UNIVERSITY OF TWENTE

Master Thesis

The impact of short selling on stock returns and volatility

Evidence from the Dutch stock market

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Date: September 2019

ABSTRACT

This study examines the impact of short selling on individual stock returns and stock volatility in the Netherlands. A sample consisting of 1066 observed short positions in 38 companies listed on the Dutch stock exchange is used. The sample period runs from 2 January 2017 to 29 December 2017. An OLS regression is used to test the impact of short selling on stock returns and volatility over different time periods of 5, 10 and 22 days. There is no significant statistical evidence to suggest that short selling decreases abnormal stock returns or that short selling increases stock volatility. There is even some evidence suggesting that short selling decreases stock volatility. Finally, a statistically significant relationship is found between multiple short positions in a specific time period and the returns and volatilities of that time period. This indicates that multiple short positions occurring in a short time period has a significant impact on the returns and volatility levels of that specific time period.

ACKNOWLEDGEMENTS

This assignment is written as a final thesis at the University of Twente for the Master Business Administration, with a specialization in Financial Management. I would like to acknowledge several people for their support during this period. Firstly I would like to thank my supervisors Dr. X. Huang and Prof.dr. M.R. Kabir, for their continuous feedback and suggestions for improvements. Additionally, I would like to thank my family and friends for their support and contributions throughout this period.

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1. INTRODUCTION

This study looks at the effects of short selling on individual stock returns and volatility in the Netherlands. The first chapter introduces the topic and provides some background information on the topic. Furthermore the academic and practical relevance of the study will be described. Finally, the objectives and structure of the study will be presented.

1.1. Background

Short selling is a stock market phenomenon that is sometimes considered controversial and is cause for a lot of discussions, especially following the global financial crisis in 2008. Short sellers are at times seen as unethical and ruthless people that are out to destroy companies and drive down stock prices. However, there is a case to be made that short selling can reduce or prevent overvaluation of stock prices. A key debatable issue regarding short selling is the effect of short selling regulations. Short selling has been subject to many different regulations, but there is no consensus regarding the effect of these regulations and whether they are truly necessary or not. Short selling has been banned in many countries following the global crisis while in other countries stricter regulations have been put in place to manage the effects, the reason for these actions is that short selling was seen as a big cause of the crisis (Baklaci, Suer, & Yelkenci, 2016). In 2012 the European Union imposed the Short Selling Regulation. This is a regulation that focused on making short selling more transparent to the public. Companies are required to report any net short positions they have in a company's stock that is equal to or exceeds 0.2% of that company's outstanding share capital and every 0.1% above that. Furthermore, positions have to be disclosed to the public if they are equal to 0.5% of a company's share capital and every 0.1% above that. These bans and restrictions were put in place because regulators felt that short selling was increasing stock volatility and was causing downward spirals of prices. By implementing regulations, the hope was that these issues would be countered and that the markets could start recovering. However, considering the importance of the issue there is still very little evidence of the effects of these regulations on the markets (Alves, Mendes, & Pereira da Silva, 2016).

Short selling is a risky investment position that is contrasted with taking a long position in a stock. The most common form of investing in stocks is by taking a long position in a stock. Going 'long' means buying a stock with the expectation that it is going to increase in value, and then selling it at a higher value to make a profit. A person with a long position is generally interested in long-term profits rather than short-term profits. Short selling means

selling a security that is not owned by the seller or that is borrowed by the seller. The intention behind short selling is that the price of the security will drop, to subsequently buy the security back at this lower price to make a profit on the difference. Short sellers have to pay a fee to the people they wish to borrow the security from, this has to be taken into account in their profit calculations. The high risk of a short sale comes from the fact that the potential loss is infinite whilst the profit is limited. A security can only drop in value by 100%, but it can increase in value infinitely. Long positions work the other way around. A security can drop down to 0 at worst, which means you only lose the amount you invested. However, it can rise infinitely, so profit potential is unlimited when it comes to taking a long position.

An interesting phenomenon that happens when a highly shorted stock actually goes up in price is a short squeeze. This is a situation in which a stock goes up in price causing short sellers to close out their position. However, due to the fact that the stock is so highly shorted, many short sellers will try to get out at the same time.
This causes the price to go up even more and puts more pressure on the short sellers, resulting in them being squeezed out of their positions and incurring significant losses.

Short selling can be used for speculative purposes, arbitrage and hedging purposes. Speculative trading usually involves an opportunity where a person expects to make a big profit in a short period of time whilst also running a big risk of losing the investment. Speculative traders are often very knowledgeable and well informed about their trades this is due to the large risk that is involved. Arbitrage represents an opportunity for traders to make a risk-free profit. Arbitrage is characterized by simultaneously buying and selling a specific asset, if the asset is mispriced. This mispricing can occur when one security is traded at different prices in different markets. Hedging purposes are more contained and less risky compared to speculative purposes. Hedging is used to protect an investment or to reduce losses of an investment. Hedging involves off-setting trading positions to reduce the impact of potential losses. However, as well as reducing potential losses, hedging also reduces potential profits. Speculative purposes and arbitrage are motivated by profits whilst hedging purposes are motivated by protection.

1.2. Academic relevance

Short selling receives a lot of negative attention due to its supposed unethical practices and supposed negative influence on the stock markets. With all this negative attention it makes it a very intriguing topic. However, by looking at the theoretical and empirical research it is quite clear that there is no consensus regarding the effects of short selling on stock markets. It seems more information and research is needed to actually be able to make profound

claims about what short selling represents in relation to the stock markets and economy. All in all this makes it a very interesting topic to engage in and contribute to the debate.

Individual stock returns and volatility are considered important tools in the financial literature. They are used in capital budgeting and portfolio management decisions, which can be good indicators for a company's financial health and prospects. Additionally, being able to predict market movements can help in creating more realistic asset pricing models (Rapach and Zhou, 2013). Furthermore, stock market returns and volatility are important insights into the state of an economy. Decreasing returns can cause an increase in risk and volatility, which can in turn cause markets to fall (Schwert, 1990). Having a tool like short selling that can potentially influence returns and volatility, according to some theories, is troublesome. Some of the main theories on short selling and stock returns come from Miller (1977) and Diamond and Verrechia (1987). Both theories state that short selling should result in decreasing stock returns. However, returns should decrease because stocks are overpriced and are merely reverting to their actual market value, rather than putting downwards pressure on prices and destabilizing markets. In practice, results are not conclusive and there is no consensus. Some studies show that short selling does have a negative relationship with stock returns (Desai, Ramesh, Thiagarajan, & Balachandran, 2002; Christophe, Ferri, & Angel, 2004; Diether, Lee, & Werner, 2009). On the other hand, there are studies that find no relationship at all (Figlewski and Webb, 1993; Daske, Richardson, & Tuna, 2002). Theories on short selling and stock volatility mainly result from debates among regulators and academics. Regulators are afraid that short selling can put downward pressure on prices and increase volatility in falling markets causing the markets to collapse. Therefore, short selling should be regulated. Academics on the other hand believe that short selling is vital in preventing stocks from being overpriced and that it has no effect on volatility. In practice, there is no consensus in the results. Scheinkman and Xiong (2003) and Saffi and Sigurdsson (2011) find that removing short selling constraints does not increase stock volatility. Diether et al. (2009) mention that short selling stabilizes markets. Whilst on the other hand, Henry and McKenzie (2006) showcase that volatility increases after a period of short selling and Aitken, Frino, McCorry, & Swan (1998) add that when short selling is made transparent it can also increase volatility. There is a lack of consensus among researchers and a lack of focus on European markets.

1.3. Practical Relevance

This study focuses on the debate surrounding short selling and its effects on stock markets. There is limited research available on the topic and the results are very inconsistent. There are different groups with different arguments. There is a group that finds evidence that short

selling destabilizes stock markets and that regulations should be put in place to prevent this. There is a group that finds evidence that short selling stabilizes the market and returns it to its most efficient state. All in all there is no consensus regarding the results which makes it difficult to come to strong conclusions. Added to these mixed results is the fact that most of the literature focuses on the American and Chinese stock markets, because they have more public information available regarding short selling. However, in 2012 the European Union imposed the Short Selling Regulation. This is a regulation that focuses on making short selling more transparent to the public. Companies are required to report any net short positions they have in a company's stock that reaches a certain threshold to the public. These positions are update daily. The introduction of this regulation opens up more opportunities to research short selling within Europe. This study adds to the current literature by focusing on the limited research available from Europe and specifically looking at the Netherlands which has little prior research available on the effects of short selling on stock returns and volatility. This could result in more literature focusing on European countries and building a better understanding of short selling in the European markets. In addition, the net short positions that are disclosed in the Netherlands allow for a unique research opportunity, because they exclude short positions motivated by hedging or arbitrage. The only positions that are registered are positions used for speculative purposes. Most other studies have samples that include aggregated short positions, which includes short positions taken for speculative purposes as well as hedging and arbitrage strategies. In this line of research it is beneficial to only look at speculative short selling, because these trades are initiated with the expectation of a price change. Hedging on the other hand focuses on minimizing risk and arbitrage focuses on making a risk free profit. Finally, this study will focus on a post crisis sample of the year 2017, making it a very contemporary study at this point in time.

1.4. Research questions

The study presents two main research questions:

RQ1: What is the impact of short selling on individual stock returns in the Netherlands?

RQ2: What is the impact of short selling on individual stock volatility in the Netherlands?

The goal of this study is to answer these questions and add to the existing debate about the effects of short selling on stock markets, with contemporary evidence from the Dutch stock market.

1.5. Structure

The study is structured as follows. The first part will give an overview on the related literature regarding the subject of short selling and stock returns and stock volatility. The literature review will include topics such as short selling, short selling constraints, and alternatives for short selling. Furthermore, an insight will be given into the potential effects and relationships between short selling and stock returns and stock volatility. The second part will describe the institutional background concerning this study. The third part will present the hypotheses and explain the reasoning behind formulation of these hypotheses. The fourth part will showcase the research method and design. The fifth part will describe the data and sample used in this study. The final part will show a planning for the remaining parts of the study.

2. LITERATURE REVIEW

In this chapter the related literature to this study will be analyzed. The first part of the literature will focus on introducing the concept of short selling and alternatives for short selling. The second part of the literature will focus on informed trading and the relationships between short selling and news events and short selling and price efficiency. The final part of the literature will focus on the impact of short selling on individual stock returns and volatility.

2.1. What is short selling?

Short selling is the practice of selling a security that someone does not actually own. Traders short sell a security with the intention of buying it back later at a lower price, to profit from a price decline. Shorting allows investors who do not own a perceived overpriced stock to sell this stock (Miller, 1977). Short selling often causes frustrations with executives of companies subjected to the practice. Some form of shorting is permitted in most major stock markets since short sellers may add liquidity to the market and can contribute to price discovery.
In a short sale, the seller does not own the security on the trading day, but has to deliver this security when the transaction is settled.

A short sale is either covered or naked. Naked short selling involves short selling shares without confirming the availability of these shares. In normal cases a short seller has to borrow the stock or confirm that it can be borrowed to initiate a short sale. With naked short selling, the investor shorts shares without actually confirming if he or she can obtain the required shares, it involves a lot of risk but can also yield high rewards. A naked short sale has the risk of failure to deliver (FTD) (Marsh and Payne, 2012).

Short sales are usually realized through equity loans. The short seller borrows shares from an equity lender, the seller then delivers the shares to the buyer. This gives the seller a debt of shares to the lender, which gives him short exposure. However, if the seller doesn't deliver any shares to the buyer, the seller gains short exposure towards the buyer. By failing to deliver, the risk of the short seller not repaying his debt moves from the lender to the buyer. There are mechanisms in place to prevent these things from happening. A seller has to put up collateral when dealing with a lender, to protect the lender. The buyer is protected by an intermediating party that takes margin and levels it with the market, making sure the buyer is protected from a potential FTD by the seller (Evans, Geczy, Musto, & Reed, 2008; Stratmann and Welborn, 2016). Borrowing shares to sell short can be difficult. If the seller's broker has margin accounts that are long the stock or owns the stock himself he can create the loan through internal practices. However, if the broker does not have the stocks available they will

have to find an institution or individual willing to lend the shares. It can be difficult to find lenders for some shares, especially illiquid small stocks (Jones and Lamont, 2002).
Figure 1 will showcase a basic shorting process. The process starts with the short seller telling the broker that they wish to short a stock. The broker will then try to locate a lender for this stock as shown in step 0. Once the stock has been located it will be lent out to the short seller and steps 1 through 5 will follow. For simplistic purposes, additional costs such as borrowing fees and interest payments have been excluded from this model.

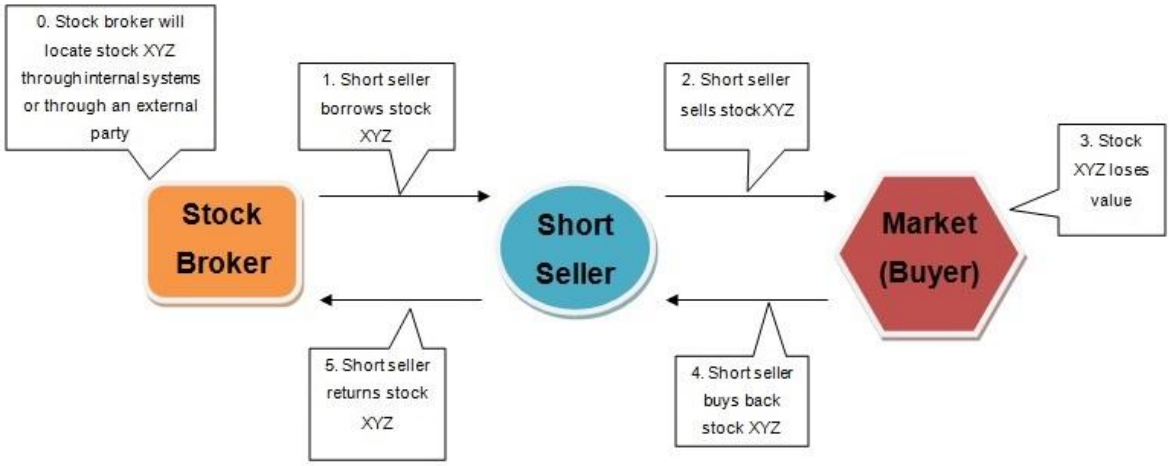

Figure 1: Basic short selling process

Short sellers sometimes fail to deliver on purpose to manipulate the price of a security, or to avoid borrowing costs. A high amount of fails to deliver may deny shareholders the benefits of share ownership such as voting and lending. Moreover, sellers that fail to deliver may try to use this extra freedom to participate in trading activities to improperly decrease the price of a security (Stratmann and Welborn, 2016)

2.2. Why do people short?

Short selling allows investors to profit from a decline in prices. There are several reasons why someone would want to short. Short selling can be used for speculative purposes, hedging purposes and arbitrage strategies. Speculative trading usually involves an opportunity where a person expects to make a big profit in a short period of time whilst also running a big risk of losing the investment. For example, an investor may have information that leads him to believe that a specific stock will drop in price in the near future, so he shorts the stock hoping to profit from the decline in price. If his information and timing are correct, the investor can make a nice profit. However, if he is wrong he can incur significant losses depending on how he manages his risk. Speculative traders are often very knowledgeable and well informed about their trades this is due to the large risk that is involved. Hedging purposes are more contained and less risky. Hedging is used to protect an investment or to reduce losses of an investment. Hedging involves off-setting trading positions to reduce the

impact of potential losses. Whilst hedging can protect an investment it will also reduce the potential profits of the investment. Speculative purposes are motivated by profits whilst hedging purposes are motivated by protection. Short selling can also be used for arbitrage purposes. Arbitrage represents an opportunity for traders to make a risk-free profit. Arbitrage is characterized by simultaneously buying and selling a specific asset, if the asset is mispriced. This mispricing can occur when one security is traded at different prices in different markets. For example, a stock can trade for €10,- on the NYSE, while at the same time it trades for €10,10 on Euronext. This allows traders the opportunity to short the stock on Euronext and immediately buy them back on the NYSE for a profit of €0,10 per share, until the prices are corrected. Arbitrage opportunities are often corrected in a matter of seconds, which makes it very difficult for traders to find these opportunities and exploit them.

