LIQUIDITY RISK, FIRM RISK, AND ISSUE RISK PREMIUM EFFECTS ON THE
ABNORMAL RETURNS TO NEW ISSUES OF CONVERTIBLE BONDS

JINLIN LIU* and LORNE N. SWITZER

Abstract

This paper provides new evidence on the effects of the risk profiles of firms on the returns to convertible bond issues. Liquidity risk, firm risk, and issue risk premium factors are examined as determinants of abnormal returns around the convertible bond issue dates. The market responds favorably to the issuance of convertible bonds by issuers with mild levels of firm volatility risk. Liquidity risk (issue size) and issue risk premium factors (convertible Vega) have significantly negative effects on abnormal returns around the issue date. The findings are robust to different grouping criteria and estimation methods.

September 2009

JEL Classification: G12, G14, G30, G32;

Keywords: convertible bonds, liquidity, firm risk, Vega

*John Molson School of Business, Concordia University, Montreal, CANADA. We would like to thank Stylianos Perrakis, Sandra Betton and Jean-Claude Cosset for their comments. Financial support from the FQRSC and the SSHRC is gratefully acknowledged. Please address all correspondence to: Jinlin Liu, Department of Finance, John Molson School of Business, Concordia University, Montreal, Quebec, CANADA, jliu@jmsb.concordia.ca.
1. INTRODUCTION

Convertible bonds, hereinafter referred as CBs, are financial debentures that can be converted into a preset number of shares at a premium to the stock price at issuance. They are hybrid securities with both debt and equity features, and have served as a major source of financing for firms over the past two decades. According to SDC data, from 1995 to 2006, the total value of CB issues increased in the US by 581.60%. Over this period, the ratio of CB financing to equity financing expanded from 10.15% to 36.75%. The rapid growth of the CB market can be attributed to several factors: 1) CBs reduce cash flow outlays as a consequence of their lower coupon interest costs relative to regular corporate bonds, 2) the dilution effects of CBs are smaller than outright seasoned equity issues, since at issue time, the conversion price is set higher than the current stock price, 3) the timing of the dilution effect is favourable to the firm: i.e. conversion occurs when the firm’s improved operations are reflected in its share price, 4) CBs can mitigate agency costs, and 5) CB portfolios provide comparable returns to those of equity portfolios but with much lower levels of volatility.1

It remains somewhat of a puzzle that a considerable body of empirical evidence demonstrates that the issuance of new CB’s is associated with negative abnormal returns of the underlying shares since: 1) the market normally reacts positively to straight corporate bond issuance; 2) CB’s have payoff structures that entail a straight bond component and an equity option component; and 3) in spite of the negative equity market reaction to CB issuance, the market for CB’s has grown rapidly over time (e.g., Smith,1986; Davidson et al., 1995). One possible resolution of the puzzle that has been adduced is that due to dilution effects, investors

---

1 Woodson and Woodson (2002) find that the returns of convertible, equity index, and bond portfolio are 14.28%, 8.69%, and 6.55%, while the standard deviation are 8.62%, 13.25%, and 4.29% respectively.
perceive CB’s as equity from the outset, rather than debt.\textsuperscript{2} In this vein, according to the pecking order theory, the market reaction should be negative. However, the evidence that we provide in this paper demonstrates that \textit{dilution effects are negligible}. What then explains the abnormal equity performance of firms that issue CBs?

This paper serves to provide new evidence on this score. In particular, we examine the underlying firm characteristics that serve as drivers of the abnormal returns when CB’s are issued. The focus is on the relationship between the short-term wealth effect\textsuperscript{3} around the issuance of CBs and the characteristics of issuer firms and the features embodied in the issues themselves. In particular, we examine the impact of three factors suggested in Section 3: liquidity risk (logarithm of issue size), issue risk (Vega, which measures the sensitivity of CB value to the volatility of underlying stocks), and firm volatility risk (standard deviation of beta\textsuperscript{4}) on the abnormal returns to convertible bond issues.

We find that all of these three risk factors serve as significant drivers for the abnormal returns around the CB issue date. The market responds favourably to the issuance of convertible bonds by issuers with mild level of firm volatility risk. However, liquidity risk and issue risk are significantly negatively related to performance. The latter two risk components serve to offset the risk management benefits of convertibles for firms. These findings are robust to different grouping criteria and estimation methods.

The remainder of this paper is organized as follows: Section 2 provides a brief literature

\textsuperscript{2} See Asquith and Mullins (1986).

\textsuperscript{3} Fabozzi, Liu, and Switzer (2009) demonstrate that a naked long position of CBs from issue date can generate good returns at the end of two or three years after issuance, especially for CBs with low ratings and large issue size.

\textsuperscript{4} If we deem stock price include the market reactions to all information, the standard deviation of beta could be a very good proxy for the firm’s general risk.
review. Section 3 proposes a theoretical analysis of the wealth effect of CBs. Section 4 describes
the data used in this paper. Section 5 explains the methodology and proxies employed in this
study. Results are reported in section 6. An analysis of the effects of CB issuance for different
firms is presented in Section 7. The paper concludes with a summary in section 8.

2. LITERATURE REVIEW

A considerable body of research over the past half century has looked at
a) the normative question: why firms should use CBs? and

b) the positive question: how does the market reacts to the issuance of CBs?

Modigliani and Miller (1958, 1961, and 1963) propose that financing decision, including
the issuance of convertibles, is irrelevant to a firm’s valuation. Stiglitz (1969 and 1974)
demonstrates the validity of the irrelevance theory under more general conditions. However,
Jensen and Meckling (1976) and Green (1984) provide seminal arguments that CBs can be used
to alleviate existing shareholders’ risk-taking incentives that are at the expense of bondholders by
allowing debt holders to share in the upside. Myers and Majluf (1984) and Myers (1984) argue
that firms issue CBs to avoid asymmetric information in their pecking order theory. They argue
that CBs should dominate equity financing since CBs are less risky. Heinkel and Zechner (1990)
show that with new investment opportunities and subsequent informational asymmetry,
all-equity financed firms will over-invest. Constantinides and Grundy (1989) and Stein (1992)
suggest firms use CBs to inject new equity into the capital structure with lower asymmetric
information costs. Lewis, Rogalski, and Seward (2001) explain the use of CBs on the base of
asymmetric information approach and demonstrate that firms can use different financial
instruments to time the market based on managements’ expectations.

Brennan and Kraus (1987) and Brennan and Schwartz (1988) argue that the appeal of CB’s relates to their immunity to company risk. Mayers (1998) argues that firms use CBs to reduce financing costs as an alternative to sequential financings that use equity and/or straight debt when facing serially correlated real investment option opportunities.

Several empirical papers have examined the motivation for firms to issue CB’s, firm characteristics associated with CB issues, and the market reaction to CB issuance. Billingsley and Smith (1996) conclude that firms use convertibles primarily as an alternative to straight debt as a means to preserve cash flow via lower interest costs. Essig (1992) shows that the ratios of R&D to sales, market value to book value of equity, and long-term debt to equity as well as the volatility of the firm's cash flows, are all positively associated with firms' propensities to employ convertible debt. Lee and Figlewicz (1999) compare different characteristics of firms that issue convertible debt versus convertible preferred stock. The choice of the former is found to be associated with proxies for asymmetric information, financial distress, and taxes.

Dann and Mikkelson (1984) and Eckbo (1986) show significantly negative effects of the CBs offering. Davidson III, Glascock and Schwartz (1995) confirm the negative effects of using CBs and find that low conversion prices send more negative information to the market, which is consistent with the signaling argument proposed by Kim (1990). Arshanapalli, Fabozzi, Switzer, and Gosselin (2005) confirm that during the period from two days before to two days after the issuance of CBs, there is a significantly negative return of –2.19%. Loncarski, Horst and Veld (2006) study the Canadian market, and show evidence of price pressure effects, and an increase in short interest around the issuance date of CBs.

In sum, the existing theoretical and empirical literature has identified and tested several
factors affecting the returns to convertible issues. Previous studies have essentially focused on
the issuers’ perspective alone. Section 3 proposes that liquidity risk, firm risk, and issue risk
premium factors should be the key determinants of abnormal returns around the convertible bond
issue dates, and that the market should not discount firms with firms with low or mild levels of
such risks. Our paper serves to provide evidence on the performance of this approach to in
explaining abnormal returns of CB issuers vs. alternative models based on the standard efficient
markets hypothesis, as well as models that incorporate fundamental issuer characteristics in the
estimation.

3. A MODEL TO STUDY THE WEALTH EFFECT OF CONVERTIBLE BONDS

Technically, the valuation models of CBs can be classified into several categories. The
first group, known in the literature as structural models, uses the value of the firm as the
underlying state variable, with the lower reorganization boundary and the allocation of residual
values of the firm on liquidation are treated exogenously (Sundaresan (2000)). Ingersoll (1977)
and Nyborg (1996) use this method to price CBs, and Lewis (1991) extends it to incorporate
more complicated capital structures. These models are well entrenched in economic theory, and
are straightforward to implement when sufficient restrictions are included for deriving closed
form solutions. However, empirically, such models have several limitations, including: 1)
different call and put features cannot be easily incorporated, 2) path-dependent features cannot
be incorporated, and 3) there is no reliable data source of firm value in continuous time.

An alternative to structural models that is favored by practitioners is the class of reduced
form models that use the value of equity as the underlying state variable, with default outcomes
and recovery rates set exogenously. For these models, a CB is a corporate bond plus a call option
on firm equity. One common practice when we study the risks and sensitivities of CBs is to treat the call option of CBs as the main source of risk of CBs and calculate the Greeks of CBs based on Merton (1973) model, which extend the Black and Scholes (1973) model by incorporating dividend rates.

Our approach herein is to develop a new structural model for CBs, which extends previous work, to allow us to calculate the value of the CB issuing firm from the issue date.

Assume that a firm has a value $V$ which follows a diffusion process with constant rate of return volatility:

$$\frac{dV}{V} = \mu dt + \sigma dW$$  \hspace{1cm} (1)

where $\mu(\cdot)$ is the drift, and $W$ is a standard Brownian motion. Similar to Black and Cox (1976), we assume that there exists a riskless asset that pays a constant rate of interest $r$. We assume further that at the outset there is only equity in the firm’s capital structure, and the firm subsequently chooses to issue CBs to raise capital. Let $F_1(V, \tau)$ and $F_2(V, \tau)$ be the values of CB and equity respectively. The Value of the firm, $V$ can be written as:

$$V = F_1(V, \tau) + F_2(V, \tau)$$ \hspace{1cm} (2)

It is well-known that the CB’s value follows the partial differential equation

$$\frac{1}{2} \sigma^2 V^2 F_{1,VV} (V, \tau) + rVF_{1,V} (V, \tau) - rF_1(V, \tau) + F_{1,\tau} = 0$$ \hspace{1cm} (3)

where $F_{1,V}$ and $F_{1,VV}$ are the first-order and second-order of partial differential of $F_1$ with respect to $V$ respectively, $\tau$ is the time to maturity.

