# The influence of short selling on stock returns - Evidence from the Netherlands

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**ABSTRACT**

**In this paper, the influence of short selling on stock returns is investigated by means of data from the Netherlands. The sample consists of 1,119 observations of announced total net short positions in the register of the AFM for 25 Dutch listed firms over the period from January 2013 to December 2014. It is found that the net short position taken in a firm has a statistically significant impact on the abnormal return of the stock of that firm. This result is consistent with findings from prior literature. Furthermore, there seems to be some evidence to suggest that the availability of options for a stock has a negative effect on the abnormal return as well. Finally, a significant influence of short sales which were announced in the last three trading days of a tax year on stock returns was not found.**

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**Keywords**

Short selling, stock return, the Netherlands, informed short selling, uninformed short selling, stock market, options, tax



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# 1. INTRODUCTION

It seems that short selling is quite a controversial topic, both in research and in practice (Boehmer & Wu, 2013). Short selling, also called 'going short' or 'taking a short position', occurs when an investor expects the price of a stock to fall. The investor then chooses to sell a stock which he borrows and intends to buy the stock back at a lower price in order to return it to the lender. By doing this, the investor attempts to make a profit by selling at a higher price and buying at a lower price.

Several researchers have investigated the relationship between short selling activity and returns on stock. However, not all of these researchers have come to the same conclusions (Aitken, Frino, McCorry & Swan, 1998). Therefore, it is interesting to do further research on the subject of short selling. Nevertheless, as the literature review of this paper will show, many researchers believe short selling has an informational value and, thus, impacts stock returns, at least to some extent.

The literature discussed in this paper also indicates that many researchers have investigated short selling and its relationship to abnormal returns in countries outside Europe, mainly in the United States. As a consequence, research on this relationship in European countries is an interesting opportunity. One of these countries which has not been researched very often with regard to short selling is the Netherlands. There are some studies which do include the Netherlands in their sample, such as Bris, Goetzmann, and Zhu (2007), Beber and Pagano (2013), and Bernal, Herinckx, and Szafarz (2014). Nevertheless, these papers merely study the effect of short selling bans, restrictions, and regulations on the stock market by performing cross-country comparisons.

The fact that the Netherlands have not been researched in many studies with regard to short selling might be due to the fact that the records regarding short selling were not publically available before November 2012. Due to a change in the European regulation with regard to short selling, initiated in November 2012, European market authorities are now obligated to publish notifications of net short positions when reaching 0.5% of the total outstanding share capital of a firm (AFM, n.d.). The Dutch market authority (the AFM) has thus published these notifications from November 2012 onwards.

For these reasons, researching the relationship between short selling and stock returns in the Netherlands is an interesting opportunity to contribute to the existing body of knowledge. Furthermore, insight into this relationship contributes to practice as it can provide useful guidance for investors in the Dutch stock market with regard to their short selling strategies, as well as the interpretation of short selling data. Hence, the research question of this paper is *'How does short selling influence stock returns in the Netherlands?'*

The rest of this paper is structured as follows. Section 2 will provide a review of the existing literature and the theoretical framework used in this paper. Further, in section 3 and 4 the methodology and data used in this research will be described. After this, in section 5 the results of the model will be discussed. Finally, section 6 will provide the conclusions of this research as well as a number of limitations of this study and some recommendations for further research and for practice.

# 2. LITERATURE REVIEW & HYPOTHESIS

In this section, a systematic review of the existing literature on the influence of short selling on stock returns is provided. On top of that, the hypothesis regarding the influence of short selling on stock returns in the Netherlands will be developed.

## 2.1 Literature review

In the past few decades, quite some research on short selling has been done. First of all, some researchers have investigated the effect of short selling bans, restrictions, and regulations (see for example: Bris et al., 2007; Beber & Pagano, 2013; Bernal et al., 2014). Moreover, authors have written about the influence of short selling on the price discovery process or price efficiency (see for example: Boehmer & Wu, 2013; Chang, Luo & Ren, 2015). Furthermore, researchers have tested the relationship between short selling and stock returns, the subject of this paper. While researchers have yielded different results, they do not unanimously agree on the existence, nor the strength, of this relationship. A number of these authors and their results will be discussed and compared in this section. In general, there are two views regarding short selling which are adopted by researchers, each with its own implications: informed short selling and uninformed short selling. These two views are discussed below.

### *2.1.1 Informed short selling*

Many researchers assume that short selling is informed, or informative. Informed short selling indicates that it is assumed that investors sell short because they have information that leads them to believe that a certain stock is overpriced.

For example, a study that is often quoted by other authors to back up the hypothesis that short selling is informed, is the study of Diamond and Verrecchia (1987). They state that informed short sellers also have access to private information, whereas uninformed short sellers only have access to public information. Hence, when the amount of short sales in a certain stock unexpectedly increases, indicating that certain negative information was not reflected in the stock price yet, stock returns decline. Moreover, the fact that informed short sellers have access to private information means that informed short sellers are more likely to be willing to bear the costs associated with short selling. Senchack and Starks (1993) confirm the notion of Diamond and Verrecchia (1987) after conducting research on a sample of firms in the United States. Their results indicate that increases of short interest in a stock lead to negative price reactions. Next to this, their findings suggest that a more negative price reaction to short selling will occur when the change in unexpected short selling is larger.

Additionally, Figlewski and Webb (1993), by extending on Figlewski (1981), also find that short positions in a certain stock negatively influence excess returns for that stock in firms which are listed in the United States. They find that this relationship is statistically significant as well. Furthermore, Aitken et al. (1998), by doing research on the Australian stock market, find evidence that short sales are informative. Their results show a negative abnormal return following short sales in the stock of companies. They state that "short sales are almost instantaneously bad news" in a transparent stock market, such as the Australian stock market (p. 2221).

Dechow, Hutton, Meulbroek, and Sloan (2001) add to this view by researching firms which are listed in the United States. They describe short sellers as rational investors, who invest based on information in order to maximise their returns. More precisely, they argue that investors take short positions in stocks which have low fundamental-to-price ratios and are believed to be overpriced. Short sellers are also found to look for stocks which do not have high transaction costs related to short selling, to distinguish between several underlying reasons for low fundamental-to-price ratios, and to use additional information to fundamental-to-price ratios to predict future stock returns. On top of that, Desai, Ramesh, Thiagarajan, and Balachandran (2002) performed empirical tests on firms in the Nasdaq

market, which showed that short selling is informed. They also found that the abnormal returns on stocks tend to increase with the rise of short interest in these stocks. Finally, Boehmer & Wu (2013) base their research on the impact of short selling in the price discovery process entirely on the assumption that short selling is informative.

Nevertheless, there are also authors who do not find a consistent (negative) relationship between short selling and stock returns. For example, Brent, Morse, and Stice (1990) do not find enough evidence to suggest that short selling negatively influences stock returns on the New York Stock Exchange. They state that short selling does not seem to be useful to predict stock returns in the short run. Another research that does not find a negative relationship between stock returns for firms listed in the United States, is the paper of Woolridge and Dickinson (1994). They suggest that, therefore, short sales are not necessarily informed. This suggests there is another theory regarding the motives of investors to engage in short selling.

### *2.1.2 Uninformed short selling*

This other view regarding short selling is opposite to the theory of informed short selling. This theory, called uninformed short selling, assumes that the investor does not have specific information that gives him reason to believe that the price will drop. Merely, the investor chooses to take a short position in a stock because of different reasons. In the short selling literature, several factors that increase the likelihood of informed short selling are brought up.