Short selling has several advantages and disadvantages. One advantage is that short sales allow an investor to create stock in a company by paying any dividends to the owner of the existing stock and to buy back the borrowed shares in the form of valid stocks upon demand. From the perspective of the holder of the stock that is borrowed, this created stock is equal to an original stock except for voting power, because this person will still receive dividends. This will satisfy their wish to have stock in the company. However, in a normal situation the lender of the stock will not actually be aware that his stocks are being loaned out. The result is that short sales increase the supply of stock on the market by the amount of the outstanding short position, because one person will still receive benefits of the stocks that have been loaned out whilst the other person actually owns the stocks and will also receive benefits (Miller, 1977). Furthermore, short selling is one of the few investment tools to make money in a declining market. Additionally, Miller (1977) states that short selling leads to better pricing. Short selling allows negative information to be incorporated into stock prices which prevents them from becoming overvalued.

Short selling also has several disadvantages. Short selling can be costly. As long as a short position is open, the short seller has to pay dividends to the lender, a borrowing fee to a brokerage, and interest on a margin account. The value of the borrowing fee depends on how difficult it is for the brokerage to acquire the shares. The interest payments depend on the value of money that is required for the margin account. These costs vary across stocks. (Bernal, Herinckx, & Szafarz, 2014). An increase in short interest in a stock is often seen as a signal that the stock price is going to drop, because market participants often believe that short sellers have significant private information. In general, a short sale is costlier than a long sale. Due to this cost constraint, Diamond and Verrecchia (1987) predict that only investors who are well informed about a considerable price decline will choose to short,

hence large increases in short interest should be followed by negative abnormal returns (Mohamad, Jaafar, Hodgkinson, & Wells, 2013). Additionally short positions can be subject to margin calls and recalls. A margin call means the short seller has to put up additional capital to keep the position open. A reason for this might be that the stock price has gone up instead of down, so more margin is needed to keep the position open. If no additional money is available the position will be closed and the short seller will have to buy back the short at a loss. A recall means the shares need to be returned immediately. This can happen if the original owner of the shares wants to sell them. If the short seller cannot find a way to borrow the shares from someone else he will be forced to close out the position at a loss. Finally, a short sale's loss is potentially unlimited. In contrast with a long position where you can only lose the amount of money you invested. In theory, with a short position the stock price could go up infinitely, meaning the loss could become greater than the initial investment.

2.3. Constraints on short selling

Short selling can be subject to many constraints ranging from high borrowing costs, to not being able to reinvest profits immediately, to prohibition of shorting a specific share altogether. To sell short, the stock must be borrowed from someone who owns the stock. Finding a willing lender can be costly and time-consuming. When a stock is low in supply or otherwise difficult to obtain it can take time to find a lender, and for the same reason the cost of borrowing the stock can also be very high. When a lender is found they will charge a fee to the short seller in return for the stock. The fee is determined by the supply and demand for the stock. Besides the fee there are other costs associated with short selling, for example, the risk of the position having to be closed forcefully due to the loan being recalled. The lender has the right to recall the stocks at any given time. If the lender decides to recall the loan when the shares have increased in price, the short seller is forced to close out the position at a loss if he can't find any way to borrow the shares from somewhere else. Furthermore, Liu and Longstaff (2003) mention that short sellers have to put up additional collateral on their margin account if the price of the stock rises. However, if the seller runs out of capital they will have to close out the position at a loss. There is also the constraint that profits cannot always be reinvested immediately, it can take a few days before the actual short sale is settled and the seller receives his profits. Besides these costs, legal and institutional issues can also prevent investors from selling short. For example, a limit could be placed on how many shares can be shorted or it could be prohibited to short a specific share altogether. All these issues and costs are referred to as short sale constraints (Miller, 1977).

Miller (1977) states that short sale constraints can prevent negative information from being expressed in stock prices. Shorting constraints can cause mispricing of securities to take place. However, shorting constraints are not the only cause for mispricing. Constraints explain why a rational well informed investor cannot short a stock, but it does not explain why someone would still buy the overpriced stock. The other cause of mispricing must be a group of investors that are not well informed. This belief of uninformed and informed investors comes from an important condition that exists in short selling. Not all shares can be lent out. Someone must eventually own the share so a form of divergence of opinion must exist among the investors causing one group to buy overpriced securities and another to short them.

Theories on short constraints predict that firms that are subject to severe short sale constraints will on average be overpriced and will have lower subsequent returns in the future (Duffie, 1996; Blocher, Reed, & Van Wessep, 2013). The empirical issue is to exactly pinpoint which firms and points in time are subject to these significant constraints (Beneish, Lee, & Nichols, 2015). In contrast to these theories, Boehmer et al., (2011) find no specific price differences during shorting bans in the US and conclude against the overvaluation theory. Beber and Pagano (2013) studied shorting restrictions in 30 different countries in 2008-2009, and also find no significant differences in prices. However, Beber and Pagano (2013) do find evidence for reduced market liquidity and price discovery. Boulton and Braga-Alves (2010) also provide support for lower trading volumes and reduced information efficiency during short sale bans. Boehmer et al. (2011) show that short sale bans in 2008 had similar effects on the US stock market quality.

The theory of Diamond and Verrecchia (1987) mentions an important fact that not all traders face the same costs of short selling. Three groups of traders are given. The first group are market makers and traders who can short at no cost and immediately receive profits for reinvestment. The second group can sell short but cannot immediately receive the profits. The third group cannot short at all. There exist informed traders who have private information and uninformed traders who only use public information. Making short selling costlier will make it less attractive and it is expected that those willing to pay for these costs are the ones that will receive the greatest benefits. It is expected that short selling costs reduce the number of short sales taking place and influences the ratio of informed to uninformed traders in the short selling pool.

Two types of short selling constraints are specified. The first constraint is prohibition, the assumption is that there exists a cost which will prevent traders who want to sell short from

doing so. Short prohibition affects both informed and uninformed traders. Some examples could be legal or contractual prohibition by institutions or the inability to borrow stocks. The second constraint is restriction, the belief is that if profits cannot be reinvested immediately, or there are additional costs of borrowing, only investors who have strong reasons to expect a significant price decline will choose to short. Short selling restrictions are expected to impact the proportion of the amount of informed traders compared to uninformed traders, it should drive out uninformed traders and mostly informed traders should remain. In contrast, short prohibition drives out all traders. It is theorized that a cost exists which only drives out uninformed traders and will cause information efficiency to improve, which is in contrast with popular belief about short selling restrictions. Kolasinski, Reed, and Thornock (2013) analyze short sales during US bans and find evidence that higher costs to short selling do indeed drive out uninformed investors and increase information efficiency.

An informed trader buys if a security is underpriced and sells if it is overpriced. A share is underpriced if the price is less than the trader's expectation of the liquidation value. A share is overpriced if the price is more than the trader's expectation. An informed investor trades on the available information and the current stock price. A market maker would lose money if they traded with only informed investors, because informed traders only buy when the price is too low and sell when the price is too high. The willingness to short is related to the costs associated with a sale. The introduction of options allows for a lower cost method of creating a short position.

2.4. Alternatives for short selling

Short selling is not the only investment tool to make money in a declining market. Options can be a useful alternative for short selling, because options are a cheaper way of obtaining a short position. Figlewski and Webb (1993) find that optionable stocks have higher short interest. Sorescu (2000) shows that when options are introduced for specific stocks the prices of these stocks fall. This is in line with the idea that options allow negative information to be expressed into a stock price. Options give investors the possibility to simulate a short position if they believe a stock's value will decrease. The two most common types of options are call and put options. A call option gives the buyer of the option the right to buy a stock at a specific strike price before a specific expiration date. A put option gives the buyer of the option the right to sell a stock at a specified strike price before a specific expiration date. Options also have an expiration date so the option has to be exercised before or on this expiration date.

Both parties on either side of the option believe they can make a profit. The buyer of a call option believes that the stock will increase in price, while the seller/writer of the option thinks the price will not increase. On the other hand the buyer of a put option believes the stock will decrease in price, while the seller of the option believes the price will not decrease. Selling a call option and buying a put option can both be used as alternatives to create a short position in a specific security. The buyer of the option has to pay a fee to the seller of the option, this is the maximum potential profit of the seller. On the other hand the fee is the maximum loss for the buyer of the option. The buyer of the option pays the fee in the hope that the profit he or she can make will exceed the value of this fee. For example, a trader buys a call option with a strike price of €10,-, for €2,-. The value of the stock increases to €15,-, before the option expires. In this case the buyer makes a profit of 15 – (10+2) = €3,- per share. Figures 1 and 2 show the payoff profiles for a buyer and a seller of a call option. The blue line indicates the profit/loss and the grey line indicates the share price. The part where the blue line is horizontal indicates the option fee, the part where both lines intersect indicates the break-even point.

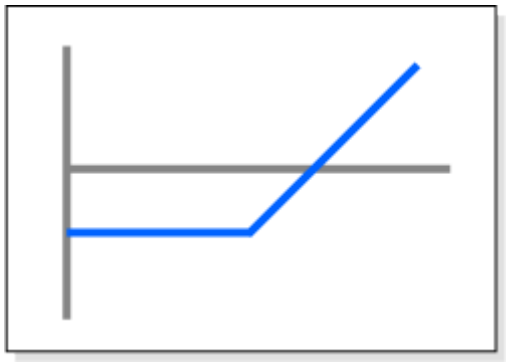

Figure 2: Payoff profile buyer call option

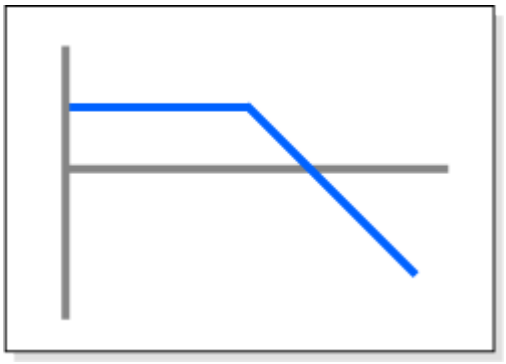

Figure 3: Payoff profile seller call option

A put option works the other way around. The buyer of a put option expects the price of a stock to decrease. Put options can be used as an alternative for short selling. For example, a trader buys a put option for €1,-, with a strike price of €15,-. The value of the stock decreases to €10,- before the option expires. In this case the buyer makes a profit of (15-1) – 10 = €4,- per share. Figures 3 and 4 show the payoff profiles for a buyer and a seller of a put option. The blue line indicates the profit/loss and the grey line indicates the share price. The part where the blue line is horizontal indicates the option fee, the part where both lines intersect indicates the break-even point.

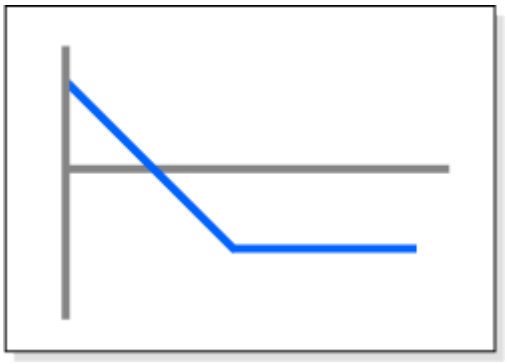

Figure 4: Payoff profile buyer put option

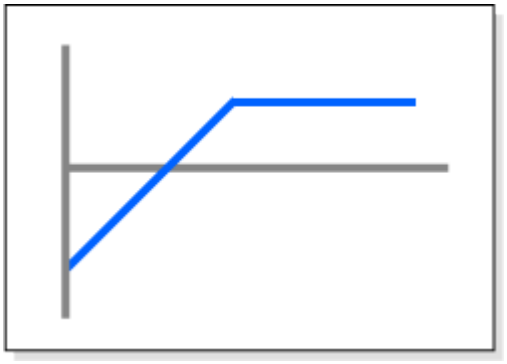

Figure 5: Payoff profile seller put option

The relation between the strike price and the current price of the stock is what determines whether an option is valuable or not. The length of the expiration date and the price volatility of the stock are important determinants of the eventual strike price. The writer/seller of the option runs the risk of having to buy from or sell to the option buyer at the strike price. This could result in large losses. For example, the seller writes a call option with a strike price of €20,-, but the stock prices goes up to €30,-. The seller has to provide the shares to the buyer, so the seller will have to buy the stocks for €30,- per share and then sell them to the option buyer at €20,- per share which will result in a loss of 30 – 20 = €10,- per share.

Put options can be used as an alternative for short selling. However, there are a few differences between short selling and using put options to create a short position.
Firstly, short selling is far riskier than using put options. The reward of a short sale is limited, because a stock can only drop in price to a minimum of zero. However, the potential losses of a short sale are unlimited. When using put options the maximum loss is the fee that has been paid to the writer of the option, while the profit potential is limited to the difference between the strike price and the current price. If the option does not work out, a trader will simply choose not to exercise the option and let it expire. Secondly, short selling can be more expensive than buying put options. Short selling requires the seller to put funds in a margin account to make sure enough money is available to go through with the sale. A put option buyer does not have to open a margin account, buying put options can also be done with a cash account. However, the writer of a put option does have to put up margin. This means that buying put options to create a short position is possible for traders with limited capital. A cash account allows you to deposit cash and buy stocks, bonds and other investments with your cash. A margin account allows you to borrow additional capital against an interest rate. This means you can invest more, but will also have to earn a larger return to cover your additional interest costs. Short selling can only be done through margin accounts. The biggest problem for a put option buyer is time, if the stock value does not decrease

before the expiration date the buyer will run the risk of losing his entire investment in the specific options. In conclusion, short selling has a higher profit potential than put options and can be held for unlimited time as long as the seller has sufficient funds to put up in his margin account. On the other hand, the potential losses of a put option are always fixed. The choice between short selling and using put options depends on several factors, including risk tolerance, funds available, information levels and, the purpose of the trade. The figure underneath showcases the different payoff profiles for a short sale and a put option. It is shown that a short sale has a higher profit potential but also has a higher risk compared to a put option. Figure 5 showcases the different payoff profiles for a short sale and a put option.

