is defined as  $T_0 - w$  and  $\tau_2$  is defined as  $T_0 + w$ . Including the time before a trade in our analysis might provide valuable insights into the market timing abilities of CEOs. When testing for statistical significance in later stages,  $\tau_1$  is defined as the actual trading day  $T_0$  and  $\tau_2$  as  $T_0 + w$ . The second component needed for statistical testing is the standard deviation of the abnormal returns  $\sigma_\epsilon$ . Unfortunately, the choice of the estimation period presents a classical trade-off between better estimates by using a longer estimation period and having more observations  $N$  by using a smaller estimation period.<sup>23</sup> As an attempt to overcome this trade-off, we use bootstrapping for each event and randomly draw  $b$  abnormal returns  $\epsilon_{i,t}$  from the estimation period with replacement. The standard deviation for event  $j$ ,  $\sigma_{\epsilon,j}$ , is then defined as the standard deviation of the randomly drawn sample.<sup>24</sup> The variance of abnormal returns for event  $j$  and event window of length  $w$  is calculated as:

$$\sigma_{w,j}^2 = (\sqrt{w+1} \sigma_{\epsilon,j})^2 \quad (6)$$

and the variance of abnormal returns for  $N$  events is defined as:

$$\sigma_{w,N}^2 = \frac{1}{N^2} \sum_{j=1}^N \sigma_{w,j}^2 \quad (7)$$

The resulting test statistic is calculated as:

$$J_1 = \frac{CAAR(\tau_1, \tau_2)}{\sqrt{\sigma_{w,N}^2}} \sim^a N(0, 1) \quad (8)$$

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<sup>23</sup>A longer estimation period would result in a higher number of trades being eliminated as a result of missing price data prior to the trade.

<sup>24</sup>In our calculations, we use 1000 as the standard number of bootstrapped abnormal returns. We check our calculations by using the sample standard deviations instead of using bootstrapped standard deviations and come to very similar results.



All previous definitions are based on the assumption that the relevant null hypothesis is  $CAAR(\tau_1, \tau_2) = 0$ . However, as outlined above, it has been shown extensively in previous research that insiders can earn abnormal returns on a statistically significant level. The main focus of this paper is thus to analyze if there are parameters such as high ownership or high committed wealth which can be utilized to successfully filter the vast number of reported insider trades and allow outside investors to profit from only trading based on these filtered trades. Hence, the question becomes if abnormal returns from filtered transactions are significantly different from unfiltered abnormal returns. To proceed with this analysis, we split our sample into two parts: The first one shows characteristics such as CEO ownership over a certain threshold, while the second one has characteristics below the threshold. All calculations except for the test statistic for the subsamples are conducted as they were defined above for the whole sample. The test statistic in this case is defined as:

$$J_1 = \frac{CAAR(\tau_1, \tau_2)_{above} - CAAR(\tau_1, \tau_2)_{below}}{\sqrt{\sigma_{w, N_{above}}^2}} \sim^a N(0, 1) \quad (9)$$

where  $CAAR(\tau_1, \tau_2)_{above}$  is the cumulative abnormal return for all trades above the threshold,  $CAAR(\tau_1, \tau_2)_{below}$  is the cumulative abnormal return for all trades below the threshold and  $\sqrt{\sigma_{w, N_{above}}^2}$  is the standard deviation of the abnormal returns for all  $N_{above}$  trades above the threshold.

As outlined previously, one of the main motivations for this study is to see whether or not insider trades which have similar characteristics also have similar return patterns. These characteristics are defined as follows:

$$Change_{i,t} = \begin{cases} \frac{TradedShares_{i,t}}{CEOShares_{i,t,post}}, & \text{if share purchase.} \\ \frac{TradedShares_{i,t}}{CEOShares_{i,t,prior}}, & \text{if share sale.} \end{cases} \quad (10)$$

where  $TradedShares_{i,t}$  is the number of shares traded by the CEO of company  $i$  on day  $t$ ,  $CEOShares_{i,t,post}$  is the number of shares held by the CEO after the trade and the number of shares held by the CEO before the trade is denoted as  $CEOShares_{i,t,prior}$ . While technically speaking, the definition for purchases is not a change but rather the percentage of new shares as a portion of all shares, it solves the problem of a change of infinity in case of no previous shareholdings. Another beneficial property is that all  $Change_{i,t}$  are now within the interval  $(0, 1]$  rather than  $(0, \infty)$ .

$$Ownership_{i,t} = \frac{CEOShares_{i,t}}{TotalShares_{i,t}} \quad (11)$$

where  $CEOShares_{i,t}$  are the shares held by the CEO of company  $i$  on day  $t$  and  $TotalShares_{i,t}$  are the total shares of company  $i$  outstanding on day  $t$ .<sup>25</sup>

$$TradedWealth_{i,t} = \frac{CEOVOLUME_{i,t} \times Price_{i,t}}{Wealth_{i,t}} \quad (12)$$

where  $CEOVOLUME_{i,t}$  is the number of shares bought or sold by the CEO of company  $i$  on day  $t$ ,  $Price_{i,t}$  is the stock price of a common stock of company  $i$  at time  $t$  and  $Wealth_{i,t}$  is the wealth of the CEO of company  $i$  on day  $t$  approximated by the latest available wealth filing at the Swedish tax authorities.<sup>26</sup>

In order to further control for the robustness of our results, we also compare insiders' returns to the market return, i.e. alpha is assumed to be zero and beta is one in the market-model. In this case, abnormal returns are computed as the difference between an insider's returns, i.e. the stock returns of the stock traded by the insider, and the market return.

Finally, we take a look at what explains abnormal returns around insider trading dates, by looking at the following regression as a starting point:

$$CAAR_{i,t} = \alpha + \beta_1(Change_{i,t}) + \beta_2(Own_{i,t}) + \beta_3(Wealth_{i,t}) + B_j\Phi_{i,t} + \epsilon_{i,t} \quad (13)$$

where  $CAAR_{i,t}$  is the cumulative abnormal return of a transaction in company  $i$  on day  $t$ ,  $\alpha$  is a constant,  $Change_{i,t}$  is a dummy variable with a value of 1 if the change in shareholding is above 20% and 0 otherwise,  $Own_{i,t}$  is a dummy variable with a value of 1 if the CEO's ownership stake is above 5% and 0 otherwise, and  $Wealth_{i,t}$  is a dummy variable with a value of 1 if the CEO's affected wealth is above 10% for the respective transaction and 0 otherwise. Other included variables for the analysis, captured together by  $\Phi_{i,t}$  in equation (13) but used independently in the actual analysis, are a company's size as measured by the natural logarithm of the market capitalization at the time of the respective insider transaction, a company's market-to-book ratio and a company's momentum, measured as the company's return over the previous

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<sup>25</sup>Our analysis is conducted using the share of capital rather than the share of voting rights. Since these two ratios only differ in a small number of cases, our results are virtually the same if the voting rights are used.

<sup>26</sup>Since wealth data is only available on an annual basis and until the year 2006, the wealth reported at the end of 2004 is used for all trades in 2005 and the wealth reported at the end of 2006 is used for all trades from this point on.

12 months.  $B_j$  captures the regression coefficients  $\beta_4$ ,  $\beta_5$ , and  $\beta_6$  for the control variables size, market-to-book ratio, and momentum. We add time and industry fixed effects in all specifications and use a number of regressions to measure the effect of these variables independently and interdependently on abnormal returns around insider trading dates. Usually, such regression analyses could be seen as an independent analysis. However, in this case we mainly use it to further explain and analyze our previous results from the event study and thereby enhance the understanding of insider trading's abnormal returns.

### 4.3.2 Trading strategy

The first part of our study mostly focuses on the profitability of insider trading for the CEOs themselves. Since this study is not about whether or not insider trading is fair or should be highly regulated, we shift our perspective away from the CEOs to outside investors and if it is possible for them to profit from public information about insider transactions to generate abnormal returns themselves. Naturally, theoretical trading strategies are vulnerable to criticism regarding model- or data-mining. To minimize the possibility of such allegations, we try to keep our strategy as simple and transparent as possible.

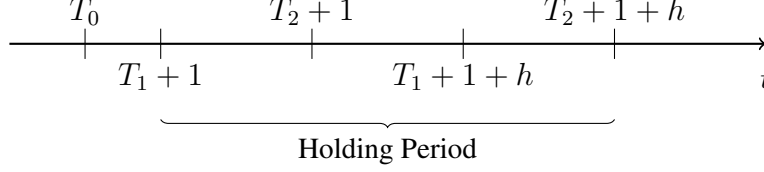
Our dataset contains the trading day ( $T_0$ ) as well as the reporting day ( $T_1$ ) for every insider trade. We do not consider any trades with a reporting delay of more than 90 days as informative and exclude them from our sample when building the trading strategy. As the exact time of reporting on the reporting day is not available, we add a lag of one more day to the reporting day. Every CEO trade is considered to be a trading signal and we follow the direction of the trade and hold a company's stock for a holding period of  $h$  days.<sup>27</sup> Because some CEOs tend to buy shares on a fairly regular basis, an independent treatment of all insider trades would result in a significant overexposure to a single company. As a solution, if a CEO buys shares and we already hold the shares as a result of a previous trade, only the holding period is extended to match the new trade while the position remains unchanged. Figure 2 below shows a graphical example of the implementation process. By repeating this procedure for every reported insider transaction, we create a portfolio of stocks with equal weight in each company with a recent CEO insider transaction. While the calculation of the portfolio return for this insider portfolio is relatively straightforward, it is unlikely that the market portfolio is the correct benchmark.

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<sup>27</sup>I.e., if a CEO buys shares, we buy shares as well and if a CEO sells shares, we (short-)sell the stock of the company. Since short selling is often not possible without further restrictions, we also conduct analyses for long-only strategies. We use a standard holding period  $h$  of 252 trading days for our analyses.

**Figure 2: Timeline trading strategy**

This figure illustrates how insider trades are transformed into trading signals. For an initial share purchase by the CEO on day  $T_0$  and reported on  $T_1$ , shares are bought on  $T_1 + 1$  with the intention to hold them until  $T_1 + 1 + h$ . At  $T_2$ , another purchase is reported and the holding period is adjusted for the new trade. As a result, the shares are held from  $T_1 + 1$  until  $T_2 + 1 + h$ .



It might be the case that CEOs of smaller companies engage in a disproportionate amount of trades and hence, small companies should have more weight in the benchmark portfolio. Previous studies such as Jegadeesh and Titman (1993) and Fama and French (1996) have identified a company's size, market-to-book ratio and momentum, measured as the performance over the past 12 months, as the most important predictors of cross sectional stock performance.

