THESIS

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MASTER ACCOUNTING AND AUDITING

The Repercussions of Short Selling

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Abstract

This paper examines whether the prospect of short selling benefits the market by analyzing the ex-post and ex-ante effects of short selling in information asymmetry. To conduct the research a natural experiment is utilized. The experiment, denoted as Reg SHO, was conducted by the SEC to carefully investigate the effects of short selling. Reg SHO was constructed as a pilot program whereby each third stock of the Russell 3000 index, ranked by trading volume, was assigned in the pilot group. These stocks were exempted from short selling restrictions from May 2005 until July 2007. In contrast, the non-pilot group, comprised of the remaining stocks of the index, experienced no change in the policy and continued trading with short selling restrictions. While comparing between the pilot and non-pilot firms in a difference-in-difference design, the findings of this paper provide strong evidence that short selling, albeit the surrounding controversy, can decrease the information asymmetries that prevail in the market.

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"There's nothing evil, per se, about selling things short. The situations in which there have been huge short interests, very often have been later revealed to be frauds or semi-frauds."

– Warren Buffet.

1. Introduction

Previous research indicates that short selling affects important attributes of capital markets such as stock liquidity, price discovery and overvaluation of stock prices. Considering such premises, a wide group of market participants supports the prospect of short selling as means of gate-keeping the market quality. However, given that there are significant concerns associated with such a trading strategy, market regulators have continuously imposed restrictions on short selling (Fang, Huang, & Karpoff, 2016). The aim of this paper is to examine whether the prospect of short selling benefits the market, by providing an exploratory study on whether short selling influences information asymmetry. Therefore, while building upon prior research, the following question is analyzed:

Does short selling influence information asymmetries that prevail in the market?

In order to conduct this research a natural experiment[1] is exploited. The experiment was conducted by the Securities and Exchange Commission (SEC)[2] to investigate the effects of short selling. On September 7, 2004, the SEC passed on the Regulation SHO (Reg SHO) which was constructed as a pilot program. Each third stock of the Russell 3000 index, ranked by trading volume, was assigned as a pilot stock and from May 2005 until July 2007 these stocks were exempted from short selling restrictions. The non-pilot group which was comprised by the remaining stocks of the index experienced no change in the policy and continued trading with restrictions.

The characteristics of this regulation create an optimal setting to study the consequences of short selling, mainly because of three reasons. First, the SEC conducted a natural experiment by randomly assigning stocks into pilot (treatment) and non-pilot (control) stocks. This division mitigates the complications of directly estimating short selling costs, a notably troublesome task (Fang et al., 2016). Secondly, the Reg SHO produced a pure exogenous shock as there is no evidence that firms themselves influenced it (Fang et al., 2016). Third, the program creates an ideal situation to exercise a difference-in-difference[3] (DiD) design, whereby the effects of short selling can be investigated while controlling for any unobserved

[1] an observational study in which the experimental conditions (treatment versus control) are beyond the control of the researcher, but are assigned as-if-random

[2] the responsible authority for stock exchange regulation in the U.S

[3] DiD is a statistical technique used in quantitative research to study the differential effect of a treatment on a 'treatment group' versus a 'control group'

confounding events.

To provide a thorough analysis, this paper investigates the effect of short selling in information asymmetry in two instances, particularly ex-post and ex-ante. The terms ex-post and ex-ante refer to the point-in-time when short selling affects information asymmetry. Therefore, the ex-post effect is determined by analyzing the information environment "after" the information has been released in the market. Thus, the information contained in stock prices is investigated. On the other hand, the ex-ante effects are determined by examining the influence of short selling in information asymmetry "before" the information has been released. More specifically, the ability that short sellers have to constrain management discretion with regard to investment efficiency and earnings management, is investigated in this instance.

The results obtained in this paper provide a strong basis for future research and the necessary means to discuss whether short selling influences information asymmetry. With regard to the ex-post effect, the findings confirm that pilot stocks experienced an increase in the information contained in the abnormal returns. In addition, regarding the short selling influences as an ex-ante mechanism, the obtained results are contradicting. The propensity to meet or beat the earnings benchmarks significantly decreases for the pilot firms during the Reg SHO; however, the evidence suggest that investment efficiency, instead of increasing, decreases in these firms. Even though the results suggest that short selling negatively influences information asymmetry in the investment efficiency analysis, we argue that these findings pertain to the methodology used in this instance. This limitation is further established in the concluding section.

Furthermore, two additional analysis are performed. The first one determines that the information contained in stock prices is enhanced asymmetrically given the direction of the earnings news. In particular, the information contained in stock prices is higher when the earnings surprise is negative. This is an important finding because prior research such as Ball and Brown (1968) regard negative news as not persistent and that investors do not value this news as important. The second analysis looks at whether short sellers aggravate a price decline. While portioning between good and bad M&A investment reactions, no trace is found for such a proposition.

Last but not least, the findings of this paper are tested for robustness in the measurement of the dependent variable and the validity of the DiD design. The results suggest that the findings do not depend on the measurements of the dependent variable and that the DiD design provides a good methodology to conduct this research.

The following sections of this paper are structured as follows. Section 2 provides a compre-

hensive overview of information asymmetry and how does it prevail in the market, while section 3 provides the theoretical background on short selling and its impact in capital markets. Furthermore, section 4 provides the hypothesis development where the potential relationship between short selling and information asymmetry is drawn. Section 5 and 6 provide a detailed description of the research design, sample and data. Sections 7, 8 and 9 discuss the main findings of this paper complemented by the additional and robustness analysis. Last but not least, section 10 and 11, describe the conclusion and limitations of this paper.

2. Information Asymmetry

An essential part of any modern economy is to allocate its resources by matching savings with investment opportunities (Palepu, Healy, & Peek, 2013). According to Palepu et al. (2013), economies that utilize this process efficiently, can exploit new business opportunities and create wealth at a rapid pace. In contrary, economies that fail to achieve such an allocation, expropriate and deteriorate their resources. Figure 1 provides a schematic overview that better visualizes the resource allocation process.

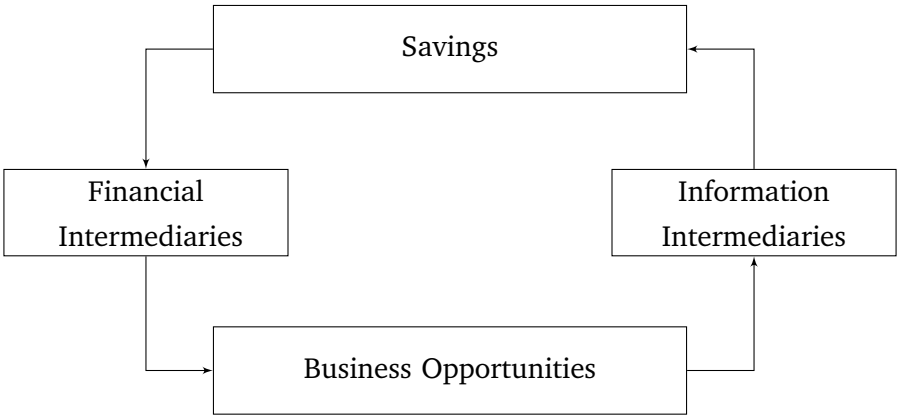

Figure 1: A simplified setting of Capital Markets

In a simplified setting of capital markets, there are two components. On the one side, there is a wide distribution of savings among households. Many existing and potential companies, that lie in the opposite of the framework, want to obtain those savings in order to finance their businesses (Healy & Palepu, 2001). Although there are economic incentives for both parties to transact with each-other, matching savings and businesses impedes because of two important reasons.

First, an adverse selection problem exists, as the management of the company possess more information about the business than households (hereafter, investors) do. Thus, in order to reap as much funding as possible, managers are biased to overvalue their current or poten-

tial investment opportunities (Healy & Palepu, 2001). This information problem (i.e. market for lemons), was initially described by Akerlof (1978).

Secondly, even in the case where investors and investment opportunities are matched, problems still prevail as managers have selfish incentives to make decisions that reflect their own interest rather than investors interests (Jensen & Meckling, 1976). This leads to a so called moral hazard problem, and occurs as a consequence of investors not playing a role in governing the company (Healy & Palepu, 2001).

There exist a number of possible solutions to adverse selection and moral hazard problems such as the development of intermediaries depicted in Figure 1 (Palepu et al., 2013). Financial intermediaries such as banks or mutual funds, have a critical position as they pool the funds from savers and use their expertise to make informed investment decisions (Palepu et al., 2013). Information intermediaries, on the other hand, such as auditors and financial analysts, play a crucial role by ensuring the integrity of information being presented and giving useful reports regarding investment opportunities (Palepu et al., 2013).

Furthermore, according to Healy and Palepu (2001), there are certain mechanisms that can reduce the informational problems that prevail in the market. For example, the usage of contracts that seek to align the interests of transacting parties, such as performance-bonuses, provide incentives to management to disclose all their private information (Healy & Palepu, 2001). In addition, the establishment of a strong board of directors creates a corporate environment that oversees and reduces the ability of management to make self-interested decisions.

This paper examines the activity of short selling as an additional factor into safeguarding the market. More specifically, this paper is focused at whether short selling can influence information asymmetry, ex-post and ex-ante. Thus, this research intends to provide genuine insights into the effects and consequences of short selling, and to potentially contribute to the betterment of knowledge of the market participants. Additionally, this paper complements the academic literature on short selling.

3. Theoretical Background

Short selling is a trading strategy that allows an investor to sell a security that they do not own with the premise to return it in the future (Asness, 2004). The rationale that drives a short selling activity is the opposite of what drives investors to buy a security. When investors buy a stock, they take a so-called long position on it because they believe that the price of the stock will increase in the future (Berk & DeMarzo, 2007). On the other hand,

when investors engage in short selling activities they take a short position on the stock (Berk & DeMarzo, 2007). This position is taken when investors have pessimistic views regarding the future of the company and anticipate a gradual market price decline.

Even though short selling is largely ungraspable, the mechanism behind it is fairly simple to understand. Imagine an investor who anticipates that the stock price of a company, which is currently trading at 10 dollars, is overvalued and will eventually decline. The investor can trade upon his pessimistic belief by engaging in following transactions. He or she can borrow and immediately sell the stock, gaining 10 dollars from the sale. To open such a position a short seller, in most of the cases, has to contact his broker or directly borrow from another investor (Asness, 2004). As the risks of short selling are theoretically unlimited[4], the short seller has to provide the broker a margin account that serves as a collateral[5] (Asness, 2004). If the price of the security drops to 5 dollars per share, the short seller buys back the stock and returns it to the lender. Consequently, the trader makes a 5 dollar profit, minus any commissions and margins of interest that he has to pay for the deal.