First of all, Diamond and Verrecchia (1987) indicate that reducing short selling costs may lead to more uninformed short selling. They argue that when short selling costs are high, only the investors which are most likely to gain benefits from selling short will actually sell short. As informed short sellers have a strong expectation the value of a stock will decrease, they will sell short, whereas uninformed short sales will take place to a lesser extent. However, when short selling costs decrease, more uninformed short sales will start to take place again. Diamond and Verrecchia (1987) mention that one way to reduce these short selling costs is by introducing options. Figlewski and Webb (1993) support this notion by stating that options can reduce the impact of short selling constraints. More specifically, they find that options appear to reduce the negative influence that short sales have on excess stock returns. According to them, their results seem to be in accordance with the hypothesis that options improve the informational efficiency of the market with regard to negative information. Likewise, Aitken et al. (1998) find evidence to suggest that short sales in optioned stocks, which relate to hedging or arbitraging, do often not have an informational motivation.

On top of that, Aitken et al. (1998) incorporate another variable that controls for arbitrage into their model, a second basis for uninformed short selling. By focusing on index-related arbitrage, they find arbitrage is a reason for short selling which is not informative. Brent et al. (1990) also discuss arbitrage as a motive for uninformed short selling. They indicate that simply holding a short and a long position in the same stock does not yield a profit. Therefore, an additional security is needed. This security can take several forms, for example a convertible security or a stock index future, but options can also be used for this purpose. Brent et al. (1990) found that more short sales occurred in stocks of firms for which such an additional security was available. Figlewski and Webb (1993) and Senchack and Starks (1993) also recognise that arbitrage can have an influence on short selling, but do not cover this subject in-depth in their paper.

A third motive which does not relate to information-based short selling is tax-related short selling. Brent et al. (1990) explain that, on the one hand, investors can go short in the same stock which they hold long in order to "lock in a profit, but delay the recognition of a capital gain" (p. 275). On the other hand, Brent et al. (1990) state that it is also possible that an investor wants to "lock in and postpone the recognition of a loss to the following year" (p. 275). Furthermore, they indicate that it is more likely that shareholders will participate in tax-related short selling when they have invested in a security which is more volatile and, thus, poses more risk to the investor. Nevertheless, their results only show a weak tendency to go short for the purpose of delaying taxes to the next financial year. On top of that, the results of Aitken et al. (1998), also controlling for tax-related short selling, show some evidence in support of the expectation that short sales which occur near the end of the financial year are more likely to be uninformed.

### *2.1.3 Conclusion on prior literature on short selling*

All in all, it seems that investors choose to engage in short selling both because of negative information they have access to and for other reasons, as summarised in Table 1.

**Table 1: Reasons for short selling**

| Category | Implication |
|---|---|
| *1. Informed short selling* | Stock is sold short because investors have negative information, causing them to believe the stock price will drop. Therefore, the announcement of a short sale has a negative effect on stock returns. |
| *2. Uninformed short selling* | Stock is not sold short based on negative information, but for other reasons. The negative effect of short selling on stock returns is mitigated. Most cited reasons are option-, arbitrage-, and tax-related short selling. |
| *2.1 Options* | Options reduce the influence of short selling constraints and the costs of short selling. In addition, options improve the informational efficiency of the stock market, which reduces the impact of short sales on stock returns. Options can also be used for arbitrage reasons. |
| *2.2 Arbitrage* | By holding a certain security in addition to simultaneously holding a short and a long position in a certain stock (for example, a convertible security or a stock index future), an investor can yield an arbitrage profit. |
| *2.3 Tax* | Investors may want to lock in a capital gain or loss and suspend it to the next financial year. This can be done by holding a long and a short position at the same time at the end of the financial year. This is not related to certain (negative) information. |

## 2.2 Hypothesis

As described in the literature review in section 2.1, there are two views on the reasons for short selling within the theoretical framework of short selling: informed short selling and uninformed short selling. On the one hand, the theory of

informed short selling suggests that short sales are informative and that the stock market will respond to the announcement of short positions in the form of a price reaction. On the other hand, the theory of uninformed short selling assumes that short sales are not motivated by information and, thus, will not lead to a stock price reaction.

Although little research has been performed on the Netherlands until now, some studies have included the Netherlands in their multi-country samples. For example, in their cross-sectional and time-series study on short sale restrictions and their effects on price efficiency, involving several countries including the Netherlands, Bris et al. (2007) find some evidence that short sale constraints seem to lead to less efficient price discovery. On the other hand, Beber and Pagano (2013), who also include the Netherlands in their cross-country study, conclude that the lift of short selling bans in all researched countries, except for the United States, did not lead to a significant change in abnormal returns. Likewise, Bernal et al. (2014) find negative stock returns for the Netherlands after lifting the regulations on short selling, but again those results are not significant.

Nevertheless, while Bris et al. (2007) and Bernal et al. (2014) do find an effect on stock returns when short selling restrictions or bans are lifted, it is reasonable to make the assumption that short selling in the Netherlands will (negatively) influence stock returns to some extent. Hence, the hypothesis of this paper is:

*H1: Short selling has a negative influence on stock returns in the Netherlands*

# 3. METHODOLOGY

In this section, the model used in this research will be developed. Next to this, an overview of the variables used in this paper will be provided.

## 3.1 Model

In order to test the hypothesis as formulated before, the following regression model, based on the model used by Aitken et al. (1998), will be used:

$$AR_{it} = \alpha_0 + \beta_1 SHORT_{it} + \beta_2 OPTIONED_i + \beta_3 MONTH_t + \varepsilon_{it} \quad (1)$$

In this model, $AR_{it}$ is the abnormal return of stock $i$ at time $t$, over a given period, taking any value in percentages. $SHORT_{it}$ is the net short selling position in stock $i$ at time $t$, as announced in the register of the AFM, taking any value between 0% and 100%. $OPTIONED_i$ is a binary variable, indicating whether options were also available for stock $i$, taking a value of either zero (no optioned stocks) or one (optioned stocks). $MONTH_t$ is also a binary variable, indicating whether the short sale was announced within the last three trading days of the financial year, taking a value of either zero (not announced within the last three trading days) or one (announced within the last three trading days).

Finally, $\alpha_0$ is the intercept, $\beta_1$, $\beta_2$ and $\beta_3$ represent the coefficients of the variables $SHORT_{it}$, $OPTIONED_i$, and $MONTH_t$ respectively, and $\varepsilon_{it}$ represents the model errors. On the one hand, coefficient $\beta_1$ is expected to take on a negative value, because it is expected that the higher the percentage of a stock that is sold short, the lower the abnormal return will be. On the other hand, the coefficients $\beta_2$ and $\beta_3$ are expected to take on a positive value, because the variables $OPTIONED_i$ and $MONTH_t$ are believed to be uninformative and, thus, mitigate the negative effect of short sales on abnormal returns.

## 3.2 Variables

### *3.2.1 Dependent variable: abnormal returns*

The dependent variable in this paper is the abnormal return of a stock over a given period as a percentage of the expected return. While the abnormal return can take any value in percentages, it is a continuous variable. Although there are several ways to calculate the abnormal return of a stock, this paper adopts a method which is similar to the one used by Dechow et al. (2001). These researchers calculate abnormal returns by comparing each stock's return to "the equal-weighted return for all NYSE and AMEX stocks over the same time period" (p. 85). However, in this research the return on the stocks is compared to the AEX Index instead, as it is related to the Dutch stock market.