As a result, Daniel et al. (1997) introduced the 'Characteristic Selectivity' (CS) measure which matches each stock to a portfolio of stocks with similar characteristics. We closely follow their methodology but have to decrease the number of bins from  $5 \times 5 \times 5 = 125$  to  $3 \times 3 \times 3 = 27$  due to our smaller sample size. First, we divide our sample of firms into three equally sized groups based on their market capitalization. Then, we divide each group into three subgroups based on their market-to-book ratio. Both of these sortings are conducted on an annual basis at the beginning of each year. Finally, each subgroup is divided into three more groups based on their past years' performance. Since this data is available with a higher frequency, this sorting is done on a monthly basis at the beginning of each month.<sup>28</sup> Figure 6 in the Appendix displays a graphical illustration of the sorting mechanism.

The benchmark return for each insider trade  $R_{i,t}$  is then calculated as the average return of all companies in the respective bin:

$$R_{i,t}^{bin} = \frac{1}{N_{i,t}^{bin}} \sum_{j \neq i} D_{i,j,t}^{bin} R_{j,t} \quad (14)$$

<sup>28</sup>Of the 347 firms included in our analysis, not all were traded during the entire sample period. On average, 261 firms were publicly traded at the same time resulting in an average bin-size of approximately 9.7 with a minimum of 6 and a maximum of 13.

with

$$D_{i,j,t}^{bin} = \begin{cases} 1, & \text{if } bin_{i,t} = bin_{j,t}. \\ 0, & \text{else.} \end{cases} \quad \text{and} \quad N_{i,t}^{bin} = \sum_{j \neq i} D_{i,j,t}^{bin} \quad (15)$$

where  $bin_{i,t}$  and  $bin_{j,t}$  are the bins of company  $i$  and company  $j$  at time  $t$ ,  $N_{i,t}^{bin}$  is the number of companies that are in the same bin as company  $i$  at time  $t$  and  $R_{j,t}$  is the return of company  $j$  in period  $t$ . Furthermore, we define the diversification at time  $t$  as:

$$Div_t = \sum_i D_{i,t}^{pos} \quad (16)$$

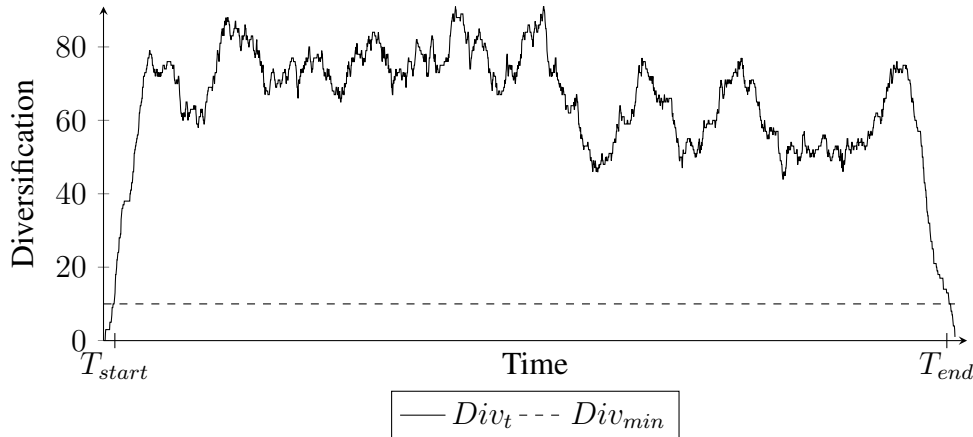
with

$$D_{i,t}^{pos} = \begin{cases} 1, & \text{if position in company } i \text{ at time } t \neq 0. \\ 0, & \text{else.} \end{cases} \quad (17)$$

Since our insider trading data starts in January 2004, by design, the first trade would have 100% weight in our portfolio until a position in another company is taken, then the first two trades would each have 50% weight and so forth.<sup>29</sup> To reduce the distortion of our results arising from a very small number of trades, we impose one last restriction: The trading starts on day  $T_{start}$  when a minimum diversification is reached ( $Div_t \geq Div_{min}$ ) and stops on day  $T_{end}$  when the diversification becomes too low ( $Div_t \leq Div_{min}$ ). Figure 3 illustrates this restriction and the diversification over time.

**Figure 3:** Illustration of diversification over time

This figure shows the diversification from January 2004 until March 2014 for a holding period of 252 trading days and allowed short-sells. For return calculations, only the period  $[T_{start}, T_{end}]$  is considered which marks the first and the last day where  $Div_t \geq Div_{min}$  and  $Div_t \leq Div_{min}$ , respectively.



<sup>29</sup> Analogously, the last trade in the sample would also have 100% weight.

We calculate the portfolio return on day  $t$ , given that  $Div_t \geq Div_{min}$ , as the equally weighted return of all active positions<sup>30</sup>:

$$R_t^{PF} = \sum_i D_{i,t}^{pos} \times (R_{i,t} - R_{i,t}^{bin}) \quad (18)$$

The abnormal returns are then assessed by using the CS measure as proposed by Daniel et al. (1997):

$$CS_{daily} = \frac{\sum_{t=T_{start}}^{T_{end}} R_t^{PF}}{T_{end} - T_{start}} \quad (19)$$

which measures the average daily abnormal return of the insider portfolio. We mainly use monthly returns for our comparison and therefore define  $CS$  as:

$$CS = CS_{daily} \times 21 \quad (20)$$

By using size, market-to-book ratio and momentum sorting mechanisms, the CS measure is closely related to an  $\alpha$  obtained from a standard four factor regression as proposed by Carhart (1997). The statistical significance is tested by using the time-series standard error of  $R_t^{PF}$ .

To check the robustness of our results, we also use the Capital Asset Pricing Model (CAPM) developed independently by Sharpe (1964), Lintner (1965), and Mossin (1966) with the following regression:

$$R_t^{PF} - Rf_t = \alpha + \beta(RM_t - Rf_t) + \epsilon_t \quad (21)$$

where  $R_t^{PF}$  is the return of the insider portfolio in month  $t$ ,  $Rf_t$  is the risk-free return in month  $t$ ,  $\beta$  measures the sensitivity of the insider portfolio to non-diversifiable risk, i.e. market risk, and  $RM_t - Rf_t$  is the month  $t$  market return (equally-weighted) minus the risk-free rate approximated by the return on 10-Y Swedish government bonds. In this setting,  $\alpha$  can be seen as the abnormal return of the insider portfolio.<sup>31</sup> The main reason we also use the CAPM as a performance evaluation measure is that – despite empirical evidence against the model’s validity – it is still used by both academics and practitioners, as outlined by Jeng et al. (2003).

<sup>30</sup>In our study, returns are generally reported before any transaction costs. As outlined by Scott and Xu (2004), transaction costs can vary significantly between different investors and can therefore not be approximated by a single number for all investors. Additionally, most managers rely on systems with multiple information signals and therefore any signal adds value without necessarily leading to an actual trade.

<sup>31</sup>The market return can only be used in a regression for long only strategies but not in case short trades are allowed as well. In this case, we calculate  $\alpha_{i,t}$  and  $\beta_{i,t}$  for a trade in company  $i$  at time  $t$ , estimate the returns over the holding period and subtract them from the realized returns to calculate the excess return of the insider portfolio. The statistical significance is again assessed by the time-series standard error of the excess returns.

## 5 Results

We begin this section by outlining the market reaction to CEO's insider transactions, measured by CAARs around the transaction date. We further present how different variables, in particular CEOs' ownership, wealth and change in shareholding, impact the market reaction. Finally, we document how outside investors can benefit from CEOs' insider transactions.

### 5.1 The market reaction to CEOs' insider transactions

Table 3 presents the market reaction to CEOs' purchases and sales and consists of four panels. Panel A outlines the results for the full sample, while Panel B, C, and D show the market reaction to CEO insider transactions which are above a 5% threshold with regard to change in shareholding, ownership, and affected wealth respectively.<sup>32</sup>

The results in Panel A strongly support our Hypotheses 1a and 1b, confirming that there is a strong positive market reaction to CEO insider purchases and a strong negative market reaction to CEO insider sales. The five-day CAAR based on the transaction day and the following four days from the market-model is 1.46% for purchases and 1.35% for sales. These results are significantly different from zero, both economically and statistically. With regard to the magnitude of CAARs, the CEO insider purchases are quite similar to the results by Fidrmuc et al. (2006) for the (0;4) event window.<sup>33</sup> Overall, the CAARs are of higher magnitude as those documented by Lakonishok and Lee (2001), who analyze a U.S. sample of all insiders, i.e. not limited to CEOs. However, contrary to our Hypothesis 1c, CEO insider purchases only lead to larger abnormal returns for our shortest event window. For longer time horizons, abnormal returns from CEOs' insider sales are higher than for purchases. Hence, the market tends to take some time to evaluate a sale, as a sale could be due to several reasons, such as changed expectations about the firm's future and diversification needs. Our findings with regard to higher abnormal returns for sales than purchases differ from the findings of other studies, such as Lakonishok and Lee (2001), Friederich et al. (2002), and Fidrmuc et al. (2006). One possible explanation is that the market seems to value CEO insider sales as being carried out based on negative insider information and not based on liquidity needs. Another explanation is the lower number of stock options in Sweden which results in fewer sales by CEOs. The actual occurring

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<sup>32</sup>Results for the unique sample as well as other ownership, wealth and change in shareholding thresholds are outlined in the Appendix.

<sup>33</sup>Fidrmuc et al. (2006) analyze the market reaction around the announcement day instead of the trading day.