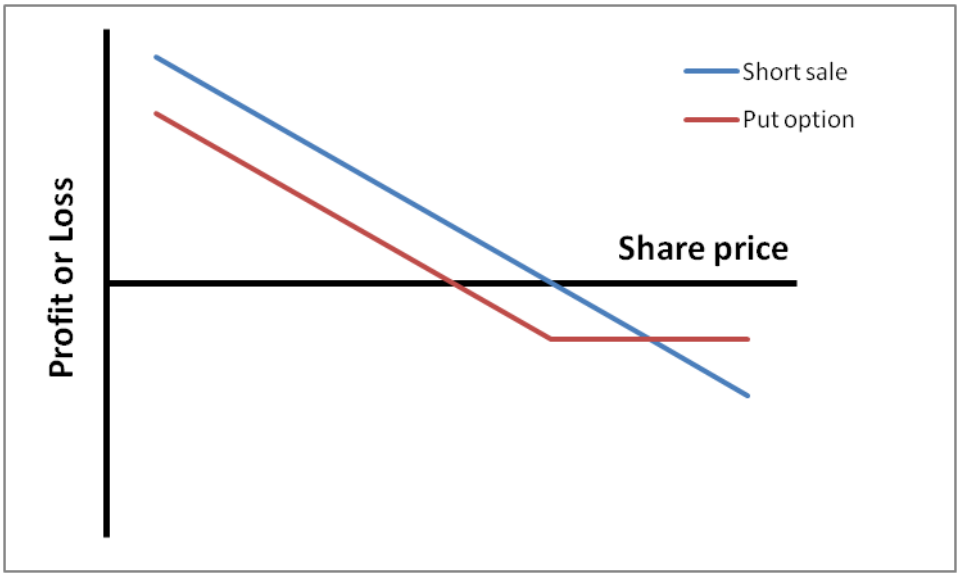

Figure 6: Payoff profiles for a short sale and a put option

2.5. Short sellers: informed or uninformed traders?

2.5.1. Theory

Shorting can be quite expensive, if investors are willing to take on high shorting costs it must mean that they are well informed and possess significant information regarding a stock. Therefore, it is expected that stocks with high short interest will have negative expected returns. This theory by Diamond and Verrecchia (1987) explains the common belief that short sellers are considered to be informed investors. Diamond and Verrecchia (1987) argue that the higher the shorting costs become the more efficient the market should be, because it will drive out uninformed traders and only informed traders will remain and be able to short.

2.5.2. Empirical evidence

Dechow, Hutton, Meulbroek, & Sloan (2001) find that at the individual stock level short sellers are informed investors who possess superior information processing abilities. At the intraday level Boehmer and Wu (2013) show that short selling improves the efficiency of intraday prices. On a global scale Daouk, Lee, & Ng (2006) showcase that short selling is

associated with lower costs of capital, increased market liquidity and increased price efficiency. Christophe, Ferri, & Hsieh (2010) suggest that some investors regarding short selling are informed traders by documenting abnormal short selling three days prior to downgrade announcements using NASDAQ data from 2000-2001. Additional empirical results demonstrate that an increase in short selling causes lower future returns, indicating that short sellers are informed investors (Senchack and Starks, 1993; Aitken et al., 1998; Desai et al., 2002; Cohen, Diether, & Malloy, 2007; Boehmer, Jones, & Zhang, 2008). On the other hand, Daske et al (2005), Blau and Wade (2012), and Blau and Pinegar (2013) argue that short sellers only participate in speculative trading and there is no evidence of informed trading by short sellers. Blau and Wade (2012) analyze that abnormal short selling happens when both downgrade and upgrades are announced using data from NYSE and NASDAQ in 2005-2006. Abnormal short selling before upgrade announcements is not in line with the theory that short sellers are informed. Although there is a lot of evidence supporting the idea that short sellers are informed traders, there is also some evidence contrasting this theory and stating that short sellers only trade for speculative purposes. Given this mixture in the literature it is hard to come to a consensus whether short sellers are really speculative or informed investors.

Short sellers are also seen as contrarians, people who oppose or reject popular opinion, who sell more after periods of positive returns. Annually, it is visible that changes in short interest are positively related to changes in prices. It is suggested that short sellers look for short positions in stocks that have been subject to price increases and then cover their position as the price declines (Dechow et al., 2001). At a daily frequency, results also show that short sellers are contrarians (Diether et al., 2009). However, some studies provide evidence that short sellers destabilize prices. Shkilko, Van Ness, & Van Ness (2012) find that short sellers drive prices down too far during price drops. Henry and Koski (2010) state that short sellers can push prices too far down just before seasoned equity offerings.

2.6. Relationship between short selling and news events

2.6.1. Theory

The debate on whether short sellers are informed or uninformed traders also introduced the theory that short selling might have a relation with company news events such as, earnings announcements, analyst announcements, seasoned equity offerings, mergers and acquisitions and, initial public offerings. There exist two lines of thinking on the potential relationship between short selling and news events. The first belief is that short sellers are sophisticated traders which might allow them to predict upcoming news events. This should

result in short selling activity increasing in the days before news announcements. However, this theory also suggests that there could be a degree of insider trading present within short selling in advance of news announcements. Insider trading is using information about a company that is not publicly available to trade its stocks or securities for a larger profit than a normal investor could make. The information often comes from someone inside the company and most forms of insider trading are illegal.

The second belief with regard to short selling around corporate news events states that short sellers are better at information processing compared to other traders. This should result in more short selling activity on or after the release dates of new information and should consequently result in lower returns.

2.6.2. Empirical evidence

Christophe et al. (2004) focus on trading in relation to earnings announcements using data from NASDAQ stocks and find that short selling increases in the five days before earnings announcements. Daske et al. (2005) also look at trading in relation to earnings announcement and management forecasts using data from NYSE stocks and find that short selling increases around these events but that it increases regardless if the news is good or bad. These papers focus only on a small sample of news events. Engelberg, Reed, & Ringgenberg (2012) created a study using data from NYSE stocks which looks at all types of corporate news events with the aim to create a more general idea of the behavior of short sellers around news events. They find that short sellers generally do not anticipate corporate news events, but usually trade on or after the news release date. Evidence suggests there might exist some relationship between the anticipation of some specific news events and short selling, but it is hard to generalize the results to all types of news and it is not clear what the implications of the relationship are. Additionally, Engelberg et al. (2012) find that abnormal short selling results in lower returns and that this effect is strongest around news events. Predictability of returns doubles on news days and quadruples on negative news days. They find that although news events only take up 22% of their sample size they account for over 45% of the total profitability from short selling. The results are attributed to the belief that short sellers are superior information processors. For example, earnings announcements often contain very lengthy documents which can be hard to process. Traders that are very competent at translating all the data into relevant information can achieve greater rewards than traders with less skill in information processing. Aitken et al. (1998) find that abnormal short selling is negatively related to stock returns in Australia. They find that this relationship is stronger after information events. Furthermore, Reed (2007) finds an increased probability of large negative returns following the announcement of significant news events such as, mergers, seasoned equity offerings, initial public offerings and,

dividend reinvestment discount programs. All in all there is a considerable amount of evidence suggesting there exists a relationship between short selling and news events. Most evidence suggests that short sellers are simply better at processing the information that is made available rather than being able to predict the information in advance.

2.7. Impact of short selling on price efficiency

2.7.1. Theory

There are two large theoretical studies regarding short selling. Miller (1977) states short selling is vital for the market because it prevents securities from being overpriced. If short selling were constrained it would prevent pessimistic investors from expressing their opinion in the form of investments and cause optimistic investors to drive up the prices resulting in lower returns in the future. The number of people with pessimistic evaluations of a stock will likely increase with the divergence of opinion about a stock. Short sales can moderate the tendency for riskier stocks to be bid up to high values. This can only happen for riskier stocks because short selling is profitable only with stocks that drop in price at a fast enough rate to cover the dividends the seller has to pay the lender of the stock. In markets without short selling the demand for a stock will come from the minority of investors who have the most optimistic expectations about it. Divergence of opinion is likely to increase with risk. It is possible that expected returns for risky stocks will be lower rather than higher. The presence of sufficient well informed investors will stop stocks from being undervalued, but there can be stocks that have been bid up to extreme values by a poorly informed minority of optimistic investors (Miller, 1977). Diamond and Verrecchia (1987) argue that when short interest increases in a stock it should be followed by negative returns. This idea comes from the belief that shorting can be quite costly and if investors are willing to face these costs it must mean that they are well informed and have significant information regarding a stock. The higher the shorting costs become the more efficient the market should be, because it will drive out uninformed traders and only informed traders will remain and be able to short.

2.7.2. Empirical evidence

Financial theory has different views on short sellers and the consequences of their trades on price discovery and. In some models, short sellers are informed traders who create efficiency by bringing mispriced securities closer to their real values (Diamond and Verrecchia 1987). In other models, short sellers use manipulative trading strategies that result in less informative prices (Goldstein and Guembel, 2008) or cause exaggerating of prices (Brunnermeier and Pedersen 2005). Marsh and Payne (2012) state that the presence of short sellers is beneficial for liquidity and price formation. Bris, Goetzmann, & Zhu (2007) add that stock prices in countries with short selling constraints are less efficient than stock prices in

countries with no short selling constrains. The study looked at over 46 countries worldwide, including the Netherlands. Chang, Cheng, & Yu (2007) focus on the regulations against short selling of individual stocks in Hong Kong and find that constraints tend to cause overvaluation and that this is more significant when the divergence of opinions becomes greater on certain stocks. Beber and Pagano (2010) add by looking at country specific differences in regulations and find that short sale bans decreased liquidity and slowed down price discovery. However, with all this evidence Jain, Jain, McInish, & McKenzie (2013) state there is still a lot of negativity regarding short selling. Although researchers have found positive effects of short selling there are still a lot of mixed results in the literature, with many researchers also finding negative results. Regulators often speak about the benefits of short selling, by emphasizing the effect it has on efficiency of information and prices. However, when markets are performing poorly these regulators often react by taking measures against short selling, claiming that it can let markets spiral out of control by putting too much downwards pressure on prices. The crisis in 2008 was no exception and short selling was banned or restricted in many countries throughout the world.

2.8. Impact of short selling on stock returns

2.8.1. Theory

Stock returns and stock volatility are considered very important for finance professionals, because they help in capital budgeting and portfolio management decisions. These decisions are big indicators of a company's financial health and prospects (Poon and Granger, 2003; Rapach, Strauss, & Wohar, 2008). For academics, being able to predict market movements helps in building realistic asset pricing models (Rapach and Zhou, 2013). One of the main theories on the impact of short selling on stock returns comes from Diamond and Verrechia (1987). The theory originates from the notion that short sellers should be informed investors because the costs of shorting are so high it would be likely to assume that investors have specific information that gives them confidence in taking on these costs. Due to the fact that investors are supposedly informed, an increase in shorting activity should result in negative abnormal returns.

2.8.2. Empirical evidence

Diether et al. (2009) analyze trading strategies by short sellers of NYSE and Nasdaq listed stocks and find a strong positive relationship between short selling activity and past returns whilst also finding that short selling intensifies following negative returns and that an increase in shorting activity results in negative abnormal returns. They also mention that to measure the effect of short selling on stock returns it is preferable to have daily or intraday data, because short sellers close out positions rather quickly, often within days. Desai et al. (2002)

find that heavily shorted stocks showcase a significant negative relation with abnormal returns looking at data from Nasdaq listed stocks. Christophe et al. (2004) find evidence that short selling activity is linked to subsequent returns looking at data from Nasdaq listed stocks. However, on the other hand, Daske et al. (2005) find no evidence to support the hypothesis that an increase in shorting activity results in negative abnormal returns while analyzing NYSE listed stocks. Furthermore, Figlewski and Webb (1993) are also unable to find evidence to support the relationship between short positions and ensuing abnormal returns. Interestingly there are two Dutch papers on the impact of short selling on stock returns with differing results. Gerritsen and Verdoorn (2014) find that as a group short sellers are able to predict negative returns. However, these returns are driven by several exceptionally high short positions. When the returns are weighted to their market value, the results lose significance. Gerritsen and Galema (2017) analyzed a short period where the AFM accidentally disclosed all short positions including positions between 0,2 and 0,5%. It was found that after the accidental disclosure of these positions, surprisingly abnormal returns turned out positive. It is noticeable that in recent years evidence has grown supporting the idea that increased shorting activity results in negative abnormal returns, however the evidence is not conclusive. These differences in results can be potentially be attributed to a few different issues. The first explanation could be that in the US short sales have significantly increased over a period from 1980 to the 2000's. It is possible that the majority of this increase in short selling comes from uninformed traders or traders that use short selling for hedging and/or arbitrage purposes, this can result in the amount of informed short trades being watered down in the large pool of overall trades.. With most studies using aggregated short sale data it is difficult to distinguish between these different groups of short sellers. A second explanation could be differing sample periods in combination with regulations placed on short selling. Short selling is a highly debated topic that still contains a lot of uncertainties. Regulations are still being adjusted and modified because regulators are looking for the optimal short selling structure. Furthermore, regulations can change in real time, when markets start falling it becomes increasingly more difficult to short because of increased costs and potential bans on certain stocks. So, different sample periods can be subject to different regulations which can influence the results. A third explanation could be the fact that many studies use small sample periods of one year to a few years which makes it difficult to generalize results to different periods.

2.9. Impact of short selling on stock volatility

2.9.1. Theory

The most commonly used measure of stock return volatility is standard deviation. This statistic measures the dispersion of returns. Financial economists find the standard deviation to be useful because it summarizes the probability of seeing extreme values of return. When the standard deviation is large, the chance of large positive or negative return is large (Schwert, 1990). Long-term volatility becomes noticeable over many months or years. Some explanations of long-term volatility are financial leverage, operating leverage and the condition of the economy. Financial and operating leverage affect the volatility of returns of common stocks. For example, an all-equity firm that issues debt to buy back half of its stock. The volatility of stock returns will increase because the stockholders still bear most of the risk of the assets, but the value of their investment is only half as large. So, increasing financial leverage will increase the volatility of stock returns. A similar case is present for firms with large fixed costs. Large amounts of operating leverage will make the value of the firm more sensitive to economic conditions. If demand falls off unexpectedly, the profits of a firm with large fixed costs will fall significantly. There is strong evidence that stock volatility increases during economic recessions. This relationship may partly reflect operating leverage, as recessions are typically associated with excess capacity and unemployment. Fixed costs for the economy would have the effect of increasing the volatility of stock returns during periods of low demand. Short-term volatility is often characterized by sharp drops in stock prices during monthly or yearly periods. Explanations for short-term volatility are often being related to the structure of securities trading. One of these explanatory factors is trading volume. There is evidence that increased trading activity and stock return volatility occur together. It is concluded that trading volume causes volatility, but only when all traders want to trade in the same direction. On the other hand, high trading activity should indicate a very efficient market, bringing together buyers and sellers in an efficient manner. Something that could cause people to all want to trade in the same direction is the arrival of new information. This could cause traders to all try to buy or sell the same security. However, if the information turns out to be true, the question could be raised whether something really is wrong with the large price changes that occurs (Schwert, 1990).

Expected volatility of financial assets is of great importance in assessing asset or portfolio risk. Volatility plays a big role in asset pricing models and trading and hedging strategies. This means accurate volatility forecasting is vital for the implementation and evaluation of asset pricing models (Uctum, Renou-Maissant, Prat, & Lecarpentier-Moyal, 2017). Saffi and Sigurdsson (2011) mention that the main theory behind the potential relationship between

short selling and stock volatility comes from regulators worldwide. The belief is that because short selling is initiated with the expectation that stock prices will go down, if too many traders put shorting pressure on a company the prices can spiral downwards and volatility will increase. Short selling should be used when a trader has fundamental evidence that a price drop can be expected. However, regulators fear that during times of falling markets traders will take advantage of short selling and start selling based purely on the fact that prices are going down because the whole market is going down.