Substituting $F_2 = V - F_1$ into the formula, we have

5 Delta, Gamma, and Vega etc.

6 We assume the CB is a zero-coupon bond for simplicity.
\[
\frac{1}{2} \sigma^2 V^2 F_2_{\nu} (V, \tau) + rVF_2_{\nu} (V, \tau) - rF_2 (V, \tau) + F_2_{\tau} = 0
\] (4)

It should be noted that if one were to assume that the value of the financial asset is time-independent, following Leland (1994), we can derive close-form solutions incorporating default risk and recovery rates. Sarkar (2003) extends this approach to study the early and late calls of CBs. Since we assume the financial asset is time-dependent, Leland-type models in which \( t \) is not present, cannot be employed here. Imposing the boundary conditions, obtain the solution of Equation (3) as:

\[
F_1(V, T) = e^{-rT} \mathbb{E}^Q \left[ V_T \right]_{\nu \leq B, \nu \leq B \leq V_T, \nu \leq \nu_T} 
\]

Consequently, we have the value of the equity \( F_2(V,T) \) for a firm with a convertible bond \( F_1(V,T) \) in its capital structure is given by:

\[
F_2(V, T) = V - F_1(V, T) = e^{-rT} \mathbb{E}^Q \left[ 0, V_T \leq B, V_T - B, \nu V_T \leq B \leq V_T, (1 - \gamma)V_T, B \leq \nu V_T \right] 
\]

\[
= C(V, B) - \gamma C(V, B, T) \] (6)

where \( B \) is the contracted payment to CB holder at maturity of the part without conversion; \( C(\star) \) is the call option value in Black-Scholes formula; \( \gamma \) is the dilution factor( \( \gamma = \frac{m}{m+n} \)), \( m \) is the shares converted from CBs, \( n \) is the initial shares before the CB

\footnote{It should be noted that if one were to assume that the value of the financial asset is time-independent, following Leland (1994), we can derive close-form solutions incorporating default risk and recovery rates. Sarkar (2003) extends this approach to study the early and late calls of CBs. Since we assume the financial asset is time-dependent, Leland-type models in which \( t \) is not present, cannot be employed here.}
issuance.

Proof: See Appendix.

Using Eq. (6) we can study the relationship between firm’s equity value and time. Part A and Part B of Figure 1 depict this relationship with smaller ($\gamma=10\%$) and bigger ($\gamma=50\%$) dilution factor respectively. We find that the relationship is bell-shaped. At the criteria of maximum of shareholder’s value, the use of CBs is more suitable for firms with lower level of risk. This is especially true if the CB issue size is relatively big compared to the current shareholder value, which is shown in the Part B of Figure 1.

Extending Merton (1974), let $\sigma_2$ be the standard deviation of the return on the equity of the firm, the ratio of the risk of the firm after the CB issuance $\sigma$, to the risk of the firm before the CB issuance $\sigma_2$ is given by:

$$
\frac{\sigma}{\sigma_2} = \frac{1}{\Phi(d_1) - \gamma \Phi(d'_1)}
$$

$$
d_1 = \frac{\ln\left( \frac{V}{B} \right) + \left( r + \frac{\sigma^2}{2} \right) \tau}{\sigma \sqrt{\tau}}
$$

$$
d'_1 = \frac{\ln\left( \frac{V\gamma}{B} \right) + \left( r + \frac{\sigma^2}{2} \right) \tau}{\sigma \sqrt{\tau}}
$$

(7)

where $\Phi(\bullet)$ is the cumulative distribution function of the standard normal distribution.

Proof: See Appendix.

Figure 2 depicts the relationship of the ratios of total risk to equity risk over time after the CB issuance. Since we assume that there are only two assets in the firm’s capital structure, the

---

8 In our database, the range of $\gamma$ is [0.002, 13.522].

9 If we deem CBs will mostly probably be converted into underlying shares, the total risks of a CB issuer have positive relation to the risk of equity of the firm in the future.
additional risk of the firm is brought by the issuance of CBs. We find that the CB issuance increases the total risk of the issuing firm. Furthermore, the lower the risk before the issuance, the higher the percentage increases of the total risk because of the CB issuance. Firms with higher risks before the CB issuance experience a more rapid decline in total risk over time relative to their counterparts.

Figure 1 and Figure 2 serve to illustrate that with uncertainty on the timing of payouts for the CB-financed project, there are different expected return/risk dynamics for firms with different levels of risk. On the whole, CB financing of new projects is more appropriate for firms whose risk profiles are not low. This can be empirically tested by looking at the impact of firm risk and issuance risk on the abnormal returns around the issuance date of CBs for firms with different risk profiles. Variation of the risk profiles over time should also influence the returns of underlying stocks after the CB issuance date. Volatility related proxies can measure the risks of CBs and equities. The standard deviation of beta is selected to measure the risk of equities since: 1) beta is a better measurement of risk than the standard deviation when we deal with diversified portfolios; 2) we want to evaluate the determinants of abnormal returns, not the returns, so we resort to higher moments of the beta; and 3) the standard deviation of beta can measure the fluctuation of the market’s attitude toward the firm issuing CBs. Vega, which measures the sensitivity of the CB price to the volatility of underlying stocks, represents one aspect of the issuance risk. Another aspect of the issuance risk is the liquidation/dilution effect that is dependent on the relative size of the CB issuance.

The reduced form of the CB model essentially separates the bond and option components of the instrument. The bond component is evaluated as a corporate bond belonging to the risk class represented by its rating, while the equity part of the CB is an option to exchange the bond
for the number of shares represented by the conversion ratio. This option will be in-the-money if the share price exceeds the conversion price, the share equivalent of the market value of the bond component, which plays the role of the option’s strike price. This evaluation can only be considered an approximation, since neither the conversion price stays constant over the life of the CB, nor does the call option follow the Black-Scholes option model. The value of the CB’s bond component varies with macroeconomic conditions as the risk spread appropriate to its class changes, implying that the conversion price (the option’s strike price) is not constant. Similarly, the Black-Scholes model applied to the option component assumes that there is no default risk of the firm, since the lognormal model of the underlying equity does not hold under such risk. Last but not least, the risk of the bond issue affects directly the option value in a complex way, since both the strike price and the probability distribution of the equity value change with it. Nonetheless, the reduced form of the model has been established as a professionally acceptable practice, and for this reason we use it for our main series of empirical tests.

4. DATA DESCRIPTION

The sample consists of all CB offerings from January 1, 1986 to December 31, 2005 for which the underlying shares are traded on the New York Stock Exchange (NYSE), the American Exchange (AMEX), or the over-the-counter (NASDAQ) market from the SDC Platinum database. The basic CB data, including conversion price, coupon rate, expiry date, issue date, ratings, and issue size are obtained from SDC. Missing observations from SDC are replaced with data from the Convertible Bond Database that was provided to us from Morgan Stanley.

The underlying stock prices of the firms in our sample are from CRSP. During the observation period, stock prices are adjusted for stock dividends or splits. The market index
returns are also from CRSP. We employ three market proxies in our tests: returns on the
value-weighted market portfolio, returns on an equally-weighted market portfolio, and returns on
the level of the Standard & Poor's 500 Composite Index.

Company financial data are obtained from the Standard & Poor's Compustat database.
Firms are included in the analyses if they have complete data on cash flow, working capital,
investment in fixed assets, the real tax rate, growth rates in assets and sales, and various size and
risk measures.

Market expectations for CB issuers are proxied by analysts’ opinions, as reported in IBES,
which includes the estimation of earnings per share, cash flow per share, sales, or operating
profit, and the Buy/Hold/Sell recommendations. The divergence of opinion across analysts is
proxied by the IBES estimate of standard deviation of the analyst forecasts. Analysts’ estimates
are updated on the Thursday before the third Friday of every month.

Benchmark interest rates such as Treasury bills/ bonds of different maturities and
corporate bonds with different ratings are obtained from Datastream. The four factor data (the
returns of market portfolio, size portfolio, book-to-market (BM) portfolio, and momentum
portfolio) for Carhart-Fama-French approach are downloaded from Kenneth R. French’s Data
Library.

The sample for calculating market reactions consists of 732 CBs issuances over the
period January 1, 1986 to December 31, 2005. A breakdown of the sample by year of issuance is
shown in Table 1. The study period includes both bullish and bearish equity market periods. The
average principal amount is highest in 2002, and reaches the second highest level in 2000. The
conversion premia are higher after 2001 (including) compared with those in earlier years. In this
sense, we infer that since 2001 CBs have become increasingly debt-like.
5. METHODOLOGY AND PROXIES

5.1. Methodology

In order to analyze the wealth effects and underlying driving factors around the issuance of CBs, we first calculate abnormal returns using standard event study methodologies, as in Brown and Warner (1980, 1985). The computed abnormal returns are then used as grouping variables, as well as dependent variables in regressions that are designed to capture the effects of the various risk factors on firm performance.

4.1.1. Abnormal Returns

Abnormal returns are calculated based on filing dates and issue dates. The Issue Date in this paper is defined as the first trading date of the underlying stocks on or after the issue date specified in SDC. The Filing Date is the date when an issuer officially transmits its CBs application or provides notice to the SEC for the issuance of CBs. We study the filing date because: 1) in an efficient market, prices should react to relevant information on the firms when it becomes public, which in many cases occurs on the Filing Date; 2) Information about the issuance of CBs shown in other resources such as newspaper reports or comments from senior officers of a listed company at the time before the filing date may be contaminated with other events, such as disclosure of other financing and investment activities.

Theoretically the information effect of CB financing on the stock price is ambiguous. The issuance of CBs could be good news for shareholders since the firm is issuing more debt with much lower financing cost compared with that of normal bonds, and the issuance of CBs might be a good signal for the future performance of the issuer. However, the issuance may be adverse, if dilution and liquidity effects are considerable.
Abnormal returns are computed using the standard market model approach. We assume that returns of underlying stocks follow the single factor market model. Significance tests are based on the methodology proposed by Patel (1976).

