Convertible bond issues by financially constrained firms

Master Thesis Financial Economics

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Abstract

This research examines the influence of financial constraints on the preferred channel of issuance for convertible bonds, the level of accompanying hedge fund involvement and explores its potential relation to subsequent firm performance. I provide evidence that paying dividends, having credit ratings and firm's size and age impacts several facets of convertible bond issues. Non-dividend paying, non-rated and young and small firms have the propensity to issue convertible bonds privately under SEC rule 144A, implying that investor demand impacts convertible bond issues by financially constrained firms. Financially constrained convertible bond issuers tend to underperform financially unconstrained convertible bond issuers up to one year after issuance. No supporting evidence is found for more hedge fund involvement with financially constrained convertible bond issuers. Underlying company financials appear not to influence firm behaviour during convertible bond issues.

Contents

1 Introduction

Firms can acquire funding in several ways; raise equity, issue straight debt or make use of hybrid securities. Convertible bonds in particular represent an important asset class amongst hybrid securities both in terms of relative volume in the U.S. capital market and by absolute dollar value. Dutordoir et al. (2014) proclaim that U.S. firms issued $510 billion worth of convertible bonds in the time span of 2000-2011. Seasoned Equity Offerings (SEO) account for $1146 billion, while regular bond issues raised $6635 billion. Despite its continued popularity in the financial markets, the area of convertible bonds remains a topic in corporate finance where academics and corporate finance practitioners engage in a vivid debate about issue motives. To quote Hillier et al. (2013): *"Probably there is no other area of corporate finance where real-world practitioners disagree as they do on the reason for issuing convertible debt"*. By means of the following research question, I want to shed light on parts of the ongoing discussion on convertible bonds:

How does the status of being financially constrained influence convertible bond issues and subsequent firm performance?

The research question combines two strings of literature. Firstly, the developments in the convertible bond market are central to this thesis. Recently, the market for convertible issues has been subject to severe changes on both the issuer side as well as on the investor side. Typically convertible bonds used to be issued by way of public offerings. Nowadays, the majority of convertible issues is privately placed with Qualified Institutional Buyers[1] under SEC rule 144A. Choi et al. (2010) argue that hedge funds represent a large portion of these Qualified Institutional Buyers. Hedge funds engage in a 'buy-and-hedge' strategy, as opposed to the traditional investor which employ a 'buy-and-hold' strategy. Close to 75% of the convertible bonds is currently bought by hedge funds (Brown et al., 2012). In addition, the shift to a different type of investor also has an effect on security design. During private negotiations, hedge funds are able to influence the design of convertible bonds. Unfavorable components for hedge funds such as call-features tend to be excluded (Grundy & Verwijmeren, 2018).

The second string of literature refers to the financial constraints that firms face when raising capital on the external capital market. Still no consensus has been reached on how to classify firms as financially constrained. At large, two different definitions of financial constraints are

[1] Institutional buyers of securities with over $100 million of investible assets.

used in the academic debate. Firstly, firm's facing a large gap in costs between using internal funds or raising external capital are deemed financially constrained (Fazzari, Hubard & Petersen, 1988). Secondly, Whited and Wu (2006) argue that financial constraints should be defined as the elasticity of the supply of external capital.

Rather than examining differences between convertible bond issuers compared to SEO's or straight debt issuers, this study solely focuses on firms issuing convertible bonds and tries to identify differences amongst them. I do so by applying the concept of financial constraints to convertible bond issues, thereby aiming to identify particular issuer characteristics affecting the design of the issues and issuer behavior. The results are linked to theories of investor's impact on corporate capital structures, contributing to the growing literature on the effect of investor demand in the capital market (Brown et al., 2019). In addition I shed light on the role of hedge funds in the capital market by examining whether they play a prominent role in supplying capital to different types of convertible bond issuers, essentially complementing and extending the findings of Brown et al. (2012). Lastly, the effect of issuer characteristics and potential hedge fund involvement on the subsequent long-term performance of the issuer is still a largely unexplored area (Dutordoir et al, 2014). By examining long-term performance of convertible bonds issuers on the basis of its financial constraint status, I can provide insights to whether specific components help explain the underperformance of convertible bond issuers found by Lewis et al. (2001).

I find that investor demand impacts convertible bond issues by financially constrained firms. Not paying dividends is an important indicator of firm behaviour during convertible bond issues and subsequent performance. Under the assumption that non-dividend payers lack transparency as opposed to dividend paying firms, non-dividend payers are more inclined to issue convertible debt under rule 144A. Firms without credit-ratings and young and small firms show similar propensities. In addition, not paying dividends has a significant negative impact on firm performance up to one year after the announcement. Although non-rated firms experience significant negative firm performance after issuance, the difference with rated firms is not significant. Furthermore, firms underlying financials assembled in the Whited-Wu index do not play a significant role in the convertible bond market. No supporting evidence is found for more hedge fund involvement during convertible bond issues by financially constrained firms.

2 Literature review

This thesis is related to two strings of corporate finance literature. Section 2.1 discusses the academic literature of financial constraints. Section 2.2 gives an overview of the current academic views on convertible bonds. At last, section 2.3 links both strings of literature to construct hypotheses for the empirical research.

2.1 Financial constraints

Standard models of investments under uncertainty assume that financial markets are efficient and frictionless (Modigliani & Miller, 1958). According to these basic corporate finance principles, firms are always able to source financing for future positive Net Present Value (NPV) projects. Information asymmetry between managers and investors concerning the firm's financial prospects however, cause considerable cost differences in using internal funds or obtaining external financing (Majulf 1984). Internal funds and external financing are no longer perfect substitutes. In an influential article, Fazzari, Hubard & Petersen (1988) argue that constraints on corporate liquidity affects firm's investment policy. High levels of information asymmetry induce higher costs for raising external capital. Hence, if positive NPV projects arise these type of firms rely heavily on their internal funds and must refrain from investing if internal funds are not sufficient. Such firm's with restricted access to the capital markets are deemed financially constraint. The opportunity costs between using internal funds and external financing is defined as the wedge (Figure 1).

Fazzari, Hubard & Petersen (1988) hypothesize that firms with a large wedge experience a high sensitivity of investment spending to incoming cash flows. Hence, financially constrained firms are only able to invest more if cash inflows are increasing. Fazzari, Hubard & Petersen (1988) use three complementary a priori measures to gauge financial constraints: (i) low market valuations of firm's assets; (ii) high volatility of sales growth and; (iii) high cost of capital. Each of these specifications are split into three subsamples, the first tertile consisting of firms facing the lowest financial constraints and the third tertile facing the highest form of financial constraints. The sensitivity of investment spending to the level of financial constraints is examined for each subsample. The authors conclude that financially constrained firms experience higher investment-cashflow sensitivity.

The article by Fazzari, Hubard and Petersen (1988) has marked the origin of an academic

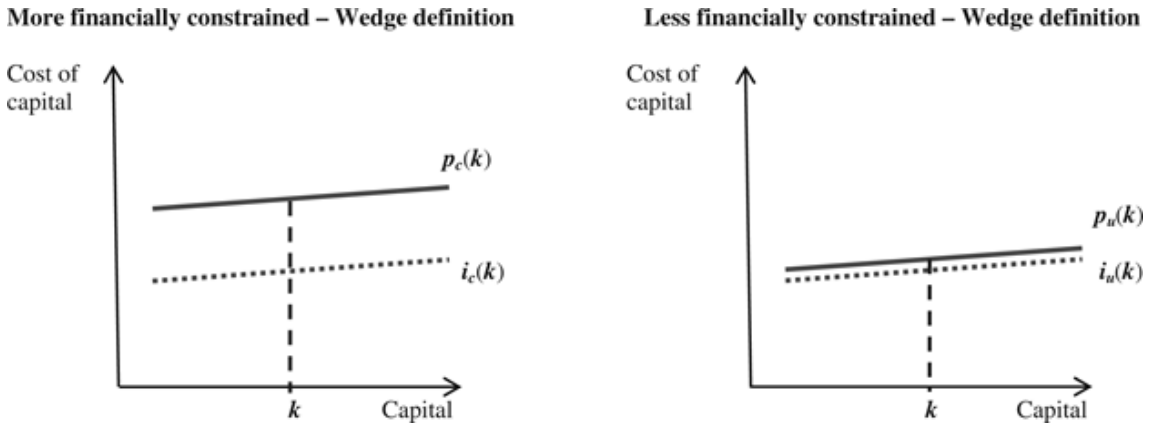


Figure 1

This figure shows the supply curves of capital faced by two hypothetical firms. Both hypothetical firms currently hold (k) units of capital. P(k) denotes the external capital of supply curve for these firms and the corresponding price level. I(k) denotes the opportunity costs of capital of internal funds.

debate whether financial constraints are an important determinant of firm financing behaviour. Amongst others, Withed & Wu (2006) argue that financial constraints should be defined as the elasticity of supply of external capital. The curvature of the supply-of-external-capital curve depends on the increasing incremental costs to raise an additional unit of external capital. Ultimately, the curve becomes vertical and the supply frictions obstructs the firm to obtain financing at the capital market. Firms are therefore financially constrained if they face a highly elastic supply of external capital curve (Whited & Wu, 2006) (Figure 2). To categorize financially constrained and unconstrained firms, Whited and Wu constructed their own index based on a structural investment model. Firms deemed constrained by their index are small, underinvested, do not have bond ratings and have relative low analyst coverage.

Since estimating a firm's wedge is challenging and observing firm's external capital supply curve is complex, Hadlock & Pierce (2010) tried measuring financial constraints indirectly. In particular, they measure financial constraints by scrutinizing management's assessment of firm's liquidity stated in the Management's Discussion & Analysis (MD&A) section in SEC 10-K filings. Furthermore, the relation of financial constraints and various firm characteristics are examined so that general inferences can be made for larger samples without extensively hand-collecting all data. Hadlock & Pierce (2010) recommend to categorize financially constrained firms solely on the variables of size and age, represented as the SA-index. The index implies that young and small firms exhibit financial constraints opposed to mature and large firms. The financial constraints falls sharply as firms grow and mature, up to a certain threshold. After

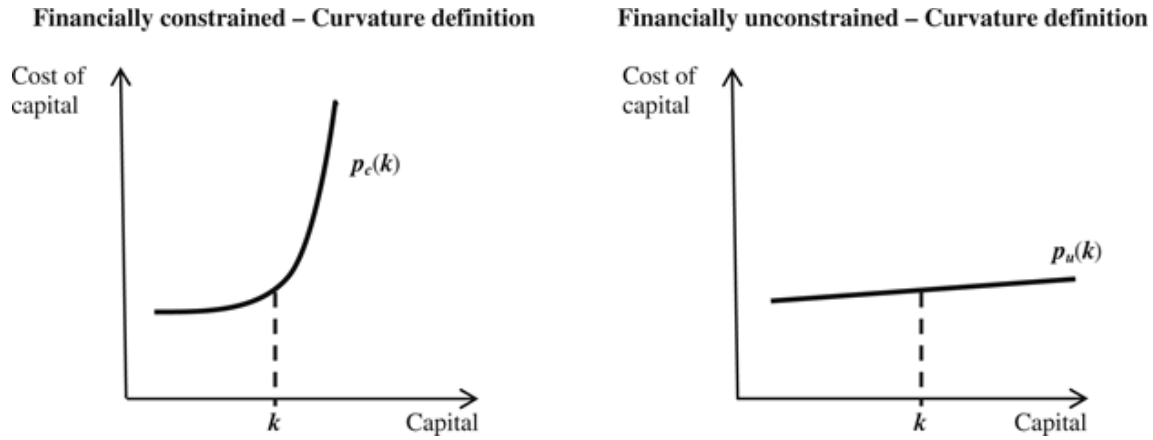


Figure 2

This figure shows the supply curves of capital faced by two hypothetical firms. Both hypothetical firms currently hold (k) units of capital. P(k) denotes the external capital of supply curve for these hypothetical firms and the corresponding price level.

reaching the threshold, the relationship appears to fade away. Consistent with the article of Hadlock and Pierce (2010), Hoberg and Maskovisc (2014) also find that younger and smaller firms are subject to financial constraints. Additionally, Hoberg and Maskovisc (2014) argue that constrained firms focusing on either issuing equity or debt cannot be systematically identified by size or age, as the characteristics of the issuing firms differ between the asset classes.

Farre-Mensa and Ljungquist (2016) try to clarify how well measures of financial constraints actually captures constraints. They examine how supposed financial constraints affect the ability to obtain external financing. In doing so, they distinguish between financial constraints reflecting the magnitude of the wedge and the elasticity of external capital supply. The authors demonstrate that financially constrained firms face no higher difficulty in obtaining credit in the debt market after an exogenous event of a state-tax increase. Furthermore, financially constrained firms tend to use part of the proceeds of equity offerings to increase payouts to shareholders, indicating that these firms do not face constraints while raising equity. Farre-Mensa and Ljungquist (2016) conclude that current definitions of financial constraints do not accurately capture the behaviour of such classified firms on the capital market. Rather than identifying financially constrained firms, univariate classifications identifies young, small and fast growing companies. The authors do provide evidence that privately held firms and junk bond issuers are facing financing frictions.