2.9.2. Empirical evidence

The relationship between short selling and stock volatility is a problematic issue and receives limited attention in the academic world. Most of the academic attention is focused on the effects of short selling on market quality, liquidity and price discovery. However, Scheinkman and Xiong (2003) showcase a decrease in trading volume and price volatility when short selling constraints are removed. Chang, Bai, & Wang (2006) add that short-sale constraints can result in lower stock prices and make them more volatile. This happens because short-sale constraints have a significant impact on informed investors, which lowers the informative value of prices. Saffi and Sigurdsson (2011) elaborate on this by studying a global data set of 26 different countries from 2005 to 2008 and find that reducing short selling constraints does not increase volatility. Diether et al. (2009) add to this with the observation that short sellers tend to be contrarians with a stabilizing effect on the market. Henry and McKenzie (2006) find results that suggest volatility is increased following a period of short selling, using a model that looks at the relationship between trading volume and volatility in the Chinese stock market. Aitken et al. (1998) add to this by researching the market reaction to short sales on an intraday basis using data from the Australian Stock Exchange. They come to the conclusion that when short sales are transparent they increase stock volatility. All in all research on short selling and stock volatility is limited and the research that is available has conflicting results. Although, there is an increase in studies that find that banning short selling increases stock volatility. The different results might be attributed to the fact that measurements for volatility are never completely the same in these studies. Furthermore, most studies use short sample periods which make it difficult to generalize results to other periods. These sample periods can also be subject to different short selling regulations which can influence the results.

2.10. Overview of literature

Table 1 Overview of literature

Topic	Conclusion
Short selling and informed trading	There is a large body of literature that states that short sellers are indeed informed traders who are able to predict subsequent returns. However, there are still studies that find a lack of evidence for this claim.
Short selling and news events	There is a considerable amount of evidence suggesting that a relationship exists between short selling and news events. However, most evidence suggest that short sellers are simply better at processing information after it has been announced rather than being able to predict it.
Short selling and price efficiency	Although a part of the literature shows that short selling improves price discovery and efficiency, there are still several studies that show negative effects on price efficiency. Regulators seem to weigh these negative effects more heavily.
Short selling and stock returns	In line with the belief that short sellers are informed investors, there is an increase in literature finding that short selling predicts negative subsequent returns. However, there are still studies that find no relationship between short selling and stock returns.
Short selling and stock volatility	There is evidence suggesting that reducing short selling constraints decreases stock volatility. However, there is enough evidence that short selling increases stock volatility to keep regulators skeptical.

3. INSTITUTIONAL BACKGROUND

In this chapter the institutional background of short selling in the EU, US and China will be described, to look at some similarities and differences between these major global economies.

3.1. Short selling regulation in the EU

In September 2008, during the Financial crisis, authorities from many countries took measures to restrict or ban short selling. Due to the financial instability, short selling was seen as a problem which could potentially intensify the downward spiral of share prices. After the announcement of the Securities and Exchange Commission (SEC) in the United States of America and the Financial Services Authority (FSA) in the United Kingdom to impose measures, the Autoriteit Financiële Markten (AFM) in the Netherlands also decided to take action and ban short selling for some financial organizations. From 1 July 2009 this ban changed in to a regulation focused on the disclosure of short positions, short sellers would have to notify the AFM of their short positions.

During the crisis many different European Union (EU) member states imposed a variety of restrictions and regulations on short selling, but there was no union in the measures taken against short selling by the different states which made them ineffective. Therefore, the European Commission decided it would be beneficial to have a uniform system in place regarding short selling. This system is called the Short Selling Regulation and came in to place on 1 November 2012. The goals of the short selling regulation are to increase transparency on short positions held by investors in certain EU securities. To ensure Member States have powers to intervene in extreme cases to reduce risks to financial stability and market confidence. To improve coordination between member states and the European Securities Markets Authorities, and to reduce risk with uncovered or naked short selling. Naked short selling involves short selling shares without confirming the existence of availability of these shares. In normal cases a short seller has to borrow the stock or confirm that it can be borrowed to initiate a short sale. With naked short selling, the investor shorts shares without actually confirming if he or she can obtain the required shares, it involves a lot of risk but can also yield high rewards.

The short sell regulation applies to natural and legal persons undertaking short selling of shares that are trading on an EU trading venue. To determine whether someone has a net short position, the short and long positions of this person have to be analyzed, this analysis has to include any form of economic interest a person has in the issued share capital of a company or sovereign debt of a member state or of the EU. This economic interest can

include everything from the use of derivatives to the use of indices. The position that remains after the long positions are subtracted from the short positions is what is considered the net short position. Apart from net positions, significant gross short positions that equal or exceed 3% of the issued share capital of a listed company also have to be disclosed to the AFM. A gross short position is a position in which the long positions have not been deducted from the short positions. Significant net short positions must be reported when they are at least equal to 0.2% of the company issued share capital and every 0.1% above that. Net short positions have to be disclosed to the public when they are equal to 0.5% of the issued share capital of a company and every 0.1% above that.

To reduce the risk of settlement failures in relation to naked short selling an investor must meet certain requirements in order to be able to enter in a short sale. A reasonable case must be made that the shares sold can actually be delivered. The investor must have borrowed the shares, entered into an agreement to borrow, or have an agreement with a third party which confirms that the shares can be delivered. These are the only conditions under which a short sale can be performed. Market makers and primary dealers are exempt from the short sell regulation.

3.2. Short selling regulation in the US

In contrast to the EU the short selling regulations in the US change more often and have been put in place since before 2012, when the short selling regulation in the EU was introduced. The first ever short selling regulation put in place in the US was the “uptick rule” in 1938, shorts could only be traded at or above the most recent price of the security and could only be traded if the most recent price movement was upward. The uptick rule was removed in 2007 allowing shorting to occur on any price tick. However, in 2010 an alternative uptick rule was implemented. This rule does not apply to all stocks and restrictions on trading on downticks are generally only applied in very dire circumstances, for example when a stock price has dropped by more than 10% compared to the previous day’s closing price.

In January 2005 the SEC introduced Regulation SHO, this is the first update on short selling regulation in the US since 1938. The main aim of this regulation was to prevent unethical traders from engaging in naked short selling. The regulation implemented a locate requirement similar to that in the EU where the investor must have borrowed the shares, entered into an agreement to borrow, or have an agreement with a third party which confirms that the shares can be delivered. In July 2009 the SEC added additional provisions to combat FTDs. These provisions required shares to be delivered for settlement by day T+3, if this was not possible and a FTD occurred, it had to be closed out by the morning after day

T+4. If the position was not closed out after this period the seller would be subject to a penalty. The EU in comparison has a settlement day of T+2 (Howell, 2016).

A point in which the EU and the US differ significantly when it comes to short selling regulation is the fact that the US has imposed restrictions on all short sales before a SEO. People who open a short position five days before the SEO are prohibited from buying shares in the offer, regardless of whether the shares would be used to cover the position.

Unlike the EU the US does not have any short selling disclosure requirements. There are some organizations that post daily short positions of certain stocks. However, these positions are usually aggregated gross short positions, which makes it impossible to find out whether these positions are held by multiple investors or whether these positions are used for speculative or hedging purposes.

3.3. Short selling regulation in China

Short selling in China is an interesting topic because it was completely banned up until 2010. In October 2008 the China Securities Regulatory Commission (CSRC) announced that there would soon be a trial for margin trading and securities lending. However, it was not until January 2010 that approval was given to introduce the trial. Finally, on February 2010 the CSRC announced initial details of stocks that would be part of the trial programme for margin trading and short selling. The CSRC would approve 90 “blue-chip’ securities, 50 from the Shanghai Stock Exchange (SSE) and 40 from the Shenzhen Stock Exchange (SZSE). Firms were required to disclose their daily short selling information to regulators before 9 A.M. on the next trading day. The brokerages that would be allowed to participate in margin trading and short selling were carefully selected by the CSRC. These brokerages were then required to carefully select their clients based on a number of criteria such as financial status, trading experience and risk preference (Sharif, 2013).

Interestingly, in China the government has a lot of power as can be seen in events in the middle of 2015, when many trading firms under pressure from the government halted all short selling activities due to the country’s stock market crash. In August 2015 regulators changed the settlement date for short selling banning short sellers from settling trades on the same day that they are initiated on. So, short sellers now had to wait one day before they could settle their positions. This was done to increase the costs of short selling and to reduce selling pressure on the market. In 2016, short selling would be picked up again.

Differences with the EU and the US are that in China short selling had always been banned up until 2010. Furthermore, the government decides which stocks can be shorted, whereas in the EU and US generally all stocks can be shorted. An overview is given of short selling regulations in the EU, US and China below in table 2.

Table 2 Overview of short selling regulations in the EU, US and China

Region	Period when legal	Period when illegal	Regulation	Disclosure
EU	Always	Never, ban on naked short selling between 09/22/2008 – 06/01/2009	Short Selling Regulation since 2012	Disclosure to regulators of initial net short positions of 0,2% and 0,1% increments up and down thereafter. Disclosure to public of initial net short positions of 0,5% and 0,1% increments up and down thereafter.
US	Always	Never, ban on naked short selling of certain stocks between 07/21/2008 – 08/12/2008. Ban on short selling of certain financial stocks between 09/19/2008 – 10/08/2008	Up-tick rule between 02/01/1938 – 07/03/2007. Alternative up-tick rule in effect since 2010. Regulation SHO since 2005.	No disclosure rules. Certain organizations create lists of aggregated gross short positions of some stocks for regulators and public use.
China	Never up until 2010	Always up until 2010	Short selling programme since 2010. Government picks list of blue-chip stocks eligible for short selling.	Disclosure of short positions to regulators on a daily basis. No disclosure to public.

4. HYPOTHESES

In this part of the report the hypothesis/hypotheses will be developed and laid out. The main questions of the research are whether short selling has an effect on stock returns and stock volatility.

The effects of short selling receive limited academic attention. From the literature that is available, it is evident that researchers are unable to come to a consensus regarding the effects. However, in practice short selling still receives a lot of blame for economical disasters such as the crisis in 2008. Therefore the choice is made to find out whether short selling does influence stocks. The first hypothesis is focused on the effect of short selling on stock returns. There are some key theories regarding the effects of short selling on stock returns. A key theory by Diamond and Verrechia (1987) predicts that because short selling is so expensive only well informed investors with specific information regarding a stock are willing to take the risk of shorting. This results in the thought that when short interest in a stock increases it should be followed by lowering returns, because only well informed investors with specific knowledge about a stock will short it. The hypothesis is formulated in the following way.

H1: Short selling decreases abnormal stock returns

The second hypothesis focuses on the effect of short selling on stock volatility. Stock volatility measures the spread of stock returns over a given period of time. The more volatile a stock is the riskier it is. A volatile stock is more susceptible to unexpected price changes, making it riskier but also giving it more profit potential than a more stable stock. There is conflicting evidence when it comes to the effects of short selling on stock volatility. Some studies suggest that short selling increases stock volatility and some provide evidence that short selling decreases stock volatility. However, there exists a relationship between stock returns and stock volatility. Duffee (1995) mentions that stock volatility increases after stock prices decrease. Saffi and Sigurdsson (2011) mention that the main theory behind the potential relationship between short selling and stock volatility comes from regulators worldwide. The belief is that because short selling is initiated with the expectation that stock prices will go down, if too many traders put shorting pressure on a company the prices can spiral downwards and volatility will increase. Short selling should be used when a trader has fundamental evidence that a price drop can be expected. However, regulators fear that during times of falling markets traders will take advantage of short selling and start selling based purely on the fact that prices are going down because the whole market is going down. So, in line with H1 the following hypothesis can be formulated.

H2: Short selling increases stock volatility

5. METHODOLOGY

In this chapter the methodology will be described. Firstly, research methods from previous studies will be examined. Secondly, the chosen research method will be described and finally the variables of the model will be presented.

5.1. Analysis of methods

When looking at the relationship between short selling and stock returns the most commonly used models are often forms of multiple regression models. Daske et al. (2005) look at the relationship between short selling and news events to find whether short sellers are able to predict these news events and are subsequently able to predict returns. They use a multiple regression model. Aitken et al. (1998) analyze the relationship between short selling and market reactions to see whether short selling can predict stock returns. Using a multiple regression model. Desai et al. (2002) use a multiple regression model to examine the relationship between short interest levels and stock returns. Christophe et al. (2004) explore the relationship between short selling and earnings announcements with multiple regression.

The appearance of regression models in previous studies is not surprising. Regression is a very common tool for analyzing the relationships among different variables, it looks at the relationship between a dependent variable and one or more independent variables. A regression can find directional relationships and it can also determine how much the values of these variables are influenced by each other. There are different forms of regression analyses. For example, logistic regression, linear regression and non-linear regression. Logistic regression is used when the dependent variable is non-metric. It could involve a dichotomous variable that only has two outcomes, for example, gender can only be male or female. Logistic regression uses a maximum likelihood estimate to measure the probability that an observation falls within one of the two possible outcomes. Linear regression is used when the dependent variable is metric. Linear regression looks at the relationship between a dependent variable and one or more independent variables. When the model contains one independent variable it is a simple linear regression and when the model contains multiple independent variables it is multiple linear regression. Linear regression is one of the first and most common used regression models. One of the most common linear regression models is the Ordinary Least Squares (OLS) method, which fits the model using a least squares method that aims to minimize the sum of square differences between the observed and predicted values of the model. A non-linear regression is a form of regression where the data cannot be fitted according to a linear model and have to be fitted using a non-linear model. When a model is non-linear there are many possible solutions to fit the model which can make it difficult to find the best one. Looking at previous studies it is evident that OLS is one

of the most frequent methods of analysis. OLS has the advantage that it is fairly simple to use. However, there are several assumptions that have to be met to be able to produce relevant results. Firstly, OLS requires that the observations are independent of each other. This means that the error term of one observation should not be able to predict the following observation, this often occurs with time series data. Secondly, there needs to be a linear relationship between the dependent variable and each of the independent variables. Thirdly, the data in OLS needs to show homoscedasticity. This means that the error terms should show equal variance along the model line. Fourthly, the data must not show multicollinearity. This means that the independent variables are not allowed to be correlated with each other. Finally, the error terms must be approximately normally distributed.

When looking at the relationship between short selling and stock volatility the most common methods of research are various forms of regressions such as time series and panel regressions. We see multiple regression models used by Diether et al. (2009), Christophe et al. (2010), and Saffi and Sigurdsson (2011).

However, some conditional volatility models are also popular. Conditional volatility models take into account that volatility is not constant throughout time. These models use assumptions that volatility is conditional on some additional factors, which can in theory give them the potential to measure volatility more accurately. Two popular forms of conditional volatility models are Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. Henry and McKenzie (2006) use an ARCH model to look at the relationship between trading volume and volatility in the Chinese stock market. An ARCH model is a statistical model used for time series data it focuses on the variance of the error terms and assumes that the error terms are heteroskedastic. It is assumed that the variance of the error terms is affected by the variances of the error terms of previous periods, this is called auto regression (AR). Furthermore, when the variances of the error terms are influenced by other variables it is considered conditional. A GARCH model is used by Baklaci et al. (2016) to look at the causality between short selling and volatility. A GARCH model is very similar to an ARCH model. However, instead of assuming an autoregressive model for the variances of the error terms, the GARCH model assumes an autoregressive moving average (ARMA) model. The difference between an AR and an ARMA model is that an AR model measures error variance based on its own output from the past, whereas an ARMA model measures error variance based on its own output and input from the past.