Market returns are calculated using an estimation period that has 250 trading days (approximately one calendar year) in length. The estimation period is the same for both the filing date and issue date event studies and ends 40 days before the event. The results we report use the Equally Weighted Index from the CRSP database as the benchmark. This index is relevant for our purpose because the dataset includes firms from different industries listed on NYSE, AMEX or NASDAQ. To test the robustness of the findings in abnormal returns, we use Carhart-Fama-French approach, which states that the abnormal return of securities is explained by the market portfolio and three factors designed to mimic risk variables related to size, book-to-market (BM) and momentum. The four-factor pricing model is the following.

$$E(R_{mt}) - R_{mt} = b_{1i} \times (E(R_{mt}) - R_{mt}) + b_{2i} \times E(SMB_{t}) + b_{3i} \times E(HML_{t}) + b_{4i} \times E(WML_{t})$$  

(8)

where $R_{jt}$ is the rate of return of the underlying common stock of the $j$th firm on day $t$, $R_{mt}$ is the rate of return of the market portfolio on day $t$, $b_{i}$ is the factor loadings, SMB is the difference in returns between portfolios of small capitalization firms and big capitalization firms, HML is the difference in returns between portfolios of high book-to-market and small book-to-market firms, and WML is the difference in returns between portfolios of stock price winners and stock price losers.

5.1.2. Comparison of mean abnormal returns across sub-samples

We also use the CRSP value-weighted portfolio as well as the S&P 500 as alternative market portfolio proxies to test for robustness. The results, which are available on request, are unaffected by the use of alternative market proxies.
In order to detect whether firm and issue characteristics are significantly different across sub-samples, we employ the mean comparison method. Sub-samples are divided into two groups based on the abnormal returns: observations with positive/negative abnormal returns. We explore several alternative time intervals and classify observations into three groups: positive/negative and almost zero abnormal returns.

The method to compare the mean is based on the general assumption that the sub-sample variances are unknown and possibly unequal. Significance is assessed based on the t-statistic:

\[
\frac{\bar{X} - \bar{Y}}{\sqrt{\frac{S_x^2}{n_x} + \frac{S_y^2}{n_y}}} \to t_{n_x+n_y-2}
\]

(9)

where \( \bar{X} \) and \( \bar{Y} \) are the mean of sample X and Y respectively; \( S_x^2 \) and \( S_y^2 \) are the variance of the two samples; \( n_x \) and \( n_y \) are the number of observations in the two samples. The null hypothesis of this test is that the mean of the two samples should be the same.

5.1.3. Regression analysis

To identify the driving factors of these abnormal returns, cross-sectional regressions are performed. What we want to examine is whether risks related to issuers and issues can explain abnormal returns around issuance.\(^{11}\) The risks selected, as per Section 3, include liquidity risk (logarithm of issue size), risks to firms (standard deviation of beta), and risk to CBs (Vega). The

\(^{11}\) A similar test conducted around the filing date is not meaningful because at the filing date, 1) the terms of the CB normally have not been determined, which means that the value of the CB cannot be assessed; 2) the actual issue date is still unknown, which means that hedged position of CBs cannot be set up yet; and 3) based on the Bloomberg database, no abnormal variations of the accumulated short interests around the filing date of CBs are observed; however an increase of accumulated short interest is observed around the issue date.
basic model estimated is:

\[ \text{Return}_{ij} = \alpha_0 + \alpha_1 \frac{\text{FCFE}}{\text{Sales}} + \alpha_2 \text{Vega} + \alpha_3 \ln (\text{Issue Size}) + \alpha_4 \text{std}(\beta) + \varepsilon_{ij} \]  

(10)

where \( \text{Return}_{ij} \) is the daily abnormal returns (AR) or cumulative abnormal returns (CAR) observed in the event windows (-2, +2) around issue date. FCFE/Sales is the firm’s Free Cash Flow to Equity normalized by sales, which relates to the cash flows available to equity holders. As this paper aims to test whether risk proxies can explain the abnormal returns, FCFE/Sales is deemed as a controlling factor only. Vega is the sensitivity of CBs value with respect to the volatility of the underlying stock, which proxies the risk related to CBs. Ln (Issue Size) is the logarithm of the total dollar amount of proceeds, which could proxy for the liquidity risk and dilution effect related to CBs. However, the market liquidity risk should be more prominent in Ln (Size) since we are looking at the short term, when the dilution effects from conversion are highly uncertain.\(^{12}\) The variable std (beta) is the standard deviation of beta estimates, which proxies for the risk of issuers.

To address the problem of heteroskedastic error terms, we employ the White (1980) procedure as developed by MacKinnon and White (1985),\(^{13}\) as well as Feasible Generalized Least Square (FGLS).

Finally, we employ the Error-components Model with fixed effects assumption to compare the CAR regressions. The fixed effects assumption, rather the random effects, is appropriate, since there are a small number of observation periods with a relatively large number of issuers.

\(^{12}\) Furthermore, as we will show subsequently, dilution effects are not significantly different across positive/negative return groups.

\(^{13}\) See also Long and Ervin (2000).
5.2. Alternative Proxy Variables

For completeness, alternative proxy variables are also used based on Gordon (1962) model:

\[ P = \frac{D_1}{K - g} \]  

where \( P \) is the price, \( D_1 \) is dividend of next period, \( K \) is the constant required rate of return, and \( g \) is the growth rate.

The proxies are divided into three groups: a) based on issuer fundamental characteristics; b) characteristics of the issue (size, CB features ; and c) the prevailing interest rate.

5.2.1. Proxies related to the issuer

We choose to test a comprehensive set of proxies related to the issuer in cash flows, growth, and risks, as well as other factors that the extant literature has proposed as determinants of the wealth effect.

Cash flow

Cash flow is important for issuers in the sense that it serves as a constraint to the firm’s financing and investment activities. Three types of cash flows are examined in this study: 1) Cash Flow from Operations, which measures the returns to the firm’s fundamental activities; 2) Free Cash Flow to the Firm (FCFF), calculated as net income plus non-cash charges-minus working capital investment plus the product of interest and one minus tax rate, and minus capital expenditures; this variable captures cash available to both equity holders and debt holders; and 3) Free Cash flow to equity (FCFE), which is the cash available to common shareholders after funding capital requirements, working capital needs, and debt financing requirements. It is calculated as FCFF minus the product of the interest rate and one minus the tax rate, plus net borrowing. By studying FCFF and FCFE simultaneously, we can disentangle the divergent
interests of shareholders v.s. bond holders. Aside from looking at absolute values of the cash flow variables, we also examine them as a proportion of total assets or total sales.

**Growth and profitability**

EPS (Earning per share) growth is a straightforward proxy of the historical growth of an issuer. We compute the growth of both the diluted EPS and basic EPS including extraordinary items in the three years preceding the issuance of CBs. Capital expenditure and R&D expenditures are good proxies for the future growth potential of issuers. Tobin's Q is another proxy for the growth of a firm. As per Chung and Pruitt (1994), Tobin's Q is defined as the sum of the book value of debt, market value of equity and the liquidating value of preferred stock, divided by the book value of total assets. Tobin’s Q is calculated at the fiscal year end preceding the issue date of CBs.

We choose the ratios of operating income over sales and over total assets at the fiscal year end preceding the issue date of CBs as proxies for the profitability of an issuer.

**Risk**

Risks are measured both from the perspective of firms (performance uncertainty of the business operation) and investors. We differentiate between three categories of risk: business risk, financial risk, and market risk.

*Business risk* is the uncertainty associated with the variability of operating income, as a consequence of fluctuating sales and production costs. Three measures of the business risk of the issuer are examined: 1) the coefficient of variation of the firm’s EBIT over a five year horizon; 2) the standard deviation of the firm’s sales over a five year period; and 3) the firm’s operating leverage, computed as the average of the absolute value of the percentage change in the firm’s operating income divided by the percentage changes in sales over a five year period. The impact
of a change in sales on the firm’s operating income will be more pronounced if it has higher fixed costs.

*Financial risk* is the additional risk a shareholder bears when a firm uses debt financing. Four proxies are used: 1) the firm’s long term debt ratio, calculated as the book value of long-term debt to the total capital of the firm; 2) the firm’s short term debt maturity structure, calculated as the ratio of short-term debt to the total debt of the firm; 3) the firm’s interest coverage, estimated as the ratio of the cash flow from the firm’s operations to interest expense before the CB issuance; 4) the long-term debt coverage ratio, estimated as the ratio of the firm’s cash flow from operations to long-term debt before the CB issuance.

*Market risk* is measured using Carhart-Fama-French-type factors including: 1) the firm’s beta and unlevered beta, calculated as the beta during the period one year and 40 days before the issue date; 2) the firm’s size to proxy for the Fama French size risk factor; 3) a proxy for the Fama French book to market factor: calculated as the absolute value of one minus the ratio of market value and book value of the equity of an issuer; 4) a (Carhart) one year momentum factor, calculated is the total rate of return on the underlying common stock during the fiscal year preceding the issuance of CBs; 5) the standard deviation of the firm’s beta calculated in the five years before the CB issuance. We also include the historical volatility of firm’s stock returns as well as higher moments of the returns (skewness and kurtosis) to capture non-normalities in the distribution of returns. Finally, Brennan and Schwartz (1988) argue that firms issue convertible debt precisely when uncertainty concerning the underlying risk of a firm’s investment projects is greatest. To proxy for the uncertainty with respect to the expectation of issuer’s future performance, we use the standard Deviation of the EPS estimation and percentage of down estimates from analysts before the issuance of CBs. These variables are retrieved from IBES.
Unlevered betas are derived from the levered beta estimates using:

$$B_U = \frac{B_i}{1 + (1 - T_c) \times \left( \frac{D}{E} \right)}$$

where $T_c$ is the firm’s tax rate and $D/E$ is the firm’s debt to equity ratio.

**Other Factors**

There are some other factors that could influence the valuation of a firm after the issuance of CBs. The first is the firm’s tax-rate, which measures the potential tax shields available to an issuer. The higher the marginal tax rates, the more issuers can take advantage of direct tax benefits of additional interest obligations associated with CBs financing. Issuers with lower profitability will derive fewer direct tax benefits from the CB’s. There are different proxies to measure the tax shield a firm can utilize. Similar to the methodology employed by Houston and Houston (1990), we use the average tax rate, which provides a summary measure of the ability of issuers to take advantage of direct tax benefits associated with additional debt financing.

Additionally, we use the firm’s depreciation rate, measured as the ratio of the firm’s depreciation charges over total PPE (Physical property, plant, and equipment) to measure non-debt tax shield. This ratio can also be deemed as the rate at which the physical plant is written off, which could be related to the guaranty of CBs. This ratio can also be related to the risk of the current fixed assets of a firm. For completeness, we also include the firm’s change in working capital as per Essig (1992), the number of industries (4-digit SIC codes an issuer has in SDC database) in which the firm operates to capture potential diversification benefits or real options as per Lee and Figlewicz (1999), and the ratio of net fixed asset (net PPE) to total assets as per Titman and Wessels (1988).
5.2.2. Issue Specific Factors

The issue specific factors that we consider are: size, conversion premium and the CBs option risk parameters.