**Table 3: Market reaction around the transaction day (full sample)**

This table reports the CAARs and test statistics for insider transactions by CEOs in Swedish companies for three intervals around the actual transaction day. Panel A displays all transactions irrespective of other factors, such as CEO ownership or wealth. In Panel B, the CAARs for all transactions in which the traded number of shares exceeds 5% of the resulting shareholding are shown. Panel C shows the CAARs for CEO insider transactions in which the CEO owns more than 5% of the company. Panel D displays the results for CEO insider transactions in which at least 5% of the CEO's wealth are affected by the insider transaction. The market model was used where  $\beta_i$ 's are estimated over the (-180;-6)-day window. The test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively.

|                                                                            | CAAR (0;4) | CAAR (0;20) | CAAR(0;62) |
|----------------------------------------------------------------------------|------------|-------------|------------|
| <b>Panel A: CEO insider purchases and sales (full sample)</b>              |            |             |            |
| CEO insider purchases (2,154 transactions)                                 |            |             |            |
| CAAR                                                                       | 1.46%***   | 2.49%***    | 4.03%***   |
| $J_1$                                                                      | 8.76       | 7.85        | 7.40       |
| CEO insider sales (666 transactions)                                       |            |             |            |
| CAAR                                                                       | -1.35%***  | -3.08%***   | -7.14%***  |
| $J_1$                                                                      | -4.01      | -4.65       | -6.17      |
| <b>Panel B: CEO insider transactions for change in shareholding &gt;5%</b> |            |             |            |
| CEO insider purchases (1,164 transactions)                                 |            |             |            |
| CAAR                                                                       | 2.11%***   | 3.20%***    | 5.64%***   |
| $J_1$                                                                      | 8.94       | 7.02        | 7.26       |
| CEO insider sales (424 transactions)                                       |            |             |            |
| CAAR                                                                       | -1.50%***  | -3.11%***   | -8.01%***  |
| $J_1$                                                                      | -3.92      | -3.95       | -6.16      |
| <b>Panel C: CEO insider transactions for ownership &gt;5%</b>              |            |             |            |
| CEO insider purchases (786 transactions)                                   |            |             |            |
| CAAR                                                                       | 0.87%***   | 1.77%***    | 0.66%      |
| $J_1$                                                                      | 3.38       | 3.62        | 0.82       |
| CEO insider sales (180 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.26%     | -1.61%      | 0.42%      |
| $J_1$                                                                      | -0.35      | -0.99       | 0.22       |
| <b>Panel D: CEO insider transactions for affected wealth &gt;5%</b>        |            |             |            |
| CEO insider purchases (282 transactions)                                   |            |             |            |
| CAAR                                                                       | 1.14%***   | 2.19%***    | 3.57%***   |
| $J_1$                                                                      | 3.28       | 3.27        | 3.09       |
| CEO insider sales (152 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.79%**   | -1.62%**    | -3.11%**   |
| $J_1$                                                                      | -1.77      | -1.91       | -2.16      |

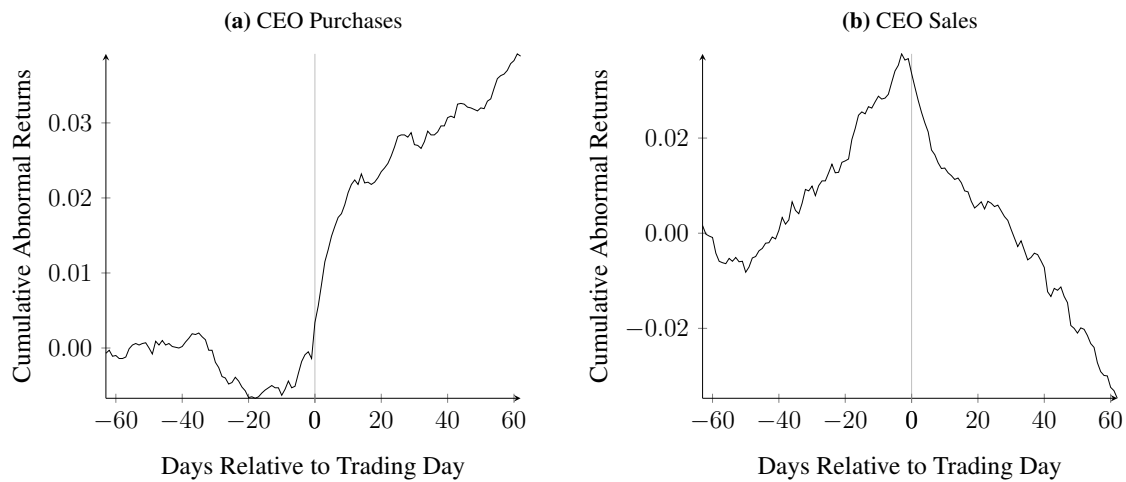


sales thus carry more information than sales in countries with more stock options granted. We therefore have to reject our Hypothesis 1c when looking at longer time horizons. Nonetheless, we conclude that CEOs trade on superior information.

Looking at the CAARs prior to a CEO's insider transaction, Figure 4 displays that CEOs are able to time their insider transactions. Prior to an insider purchase, the CAAR is negative, whereas it is significantly positive prior to an insider sale. We therefore conclude that insider transactions by CEOs in Swedish companies reveal information, with CEOs having the ability to time the market and to earn abnormal returns. With regard to insider transactions given a certain threshold for change in shareholding, ownership and wealth, the market timing abilities of CEOs in Swedish companies are displayed in Figure 5.

**Figure 4: CEO market timing abilities**

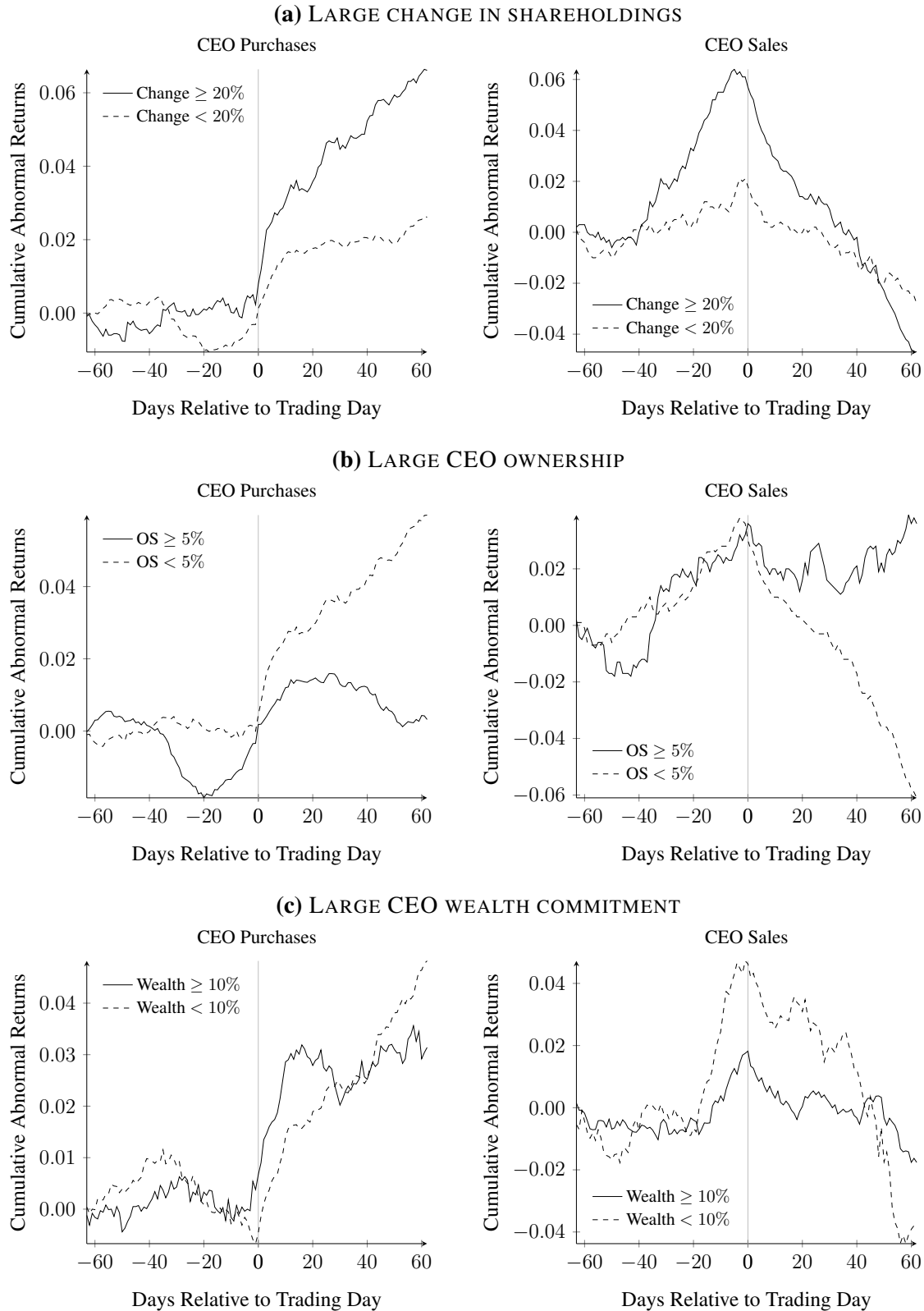
The following figure displays the cumulative average abnormal returns for CEO purchases and sales for a time window of 63 trading days around the transaction day. Abnormal returns are calculated by using the market-model and an equally-weighted market index as the benchmark return.



Hypothesis 2 asserts that a higher change in a CEO's shareholding leads to higher abnormal returns. We test this in different ways. We begin by looking at CEO insider transactions in which the traded number of shares exceeds a certain threshold of the resulting shareholding. Panel B reports the results for CEO insider transactions with a change of more than 5% in shareholding. The five-day CAAR based on the transaction day and the following four days from the market-model is 2.11% for purchases and 1.50% for sales. These differences in magnitude compared to the full sample increase for longer event windows, especially for purchases. Looking at other thresholds further corroborates our findings, with all results being statistically significant. However, in order to evaluate whether a higher change in shareholding leads to higher abnormal returns than a small change in shareholding, it is important to estimate the

**Figure 5: CEO market timing abilities with regard to different filters**

The following figures demonstrate the effect of different filters on the cumulative abnormal returns. The first subfigure (a) displays the effect of a 20% threshold in the change in CEO shareholdings on the abnormal returns. The second subfigure (b) shows the difference between companies with more than 5% CEO ownership (OS) and the remaining sample. Subfigure (c) shows the abnormal cumulative returns for trades where the CEO invests more than 10% of his personal wealth. Subfigures (a) and (b) use the full sample including overlapping trades while subfigure (c) uses only a smaller subsample of CEOs where wealth data was available.



difference in abnormal returns between high change and low change transactions. Looking at the difference in abnormal returns for transactions with a change of more than 20% and less than 20% in shareholding – as outlined in Table 4 – supports our results. A higher change in shareholding leads to higher abnormal returns. This holds for both purchases and sales and the results are statistically significant. Given our results we cannot reject Hypothesis 2, a higher change in shareholding leads to higher abnormal returns. Our findings are in line with the results by Scott and Xu (2004).

