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SECURITY DESIGN OF CALLABLE CONVERTIBLE BONDS AND ISSUERS' EXTERNAL FINANCING COSTS

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ABSTRACT:

Existing research argues that convertible bonds mitigate issuers' external financing costs of financial distress, agency conflicts and informational asymmetry. The purpose of this paper is to test whether callable convertible bonds are designed in response to costly debt- and equity-related financing problems. We identify the design (debt-, mixed- and equity-like) of callable convertible bonds using a measure of conversion probability which accounts for callability. Indeed, most of the existing empirical financial literature on convertible debt design does not pay much attention to the call feature in spite of its important repercussions on the security design. The empirical study provides evidence from 213 French callable convertible bonds over the period 1990-2010 that the issuer features, and hence the offering motives vary with the design of callable convertible debt.

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KEYWORDS: Callable convertible bonds, call feature, external financing costs, probability of conversion, security design.

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INTRODUCTION

In corporate financing decisions theory, it has been shown that convertible bonds (referred to hereafter as CBs) can be designed to mitigate a variety of debt- and equity-related external financing costs. More specifically, CBs can be structured to moderate potential asset substitution problems (Green, 1984), adverse selection and financial distress problems (Stein, 1992), sensitivity towards risk (Brennan and Schwartz, 1988), and sequential financing problems (Mayers, 1998).

Many CBs have a call provision.[1] Such bonds, referred to as "Callable Convertible Bonds" (CCBs henceforth), allow the issuing firm to call back its debt, in exchange of a payment agreed in advance when the conversion value reaches the call price[2]. One advantage of the call feature is to act as a natural hedge against interest rate risk for the issuing firm. Indeed, if interest rates fall, CBs issuers can redeem them at a predetermined price (Guntay et al. 2002). In addition, by calling their outstanding CCBs, companies are able to induce their conversion into equity when the investment option has positive value, and thus control potential overinvestment incentive.

The call feature has been already integrated into the valuation of CCBs using numerical methods (Ingersoll, 1977; Brennan and Schwartz, 1977; Tsieveriotis and Fernandes, 1998; Ho and Pfeiffer, 1996). More recently, André-Le Pogamp and Moraux (2004) proposed to value the double optional feature (conversion option and call option) by using a quasi-closed formula. The authors demonstrate that an adjusted American capped call well replicates the optimal policies of both the issuer and investors and well duplicates this complex option.

The number of CB features (e.g. conversion ratio, coupon rate, maturity date and call price) increases the flexibility of the security design. Based on the value of these features, one may obtain CCBs that have a higher or lower probability of conversion. Depending on that summary measure, a CCB could be categorized as debt-like CCBs (i.e., convertibles with a low probability of being converted into equity), mixed-like CCBs (i.e., convertibles for which the weight of equity and debt components are roughly the same) or equity-like CCBs (i.e., convertibles with a high probability of being converted into equity). According to the literature, a CBB will generate different optimal behaviors depending on this categorization which could be seen therefore as a different design, although it is triggered by a different parameterization of the same inputs.

The objective of this paper is to consider the interaction of all these features in order to determine, as far as possible, the actual security design of the CCB and to link it up to external financing problems experienced by the issuing firm. Lewis et al. (2003) have undertaken a similar study on US market. However, these authors use the conversion probability at maturity. They underline the interest of taking into

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1 For example, Korkeamaki and Moore (2004) report that 692 out of 705 CBs in their sample have a call feature.

2 In practice, this option often states that the call feature can be exercised only when the conversion value is above a certain percentage of the call price: *trigger covenant*.

account the probability of early conversion induced by the call feature, but they gave up due to the difficulty of modeling the convertible call decision. Since most CBs on the French market are callable, and they are often called prior to maturity, our objective in this paper is to address the issue outlined in Lewis et al. (2003) through the inclusion of the call feature in the security design.