The first period adopted in this paper is the trading day of the announcement of the short sale until the trading day following the announcement of the short sale (0,1), which is one of the periods used by Christophe, Ferri, and Hsieh (2010). The stock prices to calculate the abnormal returns are adjusted stock prices, meaning they are adjusted for dividends and splits. In order to calculate the abnormal return, the following procedure is adopted. First, the difference between the adjusted closing price of the stock on the day after the announcement and the adjusted closing price on the day of the announcement will be calculated in percentages. Second, the same will be done for the AEX Index. Finally, the result of step three will be subtracted from the result of step two, leading to the abnormal return for the stock in percentages of the expected return. Therefore, a positive percentage would mean that the abnormal return was higher than expected based on the return of the AEX Index, while a negative percentage would indicate the opposite. This process will be repeated for each announcement of a new or changed short position.

#### *3.2.1.1 Alternative measures of abnormal returns*

First of all, several other periods for calculating the abnormal returns will be used. The period adopted in the model (0,1) only takes into account the first day after the announcement of the short interest. It is also interesting to look at the reaction of the stock market on the announcement of a short sale over a longer period, since the market might take more time to react than just one day. Hence, two other periods are used in this research. One of these periods takes into account the period from the trading day of the announcement of the short sale until three trading days following this announcement (0,3). The other period starts on the trading day of the announcement of the short sale and ends fifteen trading days following the announcement of the short sale (0,15). These periods are derived from the periods taken by (Aitken et al., 1998) and (Senchack and Starks, 1993), as will be described next.

It is also valuable to take the response of the market into account over a period that includes the period before the event, because this allows to account for leakage of information prior to the announcement of the short selling position (see for example: Senchack and Starks, 1993). Hence, another period that will be used in this paper is the period of one day before the announcement of the short sale until one day following the announcement of the short sale (-1,1), one of the periods taken by Boehmer and Wu (2013). In order to look at a slightly longer term response of the market, a period of three days preceding the announcement of the short sale until three days following the announcement will be applied (-3,3), as adopted by Aitken et al. (1998)[1]. In addition, to look at the long-term reaction of the market, a period of fifteen days before until fifteen days

[1] Although Aitken et al. (1998) use three fifteen-minute intervals before until three fifteen-minute intervals after the short sale to calculate the abnormal return, the translation to three days before until three days after the event is believed to be a useful addition to this research, as it represents a slightly longer period than one day before until one day after the event.

after the event is used, which is similar to the method of Senchack and Starks (1993).

The model that will be used for the period (-1,1) is similar to the one which is formulated for the period (0,1). Nevertheless, a problem that comes up when using longer term periods, is that for some firms several announcements of new or changed net short positions take place in these periods. Hence, a dummy variable will be added to the regression model as described above to control for these multiple events. This variable, $MULTIPLE_{it}$, is a binary variable taking the value of either zero or one. A value of zero indicates only one announcement of a new or changed net short position in the mentioned period, whereas a value of one indicates multiple announcements of new or changed net short positions in the mentioned period. This leads to the following regression model for the abnormal return periods (0,3), (0,15), (-3,3), and (-15,15):

$$AR_{it} = \alpha_0 + \beta_1 SHORT_{it} + \beta_2 OPTIONED_i + \beta_3 MONTH_t + \beta_4 MULTIPLE_{it} + \varepsilon_{it} \quad (2)$$

In this model, $\beta_4$ is expected to take a negative value, assuming that more short selling activity will lead to a more negative abnormal return.

Furthermore, an adjusted method to calculate the abnormal returns will be applied. The method adopted in the model does not control for the differences in risks associated with the different firms (Dechow et al., 2001). Therefore, the abnormal returns will also be calculated by adapting the stock returns of the different firms by means of the 3-year betas of the stocks, as done by Figlewski (1981).

### *3.2.2 Independent variable: net short positions*

The independent variable in this research is the total (net) short selling position taken in the stock of a company on a certain date, in percentages. The net short position is a continuous variable, as it can take any value between 0% and 100%. The measures for this variable are the total net short selling positions in a company, as reported on a certain date in the short selling register of the AFM, which is updated frequently. These net short selling positions cover the shares that an investor holds short in the stock of a company subtracted by the shares which the same investor holds long in that company.

### *3.2.3 Control variables*

In addition to the dependent and independent variables, two control variables are added, based on prior research. The control variables relate to the the fact whether optioned stocks are available and to the fact whether the short sale is announced in the last three trading days of a financial year. These control variables are believed to be the most suitable to the Dutch stock market.

#### *3.2.3.1 Optioned stocks*

The first control variable relates to optioned stocks. Research has indicated that options can reduce the impact of constraints on short selling by reducing short selling costs (Diamond & Verrecchia, 1987; Figlewski & Webb, 1993). This means that short sales in optioned stocks are less likely to be informative. As a consequence, when options are available for a certain stock, the negative impact on abnormal returns is reduced. Therefore, this paper includes a binary variable to control for the fact whether optioned stocks are available for the stock in which investors take a net short position or not.

#### *3.2.3.2 Stocks traded in the last three days of the financial year*

The second control variable in the model of this paper relates to taxes. Some authors of academic articles have argued that investors might like to have a short position in a stock in which they also hold a long position, at the end of the financial year. By doing this, capital gains or losses can be locked in and carried into the next year (Brent et al., 1990; Aitken et al., 1998). Aitken et al. (1998) control for this possibility by determining whether a short position was taken in the last three trading days of the financial year. Hence, this paper also includes a binary variable to control for whether the short sale is announced in the last three trading days of the financial year (from January to December) or not.

## 4. DATA

In this section, the process of the collection and preparation of the data is described. On top of that, the descriptive statistics of the data will be provided.

### 4.1 Sample

In this study, the short selling data are obtained for several Dutch listed firms in the tax years 2013 and 2014, from January 2013 to December 2014. These are the only two full tax, or financial, years which are present in the short selling register of the AFM. The AFM collects information on net short positions in companies which are listed on the Dutch stock market. These net short positions are determined by subtracting the long position which a certain investor holds in a company from the short position which this investor holds in that company. An investor should report a net short position to the AFM as soon as a total of 0.2% of the outstanding share capital of a company or of a sovereign debt is reached and, after that, for every subsequent 0.1% above the 0.2% threshold. These notifications will be made public in the short selling register of the AFM when reaching 0.5% of the total outstanding share capital of a company and for every subsequent 0.1% above this 0.5% threshold. Net short positions in sovereign debts are not made available to the public. Net short positions appear for the last time in the register when they reach below the 0.5% threshold (AFM, n.d.). Therefore, the data used in this research solely consist of short positions in Dutch firms which are listed on the Dutch stock market and reported in the short selling register of the AFM as it was published on the 20th April 2015. The net short positions used are taken from both the current and archive parts of the AFM register for the years 2013 and 2014. These data include both new and changed net short positions, adding up to a total of 1,887 observations. Nonetheless, these data also contain several announcements of short sale positions in the same firm on the same date. Because this research considers the total announcement of a net short selling position on a certain date for a certain firm, the total net short selling positions per date for each firm are calculated. This leads to a total of 1,458 observations for 33 firms.

In order to make the dataset suitable for this research some adaptations were made. First of all, the companies which were in the register because they are listed on the Dutch stock market, but were not Dutch companies, were removed from the dataset. The reason for this is that this paper focuses on evidence from Dutch companies. Furthermore, the companies SNS Reaal N.V. and Corio N.V. were taken out of the dataset, because SNS Reaal N.V. was nationalised in February 2013 and Corio N.V. was taken over by Klépierre S.A. in July 2014. On top of that, there were no adjusted stock prices available for NSI N.V. and Wereldhave N.V. in the database and, thus, the data for these two companies were also erased from the dataset. After this, the net short positions of 0% were removed. Finally, two entries for Royal Imtech N.V. were taken out of the sample due to a lack of data. All in all, the final dataset contains 1,261 observations of announcements of new or changed net short positions for 26 firms. The other required data, including adjusted stock prices, the AEX Index, stock betas, and

information on whether optioned stocks were available for the company or not, are gathered from several other databases[2].