In a very recent paper, Brown et al. (2019) survey Australian institutional investors and asked

whether financial constraint impact investment decisions. The respondents had to rate variables according to their perceived importance as indicators of financial constraints, ranging from one (not at all important) to five (extremely important). The mean score of firm age and firm size are 2.05 and 2.94 respectively, indicating that the HP-index moderately captures financial constraints. The ratio of dividend scaled to total assets is rated 2.84, credit ratings are rated 3.04. Important factors of the WW-index are rated with average scores above 4.0, indicating investors typically measure financial constraints with components of the WW-index. Overall, 52% of the respondents consider financial constraints to be an important or extremely important factor in their investment decision.

2.2 Convertible bonds

Convertible bonds are debt securities with an embedded option to convert the bonds into shares at a pre-specified conversion price during a pre-specified conversion period. Also defined as hybrid securities, convertible bonds are structured as regular bullet bonds up until conversion. Typically, convertible bonds are eligible for conversion into shares in two ways. Firstly, if the share price of the issuer exceeds the conversion price the investor can convert the bonds into shares at his discretion. Secondly, an additional embedded call-feature creates the opportunity for the issuer to convert the convertible bonds into shares at its discretion.

2.2.1 Convertible bond issues from the perspective of the issuer

Issuing rationales

At large, four different theoretical rationales exists for why companies issue convertible debt. They are distinguished by the specific type of financing problems it assumes to alleviate when issuing convertible bonds instead of straight debt or common equity. These theories are not regarded as mutually exclusive, firms can have different reasons to issue convertible debt. Two theories take potential agency costs as the basis of their explanation, two theories start by analyzing potential adverse selection costs.

Green (1984) argues that agency costs arise between shareholders and bondholders due to conflicting interest. While bondholders receive at most the principal amount of the loan, the convex payoff function of equity incentives shareholders to generate excessive profits by means of increasing firm risk. The upside potential is typically paid out to the shareholders. The

downside of the increase risk profile however, is that firms cannot fulfil their debt requirements to bondholders. Convertible bonds are able to reduce the agency conflict by means of asset-substitution. The conversion of bonds into new shares forces existing shareholders to split the firm's upside potential with new shareholders, thereby reducing the incentive for shareholders to excessively increase firm risk or engage in overinvestment. Mayers (1998) suggests that convertible bonds can mitigate agency costs between another set of parties, namely firm's management and its shareholders. He argues that callable convertible bonds can be used by companies that have sequential financing needs to capitalize on growth options. When multiple consecutive investment opportunities arise, convertible debt as financing tool can prevent overinvestment by management. In case the investment opportunities turn out favorable, management can force conversion, reduce leverage and raise additional financing for the next investment opportunities. If not, the convertible bonds will not be converted into equity and the limited financing capacity will prevent overinvestment.

The risk uncertainty rationales of Brennan and Kraus (1987) and Brennan and Schwartz (1988) are based on the concept of information asymmetry on firm risk. If firm's management does not perceive the risk of the firm to be equal to bond investors estimations, management will not be able to raise capital. Issuing convertible bonds can resolve this issue. When valuing options the risk component actually increases the value of the option. Hence, bond investors overvalue the price of the option when considering a higher level of risk relative to management. Bond investors typically undervalue the credit component of convertible bonds since convertibles pay lower coupon rates. So the over- and undervaluation of both parties balance out and it becomes easier for investors and managers to come to an agreement on the value of the securities. The backdoor-equity model of Stein (1992) is based on the concept of information asymmetry on firm value. Issuing seasoned equity indicates that managers want to exploit overvaluation of the stock, thereby inducing a downward price pressure on the stock. However, issuing straight debt enhances the costs of financial distress. Convertible debt is regarded as a suitable compromise. According to Stein firms thus use convertible debt as way to obtain lagged equity financing without incurring adverse selection costs associated with seasoned equity offerings. Call-features are a prerequisite for the model of Stein (1992), because it enables a firm to force conversion once the share price has risen to the conversion price.

Firm performance

Firm performance, measured by stock returns, of convertible bond issuers significantly underperforms that of matched non-issuers in the years following the issuance (Lewis et al., 2001). The authors argue that the underperforming of stocks is due to the fact that poor performing companies are not eligible to issue equity by means of SEO and thus are forced to raise capital by means of convertible bond issuance. Zeidler et al. (2012) however, challenge that convertible bond offerings induce negative abnormal stock price performance. Consistent with the findings of Lewis et al. (2002) and Carlson et al. (2004), they demonstrate that especially small firms with considerable growth options experience a decline in systematic risk after convertible bonds issues. After controlling for the decline in systematic risk, the long-term stock performance is similar to the performance of their matched peers. This evidence helps to explain some cross-sectional deviations in abnormal buy-and-hold returns. Nevertheless, the majority of studies on the long-term effect of stock returns for convertible bond issuers report significant negative returns.

2.2.2 Convertible bond issues from the perspective of the buyer

Different market channels are utilized over time for issuing convertible debt. Investors in convertible bonds used to be long-term investors such as mutual funds employing a 'buy-and-hold' strategy. In recent years a shift has been observed from traditional long-term buyers to hedge funds, convertible arbitrage funds in particular. These hedge funds take a different approach known as a 'buy-and-hedge' strategy (Agarwal et al. 2011). Choi, Getmansky & Tooler (2009) document a dramatic increase in the activity and size of convertible arbitrage hedge funds during the time period ranging from the end-90s till 2006.

Convertible arbitrage strategy

Convertible arbitrage consists of the combination of a long position in convertible bonds and a short position in the underlying equity of the issuer. Using this strategy, profits can be obtained either in bull or bear markets. On the one hand, if share prices of the underlying equity improves as a result of better firm performance, the convertible bonds can be converted into equity shares as the conversion price is reached. In perfect efficient markets however properly priced convertible bonds should accurately reflect the embedded option to convert the bond into equity, thereby not resulting in excessive profits. But Ammann, Kind & Wilde (2003) provide evidence that convertible bonds tend to be underpriced. Because convertible bonds can be acquired

against a discount on the fundamental value, profits stems for a substantial amount from its underpricing (Agarwal et al., 2011). On the other hand, if share prices of the underlying equity deteriorates the convertible bonds are not eligible for conversion. Nevertheless, convertible arbitrageurs still receive a pay-off due to the short-position in the equity. By taking a long position in the convertible bond - with discount - and simultaneously short selling the equity of the issuer, an arbitrage opportunity can be created (Mitchell, 2007).

To determine the exact number of shares to be shorted, hedge funds use a hedge ratio defined as the delta measure. The delta measure represents the sensitivity of the value of the convertible bond to changes in prices of the underlying equity of the issuer. Because of its dependence on the underlying stock price of the issuer, the delta-measure is time varying. Hence, convertible arbitrageurs have to actively manage and adjust the number of stocks to be shorted to remain a (near) risk neutral position (Loncarski et al., 2009). Calamos (2005) argues that convertible arbitrageurs are inclined to buy convertible bonds with a high delta-measure. The underlying shares of such bonds typically have a higher volatility, translating into a higher value of the equity option. The increasing number of hedge funds as investors for convertible bonds derives from the ability to employ the convertible arbitrage strategy. Contrarily, traditional investors such as mutual and pension funds are constrained from engaging in convertible arbitrage strategies. Regulatory requirements, the lack of knowledge for using intricate trading strategies and self-imposed trading restrictions of such investors are the root of this trend (Brophy et al., 2009).

Convertible arbitrage hedge funds

Brophy et al. (2009) argue that hedge funds are keen to invest in PIPE[2] securities. Firms that issue PIPE securities are generally firms with relatively weak fundamentals and high levels of information asymmetry (Gomes & Phillips, 2005). Lacking alternatives options to raise capital, these firms are forced to offer large discounts on their securities. Which, in turn, generates lucrative arbitrage opportunities for hedge funds. Brophy et al. (2009) find that when hedge funds buy the majority of an PIPE placement, the average discount on the issued securities is five percentage-points higher. In essence, hedge funds position themselves as investors of the eleventh hour.

In line with the article of Brophy et al. (2009), Brown et al. (2012) examined the participation

[2]Private placements in public equity. Albeit not entirely comparable with privately placed convertible bond issues, I cite this article to demonstrate the increasing hedge fund involvement in private placements.

of hedge funds in convertible bonds issues privately placed under SEC rule 144A. Since issuers of convertible bonds are typically much larger firms compared to firms issuing PIPE securities, it is likely that alternative financing options are still eligible for these type of firms. Brown et al. (2012) find that if their sample of convertible bond issuers would have chosen to issue equity by way of SEO , the estimated issue costs are roughly two percentage-points higher than raising capital by way of convertible bonds. The prominent drivers of the higher SEO issue costs for these firms are the higher possibility of financial distress and more volatile share prices of its underlying equity. The authors conclude that for firms which meet the conditions for higher SEO issue costs, convertible bond issues are a more suitable financing method from a cost-based perspective. Moreover, Brown et al. (2012) find no significant higher discount for convertible bond issuers if the majority of the buyers is classified as hedge funds compared to issues if a minority of buyers is classified as hedge funds. This indicates that convertible bonds are not sold to hedge fund as investor of the last resort, contradicting the findings of Brophy et al. (2009) for PIPE securities.

Assuming perfect efficient capital markets, investor demand should have no effect on convertible issue volumes and design. Hedge funds as suppliers of capital have particular design preferences however. The SEC rule 144A facilitates identification of buyers of securities and creates the opportunity to examine the effect of investor demand on security volume and design. Choi et al. (2010) find that the ability of hedge funds to supply capital is an important factor in the decision to issue convertible debt. During periods of high investor demand by hedge funds for example, convertible securities firms have the propensity to issue convertibles instead of straight debt or common equity (De Jong, Duca & Dutordoir, 2013) Additionally, firms that issue convertible debt also tend to combine the issue with concurrent stock repurchase to facilitate short positions for hedge funds at a predetermined price, namely the repurchase price (De Jong, Dutordoir & Verwijmeren, 2011). Grundy & Verwijmeren (2018) argue that the likelihood of a convertible issue being callable is lower if the securities are privately placed under SEC rule 144A. During private placements convertible arbitrage hedge funds can pressure the issuer to eliminate the call-feature. Hedge funds prefer non-callable securities because the insecurity inherent to a call-option can never be perfectly hedged. In essence, suppliers of capital are proven to have an influence on convertible issues resulting in an attractive and lucrative asset class from a supplier perspective.

SEC Rule 144A

Firms relying on rule 144A are allowed to privately place the securities at issuance with qualified institutional buyers (QIBs) without registration reports required by the Securities Act of 1933. QIBs are generally large institutional investors owning at least $100 million of investable assets. Huang & Ramirez (2010) argue that QIBs offer lender specialization advantages over public investors such as improved information production, monitoring efficiency and renegotiation efficiency in financial distress. Thus QIBs are better able to serve firms with high information asymmetry and low credit quality compared to public investors and banks. Furthermore, the rule prevents filing extensive, time-consuming SEC reports and arranging costly road-shows to solicit indication of public investor interest. Hence firms are able to issue securities quicker under rule 144A.

Influence of hedge funds on firm performance

Many convertible bonds issues are recently structured as rule 144A offerings. As a result the announcement date and the issuing date of convertibles coincide. Duca et al. (2012) show that convertible issues are associated with increasingly negative announcement returns around the issue date over recent years. They argue that the price declines result from arbitrage-based short selling, inducing temporary downward price pressure on the issue- and announcement date. During the period 2000-2008 convertible offerings yield twice as negative announcement returns (-4,59%) compared to the timespan of 1984-1999 (-1-69%). Loncarski et al. (2009) find that the adverse announcement effect is especially prevalent for bonds with high delta measures because more stock has to be shorted by hedge funds to generate a delta-neutral position. De Jong et al. (2012) also provide evidence that short-sale constraints positively affect issue-date abnormal stock returns. Abnormal announcement return are more severe for U.S. firms, indicating that the more sophisticated convertible arbitrage market in the U.S. has a significant adverse impact on the abnormal return at the announcement date (Rahim et al., 2014).

Brophy et al. (2009) find that firms obtaining financing from hedge funds significantly underperform firms financed by other investors for two years after the capital injection. However, Brophy et al. (2009) study the issuance of PIPE securities and subsequent firm performance. We do not know to what extent these findings can be extrapolated to convertible bonds. As stated by Dutordoir, Lewis, Seward, and Veld (2014), the long-term performance of convertible bond issuers and the accompanying hedge fund involvement is still a largely unexplored area. This thesis has the aim to shed light on this subject.