**Issue Size**

Issue size can influence the price of CBs and underlying stock prices through dilution effects and liquidity effects, both of which are positively correlated with the number of CBs issued. The absolute issue size should be negatively related to the valuation because of liquidity effect. On the other hand however, if we deem CBs can act to reduce the agency costs associated with debt/equity financing, the issuance of CBs, especially for small but rapidly growing firms, can be an effective way to alter the risks of their total assets. So the relative size could be positively related to the valuation.

Similar to Dann and Mikkelson (1984), we employ proxies for both absolute and relative issue size. The logarithm of the total dollar amount of proceeds is chosen to proxy the absolute issue size. The relative change of the liabilities due to CB issuance is measured by the total dollar amount raised divided by the book value of total liabilities of the firm. The potential impact on equity market as a result of the CBs issue is estimated as the total dollar amount raised divided by the market value of common stock. Dilution effects are proxied by the number of shares issued upon conversion divided by the number of shares outstanding.

**Debt structure**

Since CBs are part of the debt burden of the firm before their conversion, it is worthwhile to study the relative debt structure for the valuation effect. The ratio of long-term debt before the offering divided by the market value of common stock one day before the issuance of CBs is
used to measure previous long-term debt utilization\textsuperscript{14}. The ratio of total liabilities before the offering divided by market value of common stock one day before the issuance is employed to measure debt financing capacity and total debt utilization. Finally, we use the debt ratio\textsuperscript{15} after issuance divided by debt ratio before issuance to study the change of debt ratio that is a consequence of the CB issuance.

**Proxies Related to the features of CBs**

Lewis, Rogalski, and Seward (2003) find that the market reacts differently to the debt-like vs. equity-like orientation of the CBs issuance. The more equity-like of the CBs, the more negative is the price response of the market, which is consistent with the pecking order theory of Myers (1984). Debt-like CB’s differ from equity-like CB’s in several interrelated dimensions including: conversion ratios, maturity dates, coupon rates, call periods, and the time to first call. Debt-like CBs have higher conversion premia, shorter maturities, and shorter call periods. In this study, we use three proxies to differentiate the debt and equity components. The first is the conversion premium, which is calculated as dividing the conversion price by stock price minus one. From this value, we can study how quickly the management of the issuer wants CBs to be converted into shares after their issuance. The second proxy is the conversion probability specified in the Merton (1973) model, which extend the Black and Scholes (1973) model by incorporating dividend rates. The higher the conversion probability, the more equity-like of the CBs. The formula of the conversion probability is:

\textsuperscript{14} Several capital-structure related measures here can also be deemed as issuer specific proxies. We list here for convenience.

\textsuperscript{15} Total debt divided by total assets.
\[ N(d_2) = N \left( \frac{\log \left( \frac{S}{X} \right) + (r - q - \frac{\sigma^2}{2})(T-t)}{\sigma \sqrt{T-t}} \right) \]  

(13)

where \( S \) is the price of the underlying stock price, \( X \) is the conversion price, \( q \) is the continuously compounded dividend yield of the underlying stock, \( r \) is the continuously compounded yield of 10-year Treasury bond, \( \sigma \) is the volatility of the logarithm returns of underlying stocks calculated during the period from 240 days to 1 day before the date. \( T-t \) is the time till maturity. \( N (\cdot) \) is the cumulative distribution function of standard normal distribution.

The third proxy is the sensitivity of the CB value to its underlying stock, which is also called the delta. The higher delta, the more equity component CBs have. \(^{16} \)

\[ \text{Delta} = e^{-q(T-t)} N \left( \frac{\ln \left( \frac{S}{X} \right) + (r - q + \frac{\sigma^2}{2})(T-t)}{\sigma \sqrt{T-t}} \right) \]  

(14)

Two other proxies that measure the sensitivity of CBs are used: 1) Gamma, which measures the sensitivity of delta to the price of the underlying stock. Gamma is higher when the conversion price is nearer to the underlying stock price.

\(^{16} \) The short term Greek measures used here does not consider dilution factor since around issue date, CBs are normally unconvertible, which means the short-term dilution effect could be neglected. Theoretically speaking, it can only be treated as an approximation since we treat call option for underlying stocks as the main term when we consider the Greek measures of CBs.
\[
\phi \left( \ln \left( \frac{S}{X} \right) + \left( r - q + \frac{\sigma^2}{2} \right) (T - t) \right) \frac{1}{\sigma \sqrt{T - t}}
\]

\[
\text{Gamma} = e^{-q(T-t)} \frac{1}{S \sigma \sqrt{T - t}} \left( \ln \left( \frac{S}{X} \right) + \left( r - q + \frac{\sigma^2}{2} \right) (T - t) \right)
\]

(15)

2) Vega, which measures the sensitivity of CBs value to the volatility of underlying stock. Vega is higher when conversion price is nearer to the underlying stock price.

\[
Vega = e^{-q(T-t)} S \sqrt{T - t} \phi \left( \ln \left( \frac{S}{X} \right) + \left( r - q + \frac{\sigma^2}{2} \right) (T - t) \right) \frac{1}{\sigma \sqrt{T - t}}
\]

(16)

where \( \phi (\cdot) \) is the probability distribution function of standard normal distribution.

5.2.3. Interest rate, Term structure, and Default Risk Measures

The ten year T-bond yield is used as a proxy for the macroeconomic discounting factor. Term structure risk is calculated as the difference between the return on the 3-month Treasury bill and 6-month Treasury bill. Default/credit risk is measured as the difference between the Moody’s Aaa rated corporate bond and the Moody’s Baa rated corporate bond.

6. RESULTS

In this section, we first look at the abnormal returns around filing/issue dates of CBs for our sample. We then proceed to analyze the underlying drivers of the abnormal returns first using a firm grouping approach and then using a regression models approach that is motivated by the theoretical model.

6.1. Abnormal Returns

Table 2 reports the abnormal returns for the event study conducted using the filing date of
the CB issuance as the event date. The first column shows the event window. Day 0 is the filing date, while day 1 is one day after the filing date etc. The dates in the windows are trading days. The second and third column show the Cumulative Abnormal returns (CAR) and Cumulative Average Abnormal returns (CAAR) respectively. The market returns used to calculate abnormal returns in this table is the CRSP equal-weighted market return series.\textsuperscript{17} The fourth to seventh column show the number of positive abnormal returns, of negative abnormal returns, the ratio of positive to negative returns, and the number of observations in the estimation. Z–statistics are reported in the eighth column, while the significance level is shown in the ninth column.

From Table 2, we find that the abnormal returns in all the different event windows are significantly negative at the 1\% level. The significance level is higher when the window is nearer to the SEC filing date. The abnormal return on the filing date is -0.72\% with a Z statistic of -7.60; for the (-1, 1) window it is -1.39\%, with a z-statistic of -8.10\%. Evidently, the filing of CB issuance is not perceived as good news, consistent with previous studies. The number of positive abnormal return observations is smaller than that of negative ones; however, a large portion of observations do have positive abnormal returns: the lowest and highest ratios of the number of positive to negative abnormal returns are 0.57 and 0.72 respectively.

Table 3 reports the abnormal returns for the event study that uses the CB issue date as the event date. It shows the results using a simple market model approach. The structure of this table is similar to that of Table 2. From Table 3, we find that the abnormal returns in all the different trading windows are again significantly negative at a level of 1\% using the market model. The results are more significant when the event window is in close proximity to the issue date. The abnormal return on the filing date is -0.81\% with a Z statistic of -8.76\%; for the (-1, 1) window it

\textsuperscript{17} Similar results are generated by using value-weighted market returns and S&P 500 index returns.
is -1.81%, with a z-statistic of -10.24%. The significance level is highest for the trading window of issue date and two days before the issue date, which differs from filing date effects. The number of positive abnormal return observations is smaller than that of negative ones; however, a large portion of observations have positive abnormal returns: the lowest and highest ratios of positive to negative abnormal returns are 0.48 and 0.57 respectively. If we use the Carhart-Fama-French approach to calculate abnormal returns, the results are similar. In sum, similar to the filing date results, CB issue dates also correspond to significant negative stock price reactions.

6.2. Characteristics Difference across Groups

On average, CB filings and issues are deemed as bad news events in the marketplace. However, for many firms, the abnormal returns are positive. What characterizes firms who derive favorable shareholder valuation effects around the issue dates of CBs? A summary of possible differentiating factors is shown in Table 4.

6.2.1. Characteristics related to the issuer

We first examine cash flows differences between negative and positive abnormal return portfolios (referred as “matching sub-samples” afterwards). Significant differences are observed. The ratio of average cash flows across matching sub-samples is largest around issue dates. It is interesting to note that the more cash flows issuers generate, the more negatively is the market’s reaction to the issuance, which is consistent with Section 3. That is, CB financing is more probable to be perceived as good news for medium or weak firms.

The growth and profitability differences across matching sub-samples show different significance levels. The average three-year EPS growth, which can proxy for historical growth is higher in the negative abnormal return portfolio, although the EPS growth difference is not
statistically significant between portfolios. However, the average capital expenditure and R&D to sales ratios, which proxy for future growth, are significantly higher for the negative abnormal return portfolio. In sum, it is apparent that the market reaction to the issuance of CBs is more linked to future growth prospects. Tobin’s Q is not significantly differently across the matching sub-samples, but the negative reaction portfolios also have higher Tobin’s Q values. Additionally, the profitability of the assets does not differ across matching sub-samples.

Firms with higher business risks have more negative market reactions. The ratio of standard deviation of sales to mean value of sales and the operating leverage are significantly different across groups. Leverage variables also differ. However, bankruptcy risk, as proxied by interest coverage does not appear to differ across the matching samples. Higher moments of stock returns show significantly different valuation effects. The stock return before issuance and the divergence of market to book value do not show any significant valuation effects. The beta, standard deviation of beta and standard deviation of unlevered beta all show significant differences across matching sub-samples. The larger the beta-related proxies, the lower are the abnormal returns. In sum, risks do have valuation effects around the issuance of CBs, and the market prefers firms with low or mild level of risk to issue CBs, which coheres with Section 3.

Neither the estimated EPS (from analysts) nor the differences between the absolute and relative difference between the estimated and actual EPS are significantly different across matching sub-samples; however, the volatility of the analysts’ opinion as to future EPS is significantly different between matching samples. The higher the volatility of analysts’ opinions, the more negative the market reaction, consistent with Doukas, Kim and Pantzalis (2006).

\[\text{We also group firms into three categories according to their abnormal returns, and find that those in the strongly positive abnormal return group are associated with mild levels of risk. These results are available on request.}\]
Analysts’ estimates for the upward/downward future stock price performance are in line with the ex post market reaction. The sign of the estimation error of EPS is positive in all event windows, which shows the upward bias of analysts’ estimation for CB issuing firms.