**Table 4:** Differences in abnormal returns (full sample)

This table reports the difference in CAARs when comparing different thresholds with regard to change in shareholding, ownership, and wealth, as well as the statistical significance of these differences. Panel A outlines the differences in CAARs for changes in shareholdings above 20% and below 20%. Panel B shows the differences in CAARs for insider transactions with CEO ownership above 5% and below 5%. Finally, Panel C shows the differences in CAARs for fractions of wealth of above 5% and below 5% which are affected by a respective CEO insider transaction. The market model is used and the  $\beta_i$ 's are estimated over the (-180;-6)-day window. The test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively.

| Event window:                                                                        | (0;4)     | (0;20)    | (0;62)    |
|--------------------------------------------------------------------------------------|-----------|-----------|-----------|
| <b>Panel A: CEO insider transactions with different changes in shareholding</b>      |           |           |           |
| Purchases, change > 20% vs. < 20%                                                    |           |           |           |
| Difference in CAAR                                                                   | 1.00%***  | 1.26%**   | 3.44%***  |
| $J_1$                                                                                | 3.22      | 2.13      | 3.38      |
| Sales, change > 20% vs. < 20%                                                        |           |           |           |
| Difference in CAAR                                                                   | -0.71%*   | -2.47%*** | -5.83%*** |
| $J_1$                                                                                | -1.44     | -2.62     | -3.63     |
| <b>Panel B: CEO insider transactions with ownership threshold of 5%</b>              |           |           |           |
| Purchases with ownership > 5% vs. < 5%                                               |           |           |           |
| Difference in CAAR                                                                   | -0.91%*** | -1.15%**  | -5.29%*** |
| $J_1$                                                                                | -3.55     | -2.33     | -6.29     |
| Sales with ownership > 5% vs. < 5%                                                   |           |           |           |
| Difference in CAAR                                                                   | 1.42%**   | 1.99%*    | 10.26%*** |
| $J_1$                                                                                | 1.84      | 1.36      | 4.05      |
| <b>Panel C: CEO insider transactions with different fractions of affected wealth</b> |           |           |           |
| Purchases with affected wealth > 5% vs. < 5%                                         |           |           |           |
| Difference in CAAR                                                                   | 0.00%     | -0.62%    | -1.99%**  |
| $J_1$                                                                                | 0.25      | -0.93     | -1.75     |
| Sales with affected wealth > 5% vs. < 5%                                             |           |           |           |
| Difference in CAAR                                                                   | 0.57%     | 0.34%     | 8.65%     |
| $J_1$                                                                                | 1.27      | 0.40      | 5.96      |

Buying a larger amount of shares in comparison to the overall number of shares held by a CEO, signals commitment to the firm and positive expectations about the firm's value. The same holds for CEO insider sales. By selling a large fraction of their shareholding, CEOs signal that their sale is most likely due to negative expectations about the firm's prospects and not due to liquidity or diversification needs.

Panel C summarizes the abnormal returns for CEO insider transactions in which the CEO owns more than 5% of her company. CAARs amount to 0.87% for purchases and 0.26% for sales for the five-day event window around the transaction day. These CAARs are smaller, both for purchases and sales, compared to the full sample. Moreover, the CAARs for sales transactions are not statistically significant. This also holds when increasing the ownership threshold to 10%, as documented in Table 7 in the Appendix. On the one hand, CAARs are slightly higher for transactions with a 10% ownership stake than with a 5% ownership stake, indicating that a higher ownership stake leads to a larger market reaction. One potential reason for this result is that the number of transactions is lower for the higher ownership threshold, thus giving more weight to a few companies in which the CEO owns a large stake. This overweighting of high ownership companies can distort the results and thus makes a conclusion regarding the effect of ownership on CEOs' abnormal returns difficult. On the other hand, comparing transactions in which the ownership stake was above 5% to transactions in which it was below 5% supports Hypothesis 3, i.e. that insider transactions in which a CEO has a larger ownership stake lead to a smaller reaction by the market. These results are statistically significant. Hence, we cannot reject Hypothesis 3 that a higher ownership stake leads to a smaller reaction by the market. Fidrmuc et al. (2006) come to the same conclusion when analyzing a U.K. sample and find that a higher ownership stake leads to a statistically significant smaller market reaction. The negative effects of increasing the ownership stake, in particular potential entrenchment or CEO overconfidence, reduce the positive market reaction. Hence, with an already high ownership stake the positive market reaction to foregone diversification is weakened. A similar argument in the opposite direction can be made for sales in which the ownership stake is reduced.

The final test with regard to CEOs' ability to earn abnormal returns is the effect of a CEO's wealth on abnormal returns earned from insider transactions. The results for CEO insider transactions in which at least 5% of a CEO's wealth is affected by the transaction are shown in Panel D of Table 3. The five-day CAARs for CEO insider purchases and sales in which at least 5% of the CEO's wealth is affected are 1.14% and 0.79% respectively, and thus lower than the CAARs

for the full sample. The CAARs for the 10% wealth threshold are slightly higher than for the 5% threshold, with the results for the estimated CAARs being statistically significant for all event windows analyzed. However, it is again important to look at the difference in CAARs of transactions with affected wealth above 5% and below 5%. We do not find that higher affected wealth leads to higher CAARs. Moreover, the results are statistically not significant, neither for purchases nor for sales, and therefore Hypotheses 4 cannot be supported. Based on our results the affected wealth of a CEO has no effect on the magnitude of abnormal returns in the short term. Hence, our results differ from the findings by Kallunki et al. (2009), who show a higher information content with regard to future returns for insider sales by insiders who have the greatest proportion of wealth allocated to insider stocks. However, Figure 7 in the Appendix displays the long-term market reaction to CEO insider transactions in which at least 10% of a CEO's reported wealth is affected. In the long run, the abnormal returns to transactions with a higher affected wealth are much larger. This is important to know for outside investors who want to mimic insider transactions, as they need to be invested for a certain period of time in order to recoup the transaction costs, as described by Seyhun (1998). One reason for the difference between short- and long-term results could be that market participants need some time to assess the reasons for a particular insider transaction and how the CEO's wealth is affected in that case. A CEO's wealth might not be taken into account in the beginning by a lot of market participants as this information is not readily available.

As outlined previously, we also analyze a unique sample, in which transactions with overlapping event windows are excluded. This is done in order to not give a disproportionate weighting to companies in which the CEO trades frequently. For this analysis the market-model is used as well. The detailed results for the unique sample are outlined in Table 8, 9, and 10 (Appendix) and they corroborate our findings from the full sample analysis. The estimated CAARs are of very similar magnitude. When analyzing the unique sample, CAARs for purchases are 1.37% and 0.86% for sales when looking at the five-day window around the transaction date. For longer horizons, the CAARs for sales are of higher magnitude than those for purchases. Hence, in the short run, the unique sample analysis supports Hypothesis 1c, but this does not hold in the long run, as already documented for the full sample above. With regard to the other hypotheses, our findings above are corroborated. However, differences in abnormal returns for ownership stakes above 5% and below 5% are only statistically significant for the short and the very long event window, but not for the (0;20) event window.

In order to further check our results for robustness, we also compare CEOs' returns to the market return, using the unique sample. This is equivalent to alpha being zero and beta being one in the market-model. The results are outlined in further detail in Table 11 (Appendix). The aforementioned findings with regard to our hypotheses are supported when using this benchmark as a robustness check. Except for the very long event window, the abnormal returns are of very similar magnitude as the abnormal returns for the market-model.<sup>34</sup> Hence, our findings are robust when applying a different benchmark.

Finally, we also carry out several regression analyses in order to explain abnormal returns around insider trading dates. The detailed regression results are reported in Table 12 and 13 in the Appendix for purchases and sales respectively. When looking at CEO insider purchases, change in shareholding has a significant positive effect on abnormal returns, whereas ownership has a significant negative effect. Wealth has no statistically significant effect on abnormal returns around the insider trading date. Overall, the effects for the three variables are smaller than the event study results. This is due to the fact that we control for size, market-to-book ratio, and momentum when carrying out the regression analyses but not in the event study analyses. In particular, a large part of the wealth effect seems to be captured by the three control variables, size, market-to-book, and momentum, thus leaving the wealth variable statistically insignificant. Therefore, our regression results support our earlier findings. The regression analyses on CEO insider sales lead to slightly different findings. While change in shareholding has a significant negative effect on abnormal returns from insider sales, CEO ownership has no significant effect, unlike what we obtain from our regression analysis on CEO insider purchases. Yet, wealth has a significant strong, positive effect on abnormal returns from CEO insider sales. Thus, similar to Kallunki et al. (2009), we find that a higher proportion of wealth allocated to insider stocks has a higher effect on abnormal returns.

To conclude the analysis of the market reaction to insider transactions, our findings suggest that CEOs trade on superior information, are capable of timing the market and earning abnormal returns when engaging in insider trades. Moreover, a higher change in a CEO's shareholding leads to higher abnormal returns, while a higher CEO ownership stake reduces the magnitude of abnormal returns. Finally, a CEO's wealth which is affected by a respective insider trade does not have a significant effect on the magnitude of abnormal returns in the short term.

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<sup>34</sup>As outlined above, for event studies with a longer time horizon, choosing a good benchmark for expected returns is crucial. Our results underline that long-term results are strongly influenced by the benchmark used.

## 5.2 Returns for outside investors when mimicking insider transactions

After outlining the market reaction to insider transactions by CEOs in Swedish companies and resulting abnormal returns to CEOs, we now focus on how outside investors can benefit from knowing about and mimicking these insider transactions. In total, we analyze eight strategies with regard to change in shareholding, ownership and CEOs' wealth. The results for these strategies are outlined in Table 5. For each scenario we differentiate between two strategies. The first strategy mimics both CEO insider purchases and sales, while the second strategy only mimics CEO purchases, i.e. if the CEO buys shares, the mimicking portfolio also goes long in this company, but if a sales transaction occurs, the mimicking portfolio remains unchanged.<sup>35</sup> Panel A reports the results for the two trading strategies which mimic all insider transactions, independent of additional filters such as wealth. In Panel B the results for mimicking only CEO insider transactions with a change in shareholding of at least 20% are documented. Panel C shows the results for mimicking portfolios based on CEO insider transactions in which the CEO owns less than 5% of the company. Finally, Panel D displays the results for trading strategies based on CEO insider transactions in which at least 10% of a CEO's wealth is affected by the respective insider transaction. These thresholds are chosen with respect to our earlier results on abnormal returns for CEOs.

The results in Panel A strongly indicate that outside investors can earn abnormal returns (excluding transaction costs) themselves when mimicking insider transactions by CEOs in Swedish companies. Mimicking both purchases and sales leads to an  $\alpha$  of 72 basis points per month under the CAPM. The CS measure for this strategy is slightly smaller but significant with 44 basis points per month. Hence, controlling for size, market-to-book and momentum reduces abnormal returns to outsiders but does not eliminate them. As outlined on the right side of Panel A, only mimicking CEO insider purchases leads to even higher abnormal returns for outside investors. Under the CAPM the  $\alpha$  estimate is a significant 0.93% per month and the CS measure for this long-only strategy is 0.55% per month. Thus, the same reasoning with regard to size, market-to-book and momentum also holds for this strategy. Nonetheless, outside investors can earn abnormal returns even when controlling for these factors. Therefore, our results differ from Rozeff and Zaman (1988), who find that outside investors do not earn abnormal returns when controlling for size and earnings/price ratio and assuming transaction costs of 2%. Our

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<sup>35</sup>The long-only strategy is included as there are often short-sale restrictions. Moreover, short-sales usually lead to higher transaction costs, which are avoided by a long-only strategy.

results, especially for the CS measure, are of very similar magnitude as the results by Jeng et al. (2003), who use both the CAPM and the CS measure when estimating abnormal returns to insiders for a U.S. sample. The explanatory power of our model is slightly smaller than found by Jeng et al. (2003), with an  $R^2$  of 0.74 compared to 0.77.