A number of studies have investigated the relationship between convertible debt design and financial side effects (e.g. Lewis et al. 2003; Krishnaswami and Yaman, 2008). Nevertheless, our study differs from prior research in three aspects. First and foremost, the sample is made-up exclusively of CCBs categorized based on their total conversion probability which takes into account the call feature. Second, previous empirical studies were conducted almost exclusively in US context, which makes it important to provide further evidence on the design of CBs and its role in the mitigation of the costs of external financing for French firms. Finally, we use a data set spanning 21 years (1990 to 2010), which enables us to incorporate in our analysis periods of significant financial stress, such as the Subprime Crisis of 2007 and the late-2008 Global Financial Crisis.[3]

The remainder of this paper is organized as follows. Section 1 analyzes different measures used in the literature to classify CBs as debt-, mixed- or equity-like. Section 2 presents our measure of security design that simultaneously considers all CB features, especially the call feature. Section 3 reports the empirical analysis of French CCBs offerings. In section 4 we present our testable hypotheses as well as the variables chosen to test them. Section 5 presents the main results of our empirical study conducted on the French market over the period 1990-2010 on the impact of debt- and equity-related costs of external finance on the design of CCBs. The last section concludes.

1. IDENTIFICATION OF CBS DESIGN

The CB is a hybrid and flexible security that can be structured by the issuing firm to be treated as a debt substitute, an equity substitute or a mixed security. Therefore, it is justified to analyze the main reasons explaining the issuer choice. More specifically, we consider that managers are able to correctly design CBs to mitigate financial side effects.

1.1. THE REASONS OF A CB DESIGN

Modigliani and Miller (1958) demonstrate that in a perfect market firm's financial decisions are irrelevant for its market value. In a real world, however, it is well known that capital market imperfections exist, giving rise to significant agency conflicts, informational asymmetries and costs of financial distress when firms rely on external financing, such as debt or equity to meet their liquidity needs. These costs can be mitigated through an efficient use of CBs by the issuing firm. On the one hand, CBs can be viewed as a solution for asset substitution problems. Indeed,

[3] Dutordoir and Van de Gucht (2004) and Lewis et al. (1998), among other authors, document significant interaction effects between the CB design and the general economic conditions.

according to Merton (1974), shareholders of levered firms will have incentive to force the agents to adopt higher risk projects than initially planned, since risky projects with negative *NPV* reduce the value of the firm and transfer wealth from bondholders to shareholders. However, Green (1984) demonstrates that, because convertible debt has an option feature, its value increases with risk, therefore less expropriation of wealth can occur when CBs are issued instead of straight bonds. On the other hand, Stein (1992), argues that convertible debt financing reduces adverse selection costs in informational asymmetry context, and hence considers the offering of this hybrid security as an indirect manner to issue equity ("backdoor equity").

Overall, as already discussed in Lewis et al. (1998 and 1999), the two main theories that are able to explain convertible debt issuance are the risk-shifting hypothesis and the backdoor-equity hypothesis. We expect that issuing firms will have tendency to choose the appropriate design considering these external financing costs. Our objective is to establish a link between these theories by considering CBs not as a homogeneous security, but as a real continuum of security between debt and equity with varying levels of "equity-likeness". Moreover, the interest of analyzing CBs design is to manage to infer information about the issuing firm, more particularly the features that motivate the design of the security being issued. Investors thus will be able to decode these characteristics, and enhance their understanding of the information content of the CBs issuance decision.

1.2. USUAL MEASURES OF CLASSIFICATION

In order to study CCBs types, we attempt in this section to provide an overview of the key classification measures documented in the literature. Four measures have been identified, depending on the value, the sensitivity, the expected time to becoming at-the-money, or the conversion probability of CBs.

Value-based measure

The approach based on the value of equity and debt component of the convertible debt is the most widely applied in practice due to its easiness to handle. In general, the value of the bond component, estimated through discounting the promised coupon and principal payments, is compared to the total value of the CB, as developed by Brennan and Her (1993) and King (1986). Following, the CB value is divided into two parts: a bond part and an equity part, computed as the difference between the CB value and the bond floor.

The main critic of this breakdown is that convertible debt is not composed of an equity and a bond portion, but rather of a bond component and an optional one. In addition, the link between the option value and the stock value is far from being simple. The issuer's call feature may decrease the option value without reducing the equity dominant of the CB, or more precisely the conversion probability.