2.3 Hypotheses

2.3.1 Private placement under rule 144A

Firms facing financial constraints have restricted access to the external capital market, either because of a large wedge between internal funds and external capital or an inelastic supply-of-external-capital curve. Issuing securities by means of private placements enables firms to mitigate these constraints. Gomes & Philips (2012) argue that investors in private placements are better incentivized to produce information because the costs of obtaining information is lower due to fewer free-riding problems. The reduction in perceived information asymmetry could potentially diminish adverse selection costs and thus mitigate financial constraints. Because constrained firms face higher levels of information asymmetry, these firms could potentially benefit most from the advantages of private placements. Also, 144A offerings provide the opportunity to raise external funding relatively quick (Huang & Ramirez, 2010). Hence, firms in acute need of financing are favourably disposed towards private placements by way of rule 144A. Taking the aforementioned into regard, I expect financially constrained firms to utilize the SEC rule 144A to privately place convertible bonds with QIB's in a greater extent than financially unconstrained firms:

H_1: *Financially constrained firms are more likely to issue convertible bonds under SEC rule 144A than financially unconstrained firms*

2.3.2 Subsequent public registration

Issues under rule 144A can be registered with the SEC after issuance. If approved, the bonds are eligible for public trading on specific exchanges. So, 144A issuers that subsequently register the issue with the SEC only temporarily use the 144A market up until the date of registration. Ultimately, the intention of these kind of firms is to let the issue be traded publicly. Firms that subsequently register the 144A offerings publicly therefore utilize the SEC rule 144A as a circumbendibus way to make use of the public external capital market:

H_2: *Financially constrained firms are more likely to utilize SEC rule 144A as way to bypass difficulties faced during public issues*

2.3.3 Hedge fund involvement

Up to three quarters of convertible securities is nowadays bought by hedge funds (van Marle & Verwijmeren 2017). After constructing the delta-neutral position the hedging-strategy induces hedge funds to sell after stock price increases and buy after stock price declines. Sustaining the delta-neutral position is inherently profitable for hedge funds. That is why hedge funds typically prefer issuers with high stock volatility (Brown et al., 2012). Financially constrained firms generally report high levels of stock volatility (Livdan et al., 2009). Hence, investing in convertible bonds issued by financially constrained firms could be a lucrative strategy for hedge funds. Moreover, as opposed to traditional investors, hedge funds are able to offset higher levels of risk by shortening more of the underlying equity. Investments regarded as too risky by traditional investors can therefore still be attractive investments for convertible arbitrageurs. Firms facing financial constraints typically also pose higher levels of perceived credit risk (Whited & Wu, 2006). In the absence of investment demand by traditional investors, hedge funds can act as investors of the last resort for financially constrained firms:

H_3: *Hedge fund involvement during convertible bond issues by financially constrained firms is higher relative to convertible bond issues by financially unconstrained firms*

2.3.4 Firm performance

Lewis et al. (2001) verify earlier findings in the academic literature stating that stock prices of convertible bond issuers significantly underperform that of matching non-issuers over the years following the issuance (Dutordoir et al., 2014). Instead of traditional theories trying to explain convertible bond issues, the authors reckon that poor performing companies which are not able to issue equity against a desired cost-level instead resort to convertible debt issuance. Additionally, Lewis et al. (2002) argue that idiosyncratic risk increases subsequent to issuance and consequently adversely impacts the stock performance. Hence, I expect convertible bond issuers to underperform matched non-issuers:

H_4: *Firms issuing convertible bonds underperform matched peer companies on the long term*

Chang et al. (2019) proclaim that financial constraints positively impacts the long-term abnormal return after issuance of convertible bonds because management is urged to cautiously and efficiently invest their funds. On the contrary, to my opinion higher cost of

financing for constrained firms urge them to forego on otherwise profitable, industry-wide investment opportunities. Unconstrained firms instead can capitalize on this industry-wide growth opportunities. Confirmation biases prevent investors to incorporate this phenomenon into stock prices immediately. Price adjustments will occur over a longer period of time. Also, access to external financial resources should positively impact firm's performance (Musso & Schiavo, 2008). I expect significant dispersion in firm performance after issuance.

H_5: *Financially unconstrained firms outperform financially constrained firms up to one year after convertible bond issuance*

3 Data

Section 3.1 covers the construction of the general data sample. Section 3.2 discusses the classification of financial constraints. Section 3.3 elaborates how I retrieve information needed to analyse subsequent public registration. In section 3.4 the construction for the data sample covering firm performance after issuance is addressed.

3.1 Convertible bonds

From the Mergent FISD database I extract 3,783 convertible bonds issues within the United States of America issued between January 2000 and June 2018. Issues are only incorporated in the sample under certain prerequisites. To be eligible for this research, issues should provide information on the offering amount, the issue date and information on whether the issue is either offered publicly or by means of private placement under SEC rule 144A. Following common practice, I remove issuers active in the finance industry because financial firms face regulation regarding their leverage (604 observations). For the same reason, I also delete issuers active in the utilities industry (122 observations). In addition, observations of with missing SIC codes are deleted (31 observations). After expiration of the applicable holding period of the securities determined under rule 144A, issuers can provide public trading for the convertible bonds by filling an effective SEC registration document. Subsequent to registration, securities can be traded publicly on specific exchanges. These public filings are also included in the data extracted from Mergent FISD, despite being just an extra filling for a previous privately placed convertible bond issue. To avoid double counting of the same issues, 1,077 observations with similar maturities for each unique issuer are deleted. To

Table 1: Descriptive statistics

Variables	Mean	St.dev.	p25	p50	p75
Issuer characteristics					
Firm size ($ mil)	4,414	12,422	544.8	1,318	3,441
Z-score	2.27	7.30	1.03	2.23	3.54
Return volatility	0.71	0.74	0.42	0.57	0.79
Age	27	16	19	23	33
Dividend	0.28	0.45	0	0	1
Rating	0.42	0.49	0	0	1
Tangibility	0.25	0.43	0.05	0.13	0.38
Market-to-Book	2.25	1.64	1.24	1.71	2.53
EBIT	(0.06)	0.16	(0.05)	0.03	0.08
Capex	0.28	0.90	0.02	0.05	0.14
R&D	0.67	3.10	0	0.04	0.19
Issue characteristics					
Issue proceeds ($mil)	323.13	385.16	115	200	375
Maturity	10.4	8.09	5	7	20
Rule 144A offering	0.66	0.47	0	1	1
Callable	0.92	0.27	1	1	1

The sample period is January 2000 - June 2018. Financial and utility firms are excluded. The Z-score represents the Altman Z-score, a measure for the probability on financial distress. Return volatility is annualised monthly stock return volatility up to 5 years before the issue. Age represent the amount of years since the (first) listing on a stock exchange. Dividend and Ratings are dummies set equal to one if the issuer pays dividend or has an credit rating respectively. Tangibility is scaled relative to total assets. EBIT, CAPEX and R&D are scaled relative to sales. Rule 144A offering, Callable and Callable within 3 years are dummies set equal to one if the issue is privately placed under rule 144A, if the convertible bond is callable and iff the effective date of first redemption is within 3 years after issuance respectively. Market-to-Book, EBIT, Capex and R&D are winsorized at the 1% and 99% percentile.

analyse issuer characteristics I extract specific firm information from the Compustat North America database. Due to this requirement I lose 449 observations. From the Center of Research in Security Prices (CRSP) the corresponding issuer's stock prices are derived by utilizing the merged Compustat/CRSP linkingtable. CRSP does not provide information for 81 observations, hence I drop these observations. Ultimately, the final sample is constructed and consists of 1,419 unique observations. The descriptive statistics are shown in Table 1.

3.2 Constrained and unconstrained firms

The first step in my research is to divide issuing firms in financially constrained and unconstrained subsamples. As illustrated in the literature overview, multiple methods exists to measure financial constraints. To avoid ambiguous results, I use four widely used methods to construct categories of financially constrained and unconstrained firms: (i) dividend paying firms and non-dividend paying firms; (ii) firms with or without credit rating; (iii) the Hadlock-Pierce index; (iv) the Whited-Wu index. The cross-tabulations of the four measures used are displayed in Table 2.

i. The first approach classifies firms which do not pay dividends as financially constrained. DeAngelo & DeAngelo (1990) argue that financial constraints and dividend pay-outs are negatively correlated. Firms facing difficulties in extracting external capital prefer to retain earnings for future investments. Moreover, firms that do pay dividends are able to use the dividend pay-out policy as tool to reduce information asymmetry. An increase in dividend signals positive financial prospects to investors. Dividends are only reduced if financial recovery is hardly feasible (Black, 1976). In line with Black (1976), Pathan et al. (2015) find that non-dividend paying firms have greater levels of information asymmetry, which in turns affects the ability to raise external financing on the capital market. However, classifying all non-dividend payers as financially constrained also has its limitations. Recently, firms tend to stop paying dividends and instead engage in share repurchases (Skinner, 2008). Timing and the overall level of repurchases can more easily be adjusted to recent earning developments than dividends. In addition, Dennis & Osobov (2008) argue that the number of firms that pay dividends has decreased in the period of 1994-2002, albeit the total level of dividends payed has remained the same. Firms, in particular tech-firms, lack pay-out policies and instead show the propensity to re-invest all profits.

ii. The second approach considers firms without a credit rating as financially constrained. Faulkender & Petersen (2005) argue that firms lacking credit ratings have restricted or no access to the public debt markets and are therefore compelled to borrow capital on less competitive terms and stricter covenants. Furthermore, to obtain a credit rating firms are required to disclose additional information. Rating agencies scrutinize governance risk, business risk, financial outlooks and debt covenants thereby reducing the level of (perceived) information asymmetry between the firm and investors (Fabozzi, 2013).

iii. The third approach is defined as the Hadlock-Pierce index. Hadlock & Pierce (2010) argue that the sole variables able to accurately capture financial constraints are the value of firm's total assets and its age. Their Size-Age index is extensively discussed in Section 2.1. The index is calculated as HP $= (-0.737 * Size) + (0.043 * Size^2) - (0.040 * Age)$. Size equals the natural logarithm of book assets. Age is the number of years the firm is listed with a non-missing stock price on CRSP. As stated earlier, the relationship between age and size of the firm observed by Hadlock & Pierce holds to certain threshold values. Therefore, size is winsorized at the natural logarithm of $4.5 billion and age is winsorized at thirty-seven years. Firms are thereafter ranked in ascending order and divided into tertiles. The bottom-tertile is defined as financially constrained, the middle tertile is unclassified and the upper-tertile is regarded as financially unconstrained.

iv. Lastly, I follow Whited & Wu (2006) to construct an index based on coefficients they obtained from a structural model and define it as the WW-index. An elaborate description of their theory and structural model can be found in the Section 2. As is common practice, I extrapolate the coefficients obtained by Whited & Wu and apply it to my own sample. The index[3] is calculated as WW $= -0.091 * [(ib + dp)/at] - 0.062 *$ [dividend dummy] + $0.021[dltt/at] - 0.044[log(at)] + 0.102 *$ [industry sales growth] $- 0.035 *$ [sales growth]. Firms are thereafter ranked in ascending order and divided into tertiles. As opposed to the HP-index, the bottom-tertile is defined as financially unconstrained, the middle tertile is unclassified and the upper-tertile is regarded as financially constrained. The downside of this approach is that the coefficients are not calibrated to the specific data sample of this thesis, thereby creating parameter instability (Farre-Mensa & Ljungqvist, 2016). I underscore this concern, although re-estimating the structural model and its coefficients falls outside the scope of this thesis.

Table 2 displays cross-tabulations of all measures. The first five rows display the fractions of firms classified as constrained that would also be classified as constrained by the other three measures. The fractions thus show in what extent the measures produces the same financial constrained classifications. The dividend measure captures 82.5%, 81.2% and 92.4% of the firms classified as financial constrained by the ratings measure, HP-index and WW-index respectively.

[3]The variables in italic are Compustat data items: *ib* is income before extrodinary items; *dp* is depreciation and amortization; *at* represents total assets; *dltt* is total long term debt. Dividend dummy takes the value of one if firms pay dividend in the preceding year, zero otherwise. Industry sales growth is defined as the average percentage sales growth for each three-digit SIC industry code per year. Sales growth is the yearly growth in revenue.

Table 2: Comparison of Financial Constraints Measure

		Financial Constraint Measures			
		Dividends	Ratings	HP-index	WW-index
Constrained firms	Fraction no dividend	1.000	0.825	0.812	0.924
	Fraction no ratings	0.662	1.000	0.839	0.754
	Fraction constrained HP	0.376	0.484	1.000	0.604
	Fraction constrained WW	0.421	0.429	0.594	1.000
Unconstrained firms	Fraction no dividend	0.000	0.575	0.673	0.620
	Fraction no ratings	0.359	0.000	0.446	0.491
	Fraction constrained HP	0.224	0.127	0.000	0.201
	Fraction constrained WW	0.088	0.190	0.195	0.000

This table reports cross-tabulations of four different methods measuring financial constraints to illustrate the similarities and differences amongst the measures. The upper sub-table shows the percentage of firms classified as constrained by each measure that would also be classified as constrained by the other measures. For instance, 66.2% of the firms classified as constrained by the dividend measure are also constrained according to the rating measure. The lower sub-table shows the percentage of firms classified as constrained by each measure, but nevertheless are classified as unconstrained by the other measures. For instance, 35.9% of the firms classified as unconstrained by the divided measure are classified as constrained by the rating measure.

The measure seems to have the highest correlation with the other measures. However, as displayed in Table 11 of Appendix B, 1,021 of the 1,419 observations are classified as non-dividend payers. Due to the large number of non-dividend paying firms, the measure shows relatively high levels of correlations. Additionally, the rating measure exhibits high correlations with other measures. 66.2%, 83.9% and 75.4% of the firms classified as constrained by the measures of dividends, HP-index and WW-index respectively are also classified as constrained according to the dividend measure. According to Table 11 in Appendix B, the number of observations with and without credit ratings are more evenly divided compared to the dividend measure: 819 observations do not have credit ratings, 600 observations do. Hence, the observed correlations do not exhibit the same limitation as the dividend measure. The last five rows of Table 2 show the fraction of firms classified as financially *unconstrained* that would be classified as constrained by other measures. Again, the dividend measure stands out. For instance, 57.5% of the rated firms do not pay dividends, while 67.3% of the relatively old and large firms do not pay dividends. Furthermore, the results show a relatively high agreement between the HP and WW indices. Generally, the results of Table 2 reflect that each measure classifies a largely

unique set of firms as financially constrained. Therefore, the necessity to examine all four measures simultaneously and thereby avoiding ambiguous results, becomes even more evident.