When only mimicking transactions with a change of at least 20% in shareholding, the performance of the mimicking portfolio drops, especially when controlling for size, market-to-book and momentum, i.e. when using the CS measure. Panel B shows that the abnormal returns to outsiders amount to 0.63% per month when mimicking both purchases and sales and using the CAPM as the benchmark. However, when using the CS measure this estimate, albeit still being significant, is reduced to 0.16% per month. Similar results are obtained for the long-only strategy, in which outside investors only mimic CEO insider purchases with a change in shareholding of at least 20%. Using this strategy, the estimated  $\alpha$  under the CAPM is a significant 79 basis points per months, but this estimate decreases to 35 basis points per month when using the CS measure. Therefore, our results indicate that it is not very promising for outside investors when only mimicking insider transactions with a change in shareholding of at least 20%, as the results are worse than when outside investors mimic all CEO insider transactions.

Slightly better results are achieved for mimicking only transactions in which the CEO owns less than 5% of the company, but  $\alpha$ 's are still marginally smaller than for the strategies which mimic all insider transactions by CEOs in Swedish companies. The reason for only mimicking CEO transactions in which the CEO owns less than 5% is the smaller market reaction if a CEO has a higher ownership stake. Thus, by focusing on trades with a low ownership stake, outside investors maintain the opportunity to achieve high abnormal returns for themselves. The detailed results for the strategies which are based on CEO ownership are documented in Panel C. Abnormal returns amount to 66 basis points per month when mimicking both purchases and sales and using the CAPM as the benchmark. The CS measure is 0.42% per month, i.e. controlling for size, market-to-book and momentum has a smaller negative effect than it has for the strategies which focus on change in shareholding. The long-only strategy for transactions in which the CEO owns less than 5% of the company also leads to marginally smaller  $\alpha$ 's than the long-only strategy which mimics all CEO purchases, but the results are of very similar magnitude. Mimicking only purchase transactions in which the CEO's ownership stake is below 5% leads to a significant  $\alpha$  estimate of 88 basis points per month under the CAPM, with a CS measure of 53 basis points per month. The explanatory power of the long-only strategy under



the CAPM with the ownership filter is the highest of all strategies with an estimated  $R^2$  of 0.75.

Finally, Panel D reports the results for the two strategies which are based on the CEO's wealth. Mimicking both purchases and sales in which at least 10% of a CEO's wealth is affected does not increase the abnormal returns to outside investors compared to mimicking all purchases and sales with no additional filters. Using the wealth filter leads to an  $\alpha$  estimate of 56 basis points per month under the CAPM. Surprisingly, the CS measure is 66 basis points per month and thus higher than the CAPM estimate, i.e. controlling for size, market-to-book and momentum actually increases the abnormal returns outside investors can achieve. Hence, CEOs whose wealth is more affected by the insider transactions are less likely to be from small firms, value stocks and those with high momentum. The most interesting result, however, is the abnormal returns for the long-only strategy with an affected wealth of at least 10%. By only mimicking CEO purchases in which at least 10% of a CEO's wealth is affected, outside investors can generate a significant  $\alpha$  of 110 basis points per month under the CAPM. Using the CS measure and thus controlling for size, market-to-book and momentum reduces the abnormal return, but the CS measure is still high and significant with an estimate of 81 basis points per month. Therefore, with regard to our results, the most promising strategy to outside investors is to only mimic CEO purchases in which at least 10% of a CEO's wealth is affected. This strategy is also rather simple to implement as it does not require any short-selling of stocks and the number of transactions is manageable. In our case, 109 transactions, in which a CEO buys shares and at least 10% of her wealth is affected, are mimicked.

As outlined by Jeng et al. (2003), the CS measure is estimated by using a completely different method than the computation of the  $\alpha$ 's in the CAPM. Hence, despite the CS measure being smaller for most strategies, the similarity in results of the CAPM and the CS measure is corroborating and confirming that our results are robust. To put it in a nutshell, outside investors can earn abnormal returns themselves when mimicking insider transactions by CEOs in Swedish companies. These abnormal returns are lower when controlling for size, market-to-book and momentum, but not eliminated. The most promising strategy, given our results, is to only mimic purchases in which at least 10% of a CEO's wealth is affected. Our results are also displayed graphically in Figure 8 in the Appendix to give a visual image of the abnormal return potential of the mimicking strategies. Seeing that outside investors are able to earn abnormal returns, we conclude that the semi-strong form of market efficiency is significantly violated.

**Table 5: Performance evaluation results for mimicking portfolios**

This table reports the performance evaluation results for mimicking portfolios. Each mimicking portfolio consists of the shares of companies in which CEOs engaged in insider trades over the previous 6 months. Column 3 and 6 give the results for the CAPM [equation (21)]. Column 4 and 7 give the results for the CS measure [equations (19) and (20)]. The holding period for each share is assumed to be one year. The minimum diversification is 10 companies. Avg. div. refers to the average number of different shares actually held in the mimicking portfolio and avg. holding refers to the actual average number of days a company was held in the portfolio. Excess returns are stated on a monthly basis. The symbols \*\* and \* indicate significance on the 1% and 5% levels respectively. Standard errors of the regression are reported in parentheses.

|                                                                                      |        | CAPM                                 | CS Measure |          | CAPM                            | CS Measure |
|--------------------------------------------------------------------------------------|--------|--------------------------------------|------------|----------|---------------------------------|------------|
|                                                                                      |        | <i>Mimicking purchases and sales</i> |            |          | <i>Mimicking only purchases</i> |            |
| Panel A: Mimicking strategies without additional filters                             |        |                                      |            |          |                                 |            |
| Transactions                                                                         | 888    |                                      |            | 560      |                                 |            |
| Avg. div./holding                                                                    | 96/285 |                                      |            | 78/363   |                                 |            |
| $\alpha$                                                                             |        | 0.72%**                              |            | 0.93%**  |                                 |            |
|                                                                                      |        | (0.0006)                             |            | (0.0006) |                                 |            |
| $\beta$                                                                              |        |                                      |            | 0.83%**  |                                 |            |
|                                                                                      |        |                                      |            | (0.0437) |                                 |            |
| $R^2$                                                                                |        |                                      |            | 0.74     |                                 |            |
| CS                                                                                   |        |                                      | 0.44%**    |          |                                 | 0.55%**    |
|                                                                                      |        |                                      | (0.0004)   |          |                                 | (0.0005)   |
| Panel B: Mimicking transactions with a change in shareholding of at least 20%        |        |                                      |            |          |                                 |            |
| Transactions                                                                         | 594    |                                      |            | 403      |                                 |            |
| Avg. div./holding                                                                    | 60/265 |                                      |            | 46/297   |                                 |            |
| $\alpha$                                                                             |        | 0.63%**                              |            | 0.79%*   |                                 |            |
|                                                                                      |        | (0.0007)                             |            | (0.0007) |                                 |            |
| $\beta$                                                                              |        |                                      |            | 0.83%**  |                                 |            |
|                                                                                      |        |                                      |            | (0.0538) |                                 |            |
| $R^2$                                                                                |        |                                      |            | 0.66     |                                 |            |
| CS                                                                                   |        |                                      | 0.16%**    |          |                                 | 0.35%**    |
|                                                                                      |        |                                      | (0.0005)   |          |                                 | (0.0007)   |
| Panel C: Mimicking transactions in which CEO owns less than 5% of the company        |        |                                      |            |          |                                 |            |
| Transactions                                                                         | 722    |                                      |            | 491      |                                 |            |
| Avg. div./holding                                                                    | 80/290 |                                      |            | 66/352   |                                 |            |
| $\alpha$                                                                             |        | 0.66%**                              |            | 0.88%**  |                                 |            |
|                                                                                      |        | (0.0007)                             |            | (0.0006) |                                 |            |
| $\beta$                                                                              |        |                                      |            | 0.86%**  |                                 |            |
|                                                                                      |        |                                      |            | (0.0448) |                                 |            |
| $R^2$                                                                                |        |                                      |            | 0.75     |                                 |            |
| CS                                                                                   |        |                                      | 0.42%**    |          |                                 | 0.53%**    |
|                                                                                      |        |                                      | (0.0004)   |          |                                 | (0.0005)   |
| Panel D: Mimicking transactions in which at least 10% of a CEO's wealth are affected |        |                                      |            |          |                                 |            |
| Transactions                                                                         | 201    |                                      |            | 109      |                                 |            |
| Avg. div./holding                                                                    | 21/255 |                                      |            | 15/298   |                                 |            |
| $\alpha$                                                                             |        | 0.56%**                              |            | 1.10%*   |                                 |            |
|                                                                                      |        | (0.0009)                             |            | (0.0010) |                                 |            |
| $\beta$                                                                              |        |                                      |            | 0.95%**  |                                 |            |
|                                                                                      |        |                                      |            | (0.0716) |                                 |            |
| $R^2$                                                                                |        |                                      |            | 0.67     |                                 |            |
| CS                                                                                   |        |                                      | 0.66%**    |          |                                 | 0.81%**    |
|                                                                                      |        |                                      | (0.0007)   |          |                                 | (0.0010)   |

## 6 Conclusion

As outlined by Jeng et al. (2003), there are three main motives to study insider trading: science, policy and profit. Our study focuses on science and profit. By utilizing our original data set with information about personal wealth and stock ownership of CEOs in Swedish companies from 2004-2013, our paper adds to the scientific literature about insider trading. It measures the magnitude of abnormal returns depending on three factors, namely change in shareholding, CEO ownership in the company and personal wealth invested in the company. To start out, we analyze all CEO insider trades without further restrictions and find that CEOs trade on superior information and demonstrate impressive market timing abilities for stock purchases and sales alike. Contrary to our initial intuition, sales demonstrate larger abnormal returns than purchases, suggesting that the market assumes the sale is due to changed expectations about the firm's prospects and not due to diversification or liquidity needs. The market seems to put more value on CEOs' negative expectations about the firm than on positive expectations. Thereafter, we examine the effect of considerable changes in CEOs' shareholdings and find that purchases and sales with a major change earn larger abnormal returns than small change trades in the short term. For purchases, a higher change in shareholding can be seen as a strong commitment by the CEO to her firm and positive expectations about the firm's prospects. If a CEO sells a large portion of her shareholding this can be seen as a negative signal regarding a firm's future whereas a small change would be more likely due to liquidity or diversification needs.