## 4.2 Descriptive statistics

In Table 2 the descriptive statistics are given for the dependent variable, the independent variable, and the control variables. As can be seen from this table, the standard deviations for the different measures of the abnormal returns are quite large. These high standard deviations are caused by some extreme observations of abnormal returns, which can be derived from the low minimum values and the high maximum values for all measures of abnormal returns. Therefore, another dataset was created where extreme outliers are excluded. According to De Veaux, Velleman, and Bock (2014), extreme outliers, or far outliers, are "data values farther than 3 IQRs from the quartiles" (p. 91). Hence, extreme outliers are defined as observations that lie outside a range of three times the interquartile range (IQR) below the first quartile (Q1) or above the third quartile (Q3) for either the period (-1,1), or the period (-3,3), or the period (-15,5)[3]. After doing this, 1,119 observations are left in the final sample, for 25 firms[4].

The descriptive statistics of the data after excluding the extreme outliers are presented in Table 3. When the extreme outliers are not taken into account, the standard deviations show a much lower value, also for the periods (0,1), (0,3), and (0,15). Also the minimum and maximum values for the different measures of abnormal returns take less extreme values. Especially the periods (0,3) and (0,15) still show some deviating values for the minimum and maximum values, but the standard deviations for these periods have also decreased by more than 50%. Overall, the means take logical values if compared to prior research, assuming that abnormal returns of shorted stocks are lower than expected: negative and becoming more negative when going from shorter periods to longer periods of time. Nevertheless, two values stand out. The abnormal return for the period (0,3) and the adjusted abnormal return for the period (0,3). These two means take positive values, while a negative value would be expected based on the hypothesis. Furthermore, the medians show the same negative direction as the means for most values, but again two values are different. These values concern the median of the abnormal return for the period (-3,3) and the median of the adjusted abnormal return for the period (-3,3). Regarding the net short position, the descriptive statistics show that the average total net short position announced is 1.253%, ranging from 0.050% to 7.870%. On top of that, the means for the categorical variables give some indication of the percentage of the total number of observations that takes a value of one. Hence, about 92% of the announcements of net short positions in the sample took place in optioned stocks. This number is higher than the average percentage found by Aitken et al. (1998), who found about 76% of the total short sales in their sample to be in optioned stocks. On the other hand, only about 0.9% of the short selling positions in the sample was announced in the last three trading days of a tax year, whereas Aitken et al. (1998) indicate that about 2% of the short sales in their sample occurred in the last three trading days of a tax year. Further, for all variables which account for multiple short sales within the period over which the abnormal return is calculated, more than half of the sample shows that multiple announcements took place in these periods. Additionally, this percentage grows as the period is longer. This would be logical, since the longer the period, the more opportunities to take a short position in a stock and the more information could find its way to the market.

# 5. RESULTS

In this section, the results of the model, as formulated in section 3.1, will be reported and discussed.

## 5.1 Period (0,1), (0,3), and (0,15)

The results of the regression models for the periods (0,1), (0,3), and (0,15) are reported in Table 4.

### *5.1.1 Abnormal returns*

For the periods (0,1) and (0,15), the coefficients of the variable representing the announced level of net short interest are in the expected direction, namely negative. Nevertheless, the values are not very high. Firstly, the coefficient of the $SHORT_{it}$-variable for the period (0,1) takes a value of -0.001, which means that the model predicts that an increase in the announced total net short position of one percentage point would lead to a decrease in the abnormal return in the period (0,1) of 0.001 percentage point. Secondly, the same coefficient takes a value of -0.068 for the period (0,15). This means that an increase in the announced total net short position of one percentage point would lead to a decrease in the abnormal return over the period (0,15) of 0.068 percentage point, as predicted by the model. Interestingly, the coefficient of the variable $SHORT_{it}$ shows a positive value of 0.219 in the period (-3,3). Hence, the model for this period predicts that an increase of one percentage point in the announced level of net short interest would lead to an increase of the abnormal return over the period (-3,3) by 0.219 percentage point. Nevertheless, in none of these models the variable $SHORT_{it}$ is statistically significant. Furthermore, the models do not produce any statistically significant results for the control variables. Lastly, the model fits for these three periods are very low and the models are not significant. Hence, there is no evidence to assume that short selling impacts abnormal returns of stocks significantly in the periods (0,1), (0,3), and (0,15).

### *5.1.2 Adjusted abnormal returns*

For the periods (0,1), (0,3), and (0,15), the models which take into account the abnormal returns which are adjusted for the stock betas do not yield remarkably different results from the models with the unadjusted abnormal returns. The coefficients of all variables do take slightly higher values, but are in the same direction. First of all, the coefficients of the $SHORT_{it}$-variables are in the expected (negative) direction for the periods (0,1) and (0,15), taking the values of -0.014 and -0.221 respectively. Thus, the model predicts that a rise in the announced total net short position in the stock of a firm by one percentage point would lead to a 0.014 percentage point lower abnormal return for the period (0,1) and a 0.221 percentage point lower abnormal return for the period (0,15). The variable $SHORT_{it}$ again shows a deviating value for the period (0,3),

[2] These databases were respectively Yahoo Finance, ORBIS, and the AEX.

[3] The reason why the outliers are not excluded for the periods (0,1), (0,3), and (0,15), although there seem to be some higher values left in these periods, is that these periods are already included in the periods (-1,1), (-3,3), and (-15,15). Therefore, most of the outliers for these period are already removed and taking out the other outliers for the periods (0,1), (0,3), and (0,15) would bias the results of the other periods by taking out values which are not deviating for these periods. Furthermore, creating two different samples would make comparisons among the different periods less meaningful, since they would not be based on the same observations.

[4] The two observations for Pharming Group N.V. both belong to the extreme outliers. As a consequence, this firm is not present in the final sample without extreme outliers anymore. See Appendix A for a detailed overview of the firms in this research.

**Table 2: Descriptive statistics**

Descriptive statistics of all the variables used in this paper (N = 1,261), with the variables in the rows and the descriptive statistics in the columns. Decimal numbers are rounded to three decimals.

| Variable | Mean | Median | Mode (smallest) | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| *Abnormal return (0,1)* | 0.608% | -0.100% | -0.970% | 20.200% | -68.181% | 482.207 |
| *Abnormal return (0,3)* | 1.461% | -0.092% | -83.217% | 27.599% | -83.217% | 515.906% |
| *Abnormal return (0,15)* | -0.917% | -0.977% | -94.286% | 28.392% | -94.286% | 445.062% |
| *Abnormal return (0,1) – adjusted* | 0.592% | -0.131% | -68.704% | 20.200% | -68.704% | 481.877% |
| *Abnormal return (0,3) – adjusted* | 1.418% | -0.132% | -83.573% | 27.613% | -83.573% | 515.139% |
| *Abnormal return (0,15) – adjusted* | -1.076% | -0.730% | -96.934% | 28.545% | -96.934% | 447.122% |
| *Abnormal return (-1,1)* | 0.845% | -0.087% | -75.893% | 24.548% | -75.893% | 508.171% |
| *Abnormal return (-3,3)* | 0.855% | -0.119% | -82.428% | 29.407% | -82.428% | 512.686% |
| *Abnormal return (-15,15)* | -5.807% | -3.323% | -98.418% | 24.183% | -98.418% | 221.770% |
| *Abnormal return (-1,1) – adjusted* | 0.825% | -0.087% | -76.565% | 24.541% | -76.565% | 507.678% |
| *Abnormal return (-3,3) – adjusted* | 0.763% | -0.212% | -82.135% | 29.349% | -82.135% | 511.638% |
| *Abnormal return (-15,15) – adjusted* | -6.072% | -3.469% | -102.936% | 24.252% | -102.936% | 221.658% |
| *Net short position* | 1.339% | 0.920% | 0.490% | 1.056% | 0.050% | 7.870% |
| *Options* | 0.926 | 1 | 1 | - | 0 | 1 |
| *Tax* | 0.008 | 0 | 0 | - | 0 | 1 |
| *Multiple announcements (0,3)* | 0.722 | 1 | 1 | - | 0 | 1 |
| *Multiple announcements(0,15)* | 0.929 | 1 | 1 | - | 0 | 1 |
| *Multiple announcements (-3,3)* | 0.868 | 1 | 1 | - | 0 | 1 |
| *Multiple announcements(-15,15)* | 0.987 | 1 | 1 | - | 0 | 1 |