Sensitivity-based measure

This approach is based on the analysis of the CB price sensitivity to changes in the underlying stock price. The higher is the CB *delta* (approaching 1), the more the CB is an equity-like one. Inversely, when *delta* approaches 0, the convertible debt turns into a straight debt. The *delta* of the CB was used, among other authors, by Janjigian (1987) as a proxy of the CB equity likeness. Nevertheless, when the issuer's call feature is embedded in the CB, the delta is not linked through a monotonic relationship to the underlying stock price, and therefore may results in an inaccurate classification of the CCB.

Time-based measure

Davidson et al. (1995) use the usual geometric drift representation of the stock price to invert it and infer the implicit time to reach the conversion price. They estimate the expected time to becoming at-the money *T*, which takes into account the growth rate of the underlying stock price. They suppose that the expected stock price $E(S_T)$ is given by $E(S_T) = S_0 e^{\mu T}$, with S_0 the current price, μ the drift which measures the expected growth in the stock price, and T the expected time to becoming at-the-money. The longer (shorter) the expected time to becoming at-the-money is, the more debt- (equity-) like the CB is. The time *T* is given by:

$$T = \frac{Ln(PC) - Ln(S_0)}{\mu} \qquad (1)$$

where *PC* is the conversion price.

Two main issues of concern should be put forward when time to becoming at-the-money is applied. First, this measure does not allow comparison among CBs with different maturities. This issue can be addressed by standardizing the expected time by the CB maturity. Second, volatility of stock price is left out of analysis.

Conversion probability-based measure

Lewis et al. (1998, 1999 and 2003), among other authors, suggest using the risk neutral probability at maturity based on Black, Scholes and Merton (1973) standard assumptions as a measure of the security design[4]. These authors compute the probability on the issue date allowing the comparison of different issues and the measurement of the impact on the firm financial structure at maturity. However, the call decision is not integrated in the conversion probability measure, meaning that only voluntary conversion by bondholders is accounted for in this approach.

According to Ingersoll (1977), CB may be decomposed into a risky debt instrument and a call option with an exercise price equal to the redemption price. Relying on the usual Black-Scholes framework of option pricing, the stock price is assumed to follow a geometric Brownian motion :

[4] This criterion was also used by Burlacu (2001) in the French context.

$$\frac{dS}{S} = \mu dt + \sigma dz \qquad (2)$$

where μ is the expected rate of return on the underlying stock, σ the stock price volatility and dz the standard Brownian process. The conversion probability (*i.e.* the probability to hit the redemption price) at maturity is then computed as $N(d_2)$, where $N(.)$ represents the cumulative probability under a standard normal distribution function, and $d_2 = \frac{Ln(S/K) + (r - \sigma^2/2)(T)}{\sigma\sqrt{T}}$, with K the redemption price at maturity and r the risk-free interest rate.

Although the probability of conversion at maturity appears to be the best measure of security design since it plays a significant role in explaining security choice decisions (Lewis et al. 1999, 2003), it presents nevertheless the limitation of not taking into account the conversion prior to maturity date caused by the call feature.

In sum, previous empirical studies on the measurement of the equity component of CBs lead to heterogeneous results. This could be explained not only by the differences in the period covered by these studies and the sample used, but also more fundamentally by the methods used that do not take into account the whole characteristics of the CB, mainly the call feature.

2. Proposition of a CCB Desing Measure Integrating the Call Feature

After recalling the usual conversion probability at maturity implied by Black, Scholes and Merton's (1973) model, we propose an original measure of CCB design which incorporates the call feature. This measure, derived from André-Le Pogamp and Moraux's (2004) analysis, uses the adjusted capped call option to value the optional component of CCBs. The double optional feature of the CCB is included in the conversion probability measure referred to in this manuscript as "total conversion probability". Indeed, the conversion probability of a European call option is completed by the probability of an early conversion due to the call feature. The total conversion probability can be broken down into two components:

- The first one is the probability that the underlying asset reaches the barrier prior maturity.[5] It can be expressed as $P(S_\tau > CP)$, with *CP* the contractual call price, and $\tau \in [0;T]$ the date at which the underlying stock price reaches the call price. This probability measures the early conversion of the call feature.
- The second one is the probability of conversion at maturity knowing that the stock price stayed below the barrier during the option lifetime. More formally:

[5] Readers may refer to Reiner and Rubinstein (1991) work for a complete description of barrier options.

$$\mathrm{P}(S_T > K : S_\tau < CP) \tag{4}$$

The probability in expression (4) is equivalent to the probability of a positive value at maturity of a European *Up&Out Call* option: $\mathrm{P}(C_{UO_T} > 0)$.