In a next step, the focus is shifted to transactions in which the CEO holds a large stake in the company and we find that the market's reaction to these trades is significantly smaller than for the control group. Hence, potential entrenchment and overconfidence reduce the positive market reaction to purchases while reduced entrenchment weakens the negative market reaction to sales. In the last part of our event study, we analyze the link between the invested wealth of the CEO and the magnitude of abnormal returns. Surprisingly, the abnormal returns are larger if the CEO invests less of her personal wealth in the company. Yet, only purchases with a time horizon of three months show statistically significant differences. The long-term results are rather sensitive to the treatment of overlapping trades. After controlling for overlapping trades, transactions with high personal wealth commitment demonstrate larger abnormal returns for purchases and sales over a one-year horizon. This confirms our previous intuition that high personal wealth commitments should lead to higher abnormal returns. As already stressed,

treatment of overlapping events and the choice of a benchmark play a crucial role when analyzing insider transactions. Not controlling for overlapping events puts too much weight on single companies in which the CEO trades frequently and can thus potentially distort the results.

During the second part of our analysis, we focus on outside investors and their ability to earn abnormal returns themselves by mimicking insider trades. We thereby also add to the profit literature. We develop a simple trading algorithm and test it against the CS measure developed by Daniel et al. (1997) and against the CAPM. Our results suggest that outsiders can earn up to 0.55% abnormal returns before transaction costs per month against the CS benchmark by simply mimicking CEO stock purchases and holding them for one year. One of our main motives for this study is to test if outside investors can increase their risk adjusted returns and lower their transaction costs by focusing on specific trades. We therefore add change in shareholding, ownership and wealth filters to our trading algorithm. Our results suggest that a large fraction of the abnormal returns for large changes and low ownership companies can be explained by size, market-to-book ratio and momentum. Interestingly, by mimicking only insider purchases in which the CEO invested more than 10% of her personal wealth in one trade increases the abnormal returns to 81 basis points per month and also lowers the number of trades necessary to 109. Unfortunately, wealth data is usually not publicly available, making this strategy rather difficult to implement in reality. Nonetheless, we conclude that it would be profitable to mimic CEO insider transactions in Sweden, even without additional filters.

As outside investors can consistently beat the market without taking additional risk, the semi-strong form of market efficiency is significantly violated.

Due to the cumbersome data gathering – especially when adding additional filters – individual studies usually have a rather low number of observations and we therefore suggest that further research of insider trades should try to increase the sample size of the analysis by combining different databases instead of studying subsamples of existing databases. Moreover, most studies on insider trading focus on the U.S., where a lot of data is available due to the required SEC filings. More studies in other countries, especially in continental Europe are necessary to improve the understanding of insider transactions. In particular, thorough research on factors that might have an effect on insider transactions' abnormal returns is crucial. In a world where most of the alpha of today is the beta of tomorrow (Melas et al., 2011), investment professionals in particular should have incentives to attract new investors by offering innovative investment products based on sound academic research.

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## 7 Appendix

**Table 6:** Description of sample and corrections made to sample

This table describes the sample which was used for the analysis of insider transactions by CEOs in Sweden and the corrections which were made in order to obtain this final sample. A few of these changes are outlined in further detail below.

| Sample description for the period 2004/01/01-2013/12/31     |                        |
|-------------------------------------------------------------|------------------------|
|                                                             | Number of transactions |
| Initial dataset (all transactions by all types of insiders) | 95 513                 |
| Non-CEO transactions                                        | -82 686                |
| CEO transactions                                            | 12 827                 |
| Security & transaction type *                               | -9 227                 |
| Daily net trades**                                          | -662                   |
| Inconsistent observations                                   | -15                    |
| Missing price data (IPO related)***                         | -14                    |
| Beta estimation (180 days)****                              | -85                    |
| Transactions with only 1 or 2 shares                        | -4                     |
| Final sample                                                | 2 820                  |
| Of which                                                    |                        |
| Purchases                                                   | 2 154                  |
| Sales                                                       | 666                    |
| Unique sample*****                                          | 2 025                  |
| Of which                                                    |                        |
| Purchases                                                   | 1 556                  |
| Sales                                                       | 469                    |

\* All transaction types other than voluntary stock purchases and sales are eliminated, e.g. options, right issues, conversions, reverse splits, corrections and holding notifications.

\*\* If several transactions occurred on the same day these are aggregated and counted as one transaction. Purchases and sales are netted against each other, i.e. if sales and purchases are of the same amount on that day, no transaction is considered.

\*\*\* Are removed from the list because the trades are directly following the IPO. Thus, there is no estimation window for further investigation. Additionally, removing IPO related trades improves data quality by disentangling the IPO effect and a potential CEO purchase effect.

\*\*\*\* If not enough trading days with price data prior to the insider transaction are available to estimate the market model parameters, these trades are excluded.

\*\*\*\*\* Event window [-5,4]: For the unique sample insider transactions, which interfere with another insider transaction's event window, are excluded. Hence, if several insider transactions for the same firm occur on subsequent days only the first transaction is included in the analysis. Note that this event window includes the five days prior to the actual transaction day.

**Table 7: Market reaction around the transaction day (other thresholds)**

This table reports the CAARs and test statistics for insider transactions by CEOs in Swedish companies for three intervals around the actual transaction day for different thresholds. In Panel A, the CAARs for all transactions in which the traded number of shares exceeds a certain percentage of the resulting shareholding are shown. Panel B shows the CAARs for CEO insider transactions in which the CEO owns more than a certain fraction of the company. Panel C displays the results for CEO insider transactions in which at least a certain fraction of the CEO's wealth is affected by the insider transaction. The market model was used and the  $\beta_i$ 's are estimated over the (-180;-6)-day window. The test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively.

|                                                                                | CAAR (0;4) | CAAR (0;20) | CAAR(0;62) |
|--------------------------------------------------------------------------------|------------|-------------|------------|
| <b>Panel A: CEO insider transactions with regard to change in shareholding</b> |            |             |            |
| Purchases, change > 10% (944 transactions)                                     |            |             |            |
| CAAR                                                                           | 2.06%***   | 3.29%***    | 6.39%***   |
| $J_1$                                                                          | 7.74       | 6.37        | 7.28       |
| Purchases, change > 20% (691 transactions)                                     |            |             |            |
| CAAR                                                                           | 2.14%***   | 3.36%***    | 6.38%***   |
| $J_1$                                                                          | 6.84       | 5.68        | 6.25       |
| Sales, change > 10% (341 transactions)                                         |            |             |            |
| CAAR                                                                           | -1.67%***  | -3.43%***   | -9.28%***  |
| $J_1$                                                                          | -3.89      | -4.13       | -6.35      |
| Sales, change > 20% (268 transactions)                                         |            |             |            |
| CAAR                                                                           | -1.78%***  | -4.66%***   | -10.77%*** |
| $J_1$                                                                          | -3.54      | -4.89       | -6.59      |
| <b>Panel B: CEO insider transactions for ownership &gt;10%</b>                 |            |             |            |
| CEO insider purchases (670 transactions)                                       |            |             |            |
| CAAR                                                                           | 1.04%***   | 2.12%***    | 0.79%      |
| $J_1$                                                                          | 3.63       | 3.93        | 0.87       |
| CEO insider sales (131 transactions)                                           |            |             |            |
| CAAR                                                                           | -0.68%     | -2.97%**    | -1.35%     |
| $J_1$                                                                          | -0.74      | -1.69       | -0.44      |
| <b>Panel C: CEO insider transactions for affected wealth &gt;10%</b>           |            |             |            |
| CEO insider purchases (192 transactions)                                       |            |             |            |
| CAAR                                                                           | 1.22%***   | 2.41%***    | 2.76%**    |
| $J_1$                                                                          | 2.80       | 2.89        | 1.95       |
| CEO insider sales (137 transactions)                                           |            |             |            |
| CAAR                                                                           | -0.90%**   | -1.70%**    | -3.39%**   |
| $J_1$                                                                          | -1.91      | -1.87       | -2.20      |

**Table 8: Market reaction around the transaction day (unique sample)**

This table reports the CAARs and test statistics for insider transactions by CEOs in Swedish companies for three intervals around the actual transaction day. Panel A displays all transactions irrespective of other factors, such as CEO ownership or wealth. In Panel B, the CAARs for all transactions in which the traded number of shares exceeds 5% of the resulting shareholding are shown. Panel C shows the CAARs for CEO insider transactions in which the CEO owns more than 5% of the company. Panel D displays the results for CEO insider transactions in which at least 5% of the CEO's wealth are affected by the insider transaction. The market model was used where  $\beta_i$ 's are estimated over the (-180;-6)-day window. The test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively.

|                                                                            | CAAR (0;4) | CAAR (0;20) | CAAR(0;62) |
|----------------------------------------------------------------------------|------------|-------------|------------|
| <b>Panel A: CEO insider purchases and sales (unique sample)</b>            |            |             |            |
| CEO insider purchases (1,556 transactions)                                 |            |             |            |
| CAAR                                                                       | 1.37%***   | 2.08%***    | 3.33%***   |
| $J_1$                                                                      | 7.09       | 5.08        | 4.48       |
| CEO insider sales (469 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.86%**   | -2.91%***   | -5.82%***  |
| $J_1$                                                                      | -2.14      | -3.67       | -4.06      |
| <b>Panel B: CEO insider transactions for change in shareholding &gt;5%</b> |            |             |            |
| CEO insider purchases (990 transactions)                                   |            |             |            |
| CAAR                                                                       | 1.77%***   | 2.36%***    | 3.82%***   |
| $J_1$                                                                      | 6.93       | 3.12        | 4.14       |
| CEO insider sales (325 transactions)                                       |            |             |            |
| CAAR                                                                       | -1.16%***  | -3.25%***   | -6.96%***  |
| $J_1$                                                                      | -2.58      | -3.65       | -4.49      |
| <b>Panel C: CEO insider transactions for ownership &gt;5%</b>              |            |             |            |
| CEO insider purchases (404 transactions)                                   |            |             |            |
| CAAR                                                                       | 0.81%**    | 1.37%*      | 1.26%      |
| $J_1$                                                                      | 2.18       | 1.45        | 0.67       |
| CEO insider sales (140 transactions)                                       |            |             |            |
| CAAR                                                                       | 0.15%      | -1.74%      | -1.57%     |
| $J_1$                                                                      | 0.17       | -0.86       | -0.42      |
| <b>Panel D: CEO insider transactions for affected wealth &gt;5%</b>        |            |             |            |
| CEO insider purchases (246 transactions)                                   |            |             |            |
| CAAR                                                                       | 1.15%***   | 2.06%***    | 2.43%**    |
| $J_1$                                                                      | 3.13       | 2.92        | 1.88       |
| CEO insider sales (122 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.95%**   | -2.11%**    | -4.93%***  |
| $J_1$                                                                      | -1.86      | -2.04       | -2.67      |

**Table 9: Market reaction around the transaction day (other thresholds, unique sample)**

This table reports the CAARs and test statistics for insider transactions by CEOs in Swedish companies for three intervals around the actual transaction day for different thresholds. In Panel A, the CAARs for all CEO insider transactions in which the traded number of shares exceeds a certain percentage of the resulting shareholding are shown. Panel B shows the CAARs for CEO insider transactions in which the CEO owns more than 10% of the company. Panel C displays the results for CEO insider transactions in which at least 10% of the CEO's wealth is affected by the insider transaction. The market model was used and the  $\beta_i$ 's are estimated over the (-180;-6)-day window. The test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively.