5.2. Method used in this study

Based on the analysis in the previous chapter a multiple regression model will be used to test H1 and H2. Specifically, an Ordinary Least Squares Regression (OLS) will be used following (Figlewski and Webb, 1993; Senchack and Starks, 1993; Christophe et al., 2004). OLS regression is one of the most common models used in regression analyses, it aims to minimize the sum of square differences between the observed and predicted values of the model. OLS can produce very accurate estimates however, there are some assumptions that have to be met for the results to be valid. One of these assumptions is autocorrelation. OLS requires that there is no autocorrelation. This means that the error term of one observation should not be able to predict the following observation, this often occurs with time series data. This study has some level of time series data by looking at daily stock returns over multiple subsequent days, which means autocorrelation could present an issue. This can be combated through an autoregressive model where a lagged version of the dependent variable is added to the explanatory variables of the model (Corsi, 2009).

To test H2 the model will be slightly modified with some autoregressive elements. This choice is made based on some factors. Firstly, Dimson and Marsh (1990) state that when it comes to volatility models it might be more sensible to use a simpler model compared to something more complicated like an ARCH or GARCH model. There are no perfect models when it comes to volatility modeling and something like a simple regression can still provide very accurate results whilst being less restricted by assumptions and parameters. Corsi (2009) demonstrates that a regression model with autoregressive elements can be a great way to analyze volatility. Secondly, looking at the nature of this study the volatility measures will be based on historical data, so realized volatility values will be used which means a conditional volatility model is not necessary.

5.3. Model

This model focuses on the relation between abnormal returns and short selling and is used to test hypothesis 1. The model takes elements from (Aitken et al., 1998; Christophe et al., 2004; Daske et al., 2005; Diether et al., 2009). The regression formula is as follows:

$$\mathrm{ABRET}_{i,t} = \alpha + \beta 1\mathrm{SHORT}_{i,t} + \beta 2\mathrm{MCAP}_{i} + \beta 3\mathrm{BTM}_{i} + \beta 4\mathrm{OPTIONS}_{i} + \beta 5\mathrm{LEV}_{i} + \varepsilon_{i,t}$$

In this regression, $\mathrm{ABRET}_{i,t}$ is the abnormal return of stock *i* on day *t.* $\mathrm{SHORT}_{i,t}$ is the net short position in stock *i* at time *t* as a percentage of the total issued share capital of a company. MCAP_{i} is the market capitalization of company *i* at the end of the year prior to the sample period, market capitalization is calculated as company *i*'s outstanding shares at year end multiplied by the company's stock price at year end. BTM_{i} is the book-to-market ratio of

company *i* at the end of the year prior to the sample period, book-to-market ratio is calculated as company *i*'s common shareholders' equity at year end divided by its market capitalization at year end. $\mathrm{OPTIONS_i}$ looks at whether a stock has stock options. It has a value of 1 if a stock has options and it has a value of 0 if the stock does not have options. $\mathrm{LEV_i}$ is the leverage of company *i* at the end of the year prior to the sample period, leverage is calculated as total debt of company *i* at year end / total equity of company *i* at year end.

5.4. Variables

5.4.1. Dependent variables

5.4.1.1. Abnormal returns

The first dependent variable is abnormal stock returns. This study looks at two different measures of abnormal returns to strengthen the results. This study looks at daily return and short data as mentioned by (Daske et al., 2005), daily data will allow for more precise estimations. The first measure of abnormal returns uses a calculation similar to (Dechow et al., 2001; Desai et al., 2002; Christophe et al., 2010). First, daily returns are calculated by taking the adjusted closing price of stock *i* on day *t+1* minus the adjusted closing price of stock *i* on day *t* divided by the adjusted closing price of stock *i* on day *t*.

$$\text{Daily Return}_{i,t} = \frac{\text{ACP}_{i,t+1} - \text{ACP}_{i,t}}{\text{ACP}_{i,t}}$$

The daily return is then adjusted with a market return. The market return is calculated in the same way as the daily return, but instead using the AEX equal weighted market index. The abnormal return is then the daily return of stock *i* on day *t* minus the daily return of the market *m* on day *t.*

$$\text{ABRET}_{i,t} = \text{Daily Return}_{i,t} - \text{Market Return}_{m,t}$$

The second measure for abnormal returns follows a Capital Asset Pricing Model (CAPM) as used by Figlewski and Webb (1993):

$$\text{ALT\_RET}_{i,t} = R_{i,t} - [R_{f,x} + \beta_{i,x}(R_{m,t} - R_{f,x})]$$

$\text{ALT\_RET}_{i,t}$ = Abnormal return of stock *i* on day *t*

$R_{i,t}$ = Daily return of stock *i* on day *t*

$R_{f,x}$ = Risk free rate, using a 1 year Dutch government bond

$\beta_{i,x}$ = Beta of stock *i* in the year perceding the sample period

$R_{m,t}$ = AEX equal weighted market return on day *t*

The daily return and the market return are calculated as mentioned before however a Beta to account for volatility of the stock is added and a risk free rate using a 1 year Dutch government bond is added. Beta is calculated as the covariance between the monthly returns of stock *i* and the monthly returns of market *m*, divided by the variance of the monthly returns of market *m.* Beta is calculated over a period of one year prior to the sample period (Figlewski and Webb, 1993).

Initially, abnormal returns are calculated from the adjusted closing price of the stock on the day of the announcement of a short position to the adjusted closing price of the stock on the day after the announcement (0,1). A short position is included in the sample on the first initial day it is announced and any change in the position thereafter until the position drops below 0,5%. However, as mentioned by Boehmer, Jones, & Zhang (2008) it may be relevant to look at the reaction of returns over a longer period of time instead of just looking at the day after the announcement. The market may take longer to react to the new information. Therefore, an additional period is analyzed which is the period (0,5). This period starts on the day of the announcement of the short sale and ends five days after the announcement. This period is calculated as cumulative returns.
An issue that may occur when looking at a longer period of time after the announcement is that there could be additional announcements of or changes to the short positions during this period. A contol variable is added to combat this as used by (Kersbergen, 2015). The control variable $\mathrm{MULTIPLE}_{i,t}$ will count how many new or changed short positions are present in the periods (0,5; 0,10; 0,22).

5.4.1.2. Stock volatility

The most commonly used measure of stock return volatility is standard deviation. This statistic measures the dispersion of returns. Financial economists find the standard deviation to be useful because it summarizes the probability of seeing extreme values of return. When the standard deviation is large, the chance of large positive or negative return is large (Schwert, 1990). The standard deviation of daily returns is used as the measure for stock volatility. The calculation for $\mathrm{VOL}_{i,t}$ is the standard deviation of the daily returns of company *i* over period *t* (Christophe et al., 2010; Saffi and Sigurdsson, 2011). As mentioned before it may be interesting to look at different periods of volatility. Boehmer et al. (2008) look at returns of up to 20 days after the announcement of a short position. This study looks at three different periods of volatility. the first period looks at the volatility of the day of the announcement until 5 days after the announcement (0,5). The second period looks at the day of the announcement until 10 days after the announcement (0,10). The final period looks

at the day of the announcement until 22 days after the announcement (0,22). Based on the data of the study, the standard deviation values are scaled because they come from different time periods. For example, one standard deviation is calculated over a 10 day period whilst another is calculated over a 5 day period. Scaling them with a certain factor allows for the final values to be compared on an equal level. In this study the values are annualized (Saffi and Sigurdsson, 2011). The model to test stock volatility is slightly adjusted, as mentioned before some autoregressive elements are added. The regression formula is as follows:

$$\mathrm{VOL}_{i,t} = \alpha + \beta 1\mathrm{SHORT}_{i,t} + \beta 2\mathrm{MCAP}_{i} + \beta 3\mathrm{BTM}_{i} + \beta 4\mathrm{OPTIONS}_{i} + \beta 5\mathrm{LEV}_{i} + \beta 6\mathrm{MULTIPLE}_{i} + \beta 7\mathrm{VOLWEEK}_{i,t\text{-}5,\text{-}1} + \beta 8\mathrm{VOLMONTH}_{i,t\text{-}22,\text{-}1} + \varepsilon_{i,t}$$

These autoregressive variables take into account the autoregressive nature of stock volatility as mentioned by Corsi (2009). It is described that volatility is influenced by its own past values. For example, tomorrow's daily volatility can be partly explained by today's volatility, last week's volatility, and last month's volatility. As this study uses less frequent data than daily volatility, only control variables for the previous week's volatility and the previous month's volatility are included. The variable $\mathrm{VOLWEEK}_{i,t\text{-}5,\text{-}1}$ controls for the previous week's volatility by calculating the standard deviation of daily adjusted closing stock prices of company *i* over the previous five days *t-5,-1* before the announcement of the short position. The variable $\mathrm{VOLMONTH}_{i,t\text{-}22,\text{-}1}$ controls for the previous month's volatility by calculating the standard deviation of daily adjusted closing stock prices of company *i* over the previous twenty-two days *t-22,-1* before the announcement of the short position. Both these variables are also annualized.

5.4.2. Independent variable: Short selling

The independent variable is short selling ($\mathrm{SHORT}_{i,t}$). Short selling is calculated by using the net short position. The net short position as calculated by the AFM in the SSR is the net short position of a position holder as a percentage of the total issued share capital of a company. The variable will be calculated as the net short position in company *i* on day *t*. An advantage of the net short position is that it only includes short positions that are used for speculative purposes. It ignores short trades involving hedging purposes. The SSR only publishes net short positions of 0.5% or more of the total issued share capital of a company. Different positions in the same company on the same day are aggregated. An additional measure of short selling provided by the SSR is the number of short sellers on stock *i* on day *t* ($\mathrm{NRSHORT}_{i,t}$). This measure allows the number of individual short sellers per short position to be tested.

5.4.3. Control variables

5.4.3.1. Market capitalization

The first control variable looks at a company's market capitalization. Market capitalization looks at the difference in short interest between large cap stocks and small cap stocks. It can be quite difficult to short because the shares have to be available for lending. It can be quite problematic to find people willing to lend smaller illiquid shares compared to large cap shares (Jones and Lamont, 2002). It is expected that large cap stocks will showcase more shorting activity than small cap stocks. Market capitalization is calculated as company *i*'s outstanding shares at year end multiplied by the company's stock price at year end.

5.4.3.2. Book-to-market

The control variable book-to-market focuses on the book value of a company compared to its market value. When a company's book value is greater than its market value it is considered undervalued. When a company's book value is lower than its market value it is considered overvalued. An overvalued company is an ideal target for a short seller, it is expected that companies with a low book-to-market ratio will showcase higher shorting activity. Book-to-market ratio is calculated as company *i*'s common shareholders' equity at year end divided by its market capitalization at year end (Dechow et al., 2001; Jones and Lamont, 2002; Diether et al. 2009).

5.4.3.3. Options

The control variable Options looks at the effect of stock options on shorting activity. Options allow investors to create a much cheaper short position in a certain stock. Short selling requires investors to put funds in a margin account and constantly manage these funds, options only require a one-time fee to be paid which is much cheaper. Furthermore, options have a fixed maximum loss amount which is the fee that was paid whilst short selling has an unlimited loss potential. Figlewski and Webb (1993) find that stocks with options showcase higher short interest, because option able stocks allow investors with limited capital to also create short positions. Sorescu (2000) adds that when options are introduced to a stock the prices of the stock fall. The value of the variable is a 1 if the stock has options and a 0 if the stock does not have options.

5.4.3.4. Leverage

The final control variable Leverage is calculated as total debt of company *i* at year end / total equity of company *i* at year end. Schwert (1990) states that leverage can be a big influencer of stock returns and volatility.

Table 3 Description of variables

Dependent variables	Description	References
Abnormal stock return (ABRET)	Daily return of stock *i* on day *t* – Market return *m* on day *t*	(Dechow et al., 2001; Desai et al., 2002; Christophe et al., 2010).
Alternative abnormal stock return (ALT_RET)	$R_{i,t} - [R_{f,x} + \beta_{i,x}(R_{m,t} - R_{f,x})]$	(Figlewski and Webb, 1993)
Stock volatility (VOL)	Annualized standard deviation of daily returns of company *i* over period *n*	(Saffi and Sigurdsson, 2011)
Independent variables		
Short selling (SHORT)	Net short position in company *i* on day *t*	Short selling register
Number of short sellers (NRSHORT)	Number of short sellers of stock *i* on day *t*	Short selling register
Control variables		
Market capitalization (MCAP)	(Outstanding shares of company *i* at year end *x-1*) x (Stock price of company *i* at year end *x-1*)	(Jones and Lamont, 2002)
Book-to-market (BTM)	(Common shareholders' equity of company *i* at year end *x-1* / Market capitalization of company *i* at year end *x-1*)	(Jones and Lamont, 2002; Diether et al., 2009)
Options (OPTIONS)	Optioned stocks measured against non optioned stocks	(Figlewski and Webb, 1993)
Leverage (LEV)	(Total debt of company *i* at year end *x-1*) / (Total equity of company *i* at year end *x-1*)	(Schwert, 1990)
Previous week's volatility (VOLWEEK)	Annualized standard deviation of daily adjusted closing stock prices of company *i* over period *t-5,-1*	(Corsi, 2009)
Previous month's volatility (VOLMONTH)	Annualized standard deviation of daily adjusted closing stock prices of company *i* over period *t-22,-1*	(Corsi, 2009)
Multiple short positions (MULTIPLE)	Number of new or changed short positions in period *t*	(Kersbergen, 2015)

6. DATA

This chapter describes the data used in this study and where it was obtained.

6.1. Sample

The sample size for this study consists of 1066 observations. There are many different views regarding how large a sample should be for a reliable regression. A general rule of thumb is a sample of 50, however most researchers recommend a sample of at least 100 (Hair, Anderson, Babin, & Black. 2010). Green (1991) tests a different assumption and mentions that the size of the model is important when considering sample size. Evidence is found for a model where sample size should be 50 + 8k, where k is the number of predictor variables in the model (Green, 1991). The largest model in this study consists of 8 predictor variables, so the minimum sample size should be 50 + (8 x 8) = 114. It is clear that with 1066 observations the sample meets the minimum requirements. Gerritsen and Verdoorn (2014) use a comparable sample size, from the same data source, of 1542 observations from November 2012 to August 2014. Gerritsen and Galema (2018) show a total of 14,678 observations from the same data source from November 2012 to January 2017. However, 10,155 of these observations are confidential positions that were accidentally published, this study does not have access to these observations.

The sample is obtained from the Short Selling Register (SSR) provided by AFM. The sample contains 72 unique short positions in 38 different companies listed on the Euronext Amsterdam from January 2, 2017 to December 29, 2017. The SSR is the database in which the net short positions that have to be disclosed publicly are registered by the AFM. Positions are published daily, a short position that is at least equal to 0.5% of the issued share capital of a company and every 0.1% above will be registered in the SSR. When the short position drops below 0.5% of the issued share capital, the position will be visible in the register for one more day. The SSR was set up in 2012, so it is impossible to find data from before this period. The period that will be analyzed during this study is the year 2017. At this moment in time 2017 is the most recent year with all its data available. The standard of 365 days in a year will be adjusted due to the nature of this study involving the stock market. Based on a calculation excluding weekends and public holidays it was determined that the year 2017 consisted of 254 trading days. The sample period runs from January 2, 2017 to December 29, 2017. Data on stock returns are taken from Yahoo Finance. Other information such as a

company's market capitalization, book-to-market value and leverage are obtained from Orbis, AEX and annual reports.