3.1. Contradiction and Price Tests

Despite the fact that short selling is allowed in almost half of the exchanges in the world, its permission always come along with its contradiction. Much of the controversy, however, stands upon moral ground issues and ethical concerns that are associated with short selling activities. Short sellers, at least a part of them which is usually denominated as bear raids, try to disseminate and maximize the negative publicity of a firm by spreading rumours about the company.

This ethical indignation against short selling is long-due, and has initiated around four centuries ago with the first asset price bubble (Sharma et al., 2017). The aftermath of the 'Dutch Tulip Mania', depicted that the activities that short sellers took, magnified the negative effects and caused a violent market downturn (Sharma et al., 2017). Nevertheless, short sellers are criticized for speculating against favorable market outcomes even during good economic time-periods. This because 'betting' against optimistic behavior is considered immoral and challenges economic growth (Sharma et al., 2017).

Aware of the market ambiguity, regulators have always been cautious towards the prospect of short selling (Diether, Lee, & Werner, 2009). In the U.S., the SEC has introduced constraints on short-selling since 1938 (Diether et al., 2009). Rule 10a-1, commonly known as the tick-test, was the first one to be implemented. The objective of this rule was to signif-

[4] as short sellers trade on borrowed stock, they have to close their position at some point time; however, the price of the security can increase infinitely

[5] and pays interest during the time the position is opened

icantly refrain short sellers from exacerbating a one time price decline (Fang et al., 2016). Under the rule 10a-1, a short sale can occur at a price higher than the last traded price, or when there was no change in the last price, the short sale can only occur if the closing price was higher than the preceding one (Fang et al., 2016). Consider a stock that is traded[6] at 10 dollars per share. If an investor wants to take a short position on that stock he or she can only do so if the latest trading price before the LT was anything lower than 10 dollars. If the latest price before the LT was also 10 dollars, the investors can engage in short selling if and only if the last different price was lower than 10 dollars.

In 1994, the SEC mandated another short sale restriction (Rule 3350), however applicable only to the NASD[7] securities (Fang et al., 2016). In essence this rule is similar to the uptick rule, however a minor change exists. The rationale behind this difference, were the results of a study commissioned by NASD on short sale effects (Fang et al., 2016). This study revealed that if SEC were to adopt the same tick tests on Nasdaq securities, it would significantly hinder their trading (Fang et al., 2016). Under this rule, the restrictions on short selling are only based at the bid[8] prices (Fang et al., 2016). Consider the same stock from the previous example. Under the Rule 3350 a short sale can only occur if the latest bid price before the last bid was lower than 10 dollars (Fang et al., 2016). That is why this rule is commonly known as the bid-test.

On September 7, 2004, surprisingly, the SEC took a different path from its long-due standpoint, and passed on the Regulation SHO (Reg SHO). The Reg SHO was the finalization of the concept realise that the SEC issued in 1999. In this release, the SEC declared that short selling might benefit the market when the market rises by a large amount, as means of restraining bubbles[9]. In addition, it stated that price tests had significantly impacted the liquidity of share prices.

Reg SHO's purpose was to reduce the restrictions on short selling in order to adequately capture the market effects of relieved short selling (Fang et al., 2016). Under the Reg SHO program, each third stock of the Rusell 3000 index, ranked by volume, was assigned as a pilot stock. From 2005 to 2007, pilot stocks were exempted from short-sale price tests. The program effectively ended on mid-2007. Interesting enough, the aftermath of Reg SHO suggested results that advocated unrestricted short selling. Consequently, the SEC favored and

[6] denoted as last trade (LT)

[7] National Association of Securities Dealers

[8] the prevailing prices in the market are comprised by bid and ask prices (Berk & DeMarzo, 2007). A bid price is the price that investors get when selling a security while an ask price is the price that buyers get when buying a security. Whether the uptick makes no distinction between ask and bid prices and only looks at the latest trading price, Rule 3350 focuses only at the bid prices.

[9] in 1999 the internet bubble was at its peak

permanently mandated the policy.

However, the mandating of unrestricted short-selling caused a considerable backlash, and a large group of market participants lobbied against it (Fang et al., 2016). Most of the corporate executive managers stated that short selling constraints should be brought back as soon as practical (Fang et al., 2016). The Wall Street Journal and the New York banking oversight, stated that the SEC was not impartial in evaluating the short selling effects and that the introduction of Reg SHO increased the volatility and disrupted markets (Fang et al., 2016). The magnitude of the distress was so large that even the presidential campaign, Senator John McCain, was immersed by accusing the SEC for 'turning the capital markets into a casino'. This disturbance resulted in a reversion of rules, and the old restrictions were brought back in 2010.

3.2. Consequences of Short Selling

In order to able to understand and ascertain the ability that short selling has in influencing the information asymmetry, its impact on the financial markets is examined. Theoretically, short selling affects the following attributes of stock prices: liquidity, price discovery and opportunistic overvaluation (Beber & Pagano, 2013). In the following subsections, a comprehensive analysis of these impacts is drawn, complemented by the available empirical evidence.

3.2.1. Liquidity

According to Beber and Pagano (2013), the effect of short selling on the stock liquidity is somehow ambiguous. This uncertainty derives from two principles: restriction and prohibition effect (Diamond & Verrecchia, 1987). Whether one effect dominates the other, largely depends on the magnitude of short selling restrictions. Diamond and Verrecchia (1987), investigate the trade-off between these two effects, by analyzing them in a variant of the Glosten and Milgrom (1985) model.

On the one hand, if short selling is hindered but not completely banned, there will be additional costs imposed to short sellers (Diamond & Verrecchia, 1987). Hence, only informed investors with superior knowledge and stronger beliefs would engage in short selling activities (Diamond & Verrecchia, 1987). These restrictions create an asymmetry between informed and uninformed investors and therefore change the composition of the pool of short sellers (Beber & Pagano, 2013). A lower fraction of uninformed short sellers, in principle, improves the efficiency of price discovery and improves the liquidity of the stock (Beber & Pagano, 2013).

On the other, if short selling constraints are so large that eventually cease it, it would crowd-out both, informed and uninformed short sellers (Diamond & Verrecchia, 1987). The restriction of informed investors would prevent bad news trading and thus, reduce the efficiency and timeliness of price revelation (Diamond & Verrecchia, 1987). Such deferred uncertainty about the performance of the firm, tends to decrease the liquidity of the stock (Beber & Pagano, 2013).

The available evidence, unlike theory, is one-sided and confirms that the restrictions on short selling are associated with a simultaneous decrease in the liquidity of the stock. However, it should be noticed that this evidence pertains only to the prohibition effect. Boehmer, Jones, and Zhang (2008), investigate the liquidity consequences, measured by the bid-ask spread, of the short selling ban in the United States from September 18, 2007. They evaluate the differences in stocks that were targeted and stocks that were not targeted by the ban. Implementing a panel data approach, Boehmer et al. (2008), find evidence that the liquidity of the stock decreased significantly during the banning period.

These findings are also supported by Kolasinksi, Reed, and Thornock (2012), who examine the influence of naked short selling restriction in June 2008. Kolasinksi et al. (2012), confirm the predisposition that a ban on short selling is related with an adverse outcome on the liquidity of stocks. Additionally, Marsh and Payne (2012), study the effect of restricted short selling in the United Kingdom. They found evidence that when financial stocks where excepted from short selling, in the 2008 financial crisis, the bid-ask spread and market depth deteriorated significantly relative to non-financial stocks.

3.2.2. Price Discovery

In contrary to the liquidity attribute, the effect of short selling on price discovery is more apparent. As previously discussed, based on the model of Diamond and Verrecchia (1987), the prevention of trading upon bad news contemplation, moderates the market activity. Hence, informed investors who have strong beliefs that a firm faces an adverse future, are unable to reflect this information in the stock prices when short selling is restricted (Beber & Pagano, 2013). This in turn, impairs the process of price discovery (Beber & Pagano, 2013).

More interestingly, based on the way that short selling restrictions are usually developed, this price revelation slows down more in under-performing markets than in over-performing markets (Diamond & Verrecchia, 1987). However, this is indeed what market regulators want to achieve with these constraints. The uptick rule, for example, does not allow bad news to incorporate instantaneously in the stock prices (Diamond & Verrecchia, 1987). The rationale behind this important factor is to crowd-out unwarranted beliefs and to distinguish between negative herding behavior and fundamental information (Diamond & Verrecchia,

1987).

The available evidence in the regard of short selling and the speed of price discovery is consistent with the theoretical background. Bris, Goetzmann, and Zhu (2007), conduct a cross country analysis over 46 different equity markets, and report evidence that concludes a significant improved efficiency in the market reactions. Bris et al. (2007) find that in countries where relieved short selling is practiced, the timeliness of the incorporation of negative information is enhanced. This suggests that bans on short selling impair price discovery.

These findings are in conformity with several other studies. Reed (2002) suggest that prohibited short selling generates an asymmetry in market reactions to earnings announcement. Reed (2002) reports an irregular price adjustment when short selling bans are present. Moreover, Saffi and Sigurdsson (2010) and Boehmer and Wu (2012), suggest that the capability to engage in short selling activities enhances the efficiency of information in equity markets.

3.2.3. Overvaluation

According to Miller (1977), the existence of short selling constraints would lead to an overvaluation of stock prices. The prediction endures from the rationale that if investors have heterogeneous expectations regarding the future performance, in markets where short selling is restricted, the share prices would only reflect the valuation of investors that already own the stock (Miller, 1977). Therefore, the valuations of investors that do not own the stock and have bearish forecasts are not reflected on the share prices. Thus, when such constraints prevail in the market, prices rise above the level that would reflect all of the available information (Miller, 1977).

However, the mechanism behind the prediction of Miller (1977) fails to hold on the previously mentioned rational model of Diamond and Verrecchia (1987). Under rational expectations, markets are close to a strong form of efficiency, therefore the evaluation of uninformed investors regarding the future performance need not be biased, as they also take into consideration the restrictions that bearish investors have (Diamond & Verrecchia, 1987). Hence, the prices that hold in the equilibrium, are not overpriced (Diamond & Verrecchia, 1987).

In addition, the ambiguity of Miller (1977) predictions is contingent not only on the premise of rational expectations, but also on the assumptions of risk behavior. According to Bai, Chang, and Wang (2006), the relation between asset prices and investor's valuations ignores the way risk-assessment affects perceptions. Bai et al. (2006) states that the available literature makes the false assumption that the marginal investors are risk neutral. They argue that risk is an important determinant for asset prices, and that short sale restrictions influence the investor's risk assessment to the firm's fundamentals (Bai et al., 2006). Investors assign

relatively more risk to stocks where the price discovery process is untimely and slow (Bai et al., 2006). If investors are risk averse they become less certain about the information and the increase in risk causes the price to decline (Bai et al., 2006).