|                                                                                | CAAR (0;4) | CAAR (0;20) | CAAR(0;62) |
|--------------------------------------------------------------------------------|------------|-------------|------------|
| <b>Panel A: CEO insider transactions with regard to change in shareholding</b> |            |             |            |
| Purchases, change > 10% (819 transactions)                                     |            |             |            |
| CAAR                                                                           | 1.72%***   | 2.68%***    | 4.57%***   |
| $J_1$                                                                          | 6.00       | 4.76        | 4.54       |
| Purchases, change > 20% (619 transactions)                                     |            |             |            |
| CAAR                                                                           | 1.92%***   | 3.14%***    | 5.27%***   |
| $J_1$                                                                          | 5.85       | 4.89        | 4.46       |
| Sales, change > 10% (272 transactions)                                         |            |             |            |
| CAAR                                                                           | -1.06%**   | -3.24%***   | -7.94%***  |
| $J_1$                                                                          | -2.15      | -2.99       | -4.43      |
| Sales, change > 20% (225 transactions)                                         |            |             |            |
| CAAR                                                                           | -1.19%**   | -4.06%***   | -9.72%***  |
| $J_1$                                                                          | -2.17      | -3.53       | -5.26      |
| <b>Panel B: CEO insider transactions for ownership &gt;10%</b>                 |            |             |            |
| CEO insider purchases (313 transactions)                                       |            |             |            |
| CAAR                                                                           | 1.05%***   | 1.76%*      | 1.97%      |
| $J_1$                                                                          | 2.41       | 1.50        | 0.83       |
| CEO insider sales (103 transactions)                                           |            |             |            |
| CAAR                                                                           | -0.34%     | -2.83%*     | -3.56%     |
| $J_1$                                                                          | -0.33      | -1.38       | -0.95      |
| <b>Panel C: CEO insider transactions for affected wealth &gt;10%</b>           |            |             |            |
| CEO insider purchases (169 transactions)                                       |            |             |            |
| CAAR                                                                           | 1.38%***   | 2.62%***    | 2.87%**    |
| $J_1$                                                                          | 2.99       | 3.04        | 1.84       |
| CEO insider sales (112 transactions)                                           |            |             |            |
| CAAR                                                                           | -1.00%**   | -2.17%**    | -4.78%***  |
| $J_1$                                                                          | -1.82      | -2.05       | -2.47      |

**Table 10: Differences in abnormal returns (unique sample)**

This table reports the difference in CAARs when comparing different thresholds with regard to change in shareholding, ownership, and wealth, as well as the statistical significance of these differences. Panel A outlines the differences in CAARs for changes in shareholdings above 20% and below 20%. Panel B shows the differences in CAARs for insider transactions with CEO ownership above 5% and below 5%. Finally, Panel C shows the differences in CAARs for fractions of wealth of above 5% and below 5% which are affected by a respective CEO insider transaction. The market model is used and the  $\beta_i$ 's are estimated over the (-180;-6)-day window. The test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively.

| Event window:                                                                        | (0;4)            | (0;20)   | (0;62)    |
|--------------------------------------------------------------------------------------|------------------|----------|-----------|
| <b>Panel A: CEO insider transactions with different changes in shareholding</b>      |                  |          |           |
| Purchases with change > 20% vs. < 20%                                                |                  |          |           |
| Difference in CAAR                                                                   | 0.80%***         | 1.66%*** | 2.41%**   |
| $J_1$                                                                                | 2.49             | 2.61     | 2.14      |
| Sales with change > 20% vs. < 20%                                                    |                  |          |           |
| Difference in CAAR                                                                   | -0.79%*          | -1.99%** | -6.27%*** |
| $J_1$                                                                                | -1.47            | -1.83    | -3.23     |
| <b>Panel B: CEO insider transactions with ownership threshold of 5%</b>              |                  |          |           |
| Purchases with ownership > 5% vs. < 5%                                               |                  |          |           |
| Difference in CAAR                                                                   | -0.74%**         | -1.01%   | -2.54%*   |
| $J_1$                                                                                | -1.97            | -1.06    | -1.32     |
| Sales with ownership > 5% vs. < 5%                                                   |                  |          |           |
| Difference in CAAR                                                                   | 1.36%*           | 1.61%    | 5.50%*    |
| $J_1$                                                                                | 1.55             | 0.89     | 1.64      |
| <b>Panel C: CEO insider transactions with different fractions of affected wealth</b> |                  |          |           |
| Purchases with affected wealth > 5% vs. < 5%                                         |                  |          |           |
| Difference in CAAR                                                                   | $\approx 0.00\%$ | -0.82%   | -2.26%**  |
| $J_1$                                                                                | 0.09             | -1.14    | -1.76     |
| Sales with affected wealth > 5% vs. < 5%                                             |                  |          |           |
| Difference in CAAR                                                                   | -0.10%           | -0.42%   | 4.50%***  |
| $J_1$                                                                                | -0.20            | -0.42    | 2.45      |

**Table 11:** Market reaction around the transaction day ( $\alpha = 0$  and  $\beta = 1$ )

This table reports the CAARs and test statistics for insider transactions by CEOs in Swedish companies for three intervals around the transaction day. Panel A displays all CEO insider transactions. In Panel B, the CAARs for transactions in which the traded number of shares exceeds 5% of the resulting shareholding are shown. Panel C shows the CAARs for transactions in which the CEO owns more than 5% of the company. Panel D displays the results for transactions in which at least 5% of the CEO's wealth are affected by the transaction. To calculate CAARs, insiders' returns are compared to the market return, i.e.  $\alpha$  is assumed to be zero and  $\beta$  is one in the market model. Test statistics are outlined in the methodology section. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively. The unique sample is used for the analysis.

|                                                                            | CAAR (0;4) | CAAR (0;20) | CAAR(0;62) |
|----------------------------------------------------------------------------|------------|-------------|------------|
| <b>Panel A: CEO insider purchases and sales (unique sample)</b>            |            |             |            |
| CEO insider purchases (1,556 transactions)                                 |            |             |            |
| CAAR                                                                       | 1.19%***   | 1.48%***    | 1.53%**    |
| $J_1$                                                                      | 6.04       | 3.58        | 2.03       |
| CEO insider sales (469 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.70%**   | -2.48%***   | -4.20%***  |
| $J_1$                                                                      | -1.71      | -3.10       | -2.98      |
| <b>Panel B: CEO insider transactions for change in shareholding &gt;5%</b> |            |             |            |
| CEO insider purchases (990 transactions)                                   |            |             |            |
| CAAR                                                                       | 1.60%***   | 1.73%***    | 1.72%**    |
| $J_1$                                                                      | 6.19       | 3.39        | 1.86       |
| CEO insider sales (325 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.83%**   | -2.36%***   | -4.21%***  |
| $J_1$                                                                      | -1.77      | -2.69       | -2.74      |
| <b>Panel C: CEO insider transactions for ownership &gt;5%</b>              |            |             |            |
| CEO insider purchases (404 transactions)                                   |            |             |            |
| CAAR                                                                       | 0.67%**    | 1.20%       | 1.08%      |
| $J_1$                                                                      | 1.76       | 1.25        | 0.55       |
| CEO insider sales (140 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.15%     | -2.81%*     | -2.75%     |
| $J_1$                                                                      | -0.17      | -1.53       | -0.84      |
| <b>Panel D: CEO insider transactions for affected wealth &gt;5%</b>        |            |             |            |
| CEO insider purchases (246 transactions)                                   |            |             |            |
| CAAR                                                                       | 1.07%***   | 1.46%**     | 0.52%      |
| $J_1$                                                                      | 2.86       | 2.04        | 0.40       |
| CEO insider sales (122 transactions)                                       |            |             |            |
| CAAR                                                                       | -0.85%*    | -1.66%*     | -2.82%*    |
| $J_1$                                                                      | -1.63      | -1.62       | -1.53      |

**Table 12:** Explaining abnormal returns around insider purchases

This table reports the regression results when explaining abnormal returns around insider trading dates (for CEO purchases). The sample comprises all CEO insider purchases by CEOs in Swedish companies from 2004 to 2013. The dependent variable in the OLS regression is the abnormal returns for each insider transaction around the transaction date for a 63-day window. Control variables include change in shareholding, ownership, wealth, size, market-to-book ratio, and momentum. The definition of these variables is outlined in the methodology section. All specifications include time and industry fixed effects. Standard errors are reported in parentheses and are heteroscedasticity consistent. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively. The number of observations can slightly differ from the number of transactions for the event study analyses due to potentially missing control variables, such as market-to-book ratio or momentum.

| OLS Regression                    |                        |                        |                        |                        |
|-----------------------------------|------------------------|------------------------|------------------------|------------------------|
|                                   | (1)                    | (2)                    | (3)                    | (4)                    |
| Change in shareholding            | 0.0216*<br>(0.0127)    |                        |                        | 0.0122<br>(0.0134)     |
| Ownership                         |                        | -0.0434***<br>(0.0126) |                        | -0.0414***<br>(0.0132) |
| Wealth                            |                        |                        | -0.0010<br>(0.0158)    | -0.0217<br>(0.0158)    |
| Size                              | -0.0047<br>(0.0033)    | -0.0068**<br>(0.0034)  | -0.0044<br>(0.0033)    | -0.0062*<br>(0.0034)   |
| Market-to-book                    | -0.0022***<br>(0.0004) | -0.0022***<br>(0.0005) | -0.0022***<br>(0.0004) | -0.0022***<br>(0.0005) |
| Momentum                          | -0.1011***<br>(0.0134) | -0.1009***<br>(0.0133) | -0.1029***<br>(0.0136) | -0.1006***<br>(0.0134) |
| Constant                          | 0.1669***<br>(0.0326)  | 0.1887***<br>(0.0324)  | 0.1789***<br>(0.0321)  | 0.1800***<br>(0.0334)  |
| Fixed effects (time and industry) | Yes                    | Yes                    | Yes                    | Yes                    |
| Observations                      | 2049                   | 2049                   | 2049                   | 2049                   |
| $R^2$                             | 0.1244                 | 0.1277                 | 0.1231                 | 0.1285                 |