3.3 Subsequent public registration

Additionally, I intend to examine the relation between the subsequent public registration after rule 144A convertible bond issues and the relation with firms' financial constraint status. I classify issues with subsequent public registration as issues similar Mergent FISD issuer ID and bond maturities but different offering dates. Amongst the total number of 1,419 convertible bond issues in my dataset, 651 observations are convertible bond issues under SEC rule 144A with subsequent pubic registration. For issues with subsequent public registration the difference in offering amount and the days between the private issue and the public registration is calculated.

3.4 Firm performance

At last, I analyse the long-term performance of issuing firms for a one-year horizon. Because I want to analyse 'clean' event windows, observations are dropped if issues are followed by another convertible bond issuance within one year (365 days) of the first issue. Both issue's are dropped because the first issue is not eligible for clean analysis due to the impact of the second issue. The second issue is dropped because subsequent performance can not be isolated from the last issue which can contaminate results. Due to this limitation, I have to drop 186 observations from my sample. Moreover, I require that for the issuer at least one year of stock data is available after the issue. Some firms have been acquired or go bankrupt and therefore lack stock data for the subsequent 250 trading days. In addition, because CRSP only covers stock price information up until the 31st of December 2018 all issues during the year 2018 are also excluded. An additional 123 observations had to be dropped.[4] Furthermore, duplicates per issuer and offering date are excluded from the sample. Although these issue tranches have different bond maturities, the performance of the issuer during the first 250 trading days after the issue remain the same. An extra 30 observations are removed from the sample. Ultimately, the sample of issuers for which I can examine the long-term performance consists of 1,080 observations for 736 unique firms.

[4] Approximately an even amount of constrained and unconstrained firms had to be dropped, so I reckon no profound survivor bias will arise.

4 Methodology

Section 4.1 addresses the methodology used for the logistic regressions. Section 4.2 discusses the proposed analysis for testing difference in means between regular convertible bond issues and issues that are subsequently registered for public trading. Section 4.3 extensively describes how firm performance is examined.

4.1 Logistic models

To examine whether the likelihood of constraint firms issuing convertible bonds under rule 144A is larger compared to unconstrained firms, I make use of a logistic regression. A binary classification logistic model is the preferred method for regressions if the categorical dependent variable either takes the value of zero (e.g., regular offering) or one (e.g., rule 144A offering). The logistic model allows me to analyse how independent variables affect the probability of the dependent variable being zero or one (Cramer, 2003). To construct such logistic model, I implement a latent variable Y* representing the propensity of issuing convertible bonds under rule 144A ranging from -∞ to ∞ into a regression:

$$Y_i^* = \alpha + \beta x_i + \varepsilon_i \tag{1}$$

where x_i is a set of independent variables for observation i and β is the corresponding regression coefficient. The full model used for the logistic regressions can be found in Appendix C.[5] The relationship between the latent variable Y* and the actual dependent binary variable Y can be described as:

$$Y_i = \begin{cases} 1 & \text{if } Y_i^* > 0 \\ 0 & \text{if } Y_i^* \leq 0 \end{cases} \tag{2}$$

Following common assumptions about the error term of the logistic model[6], the probability of the dependent variable being equal to one can be defined as:

$$Pr(y = 1|\, x) = \frac{\exp(\alpha + \beta x)}{1 + \exp(\alpha + \beta x)} \tag{3}$$

The regression coefficients β for each independent variable x for observation i are estimated by a maximum likelihood model. The model estimates values for each parameter so that the

[5] I use similar logistic models to examine the relationship between embedded call-features and financial constraints, see model (2) in Appendix C.

[6] Long & Freese (2006) argue that the assumption regarding the distribution of the error term only affects the spread of the distribution but has no effect on the computed value of probability. So, because the actual assumptions are irrelevant to the outcome I restrain from an elaborate discussion of the assumptions.

likelihood of generating the actual observed data-points is greatest, conditionally on the correctness of the assumptions (Long & Freese, 2006). To examine whether single explanatory variables have a significant influence on the dependent variable, Wald tests and likelihood-ratio tests are carried out. Wald tests assesses the hypothesis if a regression coefficient is equal to zero. The likelihood-ratio test compares the log likelihood from the full model and a restricted model that imposes the constraint of the hypothesis, namely all regression coefficients β simultaneously being equal to zero.

4.2 Subsequent public registration

To detect whether financially constrained firms utilize SEC rule 144A as circumbendibus way to make use of the initially foreclosed public market, I propose two measures to empirically test the hypothesis. In my opinion, one possible important indicator to detect such behaviour is the difference between the original issue amount and the amount ultimately registered for public issuance. Firms that just temporarily make use of the 144A market should aim for a large portion of the original issue to be registered for public tradings, as this is their goal from the start. Because financially constrained firms have larger difficulties in raising funding on the public capital market, I expect that financially constrained firms have a larger likelihood to utilize rule 144A and the opportunity to subsequently register the issue publicly to indirectly achieve the benefits of publicly tradeable convertible bonds. So, by means of the Welch's t-test I examine the difference in offering amount between the original 144A issue and the following public registration. The Welch's t-test is preferred because it's reliability is higher when comparing two samples with different sizes and variances as opposed to the Student's t-test (Ruxton, 2006).

In addition, I contemplate the difference between the initial announcement date of the 144A issue and the subsequent date when the SEC filling became effective as a second proxy for firm's behaviour to utilize rule 144A as bypass to use the public external capital market. Since financially constrained firms face higher levels of information asymmetry, subsequent filing with the SEC for public trading of the convertible bonds will generally take more time to complete because a large volume of information discrepancy has to be clarified. Again, by means of the Welch's t-test the difference in days between the original 144A issue and the following public registration for constrained and unconstrained firms are investigated.

4.3 Firm performance

To examine short-term and long-term firm performance after convertible bonds issues, I deploy event studies for each convertible bond issue. An event study is a methodological tool to examine the reaction of firms' stock prices around corporate events. Event studies provide evidence on the (unanticipated) impact on shareholders wealth and helps in understanding the effect of corporate policy decisions such as convertible bond issues.

According to Kothari et al. (2007) a short-window event study is an accurate method to measure the impact of announcement events on the condition that the actual price reaction is concentrated in the event window. However, inferences for long-term event studies are far more ambiguous. The basic concern entails that long-term abnormal performance tests are joint tests of capital market efficiency and models of market equilibrium (Fama, 1970). Whether the apparent abnormal returns stem from the event subject to the research, mispricing, or simply the result of measurement problems, is still an unresolved concern in the academic field of financial economics (Kothari et al., 2007).

I investigate the long-term performance of firms by means of buy-and-hold abnormal returns, also known as BHARs. Mitchell & Stafford (2000) describe buy-and-hold abnormal returns as *"The average (multi-)year return from a strategy of investing in all firms that complete an event and selling at the end of a pre-specified holding period versus a comparable strategy using otherwise similar nonevent firms"*, which can be depicted by the following equation:

$$BHAR_i(t,T) = \prod_{t=1 \text{ to } T} (1 + R_{i,t}) - \prod_{t=1 \text{ to } T} (1 + R_{B,t}) \tag{4}$$

where R_i is the buy-and-hold abnormal return for firm i consisting of T periods, R_B is the return on a non-event firm or portfolio of firms that is matched to the event firm i. I use BHAR's because QIB investors generally buy and hold the securities for a particular timeperiod and buy-and-hold returns better resemble actual returns earned by investors. Moreover, using BHARs as measure for firm performance gives rise to the opportunity to reconcile and compare the results with studies from Lewis et al. (2001) and Zeidler et al. (2012) which use the same methodology. Van Marle & Verwijmeren (2017) show that the most prominent buyers of convertible issues - hedge funds - on average hold convertible bonds for 11.6 months, so I examine the initial wealth effect for 12 months following the issue. According to the literature, the preferred method to calculate BHARs is to assign an individual control firm to each event firm and compare the buy-and-hold returns (Lyon et al., 1999). I follow the methodology used by Brown et al. (2009) to find a single matching firm according to their similarities in industry classification, size and

Market-to-Book ratio. Additionally, I also require firms to report their financials in the same fiscal year to control for market behaviour and price momentum.[7] Size and Market-to-Book ratio's are extracted from Compustat for all U.S. firms except for firms issuing convertible bonds in my sample. I merge this file with my sample dataset and rank all firms per industry and fiscal year on size and Market-to-Book. I sum the size and Market-to-Book rank scores and match the sample firm to the firm with the lowest deviation of total rank score. If an issuing firms has multiple potential control firms with equal rank scores, the control firm is picked randomly. Control firms occasionally miss CRSP-data during the exact event date of the issuer. If so, I use data from control firms ranked secondly during the matching process with the issuing firm. Consistent with Section 3.4, a total of 1,080 issuing firms are matched with control firms.

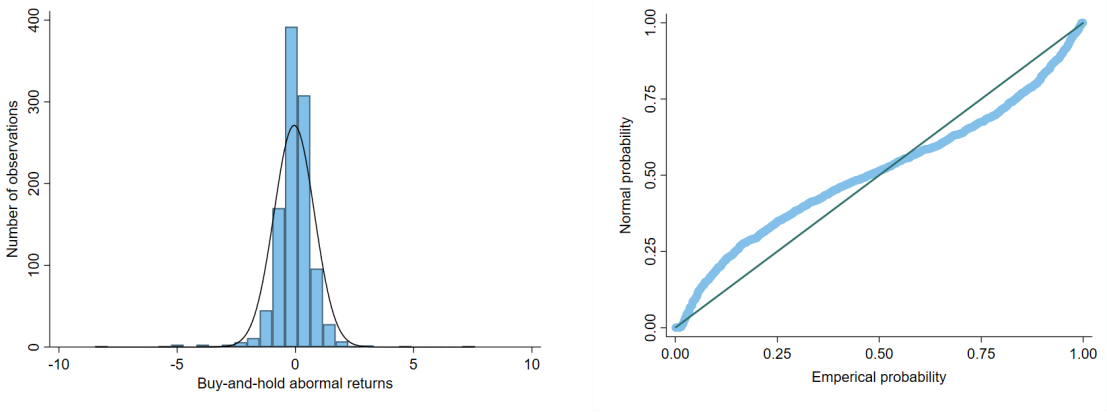
Testing the significance of the long-run abnormal returns has long been subject to discussion in the academic literature. The statistical significance of BHARs has been particularly difficult to establish because (i) long-horizon returns generally violates the assumption of normality required by many statistical tests; (ii) long-horizon returns exhibit considerable cross-correlation because the return horizons of many event firms coincide due to favorable macro-circumstances (e.g, low interest rates or increased investor demand from convertible arbitrageurs) and also because many event firms are clustered in few industries; and (iii) return volatility of the event firm exceeds that of matched firms because of event-induced risks and accompanying volatility (Kothari et al., 2007). These kind of model misspecifications results in larger variability of test statistics (Jegadeesh & Karceski, 2009). Hence, I have to appropriately adjust for these kind of pitfalls to present statistical relevant inferences.

First, the concern of BHARs violating the assumption of a normal distribution is examined by means of Figure 3. As illustrated in Figure 3(a), the BHARs seem to be distributed normally around the mean. However, the majority of observations are centred around zero. Figure 3(b) convincingly displays that the distribution of the BHARs deviates from a normal distribution. Therefore the normal distribution assumption has to be rejected.[8] Hence, regular parametric statistical tests will not suffice. To correct this issue I compute the statistical significance by means of the non-parametric sign-test. The sign-test examines whether or not the median of the distribution is different from zero. It does so by assessing the probability of BHAR being

[7] Essentially, I created groups according to industry and year of reporting and matched it to issuers with the same group variable.

[8] Statistical tests such as the Shapiro-Wilk test also fail to accept normality, however the significance of such tests has to be interpreted carefully due to the large sample size because large sample sizes produce significant results for only slight deviations from normality.

Figure 3: Distribution of one year buy-and-hold abnormal returns



(a) Histogram BHAR

(b) Normality probability graph BHAR

The figure on the left illustrates the distribution of the BHARS in a histogram. A normal density curve with sample mean and standard deviation is also plotted. The figure on the right displays the normal probability graph where the straight line resembles a perfect normal distribution.

positive by a binominal distribution function:

$$Pr(BHAR_a(T) > 0 \mid x) = \frac{n!}{(n-x)!\,x!} * (p)^x * (1-p)^{(n-x)} \tag{5}$$

Where $BHAR_a$ is the buy-and-hold abnormal return in period T for every subsampe a, n is the number of observations in the subsample, x is the number of observations larger than zero and p is equal to 0.5. I did explicitly not opt for the Wilcoxon sign-rank test. Outliers could adversely impact the results when the magnitude of the coefficients is also taking into account. As illustrated in graph 4 in appendix D, the sample does have several major outliers. To avoid biased results, I thus choose to test significance of BHARs by means of the signtest.