Thus, when the degree of information asymmetry and the slowdown of price discovery is significant, short-sale constraints can, in fact, lower asset prices. This prediction is prevalent in the model developed by Hong and Stein (2003), as well. According to this framework, short-selling can aggravate a decline in prices, rather than prevent it. The accumulated unrevealed negative information of investors who would have engaged in short sales surfaces only when the market begins to drop, thereby exacerbating the price decline (Hong & Stein, 2003).

Unfortunately, alike theory, the empirical evidence of short selling effects on overpricing, is mixed. Jones and Lamont (2002) use data of the institutional costs on short selling in the NYSE for a period of seven years from 1926 to 1933, and find supporting evidence that short selling restrictions are associated with overpricing. Their results are further enforced and validated by Chang, Cheng, and Yu (2007), who examine the stock price data from the Hong Kong market. In addition, Bris et al. (2007), report a decrease in the negative skewness for the overall market returns when short selling constraints are present. However, their results do not hold for individual stock prices. In contrast, Boehmer et al. (2008) and Diether et al. (2009), investigate the stock market reactions after the uptick rule removal, and find no significant evidence on this association.

Recent evidence regarding the short selling ban of 2008, which followed after the financial crisis, provides likewise complicated and ambiguous conclusions. Boehmer, Jones, and Zhang (2013), report significant positive association between stock prices and the announcement of the ban. Nonetheless, Boehmer et al. (2013) acknowledge the fact that their results may be spurious due to concurrent events, such as the release of the Troubled Asset Relief Program (TARP). Boehmer et al. (2013) concerns are further enforced by the realization that stocks that were later added in the ban list, went under no such positive returns. In addition, Harris, Namvar, and Phillips (2009), try to overcome this issue by controlling for these events. While implementing a TARP index, Harris et al. (2009) conclude that stocks that were banned from short selling experienced positive abnormal returns. However, these abnormal returns endured even after the ban was lifted. Furthermore, Zhao (2007) study the effect of short selling with regard to overvaluation during the Reg SHO program. The results suggest that when removing the short sale restrictions, stock overvaluation is mitigated by at least 2% annually (Zhao, 2007).

4. Hypothesis Development

The first hypothesis speculates on the ex-post effect of short selling in information asymmetry. As mentioned in the introduction section, the ex-post association is determined by examining the information contained in stock prices. According to the efficient market hypothesis, information asymmetry is decreased when stock prices reflect all of the available public information ((Fama, 1965), Roberts (1967) and Malkiel (1989)). Given that short selling attributes to changes in liquidity, price discovery and overvaluation, it can be argued that when short selling is relieved, the information incorporated in stock prices, changes. If short selling, unequivocally, influences these three attributes, it removes the asymmetry across bullish and bearish investors. Thus, consequently the stock prices would reflect a larger pool of beliefs. However, as demonstrated in the previous section, the theoretical and empirical impacts of short selling are ambiguous.

First, the impact on liquidity largely depends on the restriction and the prohibition effect (Diamond & Verrecchia, 1987). If the uptick rule and the bid-test had a prohibition effect, then their removal would definitely enhance the information in the stock prices. However, based on the way that restrictions on short selling are designed, it can be inferred that they have a restriction effect and not a prohibition one. Thus, the effect that a lift of such restrictions has in information efficiency, is ambiguous.

Secondly, the impact of short selling in overvaluation is also dependent on several considerations. If the predictions of Miller (1977) hold, then stock prices reflect only the beliefs of bullish investors. Given such asymmetry in what stock prices reflect, information contained in stock prices decreases. However, as previously depicted, the predictions of (Miller, 1977) fail to hold in a rational expectations model and on the assumption of risk behavior (Diamond & Verrecchia, 1987) and (Bai et al., 2006). Furthermore, the empirical evidence in this instance, as theory, is mixed. Thus, as in the case of liquidity attribute, the effect that a lift of short selling restrictions has in information efficiency is ambiguous.

Lastly, even though the attribute of short selling in price discovery is more apparent, it largely depends on the impact that short selling has on liquidity and overvaluation. Therefore, the ambiguity in this is instance is present as well. Given these uncertainties it cannot be concluded whether there exists an ex-post association between short selling and information asymmetry. Therefore, the first hypothesis of this paper is formed in the null form.

H1: Short selling does not have an ex-post effect in information asymmetry.

The second hypothesis, speculates on the ex-ante relationship between short selling and information asymmetry. This association is determined by the ability that short sellers have to

restrain managerial behaviour ex-ante. To develop this hypothesis, the attention is placed in short selling itself and not on the effects that short selling has. Short sellers announce and disseminate bad news in order to reap the benefits of a price decline. According to Chang, Lin, and Ma (2018), short sellers are somehow analogues to price analysts. As a matter of fact, Jensen and Meckling (1976) state that these two important information suppliers, are commonly viewed as gatekeepers in the capital markets.

Analysts serve as a mechanism which reduces asymmetric information and enhances management's desirable behavior (Chen, Harford, & Lin, 2015). They provide reports to investors by analyzing public information with the mere intention of gaining insider knowledge for the firm (Palepu et al., 2013). According to Chang et al. (2018), having more active short sellers, is similar to having more analysts following a firm. Their increased number scrutinizes management's decisions to a greater extent. However, what distinguishes them is that, unlike analysts, short sellers risk their own capital in their assessment. Thus, they do not suffer from well known conflicts of interest (Francis, Hanna, & Philbrick, 1997), and consequently produce more reliable signals (Chang et al., 2018).

Based on the above analysis, the short selling prospect is anticipated to present larger threats for managers and their decision discretion. Thereby, the second hypothesis is formulated, in the alternative form.

H2: Short selling has an ex-ante effect in information asymmetry.

5. Research Design

To answer the first hypothesis, the information contained in the stock prices around earnings announcements, is compared between pilot and non-pilot firms, in a two-step approach. The first step incorporates an event study to effectively capture the investors reactions to abnormal earnings for both firm-groups. This is done by estimating the surprise factor in the market returns. The surprise factor can be calculated as the realized returns minus the expected returns. To estimate the expected returns, the CAPM[10] model is used as following:

$$R_{it} = \alpha + \beta(R_{mt}) + e_{it} \tag{1}$$

The alfa and beta coefficients of the model are approximated by regressing each firm's daily returns with the market daily returns, on a thirty day period on the time span of [-60, -31] relative to the announcement date. The S&P 500 index, which is comprised from the biggest 500 U.S. companies, is used as a proxy for the overall market return.

[10] Sharpe (1964), Lintner (1965), Black (1972)

Subsequently, the expected returns are estimated in the period of [-1, +1] around the event date. The actual stock returns are then compared with these expected returns and the abnormal return is calculated as the difference between them. Consequently, cumulative abnormal returns (CAR) are computed using the formula below:

$$CAR_{it} = \sum_{t-1}^{t+1} AR_{it} \tag{2}$$

Following the estimation of CAR, the relationship between market returns and earnings information, hence the earnings response coefficient, needs to be computed. This is done through regressing the abnormal earnings (AE) with CAR. There are generally two ways to measure abnormal earnings: the time series approach and the analyst forecast. In this paper the latter approach is used given that it is less prone to econometric issues. Therefore, to calculate AE, we compute the difference between the actual earnings per share and the mean estimate forecast. Subsequently, CAR is regressed with unexpected earnings and several control variables based on prior literature.

$$CAR = \alpha + \beta_1(AE) + CONTROLS \tag{3}$$

The beta of the equation represents the earnings response coefficient. In other words, the manner in which the market response to a surprise factor in book earnings. The control variable represents all the variables that moderate the earnings response coefficient. Previous research has shown that the relationship between earnings and stock returns, varies cross-sectionally and inter-temporally; for example, see Kormendi and Lipe (1987), Biddle and Seow (1991) and Nichols and Wahlen (2004).

Stattman (1980) and Chan, Hamao, and Lakonishok (1991), show that growth opportunities, measured by the market-to-book ratio are highly correlated with stock returns. This is because investors are more prone to invest in companies with a higher growth prospect. Secondly, as shareholders want a bigger piece of return than debt-holders, they are more likely to invest in firms with lower leverage ratios (Bhandari, 1988).

In addition, following Sharpe (1964), Lintner (1965), Black (1972) and Banz (1981) investors want to be compensated for the risk of investing. Thus, they require higher returns for firms with smaller size or higher risk. Furthermore, according to Fama and French (1995) there exists an abnormality in the market that leads to firms that are lower in size to obtain higher returns than bigger firms. And last but not least, the similarity of expectations affects the way in which investors anticipate news and the abnormal returns surrounding announcement events (Nichols & Wahlen, 2004).

All these control variables affect CAR either directly or in a moderating way by influencing the earnings response coefficient. Therefore, in order to provide a more effective and complete research, all these control variables together with a respective interection effect with AE will be added in the analysis.

The second step, pertains to comparing the squared residuals[11] of the ERC regression across pilot and non-pilot firms. The squared residuals, in general, show the part in the dependent variable that cannot be explained by the factors implemented in the first regression. In this analysis, the higher the squared residuals, the more information is contained in stock prices that cannot be attributed to the abnormal earnings or control factors. Therefore, if short selling affects information efficiency, the squared residuals should should be higher for the pilot firms, suggesting more information contained in stock prices. In order to compare between firm-groups, the residuals of are incorporated in the DiD design, in the following manner:

$$RESQ = \alpha + \beta_1(PILOT) + \beta_2(DURING) + \beta_3(PILOT \times DURING) \tag{4}$$

The variable RESQ represents the squared residuals. The PILOT is a dummy variable which determines whether the stock is a pilot or a non-pilot stock. Similarly, the dummy variable DURING determines whether the time period is before or during the Reg SHO. The coefficient of interest, however, is the third one which represents whether there is a difference in residuals between the treatment and the control group, while taking general time trends in account.

To answer the second hypothesis two aspects of the ex-ante effect of short selling in information asymmetry, are examined. The first analysis investigates whether short selling improves the managerial decisions with regard to investment decisions. To measure investment efficiency we focus on the mergers and acquisition announcements. The abnormal returns surrounding these M&A events depict investors perceptions regarding management investment decisions (Chang et al., 2018). According to the expectations of this paper, given that short selling produces threats to managers, it should, ideally, make managers pursue better investment decisions. Therefore, the market should react relatively more positively on these announcements for pilot firms.