**Table 3: Descriptive statistics, after excluding extreme outliers**

Descriptive statistics of all the variables used in this paper after excluding the extreme outliers (N = 1,119), with the variables in the rows and the descriptive statistics in the columns. Decimal numbers are rounded to three decimals.

| Variable | Mean | Median | Mode (smallest) | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| *Abnormal return (0,1)* | -0.012% | -0.012% | -0.970% | 2.360% | -13.838% | 20.736% |
| *Abnormal return (0,3)* | 0.307% | -0.020% | -18.746 | 9.379% | -18.746% | 224.389% |
| *Abnormal return (0,15)* | -0.996% | -0.768% | -58.453% | 12.595% | -58.453% | 214.585% |
| *Abnormal return (0,1) – adjusted* | -0.031% | -0.087% | -13.743% | 2.351% | -13.743% | 19.817% |
| *Abnormal return (0,3) – adjusted* | 0.263% | -0.054% | -19.491% | 9.422% | -19.491% | 225.693% |
| *Abnormal return (0,15) – adjusted* | -1.098% | -0.626% | -59.105% | 12.601% | -59.105% | 215.574% |
| *Abnormal return (-1,1)* | -0.014% | -0.010% | -12.328% | 3.259% | -12.328% | 12.796% |
| *Abnormal return (-3,3)* | -0.267% | 0.073% | -23.532% | 5.810% | -23.532% | 21.915% |
| *Abnormal return (-15,15)* | -3.547% | -2.548% | -56.355% | 14.667% | -56.355% | 46.443% |
| *Abnormal return (-1,1) – adjusted* | -0.037% | -0.038% | -12.360% | 3.278% | -12.360% | 12.744% |
| *Abnormal return (-3,3) – adjusted* | -0.362% | 0.030% | -22.627% | 5.812% | -22.627% | 22.668% |
| *Abnormal return (-15,15) – adjusted* | -3.759% | -2.621% | -60.270% | 14.680% | -60.270% | 46.543% |
| *Net short position* | 1.253% | 0.890% | 0.490% | 0.978% | 0.050% | 7.870% |
| *Options* | 0.920 | 1 | 1 | - | 0 | 1 |
| *Tax* | 0.009 | 0 | 0 | - | 0 | 1 |
| *Multiple announcements (0,3)* | 0.698 | 1 | 1 | - | 0 | 1 |
| *Multiple announcements (0,15)* | 0.921 | 1 | 1 | - | 0 | 1 |
| *Multiple announcements (-3,3)* | 0.856 | 1 | 1 | - | 0 | 1 |
| *Multiple announcements (-15,15)* | 0.986 | 1 | 1 | - | 0 | 1 |

**Table 4: Results for the periods (0,1), (0,3), and (0,15)**

The results for the regression models. The periods are represented in the columns, whereas the rows show the values for each of the variables in the models. For the description of each of the variables, see section 3.2. The first number in each cell indicates the coefficient in the regression model, while the value between brackets represents the result of the t-test. At the bottom, the adjusted $R^2$ and the F-statistic for each of the different models are reported. (N = 1,119)

| | **Abnormal return** | | | **Abnormal return – adjusted for stock beta** | | |
|---|---|---|---|---|---|---|
| | **Period (0,1)** | **Period (0,3)** | **Period (0,15)** | **Period (0,1)** | **Period (0,3)** | **Period (0,15)** |
| *Intercept* | 0.147 | 0.498 | -0.813 | 0.230 | 0.667 | 0.427 |
| | (0.566) | (0.462) | (-0.458) | (0.893) | (0.617) | (0.240) |
| $SHORT_{it}$ | -0.001 | 0.219 | -0.068 | -0.014 | 0.159 | -0.221 |
| | (-0.014) | (0.737) | (-0.173) | (-0.195) | (0.532) | (-0.563) |
| $OPTIONED_i$ | -0.176 | -0.545 | 0.836 | -0.270 | -0.669 | -0.296 |
| | (-0.671) | (-0.521) | (0.593) | (-1.031) | (-0.637) | (-0.210) |
| $MONTH_t$ | 0.504 | 0.308 | 3.947 | 0.569 | 0.277 | 3.745 |
| | (0.671) | (0.103) | (0.984) | (0.760) | (0.092) | (0.933) |
| $MULTIPLE_{it}$ | - | 0.048 | -0.979 | - | 0.014 | -1.094 |
| | | (0.076) | (-0.686) | | (0.022) | (-0.766) |
| *Adjusted* $R^2$ | -0.002 | -0.003 | -0.002 | -0.001 | -0.003 | -0.002 |
| *F-statistic* | 0.316 | 0.203 | 0.424 | 0.604 | 0.164 | 0.517 |

**Table 5: Results for the periods (-1,1), (3,3), and (15,15)**

The results for the regression models. The periods are represented in the columns, whereas the rows show the values for each of the variables in the models. For the description of each of the variables, see section 3.2. The first number in each cell indicates the coefficient in the regression model, while the value between brackets represents the result of the t-test. At the bottom, the adjusted $R^2$ and the F-statistic for each of the different models are reported. (N = 1,119)

| | **Abnormal return** | | | **Abnormal return – adjusted for stock beta** | | |
|---|---|---|---|---|---|---|
| | **Period (-1,1)** | **Period (-3,3)** | **Period (-15,15)** | **Period (-1,1)** | **Period (-3,3)** | **Period (-15,15)** |
| *Intercept* | 0.695* | 2.154*** | 4.521 | 0.904** | 2.354*** | 5.666 |
| | (1.950) | (2.950) | (1.176) | (2.526) | (3.230) | (1.481) |
| $SHORT_{it}$ | -0.259*** | -0.378** | -3.098*** | -0.292*** | -0.488*** | -3.386*** |
| | (-2.589) | (-2.082) | (-7.003) | (-2.909) | (-2.691) | (-7.688) |
| $OPTIONED_i$ | -0.428 | -1.536** | -1.101 | -0.634* | -1.701*** | -2.135 |
| | (-1.185) | (-2.385) | (-0.691) | (-1.748) | (-2.648) | (-1.345) |
| $MONTH_t$ | 1.011 | 0.262 | 8.078* | 0.908 | -0.166 | 7.248 |
| | (0.978) | (0.142) | (1.773) | (0.875) | (-0.90) | (1.598) |
| $MULTIPLE_{it}$ | - | -0.625 | -3.291 | - | -0.626 | -3.329 |
| | | (-1.236) | (-0.909) | | (-1.242) | (-0.923) |
| *Adjusted* $R^2$ | 0.006 | 0.010 | 0.045 | 0.010 | 0.014 | 0.055 |
| *F-statistic* | 3.349** | 3.687*** | 14.286*** | 4.595*** | 4.984*** | 17.407*** |

* *Significant at the 0.10 level*

** *Significant at the 0.05 level*

*** *Significant at the 0.01 level*

namely a positive value of 0.159. This would indicate that the model predicts that in the period (0,3) the abnormal return would increase by 0.159 percentage point if the total announced net short interest increases by one percentage point. Nevertheless, none of these values are statistically significant, as was also the case in the models with unadjusted abnormal returns. Furthermore, the control variables did not produce statistically significant results either. Finally, the model fits take low values and the models are not significant. Hence, the results of this model do not provide enough evidence to conclude that the variables which are included in the regression models have a significant impact on the adjusted abnormal stock returns in the periods (0,1), (0,3), and (0,15).