Next, the differences in means between subsamples are examined following two steps. First, Levene's test for equality in variance is used to detect whether or not the variances of each subsample are comparable. Dependent on the outcome, either the student t-test or the Mann-Whitney U test is used to calculate differences of means between the subsamples reflecting firm's financial constraint status. The Mann-Whitney U test is suitable for subsamples with unequal variances and unequal size of the comparable subsamples as opposed to the student t-test. All categories have unequal variances except for the subsamples of the WW-index. Hence, Mann-Whitney U tests are used for every subsample except for the WW-index.

Second, I check for possible cross-correlation amongst observations. Figure 5 in Appendix E shows the distribution of issuers across Fama & French industry classifications and the

distribution of issues across years respectively. The years of the offering dates are evenly distributed. Unfortunately, the issuers seem to be concentrated into three industry classifications. Business services, Electronic Equipment and Pharmaceutical Products[9] are overly represented in the sample. A closer look into the dispersion of issues across years in the sample period for each of the industries indicates that cross-correlation of returns can be a methodological pitfall (Appendix E, Figure 6).

To verify my findings I correct for cross-correlation by matching multiple control firms to the event firm, while simultaneously allowing firms to be matched across different fiscal years. Firms experience different volatility levels across years due to different macro-economic circumstances. Allowing matched firm to report in different fiscal years therefore has an mitigating effect on cross-correlation. Potential reference firms are now only considered by their same industry classification according to Fama & French and similar firm characteristics. Furthermore, by matching multiple control firms to the event firm across different fiscal years, the possibility of overlapping long-horizon returns is decreased. The matching process starts with dividing reference firms into tertiles according to their size and Market-to-Book ratio thereby essentially creating six different categories per industry classification. Subsequently, I pick ten random firms within the same category as the issuer and extract the required stock information and financials from CRSP and Compustat. Firms with missing data are dropped. The number of matched reference firms per event firm ranges from five till ten. Subsequentely, I calculate the average buy-and-hold return across the portfolio of reference firms. For each issuing firm I test the hypothesis whether the BHAR is different from zero compared to the pseudo-portfolio's. Again, the statistical significance tests are carried out by the non-parametric sign-test test. To test whether difference in means across subsamples exists, either the student t-test or the Mann-Whitney U test is used dependent on the outcome of Levene's test of equal variances.

Third, the problem remains that any inference on the basis of BHAR relies heavily on the validity of the assumption that event firms only differ from the "otherwise similar non-event firms" in that they are involved in a corporate event (Kothari et al, 2007). However, its reasonable to assume that the risk profiles and accompanying volatility levels are higher for event firms than non-event firms.

[9]Industry Classification number 34, 36 and 13 according to Fama & French. The industries account for 14.81%, 14.71% and 13.85% respectively.

5 Firm behaviour around convertible bond issues

In this chapter I discuss the empirical results of my thesis. Section 5.1 addresses the results from the logistic regression analysing the propensity to issue convertible debt under rule 144A by financially constrained firms. Section 5.2 discusses the effects of public registration of preceding 144A issues. Section 5.3 describes the results for proxies of hedge fund involvement. Lastly, Section 5.4 discusses the robustness checks performed to verify the results.

5.1 Private placement under rule 144A

Table 3 gives an overview of an univariate analysis for differences in means of rule 144A issues amongst financially constrained and unconstrained firms. For all financial constraint classifications a significant difference exists in the utilisation of SEC rule 144A. Constrained firms exhibit a higher propensity to issue their convertible bonds under rule 144A relative to unconstrained firms. The difference between constrained and unconstrained firms issuing convertibles under rule 144A is largest for to the HP-index, essentially implying that younger and smaller firms tend to issue more convertibles under rule 144A than older and larger firms.

By means of logistic regressions I assess the propensity of firms to issue convertible bonds under SEC rule 144A. Table 4 displays four separate logistic models. Each model has different key explanatory variables, namely a variable that classifies issuing firms as financially constraint according to the four different methodologies described in section 3.2. The dependent variable in all models is the binary variable indicating whether a firm issues a convertible bond under rule 144A.

Table 3: Difference in rule 144A offerings

	Cons	Uncons	
Dividends	0.707	0.560	*2.49***
Ratings	0.737	0.568	*3.15****
HP-index	0.754	0.545	*3.22****
WW-index	0.727	0.590	*2.09***

The variable of 144A offerings takes the value of one if convertible bonds are issued under SEC rule 144A, zero otherwise. Two proportion z-test statistics for differences in means are shown in italic. Significance at the 1%*** and 5%** respectively.

Table 4: Logistic regressions for the probability of issuing under rule 144A

	Prediction	#1 Logit	#2 Logit	#3 Logit	#4 Logit
Dividend paying	(-)	-0.513***			
		(0.146)			
Rated	(-)		-0.563***		
			(0.155)		
HP constrained	(+)			0.458***	
				(0.142)	
WW constrained	(+)				0.149
					(0.155)
Size	(-)	-0.220***	-0.155***		-0.226***
		(0.054)	(0.059)		(0.060)
Age		-0.001	-0.000		-0.002
		(0.004)	(0.004)		(0.004)
MTB	(+)	0.072	0.064	0.119***	0.083*
		(0.046)	(0.046)	(0.045)	(0.046)
Convertible arbitrage industry	(+)	0.072***	0.074***	0.068***	0.070***
		(0.011)	(0.011)	(0.011)	(0.011)
Stock volatility	(+)	-0.141	-0.125	-0.090	-0.119
		(0.094)	(0.091)	(0.082)	(0.089)
Altman Z-score	(-)	0.026*	0.027*	0.023	0.028*
		(0.015)	(0.015)	(0.015)	(0.015)
Tangibility	(-)	-0.284*	-0.274*	-0.432*	-0.336*
		(0.148)	(0.150)	(0.222)	(0.175)
Relative offering size	(-)	-0.325*	-0.297*	-0.164	0.316*
		(0.186)	(0.186)	(0.145)	(0.184)
R&D intensity	(+)	0.031	0.031	0.043*	0.034
		(0.024)	(0.024)	(0.025)	(0.025)
Constant		1.846***	1.480***	-0.129	1.770***
		(0.457)	(0.475)	(0.179)	(0.522)
Observations		1.325	1.325	1.325	1.325
Psuedo R^2		7.46%	7.52%	5.71%	6.79%

Standard errors in parentheses. Significance at the 1%***, 5%** and 10%* level respectively. Convertible arbitrage represent estimated assets by convertible arbitrageurs in $ billions. Size in natural logarithm of total assets. Relative offering size is the offering amount over market value of equity.

The results of model 1 indicate that non-dividend paying firms tend to issue their convertible bonds under rule 144A. As shown in Table 4 the coefficient of the variable that determines whether a firm pays dividends is negative and significant at the 1% level. This result implies that a significant negative relation exists between the propensity to issue convertible bonds under rule 144A and whether a firms pay dividend, supporting the hypothesis that financially constrained firms indeed exhibit a higher propensity to issue their convertible debt under rule SEC 144A. Furthermore, Table 4 presents covariates used in the logistic regression. Firm size has a highly significant negative impact on the likelihood of firms issuing convertible bonds under rule 144A. Therefore, the results are similar to the findings of Brown et al. (2012) who state that smaller firms exhibit a higher probability to utilize rule 144A compared to larger companies. The coefficient reflecting the size of the convertible arbitrage industry is positively correlated to 144A issues. This is in line with Agarwal et al. (2011). I also find that higher Altman's Z-scores (indicating lower probabilities on financial distress) is positively correlated to rule 144A issues. As opposed to my prediction, the result implies that companies reporting strong underlying financials utilize the 144A to a greater extent compared to firms with weak underlying financials. The Z-score coefficient contradicts the results by Brown et al. (2012) who report that features associated with 'good' firms increase the likelihood of firms issuing convertible bonds publicly. Tangibility is defined as the fraction of the value of property, plant and equipment over the value of total assets and is considered a proxy for the stability of financial outlooks of a firm. Tangibility appear to have a negative relationship to the probability of a firm issuing convertible bonds under rule 144A. Firms with relatively low tangibility thus exhibit a higher propensity to issue convertible debt privately, thereby verifying my expectation that firms with large portion of intangible assets make more use of rule 144A. Moreover, higher relative size of the offerings negatively impact the dependent variable. The offering amount scaled by issuer's market capitalization significantly affects the decision to issue convertible debt privately, perhaps in order to increase the speed of such small transactions as described by Huang & Ramirez (2010).

According to model 2 the dummy variable for firms favoured with a credit rating is negatively correlated with the dependent variable, implying that firms with credit-ratings are less inclined to issue convertible bonds under rule 144A. Hence, firms without any credit rating tend to issue more convertible bonds privately thereby utilizing the exemption of public offerings imitated by rule 144A. Again, the coefficient for the variable determining the financial constraint status is highly significant. Significance of the covariates is similar to model 1, where the size of the firm and its tangibility negatively affect the dependent variable and the Z-score and relative

size of the offering positively affects the dependent variable. In addition to model 1, model 2 provides evidence for accepting the hypothesis that the status of being financially constrained is an important factor for firms to utilize SEC rule 144A.

In model 3 the explanatory variables of size and age are left out due to multicollinearity issues with the variable reflecting whether a firm is classified as constrained based on the HP-index, which solely consists of a combination of the variables size and age. The results of model 3 therefore differ slightly from the other models. The key explanatory variable in model 3 is a dummy set equal to one if a firm is classified as financially constrained according to the Hadlock-Pierce index. The regression coefficient shows the expected positive sign and is highly significant, indicating that young and small firms exhibit a greater likelihood to issue convertible bonds under rule 144A. Furthermore, the Market-to-Book variable becomes highly significant. The MTB-ratio determines the estimated investment opportunities for the firm assessed by the market, suggesting that firms with favourable prospects are more likely to issue under rule 144A. In line with this finding, the variable indicating the R&D intensity of the firm also gains significance. The specialisation of QIBs to supply capital in more sophisticated transactions and the speed of the issuance could be potential drivers of this phenomenon. For model 4 the key explanatory variable is a dummy set equal to one if a firm is classified as financially constraint according to the Whited-Wu index. The regression coefficient shows the expected positive sign. However, the variable does not significantly impact the dependent variable. Hence, no compelling evidence exists whether the status of being financially constraints impacts the decision to issue convertible bonds under rule 144A according to the WW-index.

The economic impact of the coefficients displayed in Table 4 can be interpreted by making use of marginal effects. Table 5 gives an overview of these marginal effects for each financial constraint measure. Marginal effects for categorical variables reflect the change of the dependent variable that is attributable to an increase of the categorical variable from zero to one, all other variables in the model held constant. For instance, firms with credit ratings have 11.26% lower probability

Table 5: Marginal effects

	Marginal effects
Dividend paying	-10.26%
Rated	-11.26%
HP constrained	9.39%
WW constrained	3.01%

of issuing convertible debt under rule 144A than firms without credit rating. Essentially, the results indicate that financially constrained firms prefer to issue convertible bonds privately to QIB under SEC rule 144A. Together with the results found by Brown et al. (2019), we can conclude that the type of investor and the channel of issuance plays an important role in convertible bond issues. The type of investor has considerable impact on the type and channel of firm's capital issuance's.

5.2 Subsequent public registrations

Table 6 contains an univariate analysis of differences in means between groups of financially constrained and unconstrained firms for variables expected to have a relation on the decision to publicly register convertible bond issues subsequent to a private placement. The overall average subsequent public registration of 76.5% is in line with the findings of Huang & Ramirez (2010) who find that 81% of all 144A convertible bond issues are subsequently registered for public trading during the time period of 1996-2004. For all categories the likelihood for constrained firms to publicly register the previous privately place convertible bond issue is virtually the same compared to unconstrained firms. No difference in means exists.

According to the dividend and ratings classification, unconstrained firms issue more convertible bonds when the average size of the convertible arbitrage industry is larger. On the contrary, according to the HP-index constrained firm issue more convertible bonds when the average size of the convertible arbitrage industry is larger. The WW-index classification does not yield significant results. At large, the results covering the impact of the size of the convertible arbitrage industry are ambiguous. Hence, I am not able to validate the theory that financially constrained firms are appealed by the size of the convertible arbitrage industry to issue convertible debt.