To answer such a proposition a similar approach with the first hypothesis is followed. First, market model adjusted returns are estimated in the time span of [-60, -31] prior to announcement day. Thereafter, the cumulative abnormal returns are computed around the event window of [-1, +1] days relative to the announcement. To finalize the methodology,

[11] the focus is on the squared residuals as we are interested on the "absolute" difference between the realized CAR and the fitted value

the CAR are regressed in the DiD design while distinguishing between pilot and non-pilot stocks. The equation can be found below:

$$CAR_{it} = \alpha + \beta_1(PILOT_{it}) + \beta_2(DURING_t) + \beta_3(PILOT_i \times DURING_t) + CONTROLS \quad (5)$$

As previously described, the PILOT variable is constructed as a dummy that equals one if the firm is a pilot firm and zero if it is a non-pilot firm. The DURING variable is also a dummy which equals one if the time period is during the Reg SHO and zero if it is prior to that. The coefficient of interest is the third variable which measures the differences across the groups of firms during the Reg SHO. To enhance the robustness of the analysis, control variables of growth opportunities, capital structure, risk and size are included in the regression.

The second aspect considered in this instance is the effect that short selling has in reducing the management's propensity to meet or beat an earnings benchmark (MBE). This measure is widely used as a discretion proxy for earnings management. To quantify this propensity, the probability of meeting or beating the analysts forecast is considered. The MBE is constructed as a dummy variable which equals one if the actual EPS is greater or equal to the last median forecast prior to earnings announcement, and zero otherwise. Consequently, the following logistic regression is estimated to test the differences across groups:

$$MBE = \alpha + \beta_1(PILOT_{it}) + \beta_2(DURING_t) + \beta_3(PILOT_i \times DURING_t) + CONTROLS \quad (6)$$

The explanation of the dummy variables of PILOT and DURING are the same as in the prior equation. Similarly, the coefficient of interest in this regression is the third one which shows the incremental differences between pilot and non-pilot firms, while taking into consideration general time trends. Furthermore, the control variables that are included in this regression are numerous and are implemented from Ahmed, Neel, and Wang (2013). These control variables include growth opportunities, common equity change, capital structure, total debt change, sales turnover and size.

6. Sample and Data

In order to extract the necessary data, a variety of resources is used. First, the fundamental variables per each company are extracted, dependent on the analysis, either on a yearly or quarterly basis from Compustat/Capital IQ. In addition, the earnings announcement and analysts data are obtained from the I/B/E/S database. The stock prices per company and for the market are retrieved through Compustat/Capital IQ and CRSP. Last but not least, the SDC Platinum is used to obtain the merger and acquisition announcements per each company.

Table 1: Sample composition per each analysis

	Pilot Firms	Non-Pilot Firms
Panel A: Sample composition for the first hypothesis		
Firm-year observations extracted from Compustat (2000-2010)	7.216	15.838
Firm-year observations after dataset merging	5.236	10.921
Firm-year observations after period-subdivision	3.969	8.260
Deleted firm-year observations with missing values	(305)	(737)
Final sample for informational efficiency analysis	3.664	7.523
Panel B: Sample composition for investment efficiency analysis		
Firm-year observations extracted from Compustat (2000-2010)	7.216	15.838
Firm-year observations after dataset merging	2.056	4.250
Firm-year observations after period-subdivision	1.484	3.094
Deleted firm-year observations with missing values	(3)	(10)
Final sample for investment efficiency analysis	1.481	3.084
Panel C: Sample composition for meet or beat analysis		
Firm-quarter observations extracted from Compustat (2000-2010)	28.671	62.941
Firm-quarter observations after dataset merging	22.693	47.499
Firm-quarter observations after period-subdivision	16.253	33.863
Deleted firm-quarter observations with missing values	(52)	(70)
Final sample for meet or beat analysis	16.201	33.793

Note: *This table represents the sample composition for each analysis.*

Prior to creating the samples that are needed to test the hypothesis of this paper, three different datasets have to be distinguished. The first dataset is the one that contains the fundamental values for each company. The second consists of the analyst data, while the last one is a self-constructed dataset that is needed to calculate the abnormal returns. The latter one is comprised of the daily return factors per company, market returns and publication's dates for earnings and M&A announcements. The three datasets are merged with one-another dependent on the hypothesis being tested.

Table 1 represents the sample-construction for each hypothesis, subdivided into three distinct panels. Panel A illustrates the methodology used to create the sample for the first hypothesis. As it can be seen from Table 1, in the beginning there were 7216 of firm-year observations for the pilot firms and 15838 of firm-year observations for the non-pilot firms. These observations pertain to firms that were subject to the Reg SHO program and had information on fundamental variables in Compustat/Capital IQ. Subsequently, the primary dataset was merged with analysts and the abnormal return data. Thus, the observations got reduced at eventually 5236 firm-year observations for the pilot firms and 10921 firm-year observations for the non-pilot firms.

Furthermore, three approximately equally weighted periods are created. To maintain a similar approach with prior research such as Fang et al. (2016), the year 2004 is excluded from

the analysis given the fact that Reg SHO was announced on mid 2004, and therefore it may influence the results. The pre-program period contains observations from January 2002 until 2004, the during-period contains observations from 5th of May 2005 until 6th of July 2007, and the post-period contains observations from the day that Reg SHO ended until the end of 2009. It should be noticed that the post period is not investigated in the main analysis, but only used to evaluate the robustness of the DiD design. After having subdivided the sample in three different periods, all the companies that have missing values for the variables of interest are removed. The final version of the sample for the first hypothesis contains 3664 and 7523 firm-year observations for pilot and non-pilot firms, respectively.

Panel B represents the construction of the sample for the investment efficiency analysis. As in Panel A, the starting point comprises the firm-year observations for firms that were subject to Reg SHO and have fundamental information available in Compustat/Capital IQ. Thereafter, the primary dataset was merged with the abnormal return dataset. Hence, the firm-year observations gradually declined into 2056 and 4250 for the pilot and non-pilot group, respectively. Last but not least, the sample was subdivided into three sub-periods, as in Panel A, and the observations that had missing values for the variables of interest were deleted. Ultimately, Panel B is comprised of 1481 firm-year observations for pilot firms and 3084 firm-year observations for non-pilot firms.

The last panel, Panel C, is the one that comprises the sample for the MBE analysis. To create this sample, the starting point is the firm-quarter observations per each firm-group that have Compustat/Capital IQ fundamental's information. The periodicity in this case is quarterly and not annually. Therefore, there are significantly more observations Panel C than in the prior panels. The following steps taken to create the sample is to merge the primary dataset with I/B/E/S analyst's data, delete all the observations with missing values, and remove the years that are not necessary for the analysis. Eventually, the sample of Panel C is comprised with 16201 firm-year observations for the pilot firms and 33793 firm-year observations for the non-pilot firms.

After creating the samples, a univariate analysis is developed to compare the fundamental characteristics between firms. Following the same approach as Fang et al. (2016), firms are compared with respect to fiscal-year 2003, the year prior to Reg SHO announcement. In Table 2 the descriptive statistics for the each of the fundamental values used in this research, is given. The first panel provides information on mean, median and standard deviation while the second provides the t-statistics on group-mean differences. In order to account for outliers, each variable has been winsorized at the first and the last percentage of distribution.

As it can be seen in Table 2 , in the general sample there are 721 pilot firms and 1566

Table 2: Descriptive Statistics

	Panel A							
	Pilot Firms				Non-Pilot Firms			
	N	Mean	Median	SD	*N*	Mean	Median	SD
TA	721	4620.83	868.23	14178.27	1566	4703.94	715.92	16523.57
Size	721	4121.49	835.21	11663.87	1566	3322.65	617.32	10515.78
Growth	721	0.45	0.42	0.30	1566	0.47	0.43	0.32
Lev	721	2.40	1.02	3.88	1566	2.52	1.02	4.26
Turn	721	0.02	0.04	0.12	1566	-0.00	0.03	0.16
Eissue	721	0.27	0.12	0.67	1566	0.19	0.10	0.64
Dissue	721	0.20	0.07	0.55	1566	0.18	0.07	0.51

	Panel B
	Test for mean difference across firm-groups
	t-statistics
TA	0.12
Size	-1.63
Growth	0.76
Lev	0.63
Turn	-3.59
Eissue	-2.63
Dissue	-1.16

Note: *This table represents the univariate analysis across firm-groups, with regard to fundamental values, for the year 2003. Panel A provides information regarding mean, median and standard deviation, while Panel B shows the t-statistics on mean-differences across groups. The definition of the variables is given in Appendix B.*

non-pilot firms. This suggests that the control group is about twice the size of the treatment group, a particular characteristic of the Reg SHO program. The first variable examined in the descriptive is the value of total assets per group-firms. Even though total assets (TA) are not directly included in the multivariate analysis, they are necessary to construct most of the control variables. In addition, total assets are an important aspect that shows the underlying differences with respect to size across firms. As it can be inferred from the first panel, the mean value of TA for the pilot group is 4620.83 with a standard deviation of 14178.27. The same pattern can be observed for non-pilot group as well, whereby the mean of TA is equal to 4703.94 with a standard deviation of 16523.57. The t-statistics in the second panel suggests that there are no significant differences between the two groups with respect to TA.

The second variable examined in the descriptive is market value, another important measure of size. Market value exhibits, on average, higher mean for the pilot group equal to 4121.49 with a standard deviation of 11663.87. However, the t-statistics suggests that there

are insignificant differences across groups. Furthermore, the book-to-market ratio, which is an inverse measure of growth opportunities, is also insignificantly different across the two groups. The pilot-firms have on average a book-to-market ratio of 0.45 (with a standard deviation of 0.30), while non-pilot firms have a ratio of 0.47 (with a standard deviation of 0.32).

The fourth variable examined in the descriptive is the capital structure, which is approximated as the ratio between total liabilities and total equity (leverage ratio). This ratio follows the same patter across the two groups. The differences in means are insignificant as the pilot group exhibits a mean of 2.40 with a standard deviation of 3.88, while the control group exhibits a mean of 2.52 with a standard deviation of 4.26.

The last three variables are specific to the last metric (MBE analysis). As it can be seen from Table 2, the turnover ratio, which is measured as the return on assets, is the first variable which is different across companies. Pilot firms have on average a turnover ratio of 0.02, while non-pilot firms exhibit a negative and almost 0.00 turnover ratio. The t-test on means suggest that the means are significantly different (even at a 1% significance level). This suggests that pilot firms have on average a higher return on assets, and therefore perform better financially.