Tax rates are significantly different across the matching sub-samples. The higher the tax rate, the higher the tax shields, however the lower are the returns of the portfolio around CB issuance. This phenomenon may be due to a number of factors including: 1) the limited actual amount of tax shield for these firms, since both the coupon of CBs and the earnings of CB issuers are low; 2) the market treats CB more like equity, consequently the higher tax rate, the lower percentage of earnings could be shared by shareholders. The ratio of net fixed asset over total assets and the ratio of depreciation over PPE are also significantly different across matching sub-samples with negative valuation effects. Neither the number of industries nor the change in working capital is significantly different across matching sub-samples for any of the event windows examined.

6.2.2. Interest rate, term premium and credit risk premium effects

We find that the level of interest rates, interest term-structure risk and credit risk are all significantly different across matching sub-samples in the entire event windows examined. The higher the level of interest rates, term premium and credit risk premium, the more favorable the effect of the CB issuances. These results are intuitively appealing since: 1) with higher interest rates, the interest cost savings are higher; 2) in riskier economic environments, the expectations of both equity/debt investors and issuers can be more easily aligned with the use of CBs.

6.2.3. Proxies related to the issue

The total issue size of CBs is significantly different in all the event windows examined. Larger issue sizes are associated with more negative abnormal returns on the underlying stocks.
However the relative issue sizes (defined as the nominal value of the issue divided by the market value of common stock) are almost equal between the matching groups. The differential effects of the absolute and relative size imply that liquidity risk is more prominent than the dilution effect for CB issuances.

Of the three proxies for the equity vs. debt “orientation” of CBs, only the probability of converting CBs into shares is significantly different between matching groups. There is no significant difference for the conversion premium and the delta value between matching sub-samples. This contrasts with Lewis, Rogalski and Seward (2003).

Both Gamma and Vega are significantly different between matching sub-samples. CB’s with higher values of Gamma and Vega are associated with more negative market reactions, as they are perceived to be riskier.

6.3. The Drivers of Abnormal Returns

Table 5 reports the determinants of abnormal returns (AR) around the issue dates of CBs. The columns of this exhibit represent different event windows. On the upper-left (upper right) superscript shows the significance level calculated from the White method by assuming $\text{diag}\left(\hat{u}_i^2/(1-h_i)^2\right)$ (OLS method) as the covariance matrix. For each window, two models are employed. Model I include three regressors: liquidity risk (logarithm of issue size), issue risk (Vega), and firm volatility risk. Model II uses these three regressors as well as free cash flows (FCFE) to equity divided by sales as a robustness test.

On the whole, the models are significant, based on the computed F-statistics. From Table 5, we find that the influence of issue size on abnormal returns is significantly negative for the 2 trading days before the issue date, but not significant thereafter. The market impact is negatively correlated with issue size on or before the issue date. This may due to the fact that some investors
short sell the underlying stocks to set up a hedging portfolio.\textsuperscript{19} Vega has a significantly negative effect. Firm risks have positive effects on abnormal returns, but are significant in only a few cases. FCFE/Sale is only significant before the issue date.

Table 6 shows the determinants of the cumulative abnormal returns (CAR) for sample firms. The results are largely similar to those of Table 5, with the exception of the FCFE/Sale variable. Although not reported in the table, the R-square of Model I and Model II in both abnormal returns and cumulative abnormal returns decreases quite quickly in windows farther away from the issue date.

From the above, we may say the key drivers of abnormal returns around the issue date are: market liquidity impact (issue size), risks to CBs’ prices (Vega), and risks to the firm (std(Beta)). The first two of these drivers are particularly noteworthy. We find CBs can help firm to deal with firm’s risk, but the additional risks brought by the CB issuance induce negative valuation effects around issuance. These risks can explain abnormal returns near the issuance event. After CB issuance, the negative returns should maintain until the decrease in the firm’s risk overweight the increase of additional risks brought by CB issuance when CB issuer demonstrate themselves about the prospect of the new projects financed by CBs.

\textbf{6.4. Robustness Tests}

In order to test the robustness of the results, we separate the observations into different groups and run the regressions with alternative specifications.

First, market returns using value-weighted portfolio containing all issues in the CRSP database and S&P 500 Index are examined. The results are similar to what we obtain when we

\textsuperscript{19} Short interest positions for CB issuing companies rise around the issuance: the mean and median ratio of short interest after CB issuance to that before issuance are 228.08\% and 46.29\% respectively.
use the CRSP equal weighted portfolio benchmark for returns.

Second, we put the observations into three groups instead of two to compare the mean values. These three groups are significantly-negative abnormal-return group, the almost zero abnormal-return group, and the significantly-positive abnormal-return group. The results are similar to what we report in previous sub-sections. However, for risk proxies, market tends to favor firms with mild levels of risk to issue CBs.

Third, we also perform truncated regressions including only with observations with extreme absolute abnormal returns. The results are quite similar to those reported here. Fourth, we choose the real returns, not the abnormal returns, around the issue date to run the regressions. The direction, significance and direction of the impact are similar to those reported in Table 5.

Fourth, we run the regression of CAR by employing both FGLS and Error-components Model with fixed effects. Again, the results are similar to what we report in the previous sub-sections. The issue size and Vega remain the most significant drivers of abnormal returns.

Fifth, we run the regression of CAR calculated by Carhart-Fama-French approach. The results, which are reported in Table 7, are similar to those by simple market model.

Sixth, if considering the potential dilution effect of CBs, we could incorporate the dilution factor into the formula of Vega.

\[
Vega = e^{-\phi \gamma} \sqrt{T-t} 
\left( \frac{\ln \left( \frac{V}{B} \right) + \left( r - q + \frac{\sigma^2}{2} \right)(T-t) }{\sigma \sqrt{T-t}} \right) - \gamma \phi \left( \frac{\ln \left( \frac{V\gamma}{B} \right) + \left( r - q + \frac{\sigma^2}{2} \right)(T-t) }{\sigma \sqrt{T-t}} \right) 
\]

(17)

where \( \gamma = \frac{m}{m+n} \)

\(^{20}\) Although theoretically Lemma 17 is better than Lemma 16, it is not easy to implement it in empirical studies since: 1) CB normally bears a lock-up period, in which CB cannot be converted into underlying stocks. For the event
shares before the CB issuance. $V$ is the firm value, which is proxied by the sum of market value of equity, book value of normal corporate bond and the proceeds of issuing CBs. $B$ is the proceeds of CBs.

Then we can use $Vega_1$ in Eq. (17) as a proxy of CB volatility risk to run regressions on cumulative abnormal returns (CAR). The results are similar to those reported in Table 5.

Seventh, if other proxies as potential independent variables are included to explain cumulative abnormal returns, the Eq. (10) works best.

Finally, the rating of CB issuance firms could be another proxy for the firm volatility risk, since it incorporates comprehensive information about the performance of a firm. Due to lack of data, we use ratings of CB issuance instead. What we found is that the firm volatility risk is still positively related to the abnormal returns of CBs, although the influence of the CB issuance ratings is not significant anymore.\(^{21}\)

Consequently, we may say that the findings are quite robust with respect to different estimating methodologies and grouping methods.

7. AN ANALYSIS OF THE CB ISSUANCE EFFECT

The market responds favourably to the issuance of convertible bonds by issuers characterized as “mild risk” firms. However, issues that enhance $Vega$ or compromise liquidity (i.e. have high “issue risk”) are associated with negative returns.

A natural question that arises is why all types of firms issue CBs’ independent of the windows near the issue date studied here, the CB normally cannot be converted; 2) the real conversion process of CBs is quite different from what theoretical models forecast; and 3) there is not a reliable estimate of firm value because of data constraints, which means there is no proper empirical variable inputs for the expressions.

\(^{21}\) This is not surprising since the ratings of the CB's themselves may differ from those of the underlying firms.
differential issue risk. The answer is illustrated in Figure 3, which shows the wealth effects of CB issuance for different types of firms.

CB issuance influences investors’ expectations about both returns and risks of issuers. Ex ante, expected future returns for CB issuers should be higher than existing returns to the extent that CB’s are used to projects with a high risk adjusted NPV. Otherwise the option to convert into common stock would be worthless for CB issuers. Fabozzi, Liu, and Switzer (2009) provide empirical confirmation that a naked position of CBs or underlying stock from the issue date can derive superior returns over long horizons. Improved earnings expectations are also shared by analysts, although their recommendation seems to be over-optimistic. On the other hand, total risks of issuers could be higher or lower depending on the firm’s type after the issuance. If the project is successful (i.e. the firm is of higher quality) the firm’s risk will decline, as the convertible bonds are converted into common stock, ceteris paribus. However, when the issue risk is high, the return enhancement benefits for high quality firms may be offset in the short run. The change of total risk before and after CB issuance depends on these two offsetting factors.

For firms with a low quality portfolio of investment projects, the negative firm “type” effects may reinforce the negative issuance effects. The effects of CB issuance for weak firms are plotted in Figure 3, in which the probability distribution is flatter with fatter tails, but the expected returns could grow larger due to the issuance. Managers may have asymmetric information about the new project financed by CB issuance, and the firm’s prospects. Consequently, in the long-run, CB financing could be beneficial if the managers eventually move the firm value distribution further away from the default value. However, for firms initially characterized as high risk type firms, CBs may not be appropriate.

22 The bias of the estimation error of earnings for the analysts for these issues is always positive.
For firms with medium levels of risk, the market reacts more favorably because the market has more confidence that project financed by the CB will succeed. The perceived total risks of the firm will decrease, while the expected firm value will increase. CB issuance is warranted for such firms.

For firms of high quality, the market is more likely to react negatively because the risks decreased by the use of CB are likely not large enough to offset the additional risks brought by CB issuance. The perceived future return will be deemed positive but not substantial, because otherwise the good firms should issue a normal corporate bond instead. Consequently our empirical findings are consistent with the theory in Section 3 that CB’s are beneficial for firms with medium levels of risk. They are also consistent with the fact that CBs are normally treated as junk bonds in the US, even for many firms that are recognized as “blue chip.”

8. CONCLUSION

This essay examines the empirical relation between the characteristics of issuers/issue and the abnormal returns of firms that issue CB’s. We confirm that there are significant negative abnormal returns around the filing date of the notice or application to SEC and the issue date at a significance level of 1%. The abnormal return on the filing date and issue date is -0.72% and -0.81% respectively. The significance statistics is higher when the window is nearer to event date, and the significance statistics is larger for issuance date effects, which supports the view that selling pressures exist around the issuance date of CBs.

Consistent with Section 3, the market responds favorably to the issuance of convertible

---

23 For example, when issuing CBs, UPS, United Technologies, Automatic Data Processing, and CIBER have a Moody’s rating of not lower than Aa.
bonds by issuers with mild levels of firm volatility risk. Liquidity risk (issue size) and issue risk premium factors (convertible Vega) have significantly negative effects on abnormal returns around the issue date. The findings are robust to different grouping criteria and estimation methods.