Firms classified as constrained by the dividend measure and the WW-index show significantly lower differences between the offering amount of the private issue relative to the latter public registration if compared to unconstrained firms. The results indicate that these type of firms tend to publicly register larger fractions of the convertible bond that was previously issued privately under rule 144A, implying that public registration of the issue was the issuer's goal from the moment the convertible bonds were issued under rule 144A. These findings are in line with my expectations and provide evidence that firms regarded as constrained, according to the dividend measure and the WW-index, utilize SEC rule 144A as a substitute for public

Table 6: Difference in mean analysis

		Subsequent public	CB arbitrage	Δ offering amount (%)	Δ offering time (days)	Obs.
Dividends	Cons	0.755	9.060	0.085	180.2	722
	Uncons	0.798	10.901	0.101	153.9	223
		0.56	*4.22****	*1.71**	*1.99***	
Ratings	Cons	0.748	8.862	0.093	178.3	604
	Uncons	0.795	10.615	0.082	166.1	341
		0.68	*4.47****	*1.26*	*0.89*	
HP-index	Cons	0.770	10.678	0.085	158.8	357
	Uncons	0.756	8.866	0.085	184.86	258
		0.17	*3.77****	*0.02*	*1.85**	
WW-index	Cons	0.743	9.467	0.077	170.0	338
	Uncons	0.800	9.613	0.097	172.8	275
		0.71	*0.30*	*1.91**	*0.20*	

Test statistics for differences in means are shown in italic, significance levels in parentheses. Test are carried out for all 144A issues, total of 945 observations. Two proportion z-test is carried out for categorical variables, the Welch t-test for numerical variables. Convertible arbitrage represent estimated assets by convertible arbitrageurs in $ billions. Difference in offering amount is scaled by the original offering amount. Difference in offering time is the amount of days between the inital offering and the subsequent public registration.

issues. The results fail to establish such inference for the ratings measure and the HP-index. Furthermore, non-dividend paying and non-rated firms show a larger difference in days between the date of private placement and the date of public registration compared to dividend paying and rated firms. However, the difference is only significant for the dividend measure, indicating that constrained firms are able to benefit from rule 144A by raising capital quicker relative to public issues. The public registration generally takes nearly 30 days, one month, longer to complete for non-dividend paying firms relative to dividend paying firms. The results for the HP-index seem to contradict these inferences for constrained firms. Larger and older firms, deemed unconstrained by the HP-index, typically take longer to complete subsequent public registration. In the light of these findings, the hypothesis that financially constrained firms utilize SEC rule 144A as a way to bypass public issues, can not be accepted.

Not reported in Table 6 is the total average days between the date of private placement and subsequent public registration. For the whole sample the number of days amounts to 174

days, which is considerably larger than the number of days reported by Huang & Ramirez (2010). They find that during the time period of 1996-20004 80% of 144A convertible bonds is subsequently registered after 90 days. Figure 8 in Appendix D shows the time trends of the difference in offering amount and difference in offering time for 144A issues subsequently registered for public trading with the SEC. As illustrated by the graph, the difference in offering time on average is indeed shorter in the time period examined by Huang & Ramirez. Both variables do not seem to move correspondingly.

To assess whether certain issue and issuer characteristics affect the likelihood of rule 144A offerings ultimately being publicly registered, I again make use of logistic regressions. Table 7 depicts the outcomes of the logistic regression for each measure of financial constraints. No measure of financial constraints is significant. Hence, financial constraints seem not to influence the probability of 144A issues being publicly registered subsequently. Remarkably, age does seem to have an influence. Older firms that have issued convertible bonds under rule 144A apparently experience a higher propensity to publicly register the private issue. Moreover, the size of the convertible arbitrage industry has a significant and positive impact on 144A issues being registered publicly after issuance. More demand from convertible arbitrageurs gives rise to more 144A offerings, which are subsequently registered publicly. The Pseudo R^2 for all four models are very low, stressing the importance of interpreting these findings with caution.

5.3 Hedge fund involvement

To assess whether or not hedge funds are pro-actively buying convertible bonds from financially constrained firms I examine one proxy for hedge fund involvement. Livdan et al. (2009) argue that financially constrained firms are more volatile and therefore are more attractive investments for hedge funds. In line with Grundy & Verwijmeren (2018) I study the call protection of convertible bonds. The authors argue that convertible arbitrageurs dislike callable convertible bonds because callability can never be perfectly hedged, thereby endangering the delta-neutral position. Hence, convertible arbitrageurs use their buying power to negotiate non-callable convertible bond issues. Security design will be catered to investor demand (Jong et al, 2013).

Table 8 depicts the outcomes for four logistic models in which the probability of convertible bonds being callable is regressed on issuer and issue characteristics. In models 1, 2 and 4 the key independent variables, which determines whether a firms is classified as financially

Table 7: The probability of 144A offerings being subsequently registered

	Prediction	#1 Logit	#2 Logit	#3 Logit	#4 Logit
Dividend paying	(-)	0.031			
		(0.218)			
Rated	(-)		-0.005		
			(0.210)		
HP constrained	(+)			-0.184	
				(0.192)	
WW constrained	(+)				-0.143
					(0.190)
Size	(-)	0.074	0.075		0.043
		(0.087)	(0.093)		(0.097)
Age		0.020***	0.020***		0.020***
		(0.007)	(0.007)		(0.007)
MTB	(+)	0.064	0.064	0.038	0.065
		(0.058)	(0.058)	(0.057)	(0.058)
Convertible arbitrage industry	(+)	0.054***	0.054***	0.067***	0.054***
		(0.015)	(0.015)	(0.014)	(0.015)
Stock volatility	(+)	-0.052	-0.053	-0.072	-0.053
		(0.136)	(0.135)	(0.131)	(0.135)
Altman Z-score	(-)	-0.009	-0.009	-0.006	-0.009
		(0.011)	(0.011)	(0.010)	(0.011)
Tangibility	(-)	-0.114	-0.105	-0.001	-0.086
		(0.323)	(0.320)	(0.299)	(0.319)
Relative offering size	(-)	0.185	0.175	0.020	0.134
		(0.436)	(0.433)	(0.383)	(0.434)
R&D intensity		0.030	0.030	0.026	0.027
		(0.027)	(0.027)	(0.027)	(0.027)
Constant		-0.418	-0.423	0.651***	-0.131
		(0.667)	(0.692)	(0.221)	(0.768)
Observations		945	945	945	945
Psuedo R^2		3.72%	3.72%	2.56%	3.78%

Standard errors in parentheses. Significance at the 1%***, 5%** and 10%* respectively. Convertible arbitrage represent estimated assets by convertible arbitrageurs in $ billions. Size in natural logarithm of total assets. Relative offering size is the offering amount over market value of equity.

Table 8: Logistic regressions on callability

		#1 Logit	#2 Logit	#3 Logit	#4 Logit
Dividend paying	(+)	-0.228			
		(0.299)			
Rated	(+)		0.463		
			(0.307)		
HP constrained	(-)			0.477*	
				(0.277)	
WW constrained	(-)				0.122
					(0.271)
Size	(+)	-0.035	-0.116		-0.029
		(0.101)	(0.108)		(0.110)
Age		0.032***	0.028***		0.031***
		(0.010)	(0.010)		(0.009)
MTB	(-)	-0.044	-0.028	-0.102*	-0.039
		(0.065)	(0.066)	(0.061)	(0.065)
Convertible arbitrage industry	(-)	0.234***	0.231***	0.255***	0.233***
		(0.037)	(0.037)	(0.038)	(0.037)
Stock volatility	(-)	0.351	0.379	0.275	0.394
		(0.294)	(0.293)	(0.262)	(0.301)
Altman Z-score	(+)	-0.000	-0.000	0.006	-0.000
		(0.016)	(0.017)	(0.020)	(0.015)
Tangibility	(-)	0.882*	0.755	0.921*	0.849*
		(0.506)	(0.509)	(0.496)	(0.506)
Relative offering size	(+)	0.425	0.432	0.232	0.421
		(0.477)	(0.473)	(0.363)	(0.479)
R&D intensity		-0.011	-0.012	-0.017	-0.009
		(0.032)	(0.032)	(0.031)	(0.032)
Rule 144A offering	(-)	0.964***	1.030***	0.854***	0.973***
		(0.234)	(0.236)	(0.228)	(0.233)
Maturity	(-)	0.231	0.225	0.241	0.253
		(0.198)	(0.199)	(0.192)	(0.198)
Constant		-0.729	-0.285	-0.260	-0.906
		(0.947)	(0.985)	(0.464)	(1.060)
Observations		1.325	1.325	1.325	1.325
Psuedo R^2		21.83%	22.07%	20.44%	21.78%

Standard errors in parentheses. Significance at the 1%***, 5%** and 10%* respectively. Convertible arbitrage represent estimated assets by convertible arbitrageurs in $ billions. Size in natural logarithm of total assets. Relative offering size is the offering amount over market value of equity. Maturity is natural logarithm of the maturity of the bond.

constrained, are not significant. The key independent variable in model 3, a dummy variable which takes the value of one for firms deemed financially constrained according to the HP-index, is positive and significant. Contrary to my expectations, this result demonstrates that younger and smaller firms experience a larger likelihood to issue convertible bonds which can be called for redemption before the end of maturity. This could be explained by the fact that young and small firms tend to have more favourable growth options relative to large, old and mature firms. Issuing callable convertible bonds can avoid circumstances in which firm's growth options turn out to be extremely beneficial and bonds have to be converted against unfavourable ratio's. The variable determining whether an issue is privately placed under rule 144A is notably striking. The coefficient in all models is around 1.0 and highly significant. Such coefficient has an extremely large impact on the dependent variable which can be either equal to zero or one, especially considering the fact that the constant has approximately the same magnitude in all models. The 144A offering dummy indicates that convertible bond 144A offerings have extremely high probabilities of being callable, contradicting the findings of Grundy & Verwijmeren (2018). They find a significant negative relationship between convertible bonds being callable and a 144A offering. Additionally, the variable representing the size of the convertible arbitrage industry also is highly significant and positive, meaning that firms tend to issue callable convertible bonds when demand from convertible arbitrageurs grows. Again, these results contradict my expectations of investor-demand on convertible bond design. Based on my findings, the likelihood of convertible bonds being callable instead grows when the size and demand of the convertible arbitrage industry grows. Another remarkable finding is that the age of a company has highly significant and positive impact on the probability of a convertible bond being callable. Hence, the older the firm is the more likely the firm would issue callable convertible debt.

Grundy & Verwijmeren report that hedge funds prefer convertible bonds issue without callability. Based on this finding, the hypothesis that hedge funds are more involved in convertible bond issues by financially constrained firms should be rejected if the hypothesis was solely based on callability as proxy for hedge fund involvement. However, my findings have to be interpreted with careful consideration. Both Table 1 and Figure 7 in Appendix F show that a remarkably large fraction of the convertible bond issues from my dataset are callable. Figure 7 shows that that firms tend to also issue non-callable convertible bonds only since 2016. Considering this, it's hard to detect any correlations between non-callable bonds and financial constraints measures. I conclude that callability of bonds are not a good measure of apparent hedge fund involvement.

5.4 Robustness checks

Logistic regressions are the preferred methodology for regressions with a categorical variable as dependent variable. Regressing independent variables on one categorical dependent variable using an Ordinary Least Square regression gives rise to several biases. However, just to verifying the results from the logistic regressions I deliberately use OLS regressions to check key independent variables on coefficient sign and significance. No remarkable difference occurs.

6 Firm Performance

In this chapter I discuss the empirical results regarding the performance of firms subsequent to a convertible bond issue. First, Section 6.1 gives as overview of firm performance of issuing firms after issuance. Second, in Section 6.2 the firm characteristics contributing to the BHARs are analysed.

6.1 Buy-and-hold abnormal returns

Table 9 shows firm performance of convertible bond issuers measured by its stock prices. Both subtables of Table 9 divide firm performance into three different time periods: [-4,5] [1,100] and [1,250]. Day zero represents the event date and each number represents a trading day. According to the first column of panel A, constrained firms exhibit negative firm performance on the long run compared to non-event firms. In particular, financially constrained firms significantly underperform non-event firms by 7.8% over 250 trading days. Moreover, constrained firms also underperform unconstrained firms by 6% over 250 trading days. The same observation is applicable for the holding period covering 100 trading days, however the difference between the two classifications is somewhat smaller (5%). One possible explanation could be that firms paying dividend have lower free cash flow to invest due to a consistent dividend pay-out policy (Allen & Michaely, 2003). Financially unconstrained firms are therefore shielded against overinvestment and negative firm performance. For the short-term holding period around the issue date no significant difference exists between firms which pay dividends and firms which do not, although I do report highly significant negative firm performance for both constrained and unconstrained firms. Negative announcement returns for convertible bonds issuers is in line with a large amount of other academic literature

(Dutordoir et al., 2014).

The second column of Panel A depicts the performance of two groups of convertible bond issuers. Firms without credit rating are deemed constrained and firms with any credit rating (including below investment-grade ratings) are deemed unconstrained. Firms without credit rating face an average long-term performance of -7.9%. The difference in firm performance compared to rated firms however, is not significant.Additionally, both constrained and unconstrained firms face highly significant negative stock returns in the short-term. Constrained firms experience a 4.1% decline in stock returns as opposed to a 2.8% decline for unconstrained firms, also representing an statistical significant difference between the groups.

The third column illustrates the difference in firm performance if firms are divided into financially constrained and unconstrained categories according to the Hadlock-Pierce index. As illustrated in Table 9, constrained firms experience a negative firm performance of 2.9% on the long-term with moderate statistical significance. The results are in line with Zeidler et al. (2012) to a marginal extent. Zeidler at al. (2012) report significant underperformance of small companies to their matches. As shown in the table, unconstrained firms seem to face far larger negative firm performances with an average of 10.6%. However, because the distribution of long-term stock returns is non-normal the negative performance can not be deemed significant according to the sign test despite such a large underperformance. Again, the firm performance on the short term is negative and highly significant for constrained firms. Constrained firms face a 3.9% stock decline around the announcement date, which is significantly higher than the 2.7% stock decline for unconstrained firms.