Furthermore, the change in equity issuance, is also significantly different (even at 1% significance level) between the firm-groups in year 2003. According to the descriptive, pilot firms feature a higher change in equity issuance with a mean of 0.27 (and a standard deviation of 0.67). The non-pilot group, on the other hand, had on average an equity issuance change of 0.19, with a standard deviation of 0.64. Lastly, the change in debt issuance in year 2003 is insignificantly different (see Panel B). Pilot firms had on average a 20 percent change in debt issuance while non-pilot firms had on average an 18 percent change. Given the significant differences across pilot and non-pilot firms in the control variables that are necessary for the MBE analysis, a propensity score matching is performed in Appendix A.

The only control variables that are not included in the univariate analysis, are abnormal earnings, risk and dispersion. The rationale is that these variables do not constitute fundamental information and are dependent on this paper's assumptions and methodology. Abnormal earnings are calculated as the difference between realized earnings and the last analyst forecast. Risk is calculated as the volatility of stock returns in the estimation period, while dispersion, which represents the similarity of expectations, is calculated as the ratio between the standard deviation and analysts' mean earnings estimate. The complete variable description is given in Table 21 in Appendix B.

Table 3: Correlation matrix for the variables in the first two metrics

Panel A: Correlation matrix for parameters used in the first and the second analysis						
	AE	Size	Growth	Risk	Lev	Disp
AE	1.00	-	-	-	-	-
Size	0.09	1.00	-	-	-	-
Growth	-0.18	-0.14	1.00	-	-	-
Risk	-0.11	-0.08	0.32	1.00	-	-
Lev	-0.05	0.03	0.09	0.01	1.00	-
Disp	0.06	0.01	-0.01	-0.04	-0.01	1.00
Panel B: Correlation matrix for parameters used in the last analysis						
	Growth	Eissue	Lev	Dissue	Turn	Size
Growth	1.00	-	-	-	-	-
Eissue	-0.14	1.00	-	-	-	-
Lev	0.13	-0.06	1.00	-	-	-
Dissue	-0.10	0.02	0.03	1.00	-	-
Turn	-0.15	0.33	-0.03	0.02	1.00	-
Size	-0.14	0.02	0.04	0.02	0.14	1.00

Note: *This table represents the correlation matrix for the parameters used in the analysis. The definition of the variables is given in Appendix B.*

The last step of this section, comprises the correlation matrix, presented in Table 3, for all the control variables that are included in this paper. The correlation matrix is provided to examine whether there are multicollinearity issues in the analysis. In order to maintain a 6-to-6 matrix, the table is subdivided into two distinct panels. Panel A contains the control variables that are used in the first hypothesis and the investment efficiency analysis, while the Panel B contains the control variables that are used in the MBE analysis. As it can be inferred from Table 3, there are no multicollinearity issues in this paper.

7. Results

As previously described in the research design section, to answer the first hypothesis, a two-step approach is followed. In the first step the cumulative abnormal returns are regressed with the abnormal earnings, control variables and interection factors of size, growth opportunities, capital structure, risk and similarity of investor's expectations. In Table 4, the results of the first step regression, can be found. This table, as every other table that represents the findings of this paper, is divided into two parts. The first part shows the results without implementing industry fixed effects, while the second shows the results when industry fixed effects are added. To maintain similarity with prior research, only the findings of the second part are discussed.

As it can be inferred from Table 4, and as prior literature indicates, the abnormal earnings are

Table 4: Earnings response coefficient regression

	(1) CAR		(2) CAR	
AE	0.016**	(2.22)	0.016**	(2.30)
Size	0.000***	(3.20)	0.000***	(3.20)
Growth	0.008***	(2.94)	0.008***	(2.80)
Risk	2.041***	(3.32)	2.136***	(3.45)
Lev	0.000*	(1.74)	0.000	(1.39)
Disp	0.009**	(1.99)	0.009*	(1.86)
AE × Size	-0.000***	(-3.29)	-0.000***	(-3.19)
AE × Growth	0.010	(0.95)	0.010	(0.88)
AE × Risk	-3.116	(-0.87)	-3.482	(-0.97)
AE × Lev	0.000	(0.11)	0.000	(0.03)
AE × Disp	-0.006	(-0.26)	-0.001	(-0.07)
Intercept	-0.009***	(-4.94)	-0.020	(-1.03)
No. of obs.	7936		7936	
Adjusted R^2	0.006		0.007	
Fixed Effects	None		Industry	

Note: *This table represents the OLS regression regarding the earnings response coefficient, estimated with robust standard errors. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

positively associated with CAR (Ball & Brown, 1968). A unit of unexpected positive earnings leads to an increase of approximately 1.6% in CAR. The control variables, besides leverage, are all significantly and positively correlated with the abnormal returns around the event period. This means that firms that are larger in size, that have less growth opportunities and that are relatively riskier than others obtain higher CAR during earnings announcement. In addition, in firms where dispersion is higher, abnormal returns are also higher.

Moreover, the coefficient of interaction factors, despite size interaction, are insignificant. This implies that there are no moderating effects of such variables in earnings response coefficient, at least in our sample. The coefficient of the interection between size and abnormal earnings is negative. That is, for the same unit of unexpected earnings, firms of higher size obtain less positive abnormal returns in the event date.

To complete the second step of the analysis, the squared residuals of the first regression are computed and compared across pilot and non-pilot firms in the pre and the during-period. The results of the difference-in-difference regression, can be found in Table 5. These results are certainly interesting, however, up-to a certain degree anticipated. The coefficient of the PILOT dummy is significant at a 1% significance level. This coefficient is negative which means that pilot firms had lower squared residuals than non-pilot firms prior to Reg SHO.

Table 5: Test of squared residuals across firm-groups

	(1)		(2)	
	RESQ		RESQ	
PILOT	-0.001***	(-3.59)	-0.001***	(-3.55)
DURING	-0.001***	(-4.65)	-0.001***	(-4.63)
PILOT × DURING	0.001**	(2.09)	0.001**	(2.05)
Intercept	0.006***	(31.08)	0.006***	(31.05)
No. of obs.	7936		7936	
Adjusted R^2	0.003		0.003	
Fixed Effects	None		Industry	

Note: *This table represents the differences in the information contained in stock prices across firm-groups for the periods before and during the Reg SHO. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

That is, in the pre-period, the stock prices of the non-pilot firms contained relatively more information than the stock prices of the pilot firms.

The coefficient of the DURING dummy, is significantly negative as well (at a 1% significance level). This dummy represents the changes in the control group (non-pilot stocks) during the Reg SHO, as a mean to capture the general trends attributable to confounding events for both firm-groups. Thus, a negative coefficient suggests that during the Reg SHO, the information contained in stock prices generally decreased. The most interesting finding is the coefficient of the interaction between the pilot dummy and the during period. Based on this coefficient, when taking into account the general trends for all the companies, the pilot firms experienced an increase in the squared residuals (the findings are significant at a 5% significance level). This is compelling because the stock prices in these firms contained less information prior to the Reg SHO. This relationship seems to have overturned in the opposite direction when short selling constraints were relived suggesting that the prospect of short selling improves information contained in stock prices.

Furthermore, the investment efficiency analysis is examined. Cumulative abnormal returns are used to represent the market's perception regarding the investment efficiency. In Table 6, CAR around M&A announcements is compared across pilot and non-pilot firms, while controlling for several factors. As in the first hypothesis, only the results that include industry fixed effects are discussed.

The main results of Table 6 contradict the predictions and the expectations of this paper. However, prior to discussing the variables of interest in the DiD design, the coefficients of control variables are interpreted. All the controls that are included are insignificant, expect

Table 6: Investment efficiency analysis

	(1) CAR		(2) CAR	
PILOT	0.005*	(1.87)	0.005*	(1.83)
DURING	0.005**	(2.25)	0.005**	(2.26)
PILOT × DURING	-0.007**	(-1.99)	-0.007*	(-1.95)
Size	-0.000	(-0.23)	-0.000	(-0.35)
Growth	-0.000	(-0.63)	-0.000	(-0.59)
Lev	-0.000	(-0.86)	-0.000	(-0.29)
Risk	3.768***	(3.69)	3.839***	(3.79)
Intercept	0.001	(0.16)	0.004	(0.37)
No. of obs.	3404		3404	
Adjusted R^2	0.011		0.010	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to investment efficiency, for the periods before and during the Reg SHO. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the OLS regression are estimated with robust standard errors.*

for the risk control. Therefore, it can be implied that riskier firms experience on average higher CAR during M&A announcements.

Moving onto the findings for the variables of interest, the coefficient of the PILOT dummy is significantly positive at a 10% significance level. This means that pilot group experienced higher CAR, roughly by 0.5%, around their M&A announcements prior to the Reg SHO. That is, managers in these firms, made better investment decision in the pre-period, at least from the market's perspective.

In addition, the DURING dummy is, likewise, significantly positive; however even at a 5% significance level. Thus, the general trends attributable to confounding events caused a 0.5% increase in CAR for both firm-groups. However, when comparing the differences between firm-groups during the Reg SHO, it seems that managers of the pilot firms did worse investment decision. According to the findings, pilot firms experienced on average a decrease of 0.7% in CAR during the Reg SHO, when compared to non-pilot firms (the results are only significant at a 10% significance level).

Moreover, Table 7 provides the results of the probit regression regarding the probability to meet or beat the analyst forecast. As in the prior analysis, only the results that include industry fixed effects are analyzed.

First, the findings on control variables are analyzed. Besides the change in debt issuance

Table 7: Meet or beat analysis

	(1) MBE		(2) MBE	
PILOT	0.031	(1.26)	0.029	(1.20)
DURING	-0.179***	(-9.37)	-0.172***	(-8.98)
PILOT × DURING	-0.079**	(-2.36)	-0.076**	(-2.29)
Growth	-0.386***	(-18.65)	-0.356***	(-16.89)
Eissue	0.277***	(4.54)	0.303***	(4.91)
Lev	-0.014***	(-7.24)	-0.004*	(-1.78)
Dissue	0.025	(0.40)	0.034	(0.53)
Turn	5.449***	(24.70)	5.565***	(24.87)
Size	0.000***	(9.17)	0.000***	(9.18)
Intercept	1.072***	(55.23)	0.887***	(5.58)
No. of obs.	34247		34247	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to MBE, for the periods before and during the Reg SHO. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the probit regression are estimated with robust standard errors.*

measure, all the control variables are statistically significant. Highly leveraged firms, hence firms that use relatively more debt than equity, are less probable to manage earnings upwards for meeting or beating the analyst forecast (the findings are significant at a 10% significance level). In addition, firms that issue more equity, firms that have a higher turnover and firms that are larger in size, are more likely to manage earnings for MBE (the findings are significant at a 1% significance level) . Last but not least, firms that have lower growth opportunities, are less likely to engage in such a propensity (the findings are also significant at a 1% significance level).