**APPENDIX A. Proof of Equation (6)**

By substituting Equation (6) into the partial differential equation of equity, which is Equation (4), we can test whether the formula for the value of equity is correct.

\[
\begin{align*}
    rV\Phi(d_1) - \gamma V\Phi(d_1') + 0.5\sigma V \frac{\phi(d_1)}{\sqrt{T}} - 0.5\gamma \sigma V \frac{\phi(d_1')}{\sqrt{T}} - 0.5\sigma V \frac{\phi(d_1)}{\sqrt{T}} - rB e^{-rT} \Phi(d_2) + \cdots \\
    + 0.5\gamma \sigma V \frac{\phi(d_1')}{\sqrt{T}} + rB e^{-rT} \Phi(d_2') \\
    = \left( rV\Phi(d_1) - rB e^{-rT} \Phi(d_2) \right) - \left( \gamma rV\Phi(d_1') - \gamma rB e^{-rT} \Phi(d_2') \right) \\
    = rF2 \\
\end{align*}
\]

(A.1)

where

\[
\begin{align*}
    d_1 &= \frac{\ln \left( \frac{V}{B} \right) + \left( r + \frac{\sigma^2}{2} \right) T}{\sigma \sqrt{T}} \\
    d_2 &= d_1 - \sigma \sqrt{T} \\
    d_1' &= \frac{\ln \left( \frac{V\gamma}{B} \right) + \left( r + \frac{\sigma^2}{2} \right) T}{\sigma \sqrt{T}} \\
    d_2' &= d_1' - \sigma \sqrt{T} \\
\end{align*}
\]

\( \Phi(\bullet) \) is the cumulative distribution function of the standard normal distribution.

\( \phi(\bullet) \) is the probability distribution function of the standard normal distribution.
APPENDIX B. Proof of Equation (7)

We further assume that the equity of the firm follows stochastic differential equation as

\[
\frac{dF_2}{F_2} = \mu_1 dt + \sigma_2 dW_t
\]  
(A.2)

By Ito’s Lemma, we can write

\[
dF_2 = F_2 \nu dV + \frac{1}{2} F_2 \nu \nu (dV)^2 + F_2 \nu dt
\]  
(A.3)

By comparing the terms in Equation (A.1) and Equation (A.3), we have

\[
\frac{\sigma}{\sigma_2} = \frac{\sigma V}{\sigma V F_2 \nu}
\]  
(A.4)

So, we have

\[
\frac{\sigma}{\sigma_2} = \frac{1}{(\Phi(d_i) - \gamma \Phi(d_i'))}
\]  
(A.5)
REFERENCES


Accounting Research 9, 99-112.


Figure 1. The Fluctuation of Equity Value over Time

This figure depicts the change of equity value over time. The red, blue and black lines are CB issuers with a volatility of high level, middle level and low level respectively.

Part A. Low dilution factor scenario ($\gamma=10\%$)

Part B. High dilution factor scenario ($\gamma=50\%$)
Figure 2. The Variation of Risk Ratios over Time

This figure illustrates the dynamics of the ratio of total volatility to equity volatility for CB issuers after the CB issuance. The red, blue and black lines are CB issuers with a volatility of high level, middle level and low level respectively.

Panel A. Low dilution factor scenario (γ=10%)

Panel B. High dilution factor scenario (γ=50%)
Figure 3. The Effects of CB Issuance for Different Firms

This figure illustrates the effects for CB issuance for weak firm, medium firm and strong firm. The red line is the value before CB issuance, while the blue line is the value after CB issuance perceived by investors. The black vertical line is the value for default.
This table reports the yearly characteristics of convertible bonds issues used in the study. The time period is from 1986 to 2005. There are total 732 observations in the sample.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Issues</th>
<th>Coupon (%)</th>
<th>Principal Amount (Million USD)</th>
<th>Conversion Premium (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Median</td>
<td>Mean</td>
</tr>
<tr>
<td>1986</td>
<td>172</td>
<td>7.39</td>
<td>7.25</td>
<td>52.67</td>
</tr>
<tr>
<td>1987</td>
<td>129</td>
<td>7.01</td>
<td>7.00</td>
<td>70.15</td>
</tr>
<tr>
<td>1988</td>
<td>22</td>
<td>5.92</td>
<td>7.00</td>
<td>101.80</td>
</tr>
<tr>
<td>1989</td>
<td>47</td>
<td>N/A</td>
<td>N/A</td>
<td>161.89</td>
</tr>
<tr>
<td>1990</td>
<td>23</td>
<td>N/A</td>
<td>N/A</td>
<td>297.48</td>
</tr>
<tr>
<td>1991</td>
<td>40</td>
<td>N/A</td>
<td>N/A</td>
<td>322.85</td>
</tr>
<tr>
<td>1992</td>
<td>48</td>
<td>6.28</td>
<td>6.50</td>
<td>123.25</td>
</tr>
<tr>
<td>1993</td>
<td>62</td>
<td>5.30</td>
<td>5.75</td>
<td>146.75</td>
</tr>
<tr>
<td>1994</td>
<td>17</td>
<td>6.14</td>
<td>6.63</td>
<td>106.06</td>
</tr>
<tr>
<td>1995</td>
<td>12</td>
<td>6.40</td>
<td>6.69</td>
<td>124.21</td>
</tr>
<tr>
<td>1996</td>
<td>34</td>
<td>5.85</td>
<td>6.00</td>
<td>150.66</td>
</tr>
<tr>
<td>1997</td>
<td>30</td>
<td>6.10</td>
<td>6.25</td>
<td>171.93</td>
</tr>
<tr>
<td>1998</td>
<td>9</td>
<td>4.38</td>
<td>4.50</td>
<td>349.99</td>
</tr>
<tr>
<td>1999</td>
<td>7</td>
<td>3.07</td>
<td>1.50</td>
<td>627.51</td>
</tr>
<tr>
<td>2000</td>
<td>18</td>
<td>3.65</td>
<td>3.88</td>
<td>702.45</td>
</tr>
<tr>
<td>2001</td>
<td>32</td>
<td>2.28</td>
<td>1.75</td>
<td>598.35</td>
</tr>
<tr>
<td>2002</td>
<td>6</td>
<td>5.50</td>
<td>5.50</td>
<td>1025.80</td>
</tr>
<tr>
<td>2003</td>
<td>13</td>
<td>3.90</td>
<td>3.31</td>
<td>571.25</td>
</tr>
<tr>
<td>2004</td>
<td>4</td>
<td>4.84</td>
<td>5.13</td>
<td>146.25</td>
</tr>
<tr>
<td>2005</td>
<td>7</td>
<td>4.05</td>
<td>3.25</td>
<td>395.71</td>
</tr>
</tbody>
</table>

**Total** | 732 |

Note: The coupon rates in 1989, 1990, and 1991 in this sample are floating interest rate.
Table 2. Abnormal Returns around the Filing Dates of CBs

This table reports the abnormal returns for the event study conducted using the filing date of the CB issuance as the event date. The first column shows the event window. Day 0 is the filing date, while day 1 is one day after the filing date etc. The dates in the windows are trading days. The second and third column show the Cumulative Abnormal returns (CAR) and Cumulative Average Abnormal returns (CAAR) respectively. The market returns used to calculate abnormal returns in this table is the CRSP equal-weighted market return series. The fourth to seventh column show the number of positive abnormal returns, of negative abnormal returns, the ratio of positive to negative returns, and the number of observations in the estimation. Z–statistics are reported in the eighth column, while the significance level is shown in the ninth column. a, b, and c denote statistical significance at the 10%, 5% and 1% levels of a two-tails test respectively.

<table>
<thead>
<tr>
<th>Windows</th>
<th>CAR</th>
<th>CAAR</th>
<th>Number of Returns</th>
<th>Ratio</th>
<th>Total</th>
<th>Z-Values</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-10,0)</td>
<td>-1.46%</td>
<td>-0.13%</td>
<td>305 425</td>
<td>0.72</td>
<td>730</td>
<td>-4.63</td>
<td>c</td>
</tr>
<tr>
<td>(-10,1)</td>
<td>-1.92%</td>
<td>-0.16%</td>
<td>294 436</td>
<td>0.67</td>
<td>730</td>
<td>-5.88</td>
<td>c</td>
</tr>
<tr>
<td>(-10,2)</td>
<td>-1.97%</td>
<td>-0.15%</td>
<td>302 428</td>
<td>0.71</td>
<td>730</td>
<td>-5.77</td>
<td>c</td>
</tr>
<tr>
<td>(-10,5)</td>
<td>-2.16%</td>
<td>-0.14%</td>
<td>295 435</td>
<td>0.68</td>
<td>730</td>
<td>-5.63</td>
<td>c</td>
</tr>
<tr>
<td>(-5,0)</td>
<td>-1.50%</td>
<td>-0.25%</td>
<td>279 451</td>
<td>0.62</td>
<td>730</td>
<td>-6.05</td>
<td>c</td>
</tr>
<tr>
<td>(-5,1)</td>
<td>-1.96%</td>
<td>-0.28%</td>
<td>275 455</td>
<td>0.60</td>
<td>730</td>
<td>-7.49</td>
<td>c</td>
</tr>
<tr>
<td>(-5,2)</td>
<td>-2.01%</td>
<td>-0.25%</td>
<td>269 461</td>
<td>0.58</td>
<td>730</td>
<td>-7.16</td>
<td>c</td>
</tr>
<tr>
<td>(-5,5)</td>
<td>-2.20%</td>
<td>-0.20%</td>
<td>283 447</td>
<td>0.63</td>
<td>730</td>
<td>-6.63</td>
<td>c</td>
</tr>
<tr>
<td>(-2,0)</td>
<td>-1.13%</td>
<td>-0.38%</td>
<td>287 443</td>
<td>0.65</td>
<td>730</td>
<td>-6.22</td>
<td>c</td>
</tr>
<tr>
<td>(-2,1)</td>
<td>-1.59%</td>
<td>-0.40%</td>
<td>278 452</td>
<td>0.62</td>
<td>730</td>
<td>-7.89</td>
<td>c</td>
</tr>
<tr>
<td>(-2,2)</td>
<td>-1.64%</td>
<td>-0.33%</td>
<td>272 458</td>
<td>0.59</td>
<td>730</td>
<td>-7.25</td>
<td>c</td>
</tr>
<tr>
<td>(-1,0)</td>
<td>-0.93%</td>
<td>-0.47%</td>
<td>295 435</td>
<td>0.68</td>
<td>730</td>
<td>-6.39</td>
<td>c</td>
</tr>
<tr>
<td>(0,1)</td>
<td>-1.18%</td>
<td>-0.59%</td>
<td>264 466</td>
<td>0.57</td>
<td>730</td>
<td>-8.91</td>
<td>c</td>
</tr>
<tr>
<td>(-1,1)</td>
<td>-1.39%</td>
<td>-0.46%</td>
<td>277 453</td>
<td>0.61</td>
<td>730</td>
<td>-8.10</td>
<td>c</td>
</tr>
<tr>
<td>0</td>
<td>-0.72%</td>
<td>-0.72%</td>
<td>284 446</td>
<td>0.64</td>
<td>730</td>
<td>-7.60</td>
<td>c</td>
</tr>
</tbody>
</table>

Note: This table uses the Market Pricing Model. The abnormal returns using Carhart-Fama-French approach are similar.
Table 3. Abnormal Returns around the Issue Dates of CBs

This table reports for the event study conducted using the issue date of the CB issuance as the event date. The abnormal returns are estimated by the simple market model. The first column shows the event window. Day 0 is the issue date, while day 1 is one day after the issue date etc. The dates in the windows are trading days. The second and third column show the Cumulative Abnormal returns (CAR) and Cumulative Average Abnormal returns (CAAR) respectively. The market returns used to calculate abnormal returns in this table is the CRSP equal-weighted market return series. The fourth to seventh column show the number of positive abnormal returns, of negative abnormal returns, the ratio of positive to negative returns, and the number of observations in the estimation. Z–statistics are reported in the eighth column, while the significance level is shown in the ninth column. a, b, and c denote statistical significance at the 10%, 5% and 1% levels of a two-tails test respectively.