The first probability can be split up in the following way:

$$\mathrm{P}(S_\tau > CP) = \mathrm{P}(S_T > CP) + \mathrm{P}(S_T < CP : S_\tau > CP) \tag{5}$$

and the second may be developed as follows:

$$\begin{aligned}\mathrm{P}(S_T > K : S_\tau < CP) = {} & \mathrm{P}(S_T > K) - \mathrm{P}(S_T > CP) \\ & + \mathrm{P}(S_T \le K : S_\tau > CP) - \mathrm{P}(S_T < CP : S_\tau > CP)\end{aligned} \tag{6}$$

Using (5) and (6), the expression of the total conversion probability of a CCB can be shown to take the form:

$$P_{conv} = P(S_T > K) + P(S_T \le K : S_\tau > CP) \tag{7}$$

More formally:

$$P_{Conv} = N(d_2) + \left(\frac{CP}{S}\right)^{2\left(\frac{r - \frac{1}{2}\sigma^2}{\sigma^2}\right)} * N(d_2') \tag{8}$$

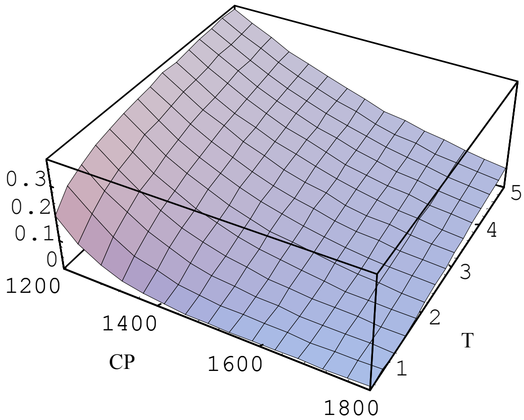
with $d_2 = \dfrac{\mathrm{Ln}(S/K) + \left(r - \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$ and

$$d_2' = \left(- \frac{\mathrm{Ln}\left(\frac{CP^2}{KS}\right) + \left(r - \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} \right)$$

The conversion probability of CCBs is then equal to $N(d_2)$ to which is added an adjustment factor related to early conversion.

We study the effect of the contractual call price, denoted *CP*, on the conversion probability of a CCB. Figure 1 plots differences between conversion probability at maturity and total conversion probability for different call prices and maturity levels.

FIGURE 1. CORRECTION OF THE CONVERSION PROBABILITY INDUCED BY THE CALL FEATURE



Notes: The figure shows the gap between the total conversion probability (as computed using equation 8) and the probability of conversion at maturity ($N(d_2)$). Simulations are performed for several call prices CP and maturity levels T . S, K, σ and r are set at 1000, 1200, 30% and 5% respectively.

Results are in accordance with our expectations. The error induced by neglecting the call feature increases as the call price is set near the redemption value and maturity is longer. For example, this error reaches the maximum value of 30% when the *CP* and *T* are set at 1200 and 5 respectively.

3. EMPIRICAL ANALYSIS OF FRENCH CCBS ISSUES

3.1. DATA SOURCES AND SAMPLE CONSTRUCTION

Our initial sample consists of all CCB issues[6] listed in the monthly information bulletins of the *Autorité des Marchés Financiers* (*AMF*)[7] conducted by French public companies between January, 1990 and December, 2010. It amounts to 253 offerings from 186 firms. Nevertheless, to be included in our final sample, CCB issues must meet the following criteria:

1. No subscription warrant, option or right should be attached to the CCB being offered (17 offerings excluded).
2. Issuing firms' daily stock prices must be available on Datastream database for the two years surrounding the offering date. Similarly, issuers' accounting data

[6] Two types of CBs have been considered in this study: standard CBs and OCEANEs (Obligation Convertible et/ou Échangeable en Actions Nouvelles ou Existantes, i.e. convertible and/or exchangeable bonds into new or existing shares).

[7] This French institution is the equivalent of the American Securities and Exchange Commission (SEC).

must be available on Worldscope database for the fiscal year preceding the offering (14 offerings excluded).