After controlling for the above-explained factors, the variables of interest can be interpreted as follows. The PILOT dummy is insignificant. This means that pilot and non-pilot firms were statistically not different, prior to the Reg SHO, with respect to the tendency of MBE. This is in conformity with the research of Fang et al. (2016), that find insignificant differences across firms, before the Reg SHO, with respect to discretionary accruals and earnings management.

Secondly, the DURING dummy is negatively significant at a 1% significance level. This means that during the time that Reg SHO took place, both firm-groups had a significant decrease in the propensity to meet or beat the analyst forecast. However, even when taking into account this decreasing general trend for both firms, the pilot firms were still significantly less likely (at a 5% significance level) to manage earnings towards the analyst forecast. This

can be inferred from the negative coefficient of the interaction term (-0.076). These suggest that when the short selling restrictions are removed, managers change their behaviour with respect to meeting or beating earnings benchmarks.

8. Additional Analysis

In this section two additional analysis are conducted in order to provide further insights for the research. In the first additional analysis the effect that short selling has in the information contained in the stock prices, is extended by portioning between positive and negative earnings news. As in the main analysis, the first step is to estimate the regression between CAR and abnormal earnings together with the control variables and their respective interaction effects with AE. This time the first-step equation is performed "quietly"[12]. The residuals of this regression are compared in Table 8, while differentiating between positive and negative news, in two distinct panels.

The result in Panel A reflects no significant findings in any of the variables. In contrast, the results in Panel B are similar to what was obtained in the main analysis. The coefficient of the PILOT dummy is negative and significant at a 5% significance level. The DURING dummy (significant at a 5% significance level) which again that the confounding events generally diminished the information contained in the stock prices. The variable of interest, therefore the interaction between the dummy variables, is positive and statistically significant at a 5% significance level. Based on these results it can be argued that the stock prices contain more information when earnings news is negative.

The second additional analysis looks at whether short sellers aggravate a price decline, a highly discussed topic amongst market regulators. In order to provide an answer for such a concern the investment efficiency analysis is revisited. However, this time a distinction is made between positive market returns and negative market returns. This distinctions makes it possible to look at the differences in the market reactions between pilot and non-pilot stocks when the market perception about an M&A announcement is bad in both firm-groups. The results are presented in Panel A and Panel B of Table 9.

The variable of interest (the interaction between the pilot and the during dummy) in both instances is not significant. This means that there is no asymmetry in CAR that depends on the news direction. Therefore, it can be said that, in contrary to what opponent of short selling argue that short sellers do not aggravate a price decline.

[12] as it does not differentiate from the main analysis

Table 8: Test of squared residuals across firm-groups, partitioned by earnings news

Panel A				
	(1)		(2)	
	RESQ		RESQ	
PILOT	-0.001***	(-3.10)	-0.001***	(-3.09)
DURING	-0.001***	(-3.81)	-0.001***	(-3.79)
PILOT × DURING	0.001	(1.40)	0.001	(1.40)
Intercept	0.006***	(27.89)	0.006***	(27.86)
No. of obs.	6578		6578	
Adjusted R^2	0.003		0.003	
Fixed Effects	None		Industry	
Panel B				
	(1)		(2)	
	RESQ		RESQ	
PILOT	-0.002**	(-2.43)	-0.002**	(-2.46)
DURING	-0.003***	(-3.57)	-0.003***	(-3.65)
PILOT × DURING	0.003**	(2.50)	0.003**	(2.49)
Intercept	0.006***	(14.05)	0.006***	(14.23)
No. of obs.	1358		1358	
Adjusted R^2	0.008		0.009	
Fixed Effects	None		Industry	

Note: *This table represents the differences in the information contained in stock prices across firm-groups, partitioned by earnings news. Panel A represents the results on positive earnings news, while Panel B represents the results on negative earnings news. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

Table 9: Additional analysis to determine whether short sellers aggravate a price decline

Panel A				
	(1)		(2)	
	CAR		CAR	
PILOT	0.003	(1.07)	0.003	(1.12)
DURING	-0.002	(-1.00)	-0.002	(-0.79)
PILOT × DURING	-0.005	(-1.37)	-0.005	(-1.25)
Size	-0.006***	(-7.62)	-0.006***	(-7.79)
Growth	0.000**	(2.48)	0.000***	(2.96)
Lev	-0.001***	(-3.23)	0.000	(0.42)
Risk	6.093***	(8.80)	6.009***	(9.09)
Intercept	0.077***	(13.33)	0.066***	(6.04)
No. of obs.	1798		1798	
Adjusted R^2	0.136		0.148	
Fixed Effects	None		Industry	
Panel B				
	(1)		(2)	
	CAR		CAR	
PILOT	0.001	(0.51)	0.001	(0.40)
DURING	0.007***	(3.38)	0.007***	(3.40)
PILOT × DURING	-0.001	(-0.32)	-0.001	(-0.33)
Size	0.004***	(5.02)	0.004***	(5.22)
Growth	-0.000***	(-2.69)	-0.000***	(-3.10)
Lev	0.001***	(3.27)	-0.000	(-0.13)
Risk	-8.741***	(-4.63)	-7.965***	(-4.32)
Intercept	-0.057***	(-9.46)	-0.044***	(-4.99)
No. of obs.	1606		1606	
Adjusted R^2	0.126		0.136	
Fixed Effects	None		Industry	

Note: *This table represents the additional analysis to determine whether short sellers aggravate a price decline. The investment efficiency analysis is portioned between two panels. Panel A represents the differences between firm-groups when market reactions are positive, while Panel B represents the differences when market reactions are negative. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the OLS regression are estimated with robust standard errors.*

9. Robustness Analysis

To enhance the validity of the findings, two robustness tests are conducted per each analysis. The first robustness test revisits the main results while using alternative measures for the dependent variables. For the first hypothesis and the investment efficiency analysis, CAR is now calculated as only the stock returns minus the market returns, in the event window

of [-1, +1]. In this instance, market returns represent the expected returns, therefore no estimation period is used. In addition, for the MBE analysis, another measure is used to capture the propensity to meet earnings benchmark. Specifically, the performance of the corresponding quarter, a year before.

The second robustness test is concerned with the validity of the difference-in-difference design. In order to check for such a proposition, another balanced sample for the post-period, from 6th of July 2007 until 2009, is added. Therefore, the main analysis is extended by comparing the pre-period with the during-period and the post-period simultaneously.

9.1. The Validity of the Dependent Variable

Table 10 represents the results for the first-stage regression of the first hypothesis. As in the main analysis, the cumulative abnormal returns are regressed with the abnormal earnings and following several studies, interection factors as control variables. The coefficient before the abnormal earnings is positive and significant at a 5% significance level. Secondly, the interaction factors are all insignificant besides the interection between the market value and abnormal earnings. This coefficient is negative and highly significant at a 1% significance level. According to the results, firms that are larger in size, obtain on average significantly lower abnormal returns, for the same earnings surprise.

In addition, Table 11, provides the results for the second stage regression. In this step the residuals of the first stage regression are compared between pilot and non-pilot firms, in the DiD design. The results are, in general, in conformity to the main analysis. The PILOT dummy is negative and significant at a 5% significance level. The DURING dummy is also significantly negative at a 5% significance level. Furthermore, the interaction coefficient of the pilot and the during dummy is positive and statistically significant at 5% significance level. The findings of the this robustness test confirm that the results for the first hypothesis of this paper stand firm, and are not dependent on the methodology of the measurement of the market response.

Moreover, Table 12 provides the results for the investment efficiency analysis. These results conform to the main analysis, however minor differences are found. First, there is no effect of the control variables in CAR (in the main findings represented in Table 6 risk was positively associated with CAR). In addition, the PILOT dummy maintains the same sign, magnitude and coefficient as in the main analysis. This coefficient is significant at 10% significance level. The DURING dummy differs from the main findings and suggest that the during the Reg SHO the investment efficiency in the control group did not change. The variable of interest, however, is almost the same. This variable suggests again that during the Reg SHO pilot firms made less efficient investment decisions when compared to the benchmark of the

Table 10: Earnings response coefficient regression

	(1) CAR		(2) CAR	
AE	0.016**	(2.22)	0.016**	(2.30)
Size	0.000***	(3.20)	0.000***	(3.20)
Growth	0.008***	(2.94)	0.008***	(2.80)
Risk	2.041***	(3.32)	2.136***	(3.45)
Lev	0.000*	(1.74)	0.000	(1.39)
Disp	0.009**	(1.99)	0.009*	(1.86)
AE × Size	-0.000***	(-3.29)	-0.000***	(-3.19)
AE × Growth	0.010	(0.95)	0.010	(0.88)
AE × Risk	-3.116	(-0.87)	-3.482	(-0.97)
AE × Lev	0.000	(0.11)	0.000	(0.03)
AE × Disp	-0.006	(-0.26)	-0.001	(-0.07)
Intercept	-0.009***	(-4.94)	-0.020	(-1.03)
No. of obs.	7936		7936	
Adjusted R^2	0.006		0.007	
Fixed Effects	None		Industry	

Note: *This table represents the OLS regression regarding the earnings response coefficient, while implementing an alternative measure for the dependent variable. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the OLS regression are estimated with robust standard errors.*

Table 11: Test of squared residuals across firm-groups

	(1) RESQ		(2) RESQ	
PILOT	-0.001***	(-3.53)	-0.001***	(-3.55)
DURING	-0.001***	(-4.40)	-0.001***	(-4.63)
PILOT × DURING	0.001*	(1.92)	0.001**	(2.05)
Intercept	0.006***	(30.72)	0.006***	(31.05)
No. of obs.	7936		7936	
Adjusted R^2	0.003		0.003	
Fixed Effects	None		Industry	

Note: *This table represents the differences in the information contained in stock prices across firm-groups, for the periods before and during the Reg SHO, while implementing an alternative measure for the dependent variable. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

non-pilot firms.