6.2. Descriptive statistics

The table in Appendix B shows the descriptive statistics of all the variables in the sample including outliers. To see if there are any outliers in the data the interquartile range is used, this is a tool provided by SPSS. The interquartile range (IQR) looks at the difference between the first quartile and the third quartile. This difference is then given a multiplier of 1.5 or 3 by SPSS. Then, outliers are detected as values being 1.5 or 3 * IQR below the first quartile or 1.5 or 3 * IQR above the third quartile. However, Hoaglin, Iglewicz, & Tukey (1986) state that an IQR multiplied by 1.5 very often detects values that are not real outliers and they propose a multiplier of 2.2. SPSS only gives multipliers of 1.5 or 3, so for this paper an IQR * 3 is used to detect outliers.

The variables ABRET(0,1), ABRET(0,5), VOL(0,5), VOL(0,10) and VOL(0,22) are checked for outliers. The variables ABRET and ABRET(0,5) show some high standard deviations which can be explained by some extreme minimum and maximum values. Removing outliers for ABRET(0,1) and ABRET(0,5) also removes outliers for the variables ALT_RET(0,1) and ALT_RET(0,5) because the calculations are quite similar. The variables VOL(0,5), VOL(0,10) and VOL(0,22) show some high maximum values, which is why they are also checked for outliers. These values show similar distributions compared to data from Jain et al. (2015). Daily and weekly returns show low means of 0.06% and 0.00% with quite high standard deviations of 2.04% and 4.58%. Monthly volatility shows a mean value of 0.02% and a standard deviation of 0.01%. Daske et al. (2005) show daily returns with a mean of 0.07% and a standard deviation of 0.18%. Furthermore, the decision was made to take the natural logarithm of the variable MCAP to reduce the standard deviation and to make it easier to read. Additionally, when looking at the minimum value for the variable SHORT it is visible that there is a value of 0. A short position of 0 indicates a position has been closed, so there is no shorting taking place anymore. Therefore, these positions will be excluded. The sample contains two short positions with a value of 0, these will be removed. Finally, the observations for the companies Altice Europe N.V. and PostNL N.V. will also be excluded as these have negative Book-to-market and Leverage ratios. After excluding outliers the sample that remains contains 931 observations.

Table 4 showcases the descriptive statistics for the variables excluding outliers. Looking at the new data it is visible that the minimum and maximum values have decreased quite a bit for the dependent variables. Furthermore, the means for both ABRET(0,1) and

ALT_RET(0,1) are negative with -0.019% and -0.027%. The means for ABRET(0,5) and ALT_RET(0,5) are a bit higher with 0.255% and 0.217%. Senchack and Starks (1993) show a similar negative ABRET(0,1) of -0.09% and a positive ABRET(0,5) of 0.065%. Mohamad et al. (2013) show a reverse pattern with a positive mean of 0.138% for ABRET and a negative mean of -0.161% for ABRET(0,5). The variables VOL(0,5), VOL(0,10) and VOL(0,22) all have similar values and distributions, with means of 0.219%, 0.225% and 0.238%, and standard deviations of 0.115%, 0.100% and 0.094%. Jain et al. (2015) show lower volatility values with a mean of 0.02% and a standard deviation of 0.01%. The table shows an average short position of 1.99% and an average number of short sellers of 2.52. Jain et al. (2015) show an average short position of 3.53% in a US based study.

The variable LOG_MCAP has a mean of 21.26 and a standard deviation of 1.013 after using a log transformation. The variable BTM shows a mean of 0.705 and a standard deviation of 0.356. Diether at al. (2009) show a mean of 0.67 for NYSE stocks and a mean of 0.55 for Nasdaq stocks. The variable LEV has a mean of 2.880 and a standard deviation of 4.561. The variable OPTIONS showcases that 92% of the stocks in the sample are stocks with options. Aitken et al. (1998) show 76% of the stocks in their sample to be optioned. The variables VOLWEEK and VOLMONTH have means of 0.269% and 0.279%. Diether et al. (2009) show a VOLWEEK of 0.02% for NYSE stocks and 0.04% for Nasdaq stocks. Finally, the variables MULTIPLE show how many short positions take place in the periods (0,5; 0,10; 0,22). A mean of 1.59 short positions in the period (0,5) is visible and this increases to 2.97 in the period (0,10) and to 6.02 in the period (0,22). This increase over a longer period of time makes sense because longer periods mean more time to incorporate changes in short positions. The variable MULTIPLE shows minimum values of 0, this indicates that in this period there are no new or changed short positions besides the initial short position.

Table 4 Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
ABRET(0,1)	931	-4.675%	4.626%	-0.019%	1.362%
ALT_RET(0,1)	931	-4.662%	5.190%	-0.027%	1.363%
ABRET(0,5)	931	-11.702%	12.341%	0.255%	3.191%
ALT_RET(0,5)	931	-11.744%	12.018%	0.217%	3.171%
VOL(0,5)	931	.028%	.677%	.219%	.115%
VOL(0,10)	931	.029%	.623%	.225%	.100%
VOL(0,22)	931	.029%	.596%	.238%	.094%
SHORT	931	0.08%	6.24%	1.99%	1.42%
NRSHORT	931	1	9	2.52	1.571
LOG_MCAP	931	18.59	23.96	21.26	1.013
BTM	931	.177	2.278	.705	.356
LEV	931	.066	20.436	2.880	4.561
OPTIONS	931	0	1	.92	.269
VOLWEEK	931	.032	2.352	.269	.233
VOLMONTH	931	.041	1.216	.279	.160
MULTIPLE(0,5)	931	0	4	1.59	1.327
MULTIPLE(0,10)	931	0	9	2.97	2.341
MULTIPLE(0,22)	931	0	21	6.02	4.569

Descriptive statistics of all variables excluding outliers. N is the number of observations. Definitions of all variables are presented in table 3.

6.3. Correlations

Tables 5 and 6 showcase Pearson's correlation matrices to check for multicollinearity between the variables in this study. The correlation matrices will be separated. Table 5 shows the matrices for the variables ABRET(0,1), ALT_RET(0,1), ABRET(0,5) and, ALT_RET(0,5). Table 6 shows the matrix for the variable VOL. the matrices are separated to give a clearer view of the correlations. Putting all the variables in one table makes it unclear and hard to read. After analyzing the correlation matrices and looking at the tolerance and variance inflation factors (VIF) it is determined that there are no multicollinearity issues in the data. Underneath some of the results of the correlation matrices will be described.

Table 5 shows the correlations between the variables using the abnormal returns for periods (0,1) and (0,5). A high correlation is present between the variables ABRET(0,1) and ALT_RET(0,1) (0.984**). This correlation makes sense because these variables are two different measures for the same objective. These variables will be used interchangeably and will not be present in the same regressions. The same is true for the variables SHORT and NRSHORT (0.872**). These two variables are also alternatives for the same objective and will be used interchangeably. ABRET(0,1) has a negative correlation with SHORT (-0.027) and NRSHORT(-0.022) and ALT_RET(0,1) has a negative correlation with SHORT(-0.027) and NRSHORT(-0.024), Beneish et al. (2015) and Jain et al. (2015) also show a negative correlation between returns and short selling. Additionally, SHORT and MCAP have a negative correlation of -0.015, Jain et al. (2015) also show a negative correlation between these two variables. The rest of the variables do not show any significant correlation. The correlations for the variables ABRET(0,5) and ALT_RET(0,5) are similar. This model also has a high correlation between the variables ABRET(0,5) and ALT_RET(0,5) (0.986**). The same explanation as mentioned earlier applies here.

Table 6 shows the correlations between the variables using volatility as the dependent variable. Volatility has a correlation significant at the 0.01 level with the two interchangeable independent variables SHORT(0.209**) and NRSHORT(0.257**). The correlations are positive indicating that an increase in short position or the number of short sellers should result in an increase in volatility, this is in line with hypothesis 2. Jain et al. (2015) also show a positive correlation between short selling and stock volatility at the 0.01 significance level. Interestingly, Jain et al. (2015) show a negative correlation significant at the 0.01 level between volatility and market capitalization, which is expected. However, in this study the correlation between VOL and MCAP is 0.017 and insignificant. It is difficult to find a precise explanation for this difference. The study by Jain et al. (2015) uses a much bigger sample of over 100,000 observations in the American stock market. Furthermore, volatility has a

correlation significant at the 0.01 level with BTM(-0.218**). This correlation is negative indicating that a lower book-to-market ratio should result in an increase in volatility, this makes sense because overvalued companies tend to be more volatile. Additionally, volatility has a 0.01 level significant correlation with its past values VOLWEEK(0.115**) and VOLMONTH(0.185**). This is explained by Corsi (2009) who states that volatility can be partly explained by its own past values. Volatility also has a correlation at the 0.01 significance level with the variable MULTIPLE(0.346**). This correlation can be explained by the fact that the variable MULTIPLE looks directly at volatility and counts how often a new short position appears or an existing short position is changed during the period over which volatility is measured. Finally, there is a significant correlation at the 0.01 level between the control variable MULTIPLE and the independent variables SHORT(0.648**) and NRSHORT(0.753**). This is explained by the fact that the variable MULTIPLE directly looks at the variables SHORT and NRSHORT and counts how often they change in a certain period.

Table 5 Pearson correlation matrix – Abnormal returns

	ABRET (0,1)	ALT_RET (0,1)	SHORT	NRSHORT	MCAP	BTM	LEV	OPTIONS
ABRET(0,1)	1							
ALT_RET(0,1)	0.984**	1						
SHORT	-0.027	-0.027	1					
NRSHORT	-0.022	-0.024	0.872**	1				
MCAP	0.007	0.005	-0.015	-0.012	1			
BTM	-0.026	-0.023	-0.084*	-0.061	-0.074*	1		
LEV	-0.043	-0.031	0.098**	-0.019	-0.127**	-0.013	1	
OPTIONS	-0.005	0.002	0.171**	0.123**	-0.093**	0.333**	0.142**	1

	ABRET(0,5)	ALT RET(0,5)	SHORT	NR SHORT	MCAP	BTM	LEV	OPT IONS	MULTIPLE (0,5)
ABRET (0,5)	1								
ALT_RET (0,5)	0.986**	1							
SHORT	-0.014	0.006	1						
NR SHORT	-0.002	0.008	0.872**	1					
MCAP	0.007	-0.003	-0.015	-0.012	1				
BTM	-0.041	-0.042	-0.084*	-0.061	-0.074*	1			
LEV	-0.045	-0.030	0.098**	-0.019	-0.127**	-0.013	1		
OPTIONS	-0.028	-0.007	0.171**	0.123**	-0.093**	0.333**	0.142**	1	
MULTIPLE (0,5)	0.058	0.064	0.499**	0.595**	-0.046	-0.055	-0.065*	0.024	1

Notes: Pearson correlation for the abnormal returns period. * Significant at 0.05 level. ** Significant at 0.01 level.

Table 6 Pearson correlation matrix – Stock volatility

	VOL	SHORT	NR SHORT	MCAP	BTM	LEV	OP TIONS	VOL WEEK	VOL MONTH	MUL TIPLE
VOL	1									
SHORT	0.209**	1								
NR SHORT	0.257**	0.872**	1							
MCAP	0.017	-0.015	-0.012	1						
BTM	-0.218**	-0.084*	-0.061	-0.074*	1					
LEV	0.064*	0.098**	-0.019	-0.127**	-0.013	1				
OPTIONS	-0.046	0.171**	0.123**	-0.093**	0.333**	0.142**	1			
VOL WEEK	0.115**	0.152**	0.156**	-0.007	-0.124**	-0.012	0.021	1		
VOL MONTH	0.185**	0.281**	0.291**	0.003	-0.139**	0.036	0.074*	0.623**	1	
MUL TIPLE	0.346**	0.648**	0.753**	-0.013	-0.077*	-0.051	0.023	0.163**	0.247**	1

Notes: Pearson correlation for stock volatility. * Significant at 0.05 level. ** Significant at 0.01 level.

7. RESULTS

This chapter shows the results of the regression analyses and some additional tests. Additionally, it shows some robustness tests for the validity of the results.

7.1. Regression results

The results of the regression analyses are shown in tables 7 and 8. Table 7 contains the regression results for the analysis of hypothesis 1, the impact of short selling on abnormal stock returns. Table 8 presents the results for the regression used to test hypothesis 2, the impact of short selling on stock volatility. The table contains all three periods of volatility (0,5;0,10;0,22).

7.1.1. Impact of short selling on abnormal stock returns

The first hypothesis states that short selling decreases abnormal stock returns. Table 7 presents the results regarding abnormal returns. The table contains several models that use different combinations of dependent and independent variables. Panel A presents the results using ABRET(0,1) and ABRET(0,5) as the dependent variable. Panel B presents the results using ALT_RET(0,1) and ALT_RET(0,5) as the dependent variable. Models 1, 3, 5 and, 7 use the variable SHORT as the independent variable. SHORT is the net short position in percentages. The models 2, 4, 6 and, 8 replace the independent variable SHORT with the variable NRSHORT, which is the number of short sellers holding a short position. This is done to strengthen the results by looking at alternative measures for variables and seeing if the results remain similar. A test of normality is performed by looking at the distribution of the residuals. The assumption of normality is met through inspection of a histogram showing the distribution of the residuals. The histogram is found in Appendix C.

Firstly, models 1, 2, 5 and, 6 are analyzed to look at returns for the period (0,1). The regressions for models 1 and 5 with the independent variable SHORT show similar results. There are no significant relationships in the regressions. However, the coefficient between short selling and abnormal returns appears to follow the expected negative direction. A negative coefficient of -0.027 is present for SHORT on ABRET(0,1) and for SHORT on ALT_RET(0,1) the coefficient is -0.030, but the results are not significant. The control variables also show no significant relationships. Most of the variables are in the expected directions. However, the variable OPTIONS shows an unexpected direction. It is expected that options decrease abnormal returns, because options make it easier and cheaper to short stocks. In contrast, options show a positive coefficient with abnormal returns. The coefficient between ABRET(0,1) and OPTIONS is 0.091 and the coefficient between ALT_RET(0,1) and

OPTIONS is 0.116. This may be explained by Diamond and Verrecchia (1987) who state that short trades through options may be less informed than regular short trades. This is because shorting through options is much easier and cheaper than regular short selling. A result of this could be that options actually reduce the negative impact on abnormal stock returns. Models 2 and 6 show the results for the regressions with the independent variable NRSHORT. The results are very similar, there are no significant relationships present. The coefficients between NRSHORT and ABRET(0,1) and ALT_RET(0,1) are negative with values of -0.023 and -0.025, but insignificant. The other control variables show the same directorial insignificant coefficients as in the regressions with the independent variable SHORT.

Finally, the model fits for these models are all very low, negative and insignificant which can be seen through the adjusted R square and the F statistics. These low model fits are not uncommon, they are present in studies by Diether et al. (2009), Jones and Lamont (2002), Saffi and Sigurdsson (2011) and we even see negative adjusted R square values in Gerritsen and Galema (2017). A low model fit is expected as mentioned by Figlewski and Webb (1993). Abnormal returns are caused by many different things so the explanatory power of a regression that tries to explain abnormal returns is generally quite low.