## 5.2 Period (-1,1), (-3,3), and (-15,15)

The results of the regression models for the periods (-1,1), (-3,3), and (-15,15) are reported in Table 5.

### *5.2.1 Abnormal returns*

For the periods (-1,1), (-3,3), and (-15,15), the coefficient of the main variable of interest, the $SHORT_{it}$-variable, is in the expected direction, namely negative. Other studies also found this negative relationship, as discussed previously in section 2.1. Moreover, for all three models, the variable $SHORT_{it}$ was found to be statistically significant at the 0.01 level. The coefficient of the $SHORT_{it}$-variable takes a value of -0.259 for the period (-1,1). This value is relatively high, as it would indicate that the model predicts that the abnormal return over the period (-1,1) would decrease by 0.259 percentage point, when the announced level of net short interest increases by one percentage point. For the period (-3,3), the coefficient of the variable that represents the announced total net short position in a stock on a certain trading day takes a value of -0.378. Therefore, the model predicts that the abnormal return over the period (-3,3) would decrease by 0.378 percentage point, when the total announced net short position increases by one percentage point. Furthermore, the coefficient of the $SHORT_{it}$-variable for the period (-15,15) is -3.098, indicating that an increase of one percentage point in the announced total net short position would lead to a decrease of the abnormal return over the period (-15,15) by 3.098 percentage point. Hence, overall, the decreases in abnormal returns due to short selling become larger if the time period over which the abnormal return is measured is longer. All in all, the results for these periods seem to be supporting the hypothesis, formulated in section 2.2, which states that short selling has a negative impact on stock returns in the Netherlands.

Regarding the control variables used in this paper, only the $OPTIONED_i$-variable was found to be statistically significant in the period (-3,3) and the $MONTH_t$-variable was found to be statistically significant in the period (-15,15). The same results were found for the other periods, but the variables were not statistically significant there. The $MONTH_t$-variable takes a statistically significant positive value in the period (-15,15) at the 0.1 level. This positive direction is in accordance with findings from prior literature and the assumption that tax-related short selling mitigates the negative effect of short selling on abnormal returns. More remarkably, the $OPTIONED_i$-variable in period (-3,3) takes a statistically significant negative value at the 0.05 level. This is remarkable, since the expectation based on prior literature is that the availability of optioned stocks would mitigate the negative effect of short selling on abnormal returns. One reason why the $OPTIONED_i$-variable is negative might be that it interacts with the SHORTit-variable, because in the case of hedging or arbitraging an investor could take options in a stock at the same time as taking a (net) short position in a stock. In this model, there does seem to be a statistically significant positive correlation between the variables $OPTIONED_i$ and $SHORT_{it}$, which is higher than the correlation between the $OPTIONED_i$-variable and the abnormal return over the period (-3,3). Nevertheless, the tolerance is still very high and the variance inflation factor is low. In addition, the Pearson correlation with the abnormal return also takes a negative value at a statistically significant level. Finally, adding an interaction term, for the variables $SHORT_{it}$ and $OPTIONED_i$, to the original regression model does not yield a significant result for the interaction term.[5] Nevertheless, more research is necessary to determine the reason for the negative coefficient of the variable $OPTIONED_i$.

### *5.2.2 Adjusted abnormal returns*

For the periods (-1,1), (-3,3), and (-15,15), the regression models which include the adjusted abnormal returns lead to slightly different results than the models which are based on the unadjusted abnormal returns. The $SHORT_{it}$-variable still takes increasingly negative values when increasing the length of the period. This variable takes the values -0.292, -0.488, and -3.386 for the periods (-1,1), (-3,3), and (-15,15) respectively. Hence, the model predicts that an increase of one percentage point in the total net short position which is announced would result in a decrease of the abnormal return of 0.292 percentage point for period (-1,1), of 0.488 percentage point for period (-3,3), and of 3.386 percentage point for period (-15,15). In addition, the $SHORT_{it}$-variable is statistically significant in all three models. Therefore, the model indicates that the announced short position on a certain date has a negative impact on the abnormal returns in the period (-1,1), (-3,3), and (-15,15). This is in accordance with the hypothesis formulated in section 2.2.

The control variables do not lead to statistically significant results with the exception of the $OPTIONED_i$-variable in the periods (-1,1) and (-3,3). Like for the model which was based on the unadjusted abnormal returns, the results imply that selling short in stocks for which options are available has a negative impact on the abnormal return of a stock in these two periods. However, this is opposite to the expectations based on prior literature as explained in the previous section. The possible reason for the negative coefficients of the $OPTIONED_i$-variable could be the interaction with the $SHORT_{it}$-variable, as described in section 5.2.1. For these models, the correlation between the variables $OPTIONED_i$ and $SHORT_{it}$ is also stronger than the correlation between the variable $OPTIONED_i$ and the abnormal return. However, in these models the tolerance is also very high, whereas the variance inflation factor is low. Additionally, the Pearson correlation with the abnormal return is also negative at a statistically significant level. Lastly, the addition of an interaction term does not lead to statistically significant coefficients for the interaction terms either.[6]

Altogether, both the model fits and the model significances are slightly higher for the models which include the adjusted abnormal returns rather than the unadjusted abnormal returns. This indicates that these models are slightly more useful in explaining the influence of short selling on stock returns. However, as indicated at the beginning of this section, the differences are relatively small.

# 6. CONCLUSIONS & RECOMMENDATIONS

In this final section, the conclusions of this paper will be discussed. Lastly, a number of limitations of this research as well as some recommendations for further research and for practice will be provided.

## 6.1 Conclusions

This paper focuses on the impact of short selling on stock returns in the Netherlands, a country which has not been researched often with regard to short selling. In order to do so, total net short selling positions which were announced for firms

[5] See Appendix B for an overview of the Pearson correlations, the tolerance, the variance inflation factor, and the regression results with the interaction term. An interaction term was chosen, because it shows the influence on abnormal returns of a possible interaction between the availability of options for a certain stock (that is, if $OPTIONED_i$ takes the value of one) and a short sale in this stock.

[6] See Appendix B.

on certain dates in the short selling register of the AFM are used. These data have been available since November 2012, due to a change in European regulation regarding short selling. The short selling data from January 2013 to December 2014 are used. The abnormal return is calculated by means of the adjusted stock prices for the firms involved. It is calculated in two ways: one measure is not adjusted in any way for the firm risk, whereas the other measure is adjusted for the stock beta. For both measures, the abnormal return is calculated over six different periods of time: (0,1), (0,3), (0,15), (-1,1), (-3,3), and (-15,15). Furthermore, two control variables are added to the model: one variable to control for the fact whether optioned stocks were available, or not, and one variable to control for the fact whether the short sale was announced in the last three trading days of a tax year, or not. Finally, for the periods (0,3), (0,15), (-3,3), and (-15,15) a variable is added to control for the fact whether more short sale announcements took place within these periods, or not.