Lastly, Table 13, provides the results for the MBE analysis. The findings are, overall, in conformity to the main analysis albeit, certain control variables have changed sign and sig-

Table 12: Investment efficiency analysis

	(1)		(2)	
	CAR		CAR	
PILOT	0.005**	(1.99)	0.005*	(1.94)
DURING	0.002	(1.15)	0.002	(1.17)
PILOT × DURING	-0.007*	(-1.93)	-0.007*	(-1.88)
Size	-0.000	(-0.62)	-0.001	(-0.76)
Growth	-0.000	(-0.68)	-0.000	(-0.56)
Lev	-0.000	(-0.98)	0.000	(0.03)
Risk	1.025	(1.41)	1.050	(1.45)
Intercept	0.006	(1.14)	0.014	(1.43)
No. of obs.	3404		3404	
Adjusted R^2	0.001		0.001	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to investment efficiency, for the periods before and during the Reg SHO. In this example, an alternative measure for the dependent variable is implemented. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the OLS regression are estimated with robust standard errors.*

Table 13: Meet or beat analysis

	(1)		(2)	
	MBE		MBE	
PILOT	0.022	(0.96)	0.016	(0.70)
DURING	-0.163***	(-9.07)	-0.171***	(-9.51)
PILOT × DURING	-0.082***	(-2.62)	-0.085***	(-2.69)
Growth	-0.559***	(-27.52)	-0.578***	(-27.89)
Eissue	0.621***	(10.88)	0.595***	(10.42)
Lev	0.008***	(4.29)	-0.003	(-1.43)
Dissue	0.143**	(2.41)	0.129**	(2.17)
Turn	6.722***	(31.37)	6.579***	(30.37)
Size	0.000***	(7.80)	0.000***	(8.86)
Intercept	0.827***	(45.27)	0.795***	(4.85)
No. of obs.	34247		34247	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to MBE, for the periods before and during the Reg SHO. In this example, an alternative measure for the dependent variable is implemented. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the probit regression are estimated with robust standard errors.*

nificance. To avoid repetition, only the coefficients that changed are discussed. These coefficients are the ones that represent leverage and debt issuance. The results convey that

firms that issue more debt are more likely to manage earnings to meet or beat the quarterly benchmarks (the results are significant at 5% significance level). In addition, the capital structure coefficient, is statistically insignificant. These findings are surprising, however several studies such as Healy and Wahlen (1999) have found that firms manage earnings with regard to debt covenants. Therefore, it may be that these debt covenants are dependent in the performance based on quarterly earnings.

Furthermore, the PILOT dummy, is again statistically not significant, suggesting that pilot and non-pilot firms were not different with respect to MBE prior to the Reg SHO program. The DURING dummy, on the other hand, as in the main findings is negative and statistically significant at a 1% significance level. The coefficient of the DiD test, the interaction between the dummy variables suggests the same outcome as the main findings (however, this time, significant at a 1% significance level as well). This means that pilot firms, during the Reg SHO, were less likely to meet or beat quarterly earnings, than non-pilot firms.

9.2. The Validity of the DiD Design

Table 14 provides the results for the first-stage regression of the first first hypothesis that is needed to test the validity of the DiD design. In this instance, the cumulative abnormal returns are regressed with abnormal earnings and the interaction factors for a longer time period. As it can be implied from the table below, the results are slightly different from the main analysis. Most interestingly, the coefficient in front of abnormal earnings, is insignificant. This means that, in this sample, we cannot make statistical inferences amongst these two variables. However, when examining the interection between the abnormal earnings and control variables, the results remain comparable. Firms that are bigger in size, obtain a lower ERC for the same magnitude of AE (the results are statistically significant at a 1% significance level). In addition, firms that have lower growth opportunities and firms that are riskier, realize a higher ERC. It should be noticed that the findings on risk and growth opportunities, are in contrary to what the prior literature predicts.

The results of the second stage regression are presented in Table 15. The results hold to the prior findings, and most importantly confirm the validity of the DiD design. To avoid repetition, only the additionally added variables are examined in detail. The PILOT dummy and the DURING dummy are negative and significant at a 1% significance level. Furthermore, the POST dummy is positive at a 1% significance level. This dummy represent the general trends in the control group regarding the information contained in the stock prices. The positive sign is highly important because in this period, the short selling restrictions were removed for both firm-groups. Hence, the non-pilot firms were also exempted from the price tests. Given such premise, an increase in the squared residuals enhances the validity of the main findings indirectly. It provides more assurance that the increase in the information

Table 14: Earnings response coefficient regression

	(1) CAR		(2) CAR	
AE	0.005	(0.88)	0.005	(0.84)
Size	0.000***	(2.82)	0.000***	(2.82)
Growth	0.007***	(3.29)	0.007***	(3.08)
Risk	-0.288	(-0.75)	-0.235	(-0.61)
Lev	0.000**	(2.02)	0.001**	(2.07)
Disp	0.003	(0.66)	0.003	(0.67)
AE × Size	-0.000***	(-2.98)	-0.000***	(-2.65)
AE × Growth	0.017**	(2.05)	0.019**	(2.24)
AE × Risk	6.505***	(3.32)	6.476***	(3.31)
AE × Lev	0.001	(0.96)	0.001	(0.74)
AE × Disp	-0.004	(-0.21)	-0.003	(-0.19)
Intercept	-0.006***	(-4.15)	-0.023	(-1.28)
No. of obs.	11187		11187	
Adjusted R^2	0.009		0.011	
Fixed Effects	None		Industry	

Note: *This table represents the OLS regression regarding the earnings response coefficient, estimated with robust standard errors. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

Table 15: Test of squared residuals across firm-groups

	(1) RESQ		(2) RESQ	
PILOT	-0.001***	(-3.10)	-0.001***	(-3.07)
DURING	-0.001***	(-4.05)	-0.001***	(-4.03)
POST	0.004***	(11.51)	0.004***	(11.38)
PILOT × DURING	0.001*	(1.76)	0.001*	(1.70)
PILOT × POST	0.000	(0.74)	0.000	(0.79)
Intercept	0.006***	(27.10)	0.006***	(27.11)
No. of obs.	11187		11187	
Adjusted R^2	0.030		0.029	
Fixed Effects	None		Industry	

Note: *This table represents the differences in the information contained in stock prices across firm-groups for the periods before, during and after the Reg SHO. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

contained in the stock prices for the pilot group during the Reg SHO, that was found in the main analysis, was attributed to short selling and not to other events.

Additionally, the interection between the pilot and the during dummy is positive and statisti-

Table 16: Investment efficiency analysis

	(1)		(2)	
	CAR		CAR	
PILOT	0.006*	(1.95)	0.006*	(1.95)
DURING	0.005**	(2.27)	0.005**	(2.30)
POST	0.000	(0.00)	-0.000	(-0.03)
PILOT × DURING	-0.008**	(-2.13)	-0.008**	(-2.12)
PILOT × POST	-0.006	(-1.36)	-0.006	(-1.35)
Size	-0.000	(-0.70)	-0.001	(-0.78)
Growth	-0.000	(-0.29)	-0.000	(-0.24)
Lev	-0.000	(-1.30)	-0.000	(-0.62)
Risk	3.111***	(3.49)	3.133***	(3.51)
Intercept	0.004	(0.69)	0.006	(0.70)
No. of obs.	4565		4565	
Adjusted R^2	0.008		0.007	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to investment efficiency, for the periods before, during and after the Reg SHO. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the OLS regression are estimated with robust standard errors.*

cally significant at a 10% significance level. On the other hand, the interaction between the pilot and the post dummy is insignificant. This means that pilot and non-pilot firms are not statistically significant from each other in the post-period in terms of information efficiency. That is, when short selling constraints were removed for both firms, the information contained in the stock prices was not significantly different between the firm-groups. A finding that strongly enhances the validity of this paper.

Table 16 provides the results for the DiD robustness test regarding investment efficiency analysis. In this instance, as in the main analysis, the only significant control variable, at a 1% significance level, is the risk measure. The variables of interest are also similar to the main analysis. The PILOT dummy is positive and statistically significant at 10% significance level, while the DURING dummy is positive and statistically significant at 5% significance level. The last dummy variable, denominated as POST, is insignificant, suggesting that after the Reg SHO there were no significant trends for the benchmark group with respect to investment efficiency.

Furthermore, the variables that test the DiD are analyzed. The interection between the pilot and the during dummy remains comparable to the main analysis. The coefficient is negative and statistically significant (this time at a 5% significance level as well). On the other hand, the interaction between the post and pilot dummy is insignificant, suggesting that there were

Table 17: Meet or beat analysis

	(1) MBE		(2) MBE	
PILOT	0.030	(1.25)	0.028	(1.14)
DURING	-0.174***	(-9.16)	-0.164***	(-8.61)
POST	-0.237***	(-12.37)	-0.236***	(-12.29)
PILOT × DURING	-0.079**	(-2.38)	-0.075**	(-2.25)
PILOT × POST	-0.036	(-1.08)	-0.033	(-0.98)
Growth	-0.357***	(-26.32)	-0.323***	(-23.41)
Eissue	0.309***	(6.50)	0.366***	(7.63)
Lev	-0.020***	(-13.22)	-0.007***	(-3.46)
Dissue	0.015	(0.28)	0.036	(0.67)
Turn	5.517***	(30.98)	5.665***	(31.45)
Size	0.000***	(10.72)	0.000***	(10.80)
Intercept	1.077***	(65.27)	0.822***	(6.50)
No. of obs.	49994		49994	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to MBE, for the periods before, during and after the Reg SHO. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the probit regression are estimated with robust standard errors.*

no differences between firm-groups after the Reg SHO. That is, after the Reg SHO ended, pilot and non-pilot firms had no difference in their investment efficiency while taking into account general time trends.

Finally, Table 17 provides the results for the DiD robustness test regarding the MBE analysis. The coefficients of control variables remain similar to the main analysis. All the variables, besides the change in debt issuance, are significant even at 1% significance level. The PILOT and the DURING dummy suggest the same outcome as in the main analysis. On the other hand, the POST dummy is negative and statistically significant at a 1% significance level. This means that the propensity to meet or beat the analyst's forecast significantly decreased after the Reg SHO for the benchmark group.

In addition, the interaction effects between the pilot dummy and the time dummies of during and post period are analyzed. The interaction between the during period and the pilot dummy conforms to the main analysis and is significantly negative (at a 5% significance level). Moreover, the interaction between the post period and the pilot dummy is statistically not significant. This finding suggest that pilot and non-pilot firms were not different in terms of the propensity to meet or beat the analysts benchmark in the 2-year period that Reg SHO ended.

Overall, throughout all three of our tests, important results were found. These findings defend the validity of our results and the power of the DiD test that was used in this paper. Ultimately, enhances the importance of our findings.

10. Conclusion

This paper examines the ex-post and ex-ante effects of short selling in information asymmetry. The ex-post effect is determined by investigating the information contained in stock prices, while the ex-ante effect is determined by analyzing the investment efficiency and the propensity to meet or beat earnings benchmark.