**Table 13:** Explaining abnormal returns around insider sales

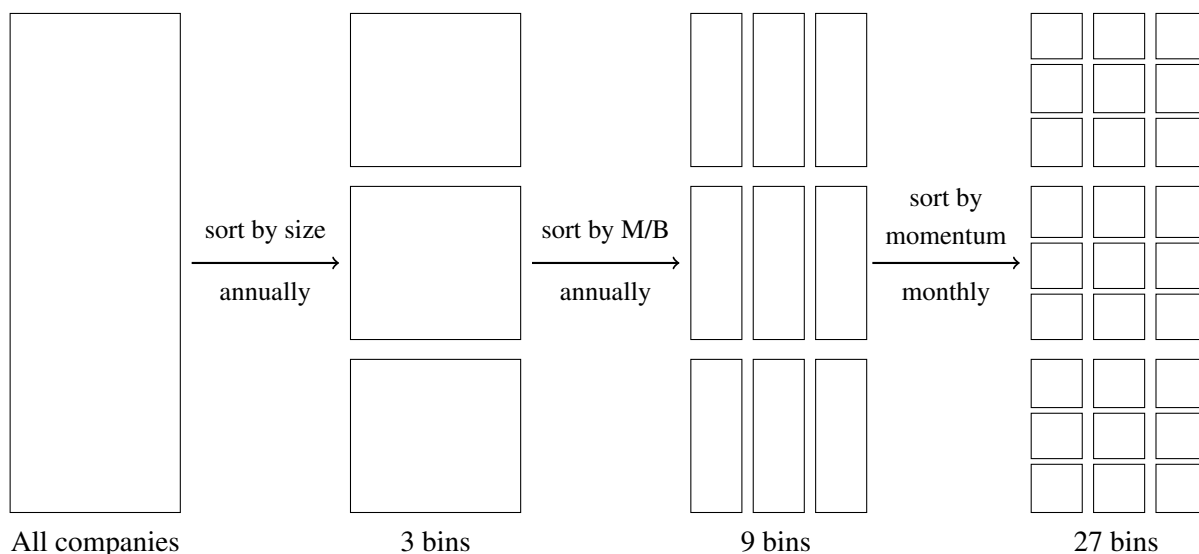
This table reports the regression results when explaining abnormal returns around insider trading dates (for CEO sales). The sample comprises all CEO insider sales by CEOs in Swedish companies from 2004 to 2013. The dependent variable in the OLS regression is the abnormal returns for each insider transaction around the transaction date for a 63-day window. Control variables include change in shareholding, ownership, wealth, size, market-to-book ratio, and momentum. The definition of these variables is outlined in the methodology section. All specifications include time and industry fixed effects. Standard errors are reported in parentheses and are heteroscedasticity consistent. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% level respectively. The number of observations can slightly differ from the number of transactions for the event study analyses due to potentially missing control variables, such as market-to-book ratio or momentum.

|                                   | OLS Regression         |                        |                        |                        |
|-----------------------------------|------------------------|------------------------|------------------------|------------------------|
|                                   | (1)                    | (2)                    | (3)                    | (4)                    |
| Change in shareholding            | -0.0406*<br>(0.0218)   |                        |                        | -0.0434*<br>(0.0227)   |
| Ownership                         |                        | 0.0129<br>(0.0263)     |                        | -0.00027<br>(0.0285)   |
| Wealth                            |                        |                        | 0.0481**<br>(0.0216)   | 0.0519**<br>(0.0229)   |
| Size                              | -0.0095<br>(0.0067)    | -0.0104<br>(0.0071)    | -0.0167**<br>(0.0071)  | -0.0151*<br>(0.0081)   |
| Market-to-book                    | -0.0005<br>(0.0004)    | -0.0005<br>(0.0004)    | -0.0006<br>(0.0004)    | -0.0006<br>(0.0004)    |
| Momentum                          | -0.1797***<br>(0.0249) | -0.1829***<br>(0.0254) | -0.1814***<br>(0.0249) | -0.1769***<br>(0.0245) |
| Constant                          | 0.1260***<br>(0.0432)  | 0.1145**<br>(0.0536)   | 0.1468***<br>(0.0450)  | 0.1486**<br>(0.0581)   |
| Fixed effects (time and industry) | Yes                    | Yes                    | Yes                    | Yes                    |
| Observations                      | 611                    | 611                    | 611                    | 611                    |
| $R^2$                             | 0.2519                 | 0.2482                 | 0.2514                 | 0.2559                 |



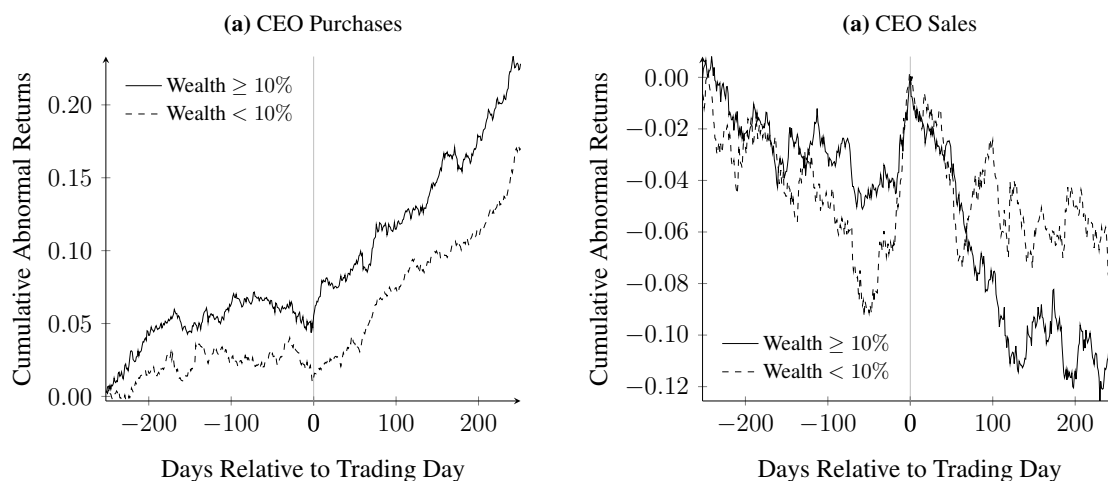
**Figure 6: Bin construction for CS measure**

This figure illustrates how the companies are divided into 27 different bins which are used to calculate the CS measure. First, we divide our sample of firms into three equally sized groups based on their market capitalization. Then, we divide each group into three subgroups based on their market-to-book ratio. Both of these sortings are conducted on an annual basis at the beginning of each year. Finally, each subgroup is divided into three more groups based on their past year's performance on a monthly basis. The benchmark return for any insider trade at time  $t$  in company  $i$  is then calculated as the average return of all companies in the same bin as company  $i$  at time  $t$  excluding company  $i$ .



**Figure 7: Abnormal returns for companies with high CEO wealth commitment – unique sample**

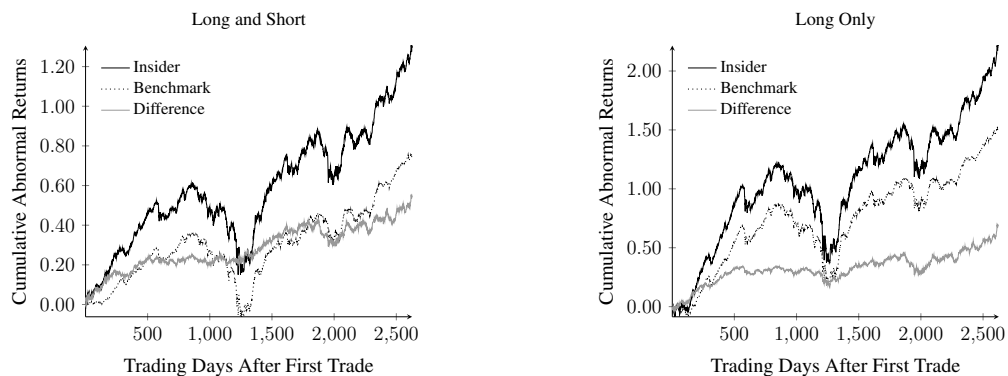
This figure shows the long term difference between trades where the CEO invested at least 10% of his declared wealth in one trade. Overlapping trades in the same event window were eliminated as outlined in the methodology section.



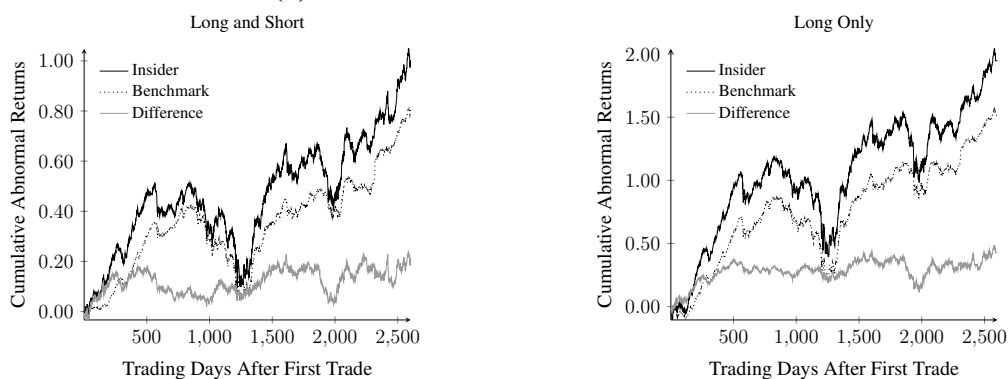
**Figure 8: Performance of insider mimicking portfolios over time**

The graphs below show the performance over the sample period with long and short trades allowed on the left side and only long trades allowed on the right side. The time on the x axes might differ from one strategy to another due to the minimum diversification restriction.

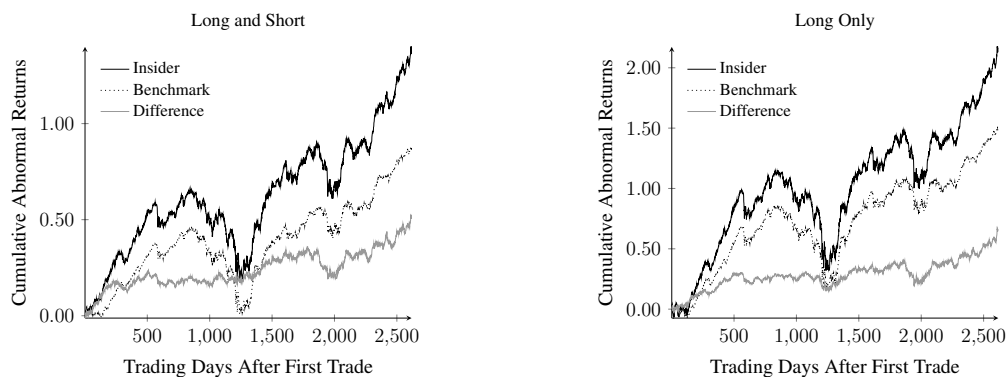
**(a) PERFORMANCE ALL TRADES**



**(b) PERFORMANCE WITH CHANGE FILTER**



**(c) PERFORMANCE WITH OWNERSHIP FILTER**



**(d) PERFORMANCE WITH WEALTH FILTER**