The results of this paper show that there is a significant effect of the net short selling position taken in a stock on the abnormal return for the periods (-1,1), (-3,3), and (-15,15). Thus, there seems to be a stock price reaction due to the announcement of a net short position. Nevertheless, a significant impact was not found for the periods (0,1), (0,3), and (0,15). Since there is a significant influence for the periods that take into account one or more days before the announcement of a net short position, in addition to the same number of days after the announcement, it seems there is some leakage of information prior to the announcement of a net short position. This could explain why there is a significantly negative price reaction due to short selling in these periods, while there is no statistically significant result for the periods that do not take into account some days prior to the announcement. Hence, it can be assumed that the hypothesis, which states that short selling negatively influences stock returns in the Netherlands, is correct. This finding is consistent with the results found in prior academic literature in this field for other countries.

Next to this, an interesting finding is that stocks for which options were available tend to have a more negative effect on abnormal returns than stocks for which options were not available. Although this result is found in most models, it is only statistically significant in three models. A negative direction of the variable that accounts for optioned stocks is not compliant with the results from prior research, which indicate that stocks for which options are available reduce the negative effect of short selling. Nevertheless, this negative impact could be due to the interrelation between the availability of optioned stocks and short selling, although the interaction term is not found to be statistically significant in this study.

Furthermore, the variable that controls for the fact whether a short sale was announced in the last three trading days and the variable that accounts for multiple announcements of short sales for the longer periods are not found to be statistically significant. These findings suggest that tax-related short selling and multiple short sale announcements within a certain period do not significantly impact stock returns in the Netherlands.

All in all, it seems that short selling in the Netherlands does have an impact on stock returns. On top of that, while the control variables are not significant in all models, it seems that short selling is likely to be driven by information. Nevertheless, since this paper only covers a limited part of the variables which influence abnormal returns, no definite statement can be made about this. Moreover, it is relevant to say that the sample of this study only covers Dutch firms which are listed on the Dutch stock market. Hence, the conclusions of this research cannot be generalised and applied to other countries. Finally, it should be noted that the short selling data used in this paper consist of net short selling data, which differs from the data used in previous studies.

## 6.2 Limitations & Recommendations for further research

As stated above, this paper does not cover all possible explanations for abnormal returns and the influence of short selling on abnormal returns. Therefore, it is recommended to do further research on the factors that can influence the abnormal returns and the nature of its relation with short selling. Likewise, it would be highly recommended to take into account other events, next to the announcement of short interest, that occurred in the same time period. This could lead to a deeper understanding of short selling in the Netherlands and its influence on stock returns. Next to this, it is recommended to use a larger dataset. Because short selling data has been available only since November 2012, there is not much data publically available yet. It would be valuable to do further research on a larger sample in a few years' time. This data will probably contain more firms as well, which could also provide additional insights. In addition, in this paper, the three-year beta was used to calculate the adjusted abnormal return. Since this beta is an estimation, it could influence the results. Hence, it would be advised to do a similar study, but with other measures of abnormal returns to look at the impact on the results. Furthermore, a closer look at the longer periods over which the abnormal returns are calculated in this study would be recommended. The short interest in this study was not averaged over the longer periods in which more than one announcement of a total net short position in the stock of a firm occurred. On top of that, it could be interesting to investigate the reasons of investors to take a short position in Dutch firms. Finally, it is advised to further research the influence of the availability of optioned stocks on abnormal returns and the interrelation between the availability of optioned stocks and short selling. This could lead to an explanation of the surprising finding in this study that optioned stocks have a more negative influence on stock returns than non-optioned stocks.

## 6.3 Recommendations for practice

It seems that on the day immediately following the announcement of a new or changed short position, three days after the announcement, and fifteen days after the announcement, there is no significant impact of short selling on the stock price. Nevertheless, the results do show a strong influence of the announcement of net short positions on abnormal returns when taking into account some days prior to the event as well. As a consequence, it appears to be possible to make profits by means of short selling in the Netherlands. It is advised that investors monitor the market closely and adjust their investment strategies to the evidence found in this research, namely that short selling does have an influence on stock returns. Finally, it would be recommended to take into account the possibility of information leakage on the market prior to the announcement of a net short position. When investors use this information, it could help them to find opportunities to make short selling profits.

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# 9. APPENDICES

## 9.1 Appendix A: The firms

In this appendix, an overview of the firms in the dataset, the sample including outliers, and the final sample excluding outliers is reported. For each of these, the number of observations for each firm, as well as the percentage of the total these observations represent, are reported.

**Table A.1 Overview of the firms in the initial dataset, the sample including outliers, and the final sample excluding outliers**

The different companies are reported in the rows. The frequencies of the observations and the percentages of the total dataset, the sample including outliers, and the final sample excluding outliers are reported in the columns for each company.

| | **Initial dataset** | | **Sample including outliers** | | **Sample excluding outliers** | |
|---|---|---|---|---|---|---|
| **Company** | **Frequency** | **Percentage** | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| *Accell Group N.V.* | 6 | 0,41% | 6 | 0,48% | 6 | 0,54% |
| *AMG Advanced Metallurgical Group N.V.* | 24 | 1,65% | 23 | 1,82% | 23 | 2,06% |
| *Aperam S.A.* | 114 | 7,82% | - | - | - | - |
| *ArcelorMittal S.A.* | 11 | 0,75% | - | - | - | - |
| *ASM International N.V.* | 8 | 0,55% | 8 | 0,63% | 8 | 0,71% |
| *BinckBank N.V.* | 12 | 0,82% | 12 | 0,95% | 12 | 1,07% |
| *Corbion N.V.* | 22 | 1,51% | 22 | 1,74% | 22 | 1,97% |
| *Corbion N.V. (voorheen CSM N.V.)* | 5 | 0,34% | 5 | 0,40% | 5 | 0,45% |
| *Core Laboratories N.V.* | 79 | 5,42% | 79 | 6,26% | 77 | 6,88% |
| *Corio N.V.* | 12 | 0,82% | - | - | - | - |
| *Eurocommercial Properties N.V.* | 4 | 0,27% | 4 | 0,32% | 4 | 0,36% |
| *Exact Holding N.V.* | 2 | 0,14% | 2 | 0,16% | 2 | 0,18% |
| *Fugro N.V.* | 180 | 12,35% | 180 | 14,27% | 165 | 14,75% |
| *Gemalto N.V.* | 70 | 4,80% | 70 | 5,55% | 69 | 6,17% |
| *Heijmans N.V.* | 52 | 3,57% | 51 | 4,04% | 51 | 4,56% |
| *Koninklijke BAM Groep N.V.* | 108 | 7,41% | 108 | 8,56% | 98 | 8,76% |
| *Koninklijke KPN N.V.* | 51 | 3,50% | 51 | 4,04% | 50 | 4,47% |
| *Koninklijke Ten Cate N.V.* | 1 | 0,07% | 1 | 0,08% | 1 | 0,09% |
| *Koninklijke Vopak N.V.* | 14 | 0,96% | 14 | 1,11% | 14 | 1,25% |
| *NSI N.V.* | 12 | 0,82% | - | - | - | - |
| *Nutreco N.V.* | 2 | 0,14% | 2 | 0,16% | 2 | 0,18% |
| *Pharming Group N.V.* | 2 | 0,14% | 2 | 0,16% | - | - |
| *PostNL N.V.* | 80 | 5,49% | 80 | 6,34% | 75 | 6,70% |
| *Royal Imtech N.V.* | 276 | 18,93% | 272 | 21,57% | 170 | 15,19% |
| *SBM Offshore N.V.* | 105 | 7,20% | 105 | 8,33% | 101 | 9,03% |
| *SNS Reaal N.V.* | 12 | 0,82% | - | - | - | - |
| *TNT Express N.V.* | 24 | 1,65% | 24 | 1,90% | 24 | 2,14% |
| *TomTom N.V.* | 79 | 5,42% | 79 | 6,26% | 79 | 7,06% |
| *Unibail-Rodamco SE* | 8 | 0,55% | - | - | - | - |
| *USG People N.V.* | 46 | 3,16% | 46 | 3,65% | 46 | 4,11% |
| *Wereldhave N.V.* | 22 | 1,51% | - | - | - | - |
| *Wolters Kluwer N.V.* | 11 | 0,75% | 11 | 0,87% | 11 | 0,98% |
| *Ziggo N.V.* | 4 | 0,27% | 4 | 0,32% | 4 | 0,36% |
| *Total* | 1,458 | 100% | 1,261 | 100% | 1,119 | 100% |