3. No other public disclosure of corporate events (such as mergers and acquisitions, seasoned equity offerings, straight bonds offerings) should be made by the issuing firm within the period of 21 trading days surrounding the announcement date (9 offerings excluded).

As a result of applying these filters, our final sample consists of 213 issues conducted by 156 firms.

3.2. FRENCH ISSUES CLASSIFICATION

Following Lewis et al. (2003), we sort CCBs into three categories based on their conversion probabilities at the announcement date. We categorize a CCB as ''debt-like'' if the conversion probability is less than 40%, as ''mixed-like'' if the conversion probability is between 40% and 60%, and as ''equity-like'' if the conversion probability is greater than 60%. The breakpoints chosen here reflect the simple observation that CCBs with higher conversion probability are more likely to be interpreted by investors as equity-like securities.

For a comparison purpose, both conversion probability at maturity and total conversion probability are computed using respectively $N(d_2)$ and equation (8), where: S is the closing underlying stock price one week prior to the announcement date; K is the conversion price; CP is the contractual call price; r is the risk-free interest rate calculated as the continuously compounded annual yield on 5-year French Government Bonds on the day preceding the announcement day; σ is the standard deviation (per annum) of the continuously compounded stock return estimated over the period 240 to 40 trading days prior to the announcement date; T is the number of years until maturity. Nevertheless, in the reminder of our analysis we will concentrate only on the total conversion probability.

FIGURE 2. CONVERSION PROBABILITY AT MATURITY

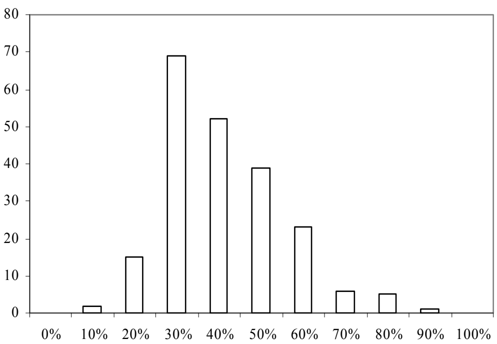
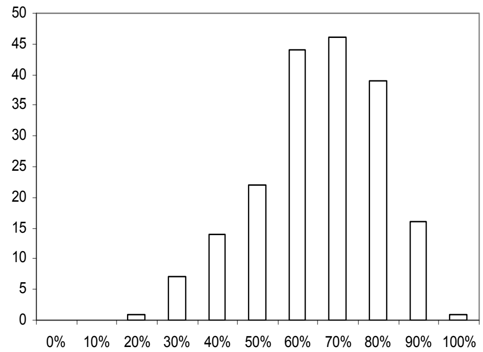


Figure 2 plots the distribution of conversion probabilities at maturity. We can see that this distribution is right skewed (skewness = 0.74) with mean and median of, respectively, 0.36 and 0.33. The majority of CCBs exhibit a conversion probability close to 30% a matter of debt-like convertible debt. The most frequent class has a probability between 0.3 and 0.5. These findings are consistent with those of Dutordoir and Van de Gucht (2004) who pointed out that Western European convertibles are more debt-like than their American counterparts.

FIGURE 3. TOTAL CONVERSION PROBABILITY (WITH THE CALL FEATURE)



Compared to Figure 2, the total conversion probability distribution shows a significant incidence of the call feature on the conversion probability. The mean and median total conversion probability increase substantially to almost 0.6.

TABLE 1. COMPARISON OF MEANS AND MEDIANS OF CONVERSION PROBABILITIES

	Conversion probability at maturity	Total conversion probability
Mean	0.36	0.59
Bootstapped T-test	-25.46***	
Median	0.33	0.59
Z-wilcoxon	-13.12***	
N	213	

Notes: The bootstrapped standard error used in the bootstrapped t-test is based on 1000 replications. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 respectively.

As displayed in Table 1, the increase induced by the callability of CBs is statistically significant at the 1% level. We can observe that the distribution is slightly skewed to the left, but fairly mound-shaped. One notes that more than two thirds of CCBs have a total conversion probability ranging between 0.6 and 0.8, and then interpreted as equity-like securities by investors.