The fourth column in Panel A shows the difference of firms performance between constrained and unconstrained firms according to Whited-Wu index. The results for the long-term and medium-term are ambiguous. The average firm performance for both holding periods are negative but do not significantly differ from zero. Furthermore, constrained and unconstrained firms do not exhibit different patterns in stock returns, implying no actual difference exists between firms regarded as financially constrained and unconstrained by the WW-index. These findings contradict the consensus of investors gauged by Brown et al. (2019), who contemplate components of the WW-index as important factors measuring financial constraints. However, on the short-term both categories again report highly significant and negative underperformance compared to nonevent firms. In particular, unconstrained firms experience a 4.5% decline in stock prices and constrained firms 3.7%. The difference amongst constrained and unconstrained firms do not show significance.

Table 9: Firm performance

Panel A: Single-control firm

	Dividend		Rated		HP index		WW index	
	Cons	Uncons	Cons	Uncons	Cons	Uncons	Cons	Uncons
BHAR(1,250)	**(0.078)****	**(0.018)**	(0.079)**	(0.009)	(0.029)*	(0.106)	(0.031)	(0.034)
BHAR(1,100)	**(0.044)****	**0.006****	(0.036)	(0.022)	(0.067)	(0.038)*	(0.040)	(0.029)
BHAR(-4,5)	(0.035)***	(0.038)***	**(0.041)*****	**(0.028)*****	**(0.039)*****	**(0.027)**	(0.037)***	(0.045)***
Observations	780	300	656	424	383	330	381	353

Panel B: Multiple control firms

	Dividend		Rated		HP index		WW index	
	Cons	Uncons	Cons	Uncons	Cons	Uncons	Cons	Uncons
BHAR(1,250)	**(0.013)*****	**0.085**	**(0.015)****	**0.060**	**(0.032)*****	**0.070***	**(0.001)****	**0.104****
BHAR(1,100)	**0.014**	**0.077*****	**0.019**	**0.051*****	**0.001****	**0.067*****	**0.020**	**0.076*****
BHAR(-4,5)	(0.043)***	(0.038)***	**(0.053)*****	**(0.024)*****	**(0.058)*****	**(0.019)*****	(0.041)***	(0.036)***
Observations	786	314	660	440	441	312	406	340

This table reports the buy-and-hold abnormal returns for firms issuing convertible bonds. The abnormal returns are computed over three different time periods measured in trading days: [-4,5], [1,100] and [1,250]. BAHRs are allocated to 'Constrained' if firms are classified as financially constrained by the particular measures. BHARs are allocated to 'Unconstrained' if firms are classified as financially unconstrained by the particular measures. Panel A depicts the BHARs calculated relative to one single control firm, Panel B depicts the BHARs calculated relative to the average return of multiple control firms. Significance levels at the 1%***, 5%** and 10%* respectively. Bold lettertype indicates whether the difference in means of financially constrained and unconstrained firms is significant at the 5% level.

In general, the results of Panel A in Table 9 partly correspond to the findings of Lewis et al. (2001). As opposed to Lewis et al. (2001) who find underperformance for all firms issuing convertible debt, I find only significant underperformance for firms issuing convertible debt for several subsamples. Most notably, firms experiencing significant negative returns after issuance face financial constraints measured by the dividend measure, rating measure and the HP-index. The results support the claim that financially constrained firms underperform financially unconstrained firms and helps identifying some of the components that attribute to the underperformance. Additionally, the results complement the findings of Zeidler et al. (2012) who report that long-term underperformance of firms issuing convertible bonds is largely explained by investor's perceived risk profiles of the issuers. Moreover, the findings reported in Table 9 panel A are are in accordance with Lewis et al. (2001) who state that poor performance occurs gradually over time because investors do not anticipate the poor performance of firms that issue convertible bonds. Furthermore, on the short-term all issuing firms yield negative returns, independent on the measures used to identify financial constraints and whether the firm actually faces financial constraints. These findings are in accordance with a wide string of literature examining the announcement effects of convertible bond issues (Rahim et al., 2014).

Panel B of Table 9 shows the results of the event study when multiple control firms are used as robustness check. As depicted in the first row of Panel B, firms classified as financially constrained according to all four measures experience significant negative returns up to one year after issuance. In addition, all unconstrained firms experience positive returns. The difference in returns between constrained and unconstrained firms is significant at the 5% level for all measures. Hence, when using the one-to-many matching methodology, the hypothesis that financially constrained firms underperform financially unconstrained firms up to one year after issuance can be accepted. The underperformance can be attributed to the months 4-12 after issuance, because in the time period up to 100 trading days after issuance no underperformance amongst issuing firms is detected. Again, for all four measures the difference in firm performance between constrained and unconstrained firms is significant. At last, consistent with Panel A, all issuing firms classified either as constrained or unconstrained, experience underperformance around the announcement period relative to non-issuing firms. Identical to Panel A, the difference in firm performance between constrained and unconstrained firms around the announcement period is significant only for the rating and HP-index measures.

The main difference between Panel A and Panel B of Table 9 is the ample evidence for significant differences in firm performance between constrained and unconstrained firms shown in Panel B. By dropping the requirement firms have to report their financials in the same fiscal year and assigning reference firms from the same size and MTB-ratio tertile classifications randomly to the event firm, differences in firm performance between constrained and unconstrained firms become larger. Also, as opposed to Panel A, unconstrained event firms in Panel B tend to show better firm performance than non-event firms up to one year after issuance.

6.2 Determinants of abnormal returns

This section analyses whether the results of Section 6.1 are robust if additional control variables are included in a multivariate regression specification. The dependent variable is the abnormal buy-and-hold return for issuing firms. The results are shown in Table 10.

The columns depicting regression number one to four show the abnormal buy-and-hold returns computed with the one-to-one matching methodology. The dividend and rating measure are significant, meaning that paying dividends and having a credit rating positively impacts the abnormal returns. These results are in line with Table 9. However, while firms classified as constrained based on the HP-index show significant underperformance in Table 9, the significance disappears in Table 10. So, when controlling for other variables possibly impacting the abnormal returns, young and small firms do not exhibit significant differences in firm performance to old and large firms. Other important determinants of firm performance are Size, Market-to-Book ratio and the fraction of R&D expenditures scaled over total assets. The results are partially corresponding to the results of Brophy et al. (2009).

The columns depicting regression number five to eight show the abnormal buy-and-hold returns computed with the one-to-many matching methodology. As opposed to the one-to-one matching methodology, by making use of the one-to-many methodology neither constraint measure has significantly affects the abnormal returns. Also strikingly, the variable reflecting the market capitalisation of the firm has lost significance. On the other hand, Market-to-Book ratio, the size of the convertible arbitrage market, the stock volatility over the five years before the issue, the tangibility of a firm, the fraction of the offering size over market value of equity and the fraction of R&D expenditures over total assets are significant determinants for buy-and-hold abnormal returns. Furthermore, the Pseudo R^2 has improved significantly in all models. The differences in results compared to the one-to-one methodology can be attributed to the differences in the

matching methodology. As described in Section 4.3 the multiple reference firms are picked randomly if the firms do have the same tertile classifications for size and Market-to-Book, within the same Fama-French 46 industry classifications. The differences in values for size and MTB-ratio however, could be large within these tertiles. As opposed to the one-to-one methodology, where firms are picked with the lowest deviation of sum of ranks, the multiple firms in the one-to-many methodology are picked randomly. The results of the one-to-many matching procedure do not allow me to accept the hypothesis that financially constrained firms significantly underperform unconstrained firms in the year after convertible bond issues.

Table 10: Determinants of BHAR

	One-to-one matching				One-to-many matching			
	#1 Reg	#2 Reg	#3 Reg	#4 Reg	#5 Reg	#6 Reg	#7 Reg	#8 Reg
Dividend paying	0.121*				0.026			
	(0.068)				(0.045)			
Rated		0.140**				-0.004		
		(0.069)				(0.046)		
HP constrained			0.094				0.010	
			(0.063)				(0.042)	
WW constrained				-0.0.31				-0.051
				(0.064)				(0.042)
Size	-0.065**	-0.080***		-0.065**	-0.005	-0.003		-0.014
	(0.026)	(0.028)		(0.029)	(0.018)	(0.019)		(0.020)
Age	0.002	0.002		0.002	-0.000	0.000		0.000
	(0.002)	(0.002)		(0.002)	(0.001)	(0.001)		(0.001)
MTB	0.042**	0.044**	0.040**	0.042**	0.078***	0.078***	0.078***	0.078***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.013)	(0.013)	(0.013)	(0.013)
Convertible arbitrage	-0.002	-0.002	-0.000	-0.002	0.016***	0.016***	0.016***	0.016***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
Stock volatility	-0.026	-0.027	-0.022	-0.028	-0.088***	-0.088***	-0.088***	-0.088***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.023)	(0.023)	(0.023)	(0.023)
Altman Z-score	-0.003	-0.004	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Tangibility	0.041	0.044	0.030	0.074	0.149**	0.155**	0.154**	0.160**
	(0.096)	(0.095)	(0.090)	(0.095)	(0.063)	(0.063)	(0.059)	(0.059)
Relative offering size	-0.160	-0.168	-0.125	-0.200	-0.298***	-0.305***	-0.302***	0.317***
	(0.125)	(0.124)	(0.115)	(0.125)	(0.083)	(0.083)	(0.076)	(0.083)
R&D intensity	-0.025***	-0.025***	-0.024***	-0.025***	-0.011**	-0.011**	-0.011**	-0.011**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)
Constant	0.326*	0.409**	-0.110	0.347	-0.142	-0.154	-0.178***	-0.054
	(0.198)	(0.205)	(0.071)	(0.231)	(0.133)	(0.138)	(0.048)	(0.155)
Observations	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080
Pseudo R^2	2.10%	2.20%	1.50%	1.80%	7.00%	6.92%	6.87%	7.10%

Standard errors in parentheses. Significance at the 1%***, 5%** and 10%* respectively. Convertible arbitrage represent estimated assets by convertible arbitrageurs in $ billions. Size in natural logarithm of total assets. Relative offering size is the offering amount over market value of equity.

7 Conclusion

The preceding analysis has examined the relationship of supposed financial constraints on multiple facets of convertible bond issues. Dependent on the measure used to gauge the level of financial constraints faced by firms, inferences can be made about the impact on convertible bond issues, accompanying hedge fund involvement during issues and the subsequent performance up to one year after the issue.

Firstly, firms that do not pay dividends can be considered as financially constrained. Non-dividend paying firms show a greater likelihood to issue convertible debt privately under rule 144A, potentially because dividends provide investors with valuable information. Non-dividend payers therefore exhibit more information asymmetry. Despite the fact that non-dividend paying firms tend to issue more in the 144A market, these firms do not show significantly more subsequent public registrations of the same bond. This results implies that constrained firms do not utilize the 144A market as way to indirectly make use of the public market. Based on the proxy of the existence of call-features, a significant higher amount of hedge fund involvement during convertible bonds issues by constrained firms can be ruled out. Finally, I do find supportive evidence for significant underperformance of constrained firms relative to unconstrained firms for both 100 and 250 trading days after issuance. The results suggest that the issuer characteristic of not paying dividends significantly simultaneously impacts how firms issue convertible bonds and its subsequent performance. Important to note is these findings should be interpreted cautiously, since the amount of firms non-dividend paying firms has increased in recent years. Share repurchases and the re-investment of profits has been an attractive alternative for paying dividends, weakening the ability to gauge financial constraints according to the dividend classification.

Secondly, firms without credit ratings can be regarded as financially constrained. I find that firms without credit rating show a higher propensity to issue convertible debt under rule 144A. Also, non-rated firms are more likely to file for public registration for the bond issue previously issued in the 144A market. However, no supportive evidence exists whether non-rated firms utilize the 144A market in order to make use of the public market via a detour. Like non-dividend paying firms, for non-rated firms I am not able to establish a connection between firms regarded as financially constrained and more hedge fund involvement. Lastly, non-rated firms face significant negative returns in the year after issuance. However, no significance could be find for the difference with unconstrained firms.

Thirdly, according to Hadlock-Pierce the sole factors that determines whether a firms faces constraints on the capital markets are size and age. I find evidence suggesting that size and age affect the probability to issue convertible debt under rule 144A and experience higher hedge fund involvement. However, I find no evidence that young and small firms show the propensity to utilize the 144A market as way to achieve public registration. I do find that young and small firms experience large announcement effect compared to old and larger firms, but no inferences can be made on the long term.

Fourthly, the Whited-Wu index assesses financial constraints on the basis of underlying financials. I've not been able to find any supportive evidence that the status of financially constrained impacts the tendency to issue convertible debt in the 144A market, the propensity to utilize the 144A market as bridge to public registration or more hedge fund involvement. Additionally, I do not find evidence on whether constrained firms underperform unconstrained firms as considered by the Whited-Wu index.

As the comprehensive description above suggests, the results of my thesis are limited by the different outcomes per measure of financial constraints. Unfortunately, still no consensus has been reached in academia on how to correctly classify financially constrained and unconstrained firms. Additionally, this thesis has only examined the difference between private placements and public issues. However, SEC rule 415 provides the opportunity of shelf-registration for U.S. firms. As alternative to the 144A issue, 415 offerings could also play a role in convertible bond issues by either constrained of unconstrained firms. Moreover, actual hedge fund involvement has not been examined in this thesis. Inferences have been made based on proxies for hedge fund involvement, limiting the power of the results. Aforementioned limitations can be fruitful areas of future research.