<table>
<thead>
<tr>
<th>Windows</th>
<th>CAR</th>
<th>CAAR</th>
<th>Number of Returns</th>
<th>Ratio</th>
<th>Total number</th>
<th>Z-Values</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-10,0)</td>
<td>-3.04%</td>
<td>-0.28%</td>
<td>256</td>
<td>476</td>
<td>0.54</td>
<td>732</td>
<td>-9.30 c</td>
</tr>
<tr>
<td>(-10,1)</td>
<td>-3.35%</td>
<td>-0.28%</td>
<td>252</td>
<td>480</td>
<td>0.53</td>
<td>732</td>
<td>-9.70 c</td>
</tr>
<tr>
<td>(-10,2)</td>
<td>-3.35%</td>
<td>-0.26%</td>
<td>257</td>
<td>475</td>
<td>0.54</td>
<td>732</td>
<td>-9.26 c</td>
</tr>
<tr>
<td>(-10,5)</td>
<td>-3.31%</td>
<td>-0.21%</td>
<td>265</td>
<td>467</td>
<td>0.57</td>
<td>732</td>
<td>-8.34 c</td>
</tr>
<tr>
<td>(-5,0)</td>
<td>-2.43%</td>
<td>-0.40%</td>
<td>243</td>
<td>489</td>
<td>0.50</td>
<td>732</td>
<td>-10.09 c</td>
</tr>
<tr>
<td>(-5,1)</td>
<td>-2.74%</td>
<td>-0.39%</td>
<td>240</td>
<td>492</td>
<td>0.49</td>
<td>732</td>
<td>-10.37 c</td>
</tr>
<tr>
<td>(-5,2)</td>
<td>-2.74%</td>
<td>-0.34%</td>
<td>248</td>
<td>484</td>
<td>0.51</td>
<td>732</td>
<td>-9.62 c</td>
</tr>
<tr>
<td>(-5,5)</td>
<td>-2.70%</td>
<td>-0.25%</td>
<td>264</td>
<td>468</td>
<td>0.56</td>
<td>732</td>
<td>-8.21 c</td>
</tr>
<tr>
<td>(-2,0)</td>
<td>-1.75%</td>
<td>-0.58%</td>
<td>253</td>
<td>479</td>
<td>0.53</td>
<td>732</td>
<td>-10.25 c</td>
</tr>
<tr>
<td>(-2,1)</td>
<td>-2.07%</td>
<td>-0.52%</td>
<td>248</td>
<td>484</td>
<td>0.51</td>
<td>732</td>
<td>-10.25 c</td>
</tr>
<tr>
<td>(-2,2)</td>
<td>-2.06%</td>
<td>-0.41%</td>
<td>254</td>
<td>478</td>
<td>0.53</td>
<td>732</td>
<td>-9.06 c</td>
</tr>
<tr>
<td>(-1,0)</td>
<td>-1.49%</td>
<td>-0.75%</td>
<td>240</td>
<td>492</td>
<td>0.49</td>
<td>732</td>
<td>-10.60 c</td>
</tr>
<tr>
<td>(0,1)</td>
<td>-1.12%</td>
<td>-0.56%</td>
<td>236</td>
<td>496</td>
<td>0.48</td>
<td>732</td>
<td>-8.13 c</td>
</tr>
<tr>
<td>(-1,1)</td>
<td>-1.81%</td>
<td>-0.60%</td>
<td>236</td>
<td>496</td>
<td>0.48</td>
<td>732</td>
<td>-10.24 c</td>
</tr>
<tr>
<td>0</td>
<td>-0.81%</td>
<td>-0.81%</td>
<td>236</td>
<td>496</td>
<td>0.48</td>
<td>732</td>
<td>-8.76 c</td>
</tr>
</tbody>
</table>

Note: This table uses the Market Pricing Model. The abnormal returns using Carhart-Fama-French approach are similar.
Table 4. Characteristics Comparison between Different CAAR Groups

This table reports the average value of the characteristics of two groups of CBs observations, those with negative and positive CAAR calculated by Carhart-Fama-French approach. The rows are different characteristics; while the columns are different event windows examined in the sample. For each characteristic in every window, the left top is the average values for negative CAAR, the left bottom is that for positive CAAR, and the right one is the significance level. 1, 2, and 3 denote statistical significance at the 10%, 5% and 1% levels of a two-tails test respectively.

<table>
<thead>
<tr>
<th>Items</th>
<th>(-10,1)</th>
<th>(-5,1)</th>
<th>(-2,1)</th>
<th>(-1,1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Sgnf</td>
<td>Mean</td>
<td>Sgnf</td>
</tr>
<tr>
<td>COF/Sales</td>
<td>0.25</td>
<td>2</td>
<td>0.29</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td></td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>FCFF/sales</td>
<td>0.69</td>
<td>3</td>
<td>0.79</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.20</td>
<td></td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>FCFE/Sales</td>
<td>0.35</td>
<td>2</td>
<td>0.37</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.17</td>
<td></td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Cap Expenditure</td>
<td>0.10</td>
<td>2</td>
<td>0.10</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.07</td>
<td></td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>R&amp;D/Sales</td>
<td>0.15</td>
<td>3</td>
<td>0.32</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td></td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Topin's Q</td>
<td>3.01</td>
<td></td>
<td>3.07</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2.26</td>
<td>0</td>
<td>1.94</td>
<td>1.81</td>
</tr>
<tr>
<td>EPS Growth</td>
<td>0.97</td>
<td></td>
<td>0.79</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.54</td>
<td></td>
<td>1.37</td>
<td>1.44</td>
</tr>
<tr>
<td>Operating Income/Sales</td>
<td>0.11</td>
<td></td>
<td>0.03</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td></td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>Net PPE/ASSETS</td>
<td>0.35</td>
<td>3</td>
<td>0.33</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.23</td>
<td></td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Depreciation/Total PPE</td>
<td>0.35</td>
<td>3</td>
<td>0.35</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.23</td>
<td></td>
<td>0.19</td>
<td>0.18</td>
</tr>
<tr>
<td>Std(Sales)/Mean Sales</td>
<td>0.31</td>
<td>3</td>
<td>0.31</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.15</td>
<td></td>
<td>0.16</td>
<td>0.13</td>
</tr>
<tr>
<td>△ Operating Earnings/△ Sales</td>
<td>3.18</td>
<td>3</td>
<td>3.19</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.03</td>
<td></td>
<td>0.86</td>
<td>1.21</td>
</tr>
<tr>
<td>Long-term Debt/Total Capital</td>
<td>0.49</td>
<td>2</td>
<td>0.52</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.28</td>
<td></td>
<td>0.21</td>
<td>0.29</td>
</tr>
<tr>
<td>Short-term Debt/Total Debt</td>
<td>0.57</td>
<td>3</td>
<td>0.58</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.38</td>
<td></td>
<td>0.35</td>
<td>0.31</td>
</tr>
<tr>
<td>COF/Interest Expense</td>
<td>-7.39</td>
<td>0</td>
<td>12.16</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4.20</td>
<td></td>
<td>6.46</td>
<td>5.71</td>
</tr>
<tr>
<td>divergence market from book</td>
<td>4.66</td>
<td>0</td>
<td>4.69</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4.99</td>
<td></td>
<td>4.76</td>
<td></td>
</tr>
<tr>
<td>Items</td>
<td>(-10,1)</td>
<td>(-5,1)</td>
<td>(-2,1)</td>
<td>(-1,1)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Sgnf</td>
<td>Mean</td>
<td>Sgnf</td>
</tr>
<tr>
<td>Stock Return</td>
<td>0.26</td>
<td>0</td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.24</td>
<td>0</td>
<td>0.23</td>
<td>0</td>
</tr>
<tr>
<td>std(Return)</td>
<td>0.45</td>
<td>2</td>
<td>0.45</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.41</td>
<td>0</td>
<td>0.41</td>
<td>0</td>
</tr>
<tr>
<td>Std(std(R))</td>
<td>0.01</td>
<td>2</td>
<td>0.01</td>
<td>3</td>
</tr>
<tr>
<td>Skewness(std(R))</td>
<td>1.18</td>
<td>0</td>
<td>1.18</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.12</td>
<td>0</td>
<td>0.91</td>
<td>1</td>
</tr>
<tr>
<td>Kurtosis(std(R))</td>
<td>5.78</td>
<td>0</td>
<td>5.84</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5.55</td>
<td>4.67</td>
<td>5.50</td>
<td>4.85</td>
</tr>
<tr>
<td>Down Estimate of Analysts</td>
<td>0.34</td>
<td>3</td>
<td>0.33</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>0</td>
<td>0.04</td>
<td>0</td>
</tr>
<tr>
<td>Std(EPS Estimation)</td>
<td>0.13</td>
<td>2</td>
<td>0.13</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.09</td>
<td>0</td>
<td>0.09</td>
<td>0</td>
</tr>
<tr>
<td>beta</td>
<td>0.88</td>
<td>3</td>
<td>0.89</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.72</td>
<td>3</td>
<td>0.75</td>
<td>3</td>
</tr>
<tr>
<td>Std(beta)</td>
<td>0.30</td>
<td>3</td>
<td>0.31</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.24</td>
<td>3</td>
<td>0.25</td>
<td>3</td>
</tr>
<tr>
<td>Std(beta_Unlevered)</td>
<td>0.43</td>
<td>3</td>
<td>0.44</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.28</td>
<td>3</td>
<td>0.28</td>
<td>3</td>
</tr>
<tr>
<td>Interest rate</td>
<td>0.07</td>
<td>3</td>
<td>0.07</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>3</td>
<td>0.08</td>
<td>3</td>
</tr>
<tr>
<td>Interest risk</td>
<td>0.17</td>
<td>2</td>
<td>0.17</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.20</td>
<td>2</td>
<td>0.21</td>
<td>2</td>
</tr>
<tr>
<td>Credit risk</td>
<td>0.98</td>
<td>3</td>
<td>0.98</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.20</td>
<td>3</td>
<td>1.25</td>
<td>3</td>
</tr>
<tr>
<td>Number of Industries</td>
<td>3.96</td>
<td>0</td>
<td>4.07</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4.28</td>
<td>3</td>
<td>3.87</td>
<td>3</td>
</tr>
<tr>
<td>Issue Size</td>
<td>5.05</td>
<td>3</td>
<td>5.21</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4.32</td>
<td>3</td>
<td>4.16</td>
<td>3</td>
</tr>
<tr>
<td>Issue Size/Equity</td>
<td>1.23</td>
<td>1</td>
<td>1.23</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1.21</td>
<td>3</td>
<td>1.21</td>
<td>3</td>
</tr>
<tr>
<td>Firm Size</td>
<td>7.12</td>
<td>3</td>
<td>7.20</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>6.14</td>
<td>3</td>
<td>5.45</td>
<td>3</td>
</tr>
<tr>
<td>Total debt</td>
<td>7.69</td>
<td>3</td>
<td>8.55</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>6.26</td>
<td>3</td>
<td>5.69</td>
<td>3</td>
</tr>
<tr>
<td>Tax rate</td>
<td>0.34</td>
<td>3</td>
<td>0.32</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.23</td>
<td>3</td>
<td>0.23</td>
<td>2</td>
</tr>
<tr>
<td>Conversion Premium</td>
<td>0.21</td>
<td>0</td>
<td>0.20</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.19</td>
<td>0</td>
<td>0.19</td>
<td>0</td>
</tr>
<tr>
<td>Delta</td>
<td>0.79</td>
<td>0</td>
<td>0.80</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.80</td>
<td>0</td>
<td>0.80</td>
<td>0</td>
</tr>
<tr>
<td>N(d2)</td>
<td>0.38</td>
<td>3</td>
<td>0.38</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.45</td>
<td>3</td>
<td>0.44</td>
<td>3</td>
</tr>
<tr>
<td>Gamma</td>
<td>0.66</td>
<td>3</td>
<td>0.64</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.39</td>
<td>3</td>
<td>0.38</td>
<td>3</td>
</tr>
<tr>
<td>Vega</td>
<td>14.25</td>
<td>3</td>
<td>14.68</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>7.84</td>
<td>3</td>
<td>7.20</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 5. Abnormal Returns Determinants around Issue Dates of CBs