Table 2 exhibits the distribution of the issues by calendar year and by industry affiliation. Panel A clearly demonstrates that the temporal distribution of CCBs offerings in our sample is to some extent cyclical. Thus, as can be seen, periods 1990, 1993-1994, 1997-2002 and 2009 show evidence of more offerings than other years. Such pattern is consistent with the "high/low volume periods" phenomenon outlined by Loughran and Ritter (2000). The latter state that corporate events, such as security offerings, which may be driven by behavioral timing on the part of managers, should logically display time clustering. Another observation that might be made is the extensive use of CCBs during periods of financial turmoil (i.e dotcom crisis and subprime crisis). Indeed, CCBs are more popular during these periods because "*a lot of investors are seeing the coupon as a way to maintain income if the dividend is cut. They are equity-type investors buying the bond as a way to get upside exposure with income.*"[8]

TABLE 2. DISTRIBUTION OF CCB OFFERINGS IN THE FINAL SAMPLE BY CALENDAR YEAR AND BY INDUSTRY

	Sample size	Debt-like	Mixed	Equity-like	Gross proceeds *(in million of €)*
Panel A: Final sample distribution by design and calendar year					
1990	11	0	1	10	2 287
1991	5	0	0	5	1 354
1992	4	0	0	4	197
1993	18	0	3	15	2 619
1994	16	1	1	14	3 792
1995	6	0	2	4	992
1996	7	0	1	6	1 667
1997	17	5	3	9	2 268
1998	11	0	2	9	386
1999	19	1	9	9	4 925
2000	11	2	5	4	3 036
2001	12	0	6	6	5 568
2002	13	3	7	3	10 417
2003	9	1	7	1	5 045
2004	10	4	5	1	2 069
2005	8	3	4	1	1 381
2006	5	1	4	0	590
2007	8	1	6	1	2 286
2008	3	1	2	0	192
2009	15	0	13	2	5 132
2010	5	1	4	0	857
Panel B: Final sample distribution by design and industry affiliation					
Basic Materials	5	1	1	3	1 176
Consumer Goods	31	3	13	15	11 831
Consumer Services	43	5	20	18	16 760
Financials	27	0	6	21	5 576
Healthcare	11	3	4	4	1 232
Industrials	45	4	18	23	7 346
Oil & Gas	5	2	4	0	2 048
Technology	40	5	16	18	8 837
Telecommunications	3	1	2	0	1 192
Utilities	3	0	1	2	1 058
Total	213	24	85	104	57 057

Notes: CCBs are classified into three categories based on their total conversion probability computed on the announcement date using the formula displayed in equation (8). We categorize a CCB as ‘‘debt-like’’ if the conversion probability is less than 40%, as ‘‘mixed-like’’ if the conversion probability is between 40% and 60%, and as ‘‘equity-like’’ if the conversion probability is greater than 60%. The industry affiliation of CCBs issuers is based on the *ICB* (Industry Classification Benchmark) system.

When the temporal distribution is refined by taking into account the design of CCBs, we observe that equity-like issues tend to occur during periods of strong volume, where the underlying stock price is more likely to be overvalued. Such pattern supports the "window of opportunity" hypothesis according to which

[8] A. de Guillenchmidt, Financial Times, 10th of May 2009.

managers time the offering of equity-linked securities to take advantage of the transitory prosperity of their firms (Ritter, 1991; Loughran and Ritter, 1995; Bayless and Chaplinsky, 1996).

At the industry level, panel B reveals that issuers represent a broad cross-section of industries (as defined by the *ICB* classification system), indicating that CCB is a useful financing tool in a variety of business conditions. However, the number of issues in different industries varies widely.

4. ISSUERS' CHARACTERISTICS AND EXTERNAL FINANCING COSTS

CCBs are designed to be viewed by investors in the market as debt-, mixed- or equity-like securities depending on the cost(s) of external financing they are supposed to prevent. We expect this recognition of CCBs design to enhance our understanding of the managerial issuance motives through a deep analysis of the relationship between the design opted by firms and debt- and equity-related costs of external finance.