## 9.2 Appendix B: Correlations, tolerances, variance inflation factors, and interaction terms

In this appendix, an overview is provided of the Pearson correlations, the tolerances, the variance inflation factors, and the regressions including interaction terms for the variables $SHORT_{it}$ and $OPTIONED_i$ for the period (-1,1) with the adjusted abnormal return and for the period (-3,3) both with the unadjusted and the adjusted abnormal return.

**Table A.2a Pearson correlations for period (-1,1) with the adjusted abnormal return**

The Pearson correlations for all variables in the regression model for the period (-1,1) with the adjusted abnormal return. For the description of each of the variables, see section 3.2. The first number in each cell indicates the correlation coefficient, while the value between brackets represents the p-value of the correlation. At the bottom, the tolerance and variance inflation factor (VIF) are reported for the independent variable and each control variable. (N = 1,119)

| | **$AR_{it}$** | **$SHORT_{it}$** | **$OPTIONED_i$** | **$MONTH_t$** |
|---|---|---|---|---|
| *$AR_{it}$* | 1 | -0.093*** (0.002) | -0.063** (0.035) | 0.030 (0.317) |
| *$SHORT_{it}$* | -0.093*** (0.002) | 1 | 0.110*** (0.000) | -0.019 (0.526) |
| *$OPTIONED_i$* | -0.063** (0.035) | 0.110*** (0.000) | 1 | -0.42 (0.158) |
| *$MONTH_t$* | 0.030 (0.317) | -0.019 (0.526) | -0.042 (0.158) | 1 |
| *Tolerance* | - | 0.988 | 0.986 | 0.998 |
| *VIF* | - | 1.012 | 1.014 | 1.002 |

**Table A.2b Pearson correlations for period (-3,3) with the unadjusted abnormal return**

The Pearson correlations for all variables in the regression model for the period (-3,3) with the unadjusted abnormal return. For the description of each of the variables, see section 3.2. The first number in each cell indicates the correlation coefficient, while the value between brackets represents the p-value of the correlation. At the bottom, the tolerance and variance inflation factor (VIF) are reported for the independent variable and each control variable. (N = 1,119)

| | **$AR_{it}$** | **$SHORT_{it}$** | **$OPTIONED_i$** | **$MONTH_t$** | **$MULTIPLE_{it}$** |
|---|---|---|---|---|---|
| *$AR_{it}$* | 1 | -0.080*** (0.008) | -0.081*** (0.007) | 0.011 (0.711) | -0.056* (0.059) |
| *$SHORT_{it}$* | -0.080*** (0.008) | 1 | 0.110*** (0.000) | -0.019 (0.526) | 0.212*** (0.000) |
| *$OPTIONED_i$* | -0.081*** (0.0007) | 0.110*** (0.000) | 1 | -0.042 (0.158) | 0.068** (0.024) |
| *$MONTH_t$* | 0.011 (0.711) | -0.019 (0.526) | -0.042 (0.158) | 1 | -0.069** (0.020) |
| *$MULTIPLE_{it}$* | -0.056* (0.059) | 0.212*** (0.000) | 0.068** (0.024) | -0.069** (0.020) | 1 |
| *Tolerance* | - | 0.946 | 0.984 | 0.994 | 0.949 |
| *VIF* | - | 1.057 | 1.016 | 1.006 | 1.054 |

* *Significant at the 0.10 level*

** *Significant at the 0.05 level*

*** *Significant at the 0.01 level*

**Table A.2c Pearson correlations for period (-3,3) with the adjusted abnormal return**

The Pearson correlations for all variables in the regression model for the period (-3,3) with the adjusted abnormal return. For the description of each of the variables, see section 3.2. The first number in each cell indicates the correlation coefficient, while the value between brackets represents the p-value of the correlation. At the bottom, the tolerance and variance inflation factor (VIF) are reported for the independent variable and each control variable. (N = 1,119)

| | $AR_{it}$ | $SHORT_{it}$ | $OPTIONED_i$ | $MONTH_t$ | $MULTIPLE_{it}$ |
|---|---|---|---|---|---|
| $AR_{it}$ | 1 | -0.099*** (0.001) | -0.091*** (0.002) | 0.005 (0.872) | -0.060** (0.043) |
| $SHORT_{it}$ | -0.099*** (0.001) | 1 | 0.110*** (0.000) | -0.019 (0.526) | 0.212*** (0.000) |
| $OPTIONED_i$ | -0.091*** (0.002) | 0.110*** (0.000) | 1 | -0.42 (0.158) | 0.068** (0.024) |
| $MONTH_t$ | 0.005 (0.872) | -0.019 (0.526) | -0.042 (0.158) | 1 | -0.069** (0.020) |
| $MULTIPLE_{it}$ | -0.060** (0.043) | 0.212*** (0.000) | 0.068** (0.024) | -0.069** (0.020) | 1 |
| *Tolerance* | - | 0.946 | 0.984 | 0.994 | 0.949 |
| *VIF* | - | 1.057 | 1.016 | 1.006 | 1.054 |

**Table A2.d: Regressions with interaction term**

The results for the regression with the interaction term of the variables $SHORT_{it}$ and $OPTIONED_i$. The periods are represented in the columns, whereas the rows show the values for each of the variables in the models. For the description of each of the variables, see section 3.2. The variable $SHORT_{it}$ is centred to avoid multicollinearity. The first number in each cell indicates the coefficient in the regression model, while the value between brackets represents the result of the t-test. At the bottom, the adjusted $R^2$ and the F-statistic for each of the different models are reported. (N = 1,119)

| | **Abnormal return** | **Abnormal return – adjusted for stock beta** | |
|---|---|---|---|
| | **Period (-3,3)** | **Period (-1,1)** | **Period (-3,3)** |
| *Intercept* | 1.362 (1.361) | 0.314 (0.637) | 1.598 (1.600) |
| $SHORT_{it}$ | -1.187 (-0.689) | -0.905 (-0.940) | -0.855 (-0.497) |
| $OPTIONED_i$ | -1.243 (-1.390) | -0.410 (-0.815) | -1.569* (-1.757) |
| $MONTH_t$ | 0.287 (0.156) | 0.922 (0.889) | -0.155 (-0.084) |
| $MULTIPLE_{it}$ | -0.597 (-1.172) | - | -0.614 (-1.208) |
| *Interaction term* | 0.816 (0.472) | 0.620 (0.640) | 0.370 (0.214) |
| *Adjusted $R^2$* | 0.009 | 0.009 | 0.013 |
| *F-statistic* | 2.992** | 3.547*** | 3.993*** |

* *Significant at the 0.10 level*

** *Significant at the 0.05 level*

*** *Significant at the 0.01 level*