To conduct the research a natural experiment is utilized. The experiment, denoted as Regulation SHO, was conducted by the SEC to carefully investigate the effects of short selling. Reg SHO was constructed as a pilot program whereby each third stock of the Russell 3000 index, ranked by trading volume, was assigned as a pilot stock. From May 2005 until July 2007, these stocks were exempted from short selling restrictions while the non-pilot group, which was comprised by the remaining stocks of the index, experienced no change in the policy and continued trading with short selling restrictions.

A difference-in-difference design is used throughout the analysis. This design makes it possible to compare between pilot and non-pilot stocks while taking into account general trend differences. The findings of this paper provide the necessary means to discuss whether short selling impacts information asymmetry. With regard to the ex-post effect, the findings confirm that pilot stocks experienced an increase in the information contained in the abnormal returns. In addition, with respect to ex-ante short selling effects, the evidence is contradicting. The propensity to meet or beat the earnings benchmark significantly decreases for the pilot firms during the Reg SHO; however, the evidence suggest that investment efficiency, instead of increasing, decreases in these firms.

The findings that relate to the investment efficiency analysis certainly contradict the prediction of this paper. However, it can be argued that these findings do not undermine the effect that short selling has in information asymmetry. The rationale lies behind the manner in which the investment efficiency was measured. Cumulative abnormal returns represent the market reactions to M&A announcements. Therefore, if CAR is negative it means that the investment decision is bad and vice versa. According to the prior literature, M&A investments are detrimental to the company, therefore on average they are bad per se. Given such premise, a decrease in CAR for the pilot firms, during the Reg SHO, would suggest that the market disseminates this information better when short selling is relieved. Thus, it can be

argued that short selling provides timely information for investors regarding the investment decisions of the firm.

Furthermore, two additional analysis are performed. The first one determines that the information contained in stock prices is enhanced asymmetrically given the direction of the earnings news. More specifically, the information contained in stock prices is higher when the earnings surprise is negative. The second analysis looks at whether short sellers aggravate a price decline. While portioning between good and bad M&A investment reactions, no trace is found for such a proposition.

Last but not least, two robustness test are conducted to verify the validity of the findings. The outcome of these tests suggests that the findings are robust in the measurement of the dependent variable and that the DiD design provides a good methodology to conduct this research.

11. Limitations

Although this paper is attentively prepared, it counts with two significant limitations. The first limitation concerns the methodology used to measure the ex-post effect of short selling. In order to capture the differences in the information that stock prices reflect, a two step approach was used. In the first step CAR was regressed with abnormal earnings and control factors to crowd out information factors that lead to abnormal returns. Control factors regarding size, growth opportunities, risk, capital structure and similarity of market expectations were included. However, prior studies suggest that the earnings response coefficient varies also with earnings persistence, earnings reliability or accrual quality. These factors, due to measurement constraints, were not included in the analysis. As a result of this exclusion, the findings might contain several biases.

In addition, in the second step, the residuals of the first regression were compared between firm-groups to measure whether short selling impacts the information contained in the stock prices. Even though the logical interpretation behind it is fairly simple, this methodology was not used in prior research. Therefore its advantages and disadvantages are arguable.

The second limitations concerns the measure of the investment efficiency. As it was explained in the conclusion section, measuring investment efficiency by CAR may distort the results and may not truly capture the essence of investment efficiency. Indeed, a measurement that does not directly depend on the stock returns would fit the research analysis to a greater degree.

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Appendices

A. Propensity Score Matching

This section aims to resolve the problems of the univariate analysis that were encountered in Table 2. As the findings on the descriptive statistics suggested, the firms used in the MBE analysis sample are significantly different with respect to financial performance and change in equity issuance. To overcome this issue, a propensity score matching test is performed. Therefore, each pilot firm is matched with a non-pilot firms, with respect to all the control variables used in the analysis. The logistic regression to achieve the score matching can be found below. In addition, Table 18 provides the output of the logistic matching test.

$$PILOT = \alpha + \beta_1(Size) + \beta_2(Growth) + \beta_3(Lev) + \beta_4(Turn) + \beta_5(Eissue) + \beta_6(Dissue) \quad (7)$$

Obviously, the sample in this case differs from the main analysis. In fiscal year 2003, the year with respect to which firm-groups are compared contains 614 pilot firms and 1107 non-pilot firms. The pre-period is comprised of a grand total of 5692 firm-quarter observations for the pilot-group, and 5755 for the non-pilot group. In addition, the during-period contains 5510 matched firm-quarter observations for the pilot group and 5615 for the non-pilot group.

Table 18: The output of the propensity score matching

	PILOT	
Size	0.000***	(6.36)
Growth	0.019	(0.89)
Lev	-0.019***	(-7.58)
Turn	1.266***	(4.53)
Eissue	-0.061	(-0.85)
Dissue	0.024	(0.30)
Intercept	-0.726***	(42.30)
No. of obs.	49994	
Pseudo R^2	0.002	

Note: *This table represents the output of the propensity score matching. In brackets z-statistics are given while, ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively.*

To provide a better understanding of the score matching test, a univariate analysis on each control variable is provided in Table 19. This table represents the descriptive statistics for total assets, market value, growth opportunities, turnover, capital structure and change in issuance of equity and debt. The first panel shows the statistical values of mean, median and standard deviations while the second shows the t-statistics on mean differences between firm-groups. As it can be inferred from the t-statistics, the differences amongst groups have

significantly decreased. The equity issuance is still statistically different, however, the divergence amongst groups has decreased.

Table 19: Descriptive Statistics

Panel A								
	Pilot Firms				Non-Pilot Firms			
	N	Mean	Median	SD	*N*	Mean	Median	SD
TA	631	6682.59	958.70	32147.53	1346	8214.51	772.94	46927.78
Size	631	4130.17	799.20	11627.39	1346	3615.96	637.06	11170.28
Growth	631	0.55	0.48	0.43	1346	0.56	0.48	0.41
Lev	631	2.57	1.08	3.91	1346	2.39	1.01	3.82
Turn	631	0.01	0.01	0.03	1346	0.01	0.01	0.03
Eissue	631	0.04	0.03	0.12	1346	0.03	0.03	0.14
Dissue	631	0.02	0.01	0.12	1346	0.02	0.01	0.13

Panel B	
	Test for mean difference across firm-groups
	t-statistics
TA	1.32
Size	-1.57
Growth	0.35
Lev	-1.57
Turn	-0.94
Eissue	-1.89
Dissue	-0.44

Note: *This table represents the univariate analysis across firm-groups, with regard to fundamental values, for the year 2003. In this example, the firm-groups are matched with regard to the control variables. Panel A provides information regarding mean, median and standard deviation, while Panel B shows the t-statistics on mean-differences across groups. The definition of the variables is given in Appendix B.*

The results for the MBE analysis are presented in Table 20 below. The sign and the significance of the control variables is similar to the main analysis. Firms that are bigger in size, that issue more equity and that perform better financially are more likely (at a 1% significance level) to engage in the propensity to meet or beat a certain benchmark. In addition, firms that have lower growth opportunities and are highly leveraged are less likely (at a 1% and 10% significance level, respectively) to manage earnings to achieve the analysts forecast.

Table 20: Meat or beat analysis

	(1) MBE		(2) MBE	
PILOT	0.038	(1.36)	0.036	(1.29)
DURING	-0.134***	(-4.84)	-0.127***	(-4.58)
PILOT × DURING	-0.122***	(-3.14)	-0.120***	(-3.07)
Growth	-0.364***	(-14.15)	-0.338***	(-12.95)
Eissue	0.318***	(4.17)	0.343***	(4.48)
Lev	-0.015***	(-6.07)	-0.005*	(-1.67)
Dissue	0.079	(1.01)	0.092	(1.16)
Turn	5.882***	(21.23)	6.024***	(21.48)
Size	0.000***	(8.23)	0.000***	(8.26)
Intercept	1.057***	(40.66)	0.928***	(4.16)
No. of obs.	22153		22153	
Fixed Effects	None		Industry	

Note: *This table represents the differences across firm-groups, with regard to MBE, for the periods before and during the Reg SHO. In this example, the firm-groups are matched with regard to the control variables. The definition of the variables is given in Appendix B. In brackets t-statistics are given, while ***, **, and * represent the significance at 1%, 5% and 10% levels, respectively. The results of the probit regression are estimated with robust standard errors.*

The results on the coefficient of interest follow the same pattern as in the main analysis. The PILOT dummy is not significant, suggesting that pilot and non-pilot firms were not significantly different with respect to meeting or beating the analyst forecast, prior to the Reg SHO program. The DURING dummy, on the other hand, is negative and statistically significant at a 1% significance level. This means that both firm-groups were less likely to MBE during the Reg SHO. The coefficient of DiD test, is negative and significant at a 1% significance level. That is, pilot firms, during the Reg SHO, were less likely to manage earnings towards the analyst's forecast even when taking into account general decreasing trends. The findings in this section, suggest that the main results of the paper are not prone to the differences between the groups of firms, another crucial aspect that enhances the research validity.

B. Variable Description

This appendix is added to provide the variable description of each parameter that is included in the analysis.

Table 21: Variable Description

PILOT	This variable is a dummy variable which equals one if the firm is in the pilot group, and zero otherwise
DURING	This variable is a dummy variable which equals one if the period under investigation is during the Reg SHO, and zero otherwise
POST	This variable is a dummy variable which equals one if the period under investigation is after the Reg SHO, and zero otherwise
CAR	This variable represents the cumulative abnormal returns measured as the difference between realized returns and the expected returns
RESQ	This variable represents the information contained in the stock prices which is not attributable to the ERC factors, measured as the squared residuals of the ERC regression
MBE	This variable is a dummy variable which equals one if the actual EPS is greater or equal to the last median forecast prior to earnings announcement, and zero otherwise
AE	This variable represents the abnormal earnings measured as the difference between actual earnings per share and analyst's mean estimate forecast
Size	This variable represents the market value extracted directly from Compustat/Capital IQ
Growth	This variable represents an inverse measure of growth opportunities measured by the book-to-market ratio
Lev	This variable represents the capital structure measured as the ratio between total debt and equity
Risk	This variable represents the risk per company measured as the volatility of stock returns
Disp	This variable represents the similarity of market expectations measured as the ration between the standard deviation and analysts' mean earnings estimate
Turn	This variable represents the economic performance of the company measured as the ratio between total assets and equity
Eissue	This variable represents the equity issuance measured as the percentage change in common stock
Dissue	This variable represents the debt issuance measured as the percentage change in total debt

Note: *This table represents the variable description per each parameter included in this paper.*