4.1. MINIMIZATION OF EXTERNAL FINANCING COSTS

According to a large body of literature on the convertible debt financing, several theoretical hypotheses are underlined. First, as developed by Lewis et al. (1999 and 2003), convertibles may mitigate costs of bondholder-stockholder agency conflicts such as risk-shifting costs, and may also be used by debt-constrained firms -as a "backdoor equity"- to alleviate adverse selection costs induced by the informational asymmetry between shareholders and investors. We consider in the style of Krishnaswami and Yaman (2008) that convertible debt can be efficiently designed to moderate different combinations of debt-and equity related costs of external finance.

Minimization of agency costs

First, recall that firms with valuable investment opportunities should choose equity financing while firms with poor investment opportunities should have recourse to debt financing. Indeed, as argued by Myers (1977), firms with valuable investment opportunities should use debt sparingly to avoid underinvestment problems. The idea is that highly levered firms may be attempting to reject positive *NPV* projects. Thus, firms with valuable investment opportunities should maintain low levels of debt and should prefer equity financing. But this may be a complicated task for firms facing significant adverse selection costs. Indeed, while an equity offering would reduce underinvestment problems, asymmetric information may render an equity issue too costly and induce the firm to prefer convertible debt. Moreover, as initially developed by Jensen and Meckling (1976) and Smith and Warner (1979), firms with straight bonds outstanding may face bondholder/stockholder conflicts of interest. These authors emphasize that managers have incentive to over-invest in more risky projects than initially planned, inducing wealth transfers from creditors to shareholders. Lenders may protect themselves against the risk shifting by adding covenants to lending agreements constraining the firm from the increase of the investment risk. However, these covenants may be costly since they deprive the firm from developing new businesses. Green (1984) demonstrates that the optional component embedded in the convertible debt induces less wealth transfer in firms with high potential of asset substitution. This type of conflicts arises when new projects occur within firms whose investments cannot be easily observed and monitored. This is typically the case of small firms with high portion of intangible assets.

Minimization of adverse selection and financial distress costs

Convertible debt may reduce informational asymmetry problems. Stein (1992) presents convertible debt as an indirect mean to raise equity and to reduce equity related financing costs when information asymmetry makes an immediate equity offering unattractive and when the firm is debt-constrained. Indeed, when debt leverage is too high, the cost of straight debt issuance would be too large. While an equity issuance should be an alternative financing way, a high level of informational asymmetry would be incongruous due to adverse selection costs (Myers and Majluf, 1984). According to Stein (1992), convertible debt use is a good compromise between the under-valuation problems of direct equity offerings and the financial distress costs that would be induced by straight debt offerings.

Brennan and Kraus (1987) and Brennan and Schwarz (1988) argue that convertible financing reduces the costs associated with uncertainty. When information asymmetry about the riskiness of assets is important, both straight debt and equity issues will be undervalued by the market. However, due to the option component, the value of the convertible debt is relatively insensitive to the risk of the issuing firm.

4.2. HYPOTHESES

We assume the ability of external financing costs to explain firms' CCBs design decisions.

H1 : *Firms would issue debt-like CCBs when they have low investment opportunities and face moderate debt financing costs.*

Indeed, if the issuing firm presents low investment opportunities, it may rationally choose to offer straight debt. The latter, however, will be too costly for financially distressed firms or firms facing bondholders/stockholders agency costs. Hence, we expect that issuers with low profitable investment opportunities, facing moderate financial distress costs and/or risk-shifting problems would be more likely to issue debt-like CCBs.

H2: *Firms would issue equity-like CCBs when they have valuable investment opportunities and moderate adverse selection costs.*

According to the financial theory of Myers (1977), firms with high levels of investment opportunities would use equity financing due to greater potential underinvestment problems. Nevertheless, the presence of adverse selection costs may moderate the optimal use of an equity financing. Therefore, we expect that firms with high quality investment opportunities would choose to issue CCBs which are structured to offer a higher probability of conversion, only if the informational asymmetry is not too large as well.

H3: *Firms design CCBs as mixed-like convertible debt when they face high adverse selection costs and/or high debt financing costs.*

If firms face high investment opportunities, they will optimally prefer equity financing securities. However, a high level of informational asymmetry may increase adverse selection costs leading the issuing firms to decrease the equity component through the issuance of mixed-like CCBs. Similarly, for firms with low investment opportunities and acute expected debt costs (i.e. high financial distress and risk shifting costs), debt would be suboptimal since it exacerbates these costs. These firms would therefore prefer mixed CCBs since their option component lowers significantly debt agency costs than debt-like CCBs do.