These results are in contrast with Desai et al. (2002), Christophe et al. (2009), and Diether et al. (2009). Desai et al. use monthly returns with a sample size of over 2000 observations from the Nasdaq. Desai et al. (2002) use four different categories for levels of short selling. These categories are short positions of 2.5%, 5%, 7.5% and, 10%, they find that higher levels of short selling decrease returns more than lower levels of short selling. The difference between this study and Desai et al. (2002) is that most of the short positions in this study fall below 2.5%. So, it might be the case that these lower short positions do not have a strong enough effect to show a significant decrease in returns. Diether et al. (2009) also find that higher levels of short selling decrease returns more than lower levels. Christophe et al. (2004) focus specifically on short selling around news events. So, a bigger effect is expected because most short sales will happen based on information rather than speculation. Furthermore, their study looks specifically at firm downgrades by financial analysts. Downgrades are negative news events so stock price reactions are also expected to be negative around these events.

This study does not specifically focus on short selling around news events. The short positions may be informational or purely speculative. This mix of short positions may reduce the effect these positions have on stock returns. Since the results for models 1, 2, 5, and, 6

are insignificant hypothesis 1 for the period (0,1) is rejected. This is in line with Daske et al. (2005) who find no relationship between short selling and abnormal returns. Daske et al. (2005) also focus on short selling around news events, but they don't specifically focus on bad news events. They explain that short selling has seen a large increase in volume in recent years which might have resulted in an increase in the number of uninformed traders. An increase in uninformed short trading may reduce the effect of short selling on stock returns.

Models 3, 4, 7 and, 8 present the results for the abnormal returns period (0,5). The layout of the table will be the same. Models 3 and 7 show the results for the regressions with the independent variable SHORT. Models 4 and 8 show the results for the regressions with the independent variable NRSHORT. However, a variable MULTIPLE(0,5) is added to control for the possibility of multiple short positions taking place in a specific time period. The results are very similar in comparison to the abnormal returns period (0,1). The same insignificant relationship is seen between SHORT, NRSHORT and the two abnormal returns measures. The coefficients become larger indicating that short selling decreases abnormal returns over a longer period of time. For example, the coefficient for SHORT on ABRET goes from -0.027 to -0.121 for ABRET(0,5), but there is no statistical significance.

However, the variable MULTIPLE(0,5) does show statistical significance in all four regressions. the coefficients for models 3, 4, 7 and, 8 are 0.195*, 0.210**, 0.187** and, 0.213**. This indicates that there is a significant relation between the amount of times a short position is changed in a given time period and the abnormal returns of that specific time period. The direction of this relationship is positive in all the regressions. This means that when a short position is changed multiple times in a given time period the abnormal returns increase for that period. This positive relationship may be explained due to the fact that the variable MULTIPLE(0,5) does not take into account the direction of the change in the short position. It may be the case that in the periods where multiple changes take place the positions are actually being lowered indicating that the stocks are performing better. Lastly, the model fits for all these regressions are low and insignificant. The same conclusion is drawn as for the period (0,1). All in all the conclusion for hypothesis 1 is that there is no significant statistical evidence indicating that short selling decreases abnormal returns

Table 7 OLS Regression abnormal returns

Panel A	Model 1 ABRET (0,1)	Model 2 ABRET (0,1)	Model 3 ABRET (0,5)	Model 4 ABRET (0,5)	Panel B	Model 5 ALT_RET (0,1)	Model 6 ALT_RET (0,1)	Model 7 ALT_RET (0,5)	Model 8 ALT_RET (0,5)
Intercept	0.076 (0.077)	0.097 (0.098)	0.363 (0.157)	0.434 (0.188)		0.041 (0.042)	0.063 (0.064)	0.626 (0.273)	0.679 (0.296)
SHORT	-0.027 (-0.837)		-0.121 (-1.383)			-0.030 (-0.915)		-0.084 (-0.967)	
NRSHORT		-0.023 (-0.807)		-0.116 (-1.379)			-0.025 (-0.865)		-0.102 (-1.228)
MCAP	0.000 (0.008)	-0.000 (-0.002)	0.008 (0.079)	0.007 (0.069)		0.000 (0.002)	0.000 (-0.009)	-0.018 (-0.169)	-0.017 (-0.168)
BTM	-0.134 (-0.991)	-0.129 (-0.962)	-0.366 (-1.157)	-0.347 (-1.102)		-0.128 (-0.948)	-0.123 (-0.914)	-0.425 (-1.353)	-0.419 (-1.340)
LEV	-0.013 (-1.298)	-0.014 (-1.392)	-0.024 (-1.004)	-0.028 (-1.180)		-0.010 (-0.953)	-0.011 (-1.054)	-0.017 (-0.736)	-0.020 (-0.859)
OPTIONS	0.091 (0.497)	0.083 (0.458)	-0.028 (-0.066)	-0.056 (-0.133)		0.116 (0.633)	0.107 (0.589)	0.200 (0.471)	0.198 (0.470)
MULTIPLE (0,5)			0.195* (2.113)	0.210** (2.137)				0.187** (2.038)	0.213** (2.175)
Adjusted R Square	-0.002	-0.002	0.002	0.002		-0.003	-0.003	0.001	0.002
F-statistic	0.644	0.634	1.359	1.357		0.493	0.475	1.158	1.254

This table presents regression results. The first number is the coefficient and the number in brackets is the t-statistic. * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level. (N = 931)

7.1.2. Impact of short selling on stock volatility

The second hypothesis states that short selling increases stock volatility. Table 8 presents the results for the regressions of the three volatility periods (0,5;0,10;0,22). Panel A will show the regressions with the independent variable SHORT and panel B will show the regressions with the variable NRSHORT.

In contrast to the results for hypothesis 1, the regression results for hypothesis 2 show some significant relationships between the variables. For the volatility period (0,5) a positive coefficient with SHORT is present. However, the coefficient of 0.004 is insignificant.
The control variables on the other hand show some significant results. A significant negative relationship exists between BTM and VOL(0,5), the coefficient is -0.021*. The negative relationship between BTM and VOL(0,5) is expected, because value stocks tend to be more stable and less volatile compared to growth stocks. A significant positive relationship is seen between LEV and VOL(0,5), the coefficient is 0,001*. An increase in leverage results in an increase in volatility. This can be explained by the fact that more leverage means more uncertainty and risk of not being able to pay back debts which causes volatility. Furthermore, significant positive relations between VOLWEEK and VOL(0,5) 0.044** and, VOLMONTH and VOL(0,5) 0.053* are present. These relationships are expected and explained by Corsi (2009) who mentions that volatility is highly influenced by its own past values. The relationship indicates that when previous volatility increases, the future volatility will also increase. A thing to note is that VOLWEEK and VOLMONTH are significantly correlated. However, tests were done where both variables were put into the model separately. These tests indicated no significant differences between the results, so the choice is made to keep both variables in the model.

Finally, as seen with the abnormal returns period (0,5) there is a statistically significant relationship between the variable MULTIPLE and VOL(0,5). The coefficient 0.019*** shows a positive relationship. This may be explained by the fact that multiple changes to a short position in a given period indicate that new information is available which can result in uncertainty. Uncertainty can result in increased volatility. Looking at the model fit it can be seen that the adjusted R square is still low (0.109) as expected, but it is much higher compared to the regressions for hypothesis 1. Additionally, the F statistic shows statistical significance with a value of 15.193***. In conclusion the model for the volatility period (0,5) shows some explanatory power, but there is insufficient statistical evidence to suggest that short selling increases volatility for the period (0,5).

Looking at the results for the period (0,10) the coefficients show similar directions, but the only two variables that show significance are BTM and MULTIPLE. BTM has a similar negative relation with VOL(0,10) as with VOL(0,5), with a coefficient of -0.036***. The variable MULTIPLE shows a similar positive relation with a coefficient of 0.012***. Looking at the model fit the results are similar to the volatility period (0,5). With an adjusted R square of 0.126 and an F statistic of 17.745*** the same conclusion can be made for the period (0,5) and (0,10).

The results for the period (0,22) are similar to the results of the period (0,5), the only variable that loses significance is VOLWEEK. This may be explained by the fact that the previous week's volatility may be too short of a period to influence the subsequent month's volatility. However, the period (0,22) presents one very interesting result. The independent variable SHORT showcases a significantly negative relationship with VOL(0,22). With a coefficient of -0.005*, this indicates that in contrast to short selling increasing volatility, it may in fact result in a decrease in volatility. Diether et al. (2009) mention that short sellers tend to be contrarians with a stabilizing effect on stock prices, this can explain the negative relationship in the model. Scheinkmann and Xiong (2003) and, Saffi and Sigurdsson (2011) also find that short selling does not increase stock volatility. Looking at the model fit the adjusted R square (0.165) and the F statistic (23.892***) show similar values compared to the other two time periods. In conclusion the regression for the period (0,22) shows some explanatory power, but insufficient statistical evidence to suggest that short selling increases stock volatility. An argument can be made that there is some evidence suggesting that short selling decreases stock volatility. When the independent variable SHORT is replaced by the variable NRSHORT the results remain very similar. The only difference that is present is that the relationship between the variable NRSHORT and VOL(0,22) loses its significance. All in all the conclusion for hypothesis 2 is that there is insufficient statistical significance to state that short selling increases stock volatility. There even is some evidence suggesting that short selling can decrease stock volatility.

These findings are in contrast with Henry and McKenzie (2006). Henry and McKenzie (2006) focus on short sellers' trading activity (volume) as their measure of short selling. They find that when short sellers' trading volume increases, stock volatility also increases. Their study compares situations where short sellers are active with situations where short sellers are not active. However, this study only looks at situations where short sellers are active and attempts to test if an increase in shorting activity has an effect on stock volatility. The findings are in line with Chang et al. (2006) and, Saffi and Sigurdsson (2011). Chang et al. (2006) find that limiting short selling for risk sharing purposes has no effect on volatility. However, limiting short selling for informational purposes can actually increase volatility. Saffi and Sigurdsson (2011) also find that if short selling is banned or constraint, it can cause stock prices to become more volatile.

Table 8 OLS Regression stock volatility periods (0,5;0,10;0,22)

Panel A	VOL(0,5)	VOL(0,10)	VOL(0,22)
Intercept	0.211***(2.679)	0.210***(3.085)	0.182***(2.934)
SHORT	0.004(1.479)	0.000(0.154)	-0.005*(-1.826)
MCAP	-0.001(-0.326)	0.000(-0.104)	0.002(0.584)
BTM	-0.021*(-1.942)	-0.036***(-3.820)	-0.048***(-5.607)
LEV	0.001*(1.686)	0.001(1.457)	0.002***(2.786)
OPTIONS	-0.022(-1.543)	-0.009(-0.719)	0.001(0.062)
VOLWEEK	0.044**(2.265)	0.026(1.518)	-0.006(-0.374)
VOLMONTH	0.053*(1.794)	0.037(1.452)	0.057**(2.428)
MULTIPLE	0.019***(5.850)	0.012***(6.931)	0.007***(9.032)
Adjusted R Square	0.109	0.126	0.165
F-statistic	15.193***	17.745***	23.892***
Panel B	VOL(0,5)	VOL(0,10)	VOL(0,22)
Intercept	0.208***(2.645)	0.209***(3.085)	0.185***(2.975)
NRSHORT	0.003(1.149)	0.001(0.232)	-0.002(-0.657)
MCAP	-0.001(-0.307)	0.000(-0.106)	0.002(0.552)
BTM	-0.022**(-2.034)	-0.036***(-3.837)	-0.047***(-5.473)
LEV	0.002*(1.878)	0.001(1.491)	0.002**(2.553)
OPTIONS	-0.021(-1.437)	-0.009(-0.730)	-0.002(-0.204)
VOLWEEK	0.045**(2.265)	0.026(1.526)	-0.005(-0.339)
VOLMONTH	0.054*(1.816)	0.037(1.432)	0.053**(2.281)
MULTIPLE	0.019***(5.491)	0.012***(6.166)	0.007***(7.362)
Adjusted R Square	0.108	0.126	0.162
F-statistic	15.071***	17.749***	23.456***

This table presents regression results. The first number is the coefficient and the number in brackets is the t-statistic. * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level. (N = 931)

7.2. Robustness test

To test the robustness of the results several mechanisms were implemented. First of all, an alternative measure for the dependent variable ABRET was used for all regressions. this variable is called ALT_RET and uses a CAPM model to more specifically calculate abnormal returns. When looking at the results of the regressions using ABRET and ALT_RET it is evident that they are very similar, indicating that there are no significant differences between the two measures. Furthermore, an alternative measure was also added for the independent variable SHORT. The variable SHORT measures the net short position in a company in percentages and the alternative variable NRSHORT measures how many short sellers hold this position. These two are correlated as a larger position is generally held by more short sellers. Looking at the results for these two measures the results remain very similar indicating that there are no significant differences between the two.

A first robustness test will be performed by testing regressions with different combinations of independent and control variables to test the effects of individual variables on the dependent variable. Only two of these regressions will be presented. Table 9 will present results using the dependent variable ABRET(0,1) and table 10 will present results using the dependent variable VOL(0,22). Table 9 shows that there are no significant differences in the results when different combinations of variables are used on ABRET(0,1). the effect SHORT on ABRET(0,1) stays between -0.022 and -0.028 in all models. The control variables show similar individual results compared to the model where all of the variables are included. Additionally, the model fits remain very low and insignificant. Table 10 shows mostly the same results when different combinations of variables are used for the dependent variable VOL(0,22). However, there are a few interesting differences. The point of interest is model 1 where only the variable SHORT is included. A significant positive relation is seen between SHORT and VOL(0,22) with a coefficient of 0.014***. This indicates that when taken on its own short selling seems to increase stock volatility. However, looking at the other models it is evident that as soon as control variables are added this relationship turns insignificant with a coefficient of -0.003 in model 2. The second interesting thing to note is the variable OPTIONS, when this variable is put in the regression on its own a significant negative coefficient of -0.020* is shown. However, in the full regression the variable has an insignificant positive coefficient of 0.001.
This indicates that on its own options reduce volatility, this may be explained by Diamond and Verrechia (1987) who state that options may reduce the negative impact of short selling on stock prices. The rest of the variables show similar results in their individual states as well as the complete model.