This table reports the determinants of abnormal returns (AR) around the issue dates of CBs. AR is calculated with equal weight market returns. FCFE is the free cash flows to equity holders divided by sales, Vega is calculated by Black-Scholes-Merton model, Ln (Size) is the logarithm of issue size, std (Beta) is standard deviation of beta. The columns of this exhibit represent different event windows. 0 is the issue date, and 1 is one trading day after the issue date etc. On the upper-left (upper right) superscript shows the significance level calculated from the White method by assuming $\text{diag}\left(\hat{\Sigma}_i^2 / (1 - h_i)^2\right)$ (OLS method) as the covariance matrix. a, b, and c denote statistical significance at the 10%, 5% and 1% levels respectively.

<table>
<thead>
<tr>
<th>Items</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>I</td>
<td>II</td>
<td>I</td>
</tr>
<tr>
<td>Intercept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCFE</td>
<td>0.0190*</td>
<td>0.0167*</td>
<td>0.0116*</td>
<td>0.0114*</td>
<td>0.0080</td>
</tr>
<tr>
<td>Vega</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(Size)</td>
<td>-0.0040*</td>
<td>-0.0043*</td>
<td>-0.0025</td>
<td>-0.0020</td>
<td>-0.0041</td>
</tr>
<tr>
<td>std(Beta)</td>
<td>0.0145*</td>
<td>0.0007</td>
<td>0.0010</td>
<td>0.0087</td>
<td>0.0005</td>
</tr>
<tr>
<td>R²</td>
<td>4.93%</td>
<td>4.27%</td>
<td>2.33%</td>
<td>5.12%</td>
<td>2.54%</td>
</tr>
<tr>
<td>F-test</td>
<td>7.60*</td>
<td>5.06*</td>
<td>3.50*</td>
<td>6.13*</td>
<td>3.83*</td>
</tr>
</tbody>
</table>
Table 6. Cumulative Abnormal Returns Determinants around Issue Dates of CBs

This table reports the determinants of cumulative abnormal returns (CAR) around the issue dates of CBs. AR is calculated with equal weight market returns. FCFE is the free cash flows to equity holders divided by sales, Vega is calculated by Black-Scholes-Merton model, Ln (Size) is the logarithm of issue size, std (Beta) is standard deviation of beta. The columns of this exhibit represent different event windows. 0 is the issue date, and 1 is one trading day after the issue date etc. On the upper-left (upper right) superscript shows the significance level calculated from the White method by assuming \( \text{diag}\left(\frac{u_t^2}{(1-h_t)^2}\right) \) (OLS method) as the covariance matrix. a, b, and c denote statistical significance at the 10%, 5% and 1% levels respectively.

<table>
<thead>
<tr>
<th>Items</th>
<th>(-2, 0) I</th>
<th>(-2, 0) II</th>
<th>(-2, 1) I</th>
<th>(-2, 1) II</th>
<th>(-2, 2) I</th>
<th>(-2, 2) II</th>
<th>(-1, 0) I</th>
<th>(-1, 0) II</th>
<th>(-1, 1) I</th>
<th>(-1, 1) II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.0386 c</td>
<td>0.0345 c</td>
<td>0.0376 c</td>
<td>0.0298 c</td>
<td>0.0410 c</td>
<td>0.0333 c</td>
<td>0.0196 b</td>
<td>0.0178 b</td>
<td>0.0186 b</td>
<td>0.0131 c</td>
</tr>
<tr>
<td>FCFE</td>
<td>--</td>
<td>-0.0037</td>
<td>--</td>
<td>-0.0025</td>
<td>--</td>
<td>0.0019</td>
<td>--</td>
<td>0.0008</td>
<td>--</td>
<td>0.0019</td>
</tr>
<tr>
<td>Vega</td>
<td>b -0.0390 c</td>
<td>b -0.0580 c</td>
<td>c -0.0614 c</td>
<td>c -0.0805 c</td>
<td>c -0.0690 c</td>
<td>c -0.0849 c</td>
<td>b -0.0181 a</td>
<td>a -0.0578 a</td>
<td>b -0.0406 c</td>
<td>c -0.0803 c</td>
</tr>
<tr>
<td>Ln(Size)</td>
<td>c -0.0106 c</td>
<td>c -0.0083 c</td>
<td>c -0.0095 c</td>
<td>b -0.0067 c</td>
<td>c -0.0091 c</td>
<td>c -0.0065 c</td>
<td>c -0.0066 c</td>
<td>c -0.0040 b</td>
<td>b -0.0055 c</td>
<td>-0.0024 c</td>
</tr>
<tr>
<td>std(Beta)</td>
<td>0.0160 b</td>
<td>0.0266 b</td>
<td>0.0277 b</td>
<td>0.0420 c</td>
<td>0.0250 a</td>
<td>0.0373 b</td>
<td>0.0015</td>
<td>0.0259 b</td>
<td>0.0132 c</td>
<td>0.0413 c</td>
</tr>
<tr>
<td>R²</td>
<td>7.84% c</td>
<td>8.64% c</td>
<td>7.16% b</td>
<td>9.07% c</td>
<td>7.05% a</td>
<td>8.97% a</td>
<td>4.12%</td>
<td>7.27% c</td>
<td>3.77%</td>
<td>8.56%</td>
</tr>
<tr>
<td>F-test</td>
<td>12.48 c</td>
<td>10.73 c</td>
<td>11.31 c</td>
<td>11.32 c</td>
<td>11.12 c</td>
<td>11.18 c</td>
<td>6.31 c</td>
<td>8.89 c</td>
<td>5.74 c</td>
<td>10.62 c</td>
</tr>
</tbody>
</table>
Table 7. Cumulative Abnormal Returns Determinants around Issue Dates of CBs

This table reports the determinants of cumulative abnormal returns (CAR) calculated by Carhart-Fama-French approach. FCFE is the free cash flows to equity holders divided by sales, Vega is calculated by Black-Scholes-Merton model, Ln (Size) is the logarithm of issue size, std (Beta) is standard deviation of beta. The columns of this exhibit represent different event windows. On the upper right superscript shows the significance level calculated from OLS. a, b, and c denote statistical significance at the 10%, 5% and 1% levels respectively.

<table>
<thead>
<tr>
<th>Items</th>
<th>(-2, 0)</th>
<th>(-2, 1)</th>
<th>(-2, 2)</th>
<th>(-1, 0)</th>
<th>(-1, 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>I</td>
<td>II</td>
<td>I</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.0357^c</td>
<td>0.0311^c</td>
<td>0.0335^c</td>
<td>0.0270^b</td>
<td>0.0352^c</td>
</tr>
<tr>
<td>FCFE</td>
<td>--</td>
<td>0.0026</td>
<td>--</td>
<td>0.0037</td>
<td>--</td>
</tr>
<tr>
<td>Vega</td>
<td>-0.0381^c</td>
<td>-0.0611^c</td>
<td>-0.0643^c</td>
<td>-0.0950^c</td>
<td>-0.0727^c</td>
</tr>
<tr>
<td>Ln(Size)</td>
<td>-0.0098^c</td>
<td>-0.0076^c</td>
<td>-0.0083^c</td>
<td>-0.0056^b</td>
<td>-0.0077^c</td>
</tr>
<tr>
<td>std(Beta)</td>
<td>0.0207</td>
<td>0.0233^b</td>
<td>0.0389^a</td>
<td>0.0429^c</td>
<td>0.0188^a</td>
</tr>
<tr>
<td>R²</td>
<td>7.09%</td>
<td>8.04%</td>
<td>6.80%</td>
<td>10.66%</td>
<td>6.91%</td>
</tr>
<tr>
<td>F-test</td>
<td>11.19^c</td>
<td>9.92^c</td>
<td>10.70^c</td>
<td>13.55^c</td>
<td>10.88^c</td>
</tr>
</tbody>
</table>