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Appendices

A Description of variables

- **Age**: First year of available stock data in the CRSP database
- **Altman Z-score**: the possibility of bankruptcy depicted by the following formula
- **Callable**: A dummy reflecting whether a convertible issue can be called for redemption
- **CB arbitrage**: The total estimated value of assets held by convertible arbitrageurs at the end of the year retrieved from the Thomson Reuters Lipper TASS database
- **Capex**: Magnitude of capital expenditures scaled relative to total assets
- **Difference in offering amount**: The offering amount in the subsequent public registration minus the preceding 144A offering amount divided by the original preceding 144A offering amount
- **Difference in offering time**: The date of public announcement of an issuance preceded by a 144A offering, measured in days
- **Dividend paying**: A dummy reflecting whether a firms payed dividend over common or preferred equity in the year preceding the year of the issue
- **EBIT**: Earnings Before Interest and Taxes
- **Market-to-Book ratio**: Market value of equity (size) divided by the book value of equity, the book value is calculated as the book value of equity times the times outstanding
- **Maturity**: Time till the date at which the issuer has to repay the borrowed amount, expressed in years

- **Industry sales growth**: Sales growth per company aggregated by three-digit SIC code industry
- **Ratings**: A dummy reflecting whether a firms had a credit rating at the begin of the fiscal year
- **R&D intensity** Magnitude of research & development expenditures scaled relative to total assets
- **Relative size**: Offering amount divided by the market value of equity at the end of the fiscal year
- **Return volatility**: annualized standard deviation of monthly stock returns, up till five years prior to issuance.
- **Sales growth**: The difference in sales between the current fiscal year and the preceding fiscal year divided by the sales of current fiscal year.
- **Size**: The value of total assets
- **Tangibility**: Net Plant, Property & Equipment divided by total assets

B Cross-tabulation of financial constraint measures

Table 11: Comparison of Financial Constraints Measures

		Dividend		Rated		HP index		WW index	
		Cons	Uncons	Cons	Uncons	Cons	Uncons	Cons	Uncons
Dividend	Cons	1,021							
	Uncons		398						
Rated	Cons	676	143	819					
	Uncons	345	255		600				
HP index	Cons	384	89	397	76	473			
	Uncons	265	208	122	351		473		
WW index	Cons	430	35	351	144	281	11	473	
	Uncons	242	224	199	267	75	297		473

This table reports the cross-tabulation of the number of observations of the four different methods measuring financial constraints. The HP-index and WW-index only display two-thirds of the observations because the middle-tertile is regarded as unclassified and therefore not displayed in the table.

C Logistic models

(1) $Y_i^* = \alpha_i + \beta_{1,i} FCmeasure + \beta_{2,i} CBarbitrage + \beta_{3,i} Size + \beta_{4,i} Age + \beta_{5,i} MTB + \beta_{6,i} Volatility + \beta_{7,i} Zscore + \beta_{8,i} Tangibility + \beta_{9,i} Relativesize + \beta_{10,i} R\&Dintensity + \varepsilon_i$

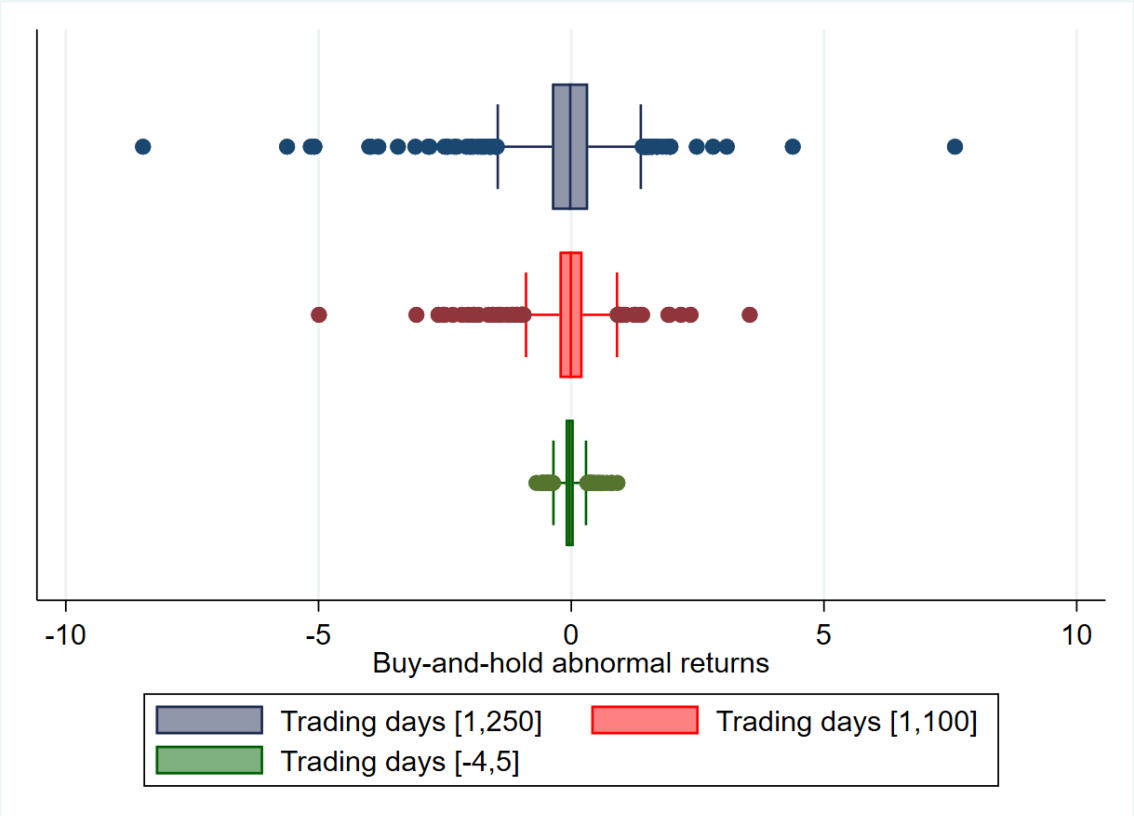
where Y_i^* represents a dummy variable whether convertible bonds are issued under SEC rule 144A.

(2) $Y_i^* = \alpha_i + \beta_{1,i} FCmeasure + \beta_{2,i} CBarbitrage + \beta_{3,i} Size + \beta_{4,i} Age + \beta_{5,i} MTB + \beta_{6,i} Volatility + \beta_{7,i} Zscore + \beta_{8,i} Tangibility + \beta_{9,i} Relativesize + \beta_{10,i} R\&Dintensity + \beta_{11,i} Rule144Adummy + \beta_{12,i} Maturity + \varepsilon_i$

where Y_i^* represents a dummy variable whether convertible bonds are callable within three years of issuance.

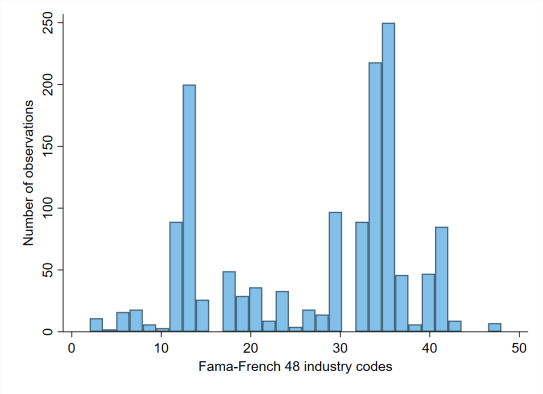
D BHAR outliers

Figure 4: Box-plot of issuer's BHARs

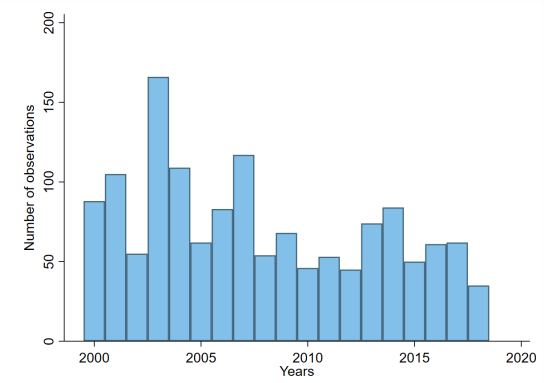


E Distribution of convertible bonds issues between industries and years

Figure 5: Checks for cross-correlation

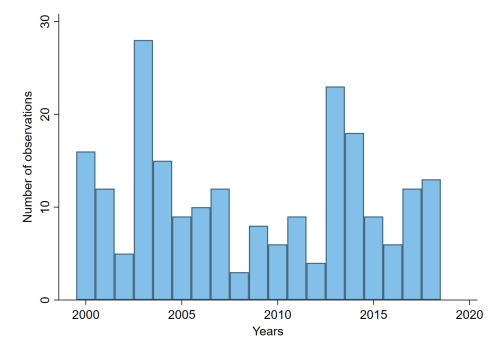


(a) Distribution of issues across industries

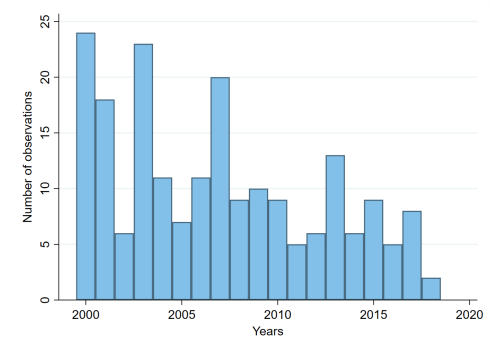


(b) Distribution of issues across years

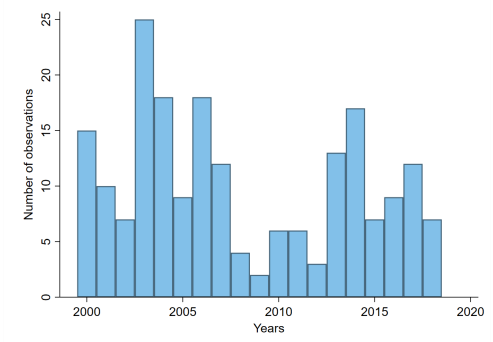
Figure 6: Distribution of issues across years for three most represented industries



(a) Distribution of issues across years in the Business Services industry



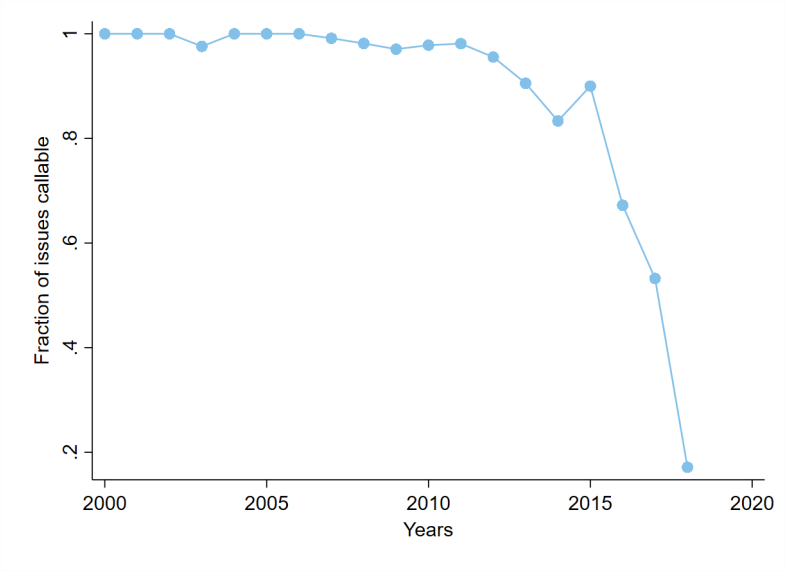
(b) Distribution of issues across years in the Electronic Equipment industry



(c) Distribution of issues across years in the Pharmaceutical Products industry

F Development of callable convertible bond issues across years

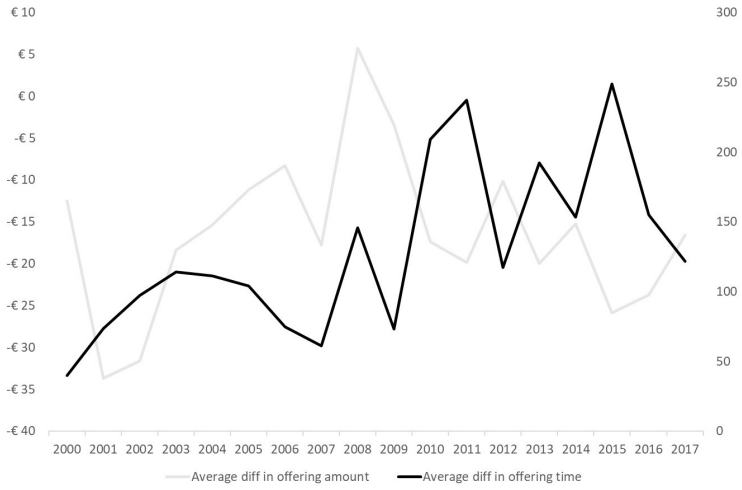
Figure 7: The fraction of callable bonds across years



This figure shows the fraction of convertible issues that are callable per year.

G Time trends for characteristics of subsequent public registrations

Figure 8: Different trends for subsequent public registration



On the left axis (line in grey) the average difference in offering amount in millions of dollars is shown. On the right axis (line in black) the average difference in offering time is displayed.