Table 9 OLS Regression dependent variable ABRET(0,1) with different combinations of control variables

	Model 1 ABRET (0,1)	Model 2 ABRET (0,1)	Model 3 ABRET (0,1)	Model 4 ABRET (0,1)	Model 5 ABRET (0,1)	Model 6 ABRET (0,1)
Intercept	0.031	-0.162	0.113	0.059	0.033	0.076
	(0.409)	(-0.172)	(0.931)	(0.740)	(0.199)	(0.077)
SHORT	-0.025	-0.025	-0.028	-0.022	-0.025	-0.027
	(-0.809)	(-0.805)	(-0.879)	(-0.683)	(-0.795)	(-0.837)
MCAP		0.009				0.000
		(0.206)				(0.008)
BTM			-0.109			-0.134
			(-0.868)			(-0.991)
LEV				-0.012		-0.013
				(-1.249)		(-1.298)
OPTIONS					-0.001	0.091
					(-0.009)	(0.497)
Adjusted R Square	0.000	-0.001	-0.001	0.000	-0.001	-0.002
F-statistic	0.655	0.348	0.704	1.107	0.327	0.644

This table presents regression results. The first number is the coefficient and the number in brackets is the t-statistic. * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level. (N = 931)

Table 10 OLS Regression dependent variable VOL(0,22) with different combinations of control variables

	Model 1 VOL (0,22)	Model 2 VOL (0,22)	Model 3 VOL (0,22)	Model 4 VOL (0,22)	Model 5 VOL (0,22)	Model 6 VOL (0,22)	Model 7 VOL (0,22)
Intercept	0.211*** (40.757)	0.183*** (28.127)	0.143 (2.352)	0.222*** (24.392)	0.178*** (26.745)	0.200*** (17.497)	0.182*** (2.934)
SHORT	0.014*** (6.512)	-0.003 (-1.220)	-0.003 (-1.213)	-0.004 (-1.408)	-0.005* (-1.663)	-0.002 (-0.844)	-0.005* (-1.826)
MCAP			0.002 (0.665)				0.002 (0.584)
BTM				-0.049*** (-6.054)			-0.048*** (-5.607)
LEV					0.002*** (2.760)		0.002*** (2.786)
OPTIONS						-0.020* (-1.804)	0.001 (0.062)
VOLWEEK		-0.003 (-0.186)	-0.003 (-0.178)	-0.008 (-0.485)	-0.001 (-0.088)	-0.004 (-0.229)	-0.006 (-0.374)
VOL MONTH		0.069** (2.895)	0.068** (2.885)	0.059** (2.549)	0.066*** (2.794)	0.071*** (2.977)	0.057** (2.428)
MULTIPLE (0,22)		0.007*** (8.666)	0.007*** (8.666)	0.007*** (8.724)	0,008*** (9.014)	0.007*** (8.397)	0.007*** (9.032)
Adjusted R Square	0.043	0.128	0.127	0.160	0.134	0.130	0.165
F-statistic	42.405***	35.040***	28.104***	36.441***	29.756***	28.751***	23.892***

This table presents regression results. The first number is the coefficient and the number in brackets is the t-statistic. * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level. (N = 931)

An additional robustness test is performed to look at the static nature of the control variables in this study. The control variables in this study (MCAP, BTM and LEV) are all calculated on an annual scale, but the sample period is only a year long. This means that every observation for a specific company has the same control variables. For example, AEGON N.V. is a company that appears in the sample eleven times, so all eleven of these observations have the same MCAP, BTM and LEV. To test whether a more dynamic approach to the control variables yield different results a regression are run including just one observation per company. To calculate one observation per company all the observations of abnormal returns, volatilities and short positions of these companies are averaged. This leaves the sample with one observation per company at only 35 observations. This is not ideal for a regression, however for the purposes of this test the regression is run anyway. Only the results for the regressions ABRET(0,1), ABRET (0,5) and VOL(0,22) are presented as the other results are fairly similar to the original regressions.

Table 11 shows the results for the three regressions. Both abnormal returns period show the same negative coefficient with short selling. As seen before the period (0,5) showcases a higher coefficient of -0.335 compared to -0.058 of the period (0,1) for the variable SHORT. However, there is no significance between the relationship. The control variables also do not show any significant relationships for both return periods indicating that a more dynamic approach does not generate significantly different results. The adjusted R square and F statistics stay very low for these two periods. Looking at the results for VOL(0,22) most of the same directions for the coefficients between the independent variables and the dependent variable remain, only the variable LOG_MCAP goes from a positive to a negative coefficient. However, significance is lost for the variables SHORT, LEV and MULTIPLE(0,22). The same pattern is visible for the adjusted R square (0.233) and F statistic (2.293*), they are a lot higher compared to the abnormal returns regressions. In conclusion making the control variables more dynamic does not appear to increase the results and significance of the models. However, as mentioned before these new regressions only contain 35 observations which is not ideal. Due to the low number of observations in this test an additional test is run.

The second test is presented in table 12. This test attempts to reduce the sample size by removing consecutive observations from the model. For example, if an observation appears in the sample 6 consecutive days in a row only the first observation is included in the regression. This test reduces the sample size to 531 observations. The results for the regressions are very similar to the results in tables 7 and 8. An interesting thing is the effect of SHORT on ABRET(0,1) has a positive coefficient of 0.011 compared to -0.027, however it is still insignificant. Additionally it is visible that the variable MULTIPLE on ABRET(0,5) with a

coefficient of 0.164 loses significance. This can be explained due to the fact that by removing most of the consecutive observations there are not many observations left with multiple short positions within 5 days of the initial observation. all in all the results do not show any significant deviations from the initial regressions in tables 7 and 8.

Table 11 OLS Regression robustness test reduced sample

	ABRET(0,1)	ABRET(0,5)	VOL(0,22)
Intercept	0.728(0.551)	-0.772(-0.234)	0.229(1.366)
SHORT	-0.058(-0.691)	-0.335(-1.194)	-0.011(-0.747)
MCAP	-0.007(-0.115)	0.069(0.451)	-0.004(-0.464)
BTM	-0.130(-0.776)	-0.068(-0.166)	-0.037*(-1.800)
LEV	-0.002(-0.086)	-0.007(-0.138)	0.002(0.946)
OPTIONS	-0.409(-1.456)	-0.182(-0.265)	0.014(0.396)
VOLWEEK		0.265(0.735)	-0.242(-1.049)
VOLMONTH			0.574*(1.982)
MULTIPLE			0.003(0.680)
Adjusted R Square	-0.037	-0.132	0.233
F-statistic	0.756	0.340	2.293*

This table presents regression results. The first number is the coefficient and the number in brackets is the t-statistic. * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level. (N = 35)

Table 12 OLS Regression consecutive observations removed from sample

	Model 1 ABRET (0,1)	Model 2 ABRET (0,5)	Model 3 VOL (0,22)
Intercept	-0.234	-3.374	0.181**
	(-0.189)	(-1.185)	(2.324)
SHORT	0.011	-0.149	-0.004
	(0.242)	(-1.222)	(-1.090)
MCAP	0.009	0.166	0.002
	(0.160)	(1.281)	(0.478)
BTM	-0.051	-0.029	-0.035***
	(-0.313)	(-0.078)	(-3.396)
LEV	-0.016	-0.079***	0.002**
	(-1.253)	(-2.727)	(2.140)
OPTIONS	0.130	0.257	-0.023
	(0.591)	(0.511)	(-1.628)
VOLWEEK			-0.059***
			(-2.646)
VOLMONTH			0.195***
			(4.969)
MULTIPLE		0.164	0.006***
		(1.382)	(4.931)
Adjusted R Square	-0.006	0.014	0.153
F-statistic	0.380	2.260**	12.947***

This table presents regression results. The first number is the coefficient and the number in brackets is the t-statistic. * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level. (N = 531)

8. CONCLUSION

This chapter will describe the conclusion and the main findings of this study. Additionally, some limitations of this research will be described and some recommendations for further research will be presented.

8.1. Main findings

This study focuses on the impact of short selling on individual stock returns and stock volatility. Previous studies have shown mixed results and most research is focused on the United States (US) due to a more publicly accessible registration system for short selling. However, the US only provides monthly data on short selling and it has been stated that more frequent data, for example daily or intraday yields more accurate results. Additionally the US only has data on gross aggregated short positions. This means that all short positions are aggregated making it impossible to distinguish which short sellers and how many of them make up a certain short position. Furthermore, gross short positions can also include short positions that are used for hedging and arbitrage purposes. This is not ideal as hedging and arbitrage motivated short selling has a different effect on prices compared to a purely speculative motivation. Ideally, only net short positions should be used as these are purely information based and should showcase a bigger effect on prices compared to hedged short positions. In November 2012, the EU put in place a system called the Short Selling Regulation. This system streamlined the registration and publication of short selling in all EU member states. Companies were required to report significant net short positions on a daily basis when they are at least equal to 0.2% of a company's issued share capital and every 0.1% above that. Positions have to be disclosed when they are equal to 0.5% of the issued share capital and every 0.1% above that. This regulation opened the doors for much more research focused on European countries.

This study focuses on the Dutch stock market and contains a sample of 1066 observations over the year 2017. The sample includes 76 short sellers and 38 companies listed on the Dutch stock market. Two hypotheses are tested in this study. The first hypothesis states that short selling decreases abnormal stock returns. This is based on a theory by Diamond and Verrechia (1987) that states that because short selling is so expensive only well informed investors with specific information regarding a stock are willing to take the risk of shorting. This results in the thought that when short interest in a stock increases it should be followed by lowering returns, because only well informed investors with specific knowledge about a stock will short it. The second hypothesis states that short selling increases stock volatility. The belief is that because short selling is initiated with the expectation that stock prices will go down, if too many traders put shorting pressure on a company the prices can spiral

downwards and volatility will increase. Short selling should be used when a trader has fundamental evidence that a price drop can be expected. However, regulators fear that during times of falling markets traders will take advantage of short selling and start selling based purely on the fact that prices are going down because the whole market is going down.

The hypotheses are tested using two OLS regressions. two alternative measures are used for abnormal returns and short selling to increase the robustness of the results. Furthermore, several time periods are tested to see if short selling affects returns and volatility over longer periods of time. The results for hypothesis 1 show no evidence of an effect of short selling on abnormal returns. This is in contrast with Desai et al. (2002), Christophe et al. (2004), and Diether et al. (2009), who do find a significant negative relationship between short selling and abnormal returns. However, the results are in line with Daske et al. (2005) who find no relationship between short selling and abnormal returns. Therefore, hypothesis 1 is rejected.

Comparing results to previous studies in the Netherlands there are some interesting points. Gerritsen and Verdoorn (2014) find that shorted stocks have lower returns compared to the market in a portfolio setting. However, this effect appears to be driven by stocks with large short interest. When the returns are weighted according to market value the relation is no longer significant. Gerritsen and Galema (2017) on the other hand find that small short positions predict future underperformance of stocks. It has to be noted that Gerritsen and Galema (2017) had access to the entire SSR database as it was accidentally leaked.

The second hypothesis is tested using three different time periods for volatility. 5 days, 10 days and 22 days after the short position is opened. The results for hypothesis 2 are quite interesting. The 5 and 10 day periods show no significant relationship between short selling and stock volatility. However, the 22 day period showcases a surprising significantly negative relationship between short selling and stock volatility. The results for hypothesis 2 are not in line with Henry and McKenzie (2006) who find a positive relationship between short selling and volatility, but they are in line with Chang et al. (2006) and, Saffi and Sigurdsson (2011) who find no evidence that short selling increases stock volatility. There may even be some evidence suggesting that short selling decreases stock volatility. In conclusion, both hypotheses are rejected.

Additionally, a control variable that tested whether changes to the short positions or appearances of new short positions in the designated time periods had an effect on returns and volatility, showed significant results. This indicates that when multiple short positions are

opened or changes to existing short positions are made in a short period of time it will have an impact on subsequent returns and volatility.

8.2. Limitations

There are some limitations to this study which will be described in this section. The first limitation of this study is related to the sample time period. Since the introduction of the Short Selling Regulation happened in November 2012 there is not a lot of data to choose from in the Netherlands. However, this study only looks at the year 2017. Although many studies use a sample period of only a year it may be interesting to test if results are consistent across multiple years. This could increase generalizability and robustness of the results.

A second limitation of this study is the disclosure of the used short positions. This study only uses short positions of 0.5% or higher as these are the only positions that are disclosed to the public. However, AFM does keep a register with short positions of 0.2% or higher which is not disclosed to the public. In January 2017, AFM accidentally disclosed the complete register to the public. Gerritsen and Galema (2017) studied this event in the Netherlands and showed that over 69% of short positions are actually between 0.2% and 0.5% as short sellers intentionally seem to keep their positions below the 0.5% mark. This indicates that a lot of information is lost by only looking at the public positions.

A third limitation in this study is the static nature of the control variables. This relates back to the first limitation regarding the sample period. The control variables used in this study are calculated on an annual scale. However, the sample period is only a year long so the control variables MCAP, BTM and LEV only have one observation per company. For example, a company that appears in the sample 50 times will have the same MCAP, BTM and LEV for those 50 observations. Increasing the sample period to multiple years could mitigate this limitation as the control variables would be different across different years.

A fourth limitation of this study is the measurement for stock volatility. This study uses the standard deviation of returns as a measure for stock volatility. This method is quite simple and static. A GARCH model uses more dynamic elements and assumes that volatility is conditional on several factors. This conditionality allows GARCH models to more accurately estimate volatility. However, a lack of expertise with this kind of model is what resulted in the choice for a measure using the standard deviation of the returns.

8.3. Recommendations

One recommendation as mentioned earlier is the sample period. It could be interesting to look at the entire life span of the Short Selling Regulation from November 2012 up until now to see if results are consistent across several years. A second recommendation is examining the possibility of obtaining the entire short selling register including positions above 0.2% from AFM. As stated over 69% of short positions are actually below 0.5% indicating that a lot of short selling information is actually missing. A final recommendation is to analyze the relationship between multiple short positions taking place or being changed in a short period of time and its effect on stock returns and volatility. This study has shown that multiple short positions occurring in a certain time period have a significant effect on the stock returns and volatility of this time period. It could be interesting to examine how this relationship works more in depth.

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APPENDICES

Appendix A List of shorted companies

AEGON N.V.	Akzo Nobel N.V.
Altice Europe N.V.	Aperam
ARCADIS N.V.	ArcelorMittal S.A.
ASM International N.V.	Basic-Fit N.V.
BE Semiconductor Industries N.V.	BinckBank N.V.
Brunel International N.V.	Flow Traders N.V.
Fugro N.V.	Galapagos N.V.
Gemalto N.V.	Heijmans N.V.
Intertrust N.V.	Koninklijke Ahold Delhaize N.V.
Koninklijke BAM Groep N.V.	Koninklijke Boskalis Westminster N.V.
Koninklijke KPN N.V.	Koninklijke Vopak N.V.
Koninklijke Wessanen N.V.	NN Group N.V.
NSI N.V.	OCI N.V.
Ordina N.V.	PostNL N.V.
SBM Offshore N.V.	Sif Holding N.V.
Signify N.V.	Takeaway.com N.V.
TKH Group N.V.	TomTom N.V.
Unibail-Rodamco	Van Lanschot Kempen N.V.
Wereldhave N.V.	

Appendix B Descriptive statistics including outliers

Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
ABRET(0,1)	1066	-21.596%	33.115%	-0.019%	2.142%
ALT_RET(0,1)	1066	-21.576%	32.992%	-0.029%	2.140%
ABRET(0,5)	1066	-25.370%	43.922%	0.417%	4.491%
ALT_RET(0,5)	1066	-25.087%	43.752%	0.389%	4.497%
VOL(0,5)	1066	.028%	2.179%	.248%	.202%
VOL(0,10)	1066	.029%	1.649%	.252%	.177%
VOL(0,22)	1066	.029%	1.203%	.273%	.175%
SHORT	1066	0.000%	6.280%	2.019%	1.471%
NRSHORT	1066	1	9	2.55	1.609
LOG_MCAP	1066	18.59	23.96	21.302	1.005
BTM	1066	-.128	2.278	.666	.381
LEV	1066	-35.370	20.436	1.476	7.807
OPTIONS	1066	0	1	.92	.270
VOLWEEK	1066	.032	2.352	.276	.233
VOLMONTH	1066	.041	1.216	.285	.161
MULTIPLE(0,5)	1066	0	4	1.64	1.350
MULTIPLE(0,10)	1066	0	9	3.08	2.425
MULTIPLE(0,22)	1066	0	21	6.24	4.791

Descriptive statistics of all variables including outliers. N is the number of observations.

Appendix C Histogram normal distribution residuals