TABLE 3. HYPOTHESES SUMMARY

<table>
<tr><th></th><th></th><th colspan="3">Adverse selection costs</th><th colspan="3">Debt financing costs</th></tr>
<tr><th></th><th></th><th>Low</th><th>Moderate</th><th>High</th><th>Low</th><th>Moderate</th><th>High</th></tr>
<tr><td rowspan="2">Investment opportunities</td><td>Low</td><td colspan="3">Equity-dominant security is suboptimal</td><td>Straight debt</td><td>Debt-like (H1)</td><td>Mixed-like (H3)</td></tr>
<tr><td>High</td><td>Equity</td><td>Equity-like (H2)</td><td>Mixed-like (H3)</td><td colspan="3">Debt-dominant security is suboptimal</td></tr>
</table>

4.3. VARIABLES

The profitability of future investment opportunities is measured by two proxies widely used in existing literature: the market-to-book ratio and the price-earnings ratio. However the profitability from assets-in-place is proxied in our study by the return on assets ratio, which is computed as the net income on total assets.

Information asymmetry has been discussed in many previous studies, and several proxies have been proposed to measure adverse selection costs. According to Myers and Majluf (1984), firms that present high amount of financial slack (computed as the sum of cash and marketable securities divided by total assets) may suffer from higher adverse selection costs. We also include the issuing firm size, measured as the book value of total assets, as an inverse proxy of both information asymmetry and financial distress costs. Brennan and Schwartz (1988) and Lewis et al. (1999) argue that small firms experience higher information asymmetries and financial distress problems, and hence significant debt- and equity-related financing costs. In addition, Krasker (1986) asserts that adverse selection costs are related to the amount raised. In fact, the larger the issue size, the worse the signal and the fall in the firm's stock price, making the probability of an equity issue less likely. The issue size is calculated as the offering proceeds divided by the market value of equity. We also use the pre-offer market run-up as a measure of information asymmetry. Indeed, Lucas and MacDonald (1990), Baker and Wrugler (2002) and Korajczyk and Levy (2003), among others, find evidence supporting the prediction of market timing, where firms' equity issues cluster in periods of stock prices run-up, during which information asymmetries are more likely to be low.

As underlined by Green (1984), firms that face high debt agency costs are characterized by high financial leverage and high volatility levels. Debt-related financing costs are proxied by the ratio long-term debt on total assets and volatility measured as the standard deviation of the issuer stock returns.

Besides, according to the transaction costs theory developed by Williamson (1988), the financing choice between debt or equity depends on the importance of redeployable assets. Evidently, the less specific is the asset, the higher will be its liquidation value. The level of debt will be then more important when redeployable assets are high. Empirically, Titman and Weissels (1988), Friend and Lang (1988) and Rajan and Zingales (1995) measured the liquidation value by tangible assets over total assets. They point out that debt use is an increasing function of tangible assets. Indeed, the higher the tangibility of assets is, the lower are the costs related to potential bankruptcy. In our paper, we use intangible assets over total assets as a proxy of financial distress costs.

5. RESULTS

Does the security design of CCBs reflect specific external financing costs and then specific type of issuers? In order to test the empirical implications summarized in hypotheses *H1*, *H2* and *H3,* we conduct a study of the issuing firms' characteristics extracted from the previous sample. Unlike Lewis et al. (2003), non-hybrid securities (i.e. straight debt and common equity) are not considered in our study. We consider only CCBs. Nevertheless, the whole spectrum is analyzed from CCBs as debt-like to CCBs as equity-like. The criterion used to categorize CCBs is the total conversion probability as computed earlier in section 2.

Firstly, we follow the standard event study methodology to examine abnormal returns around the announcement of CCBs offerings by French companies over the period (1990-2010).[9] The results of the event study are displayed in Table 4 for the whole final sample and by issuer category. Consistent with the previous empirical evidence (e.g. Dann and Mikkelson, 1984 ; Eckbo, 1986), CCB issuers exhibit mean and median abnormal returns and *CARs* which are significantly negative over all event windows considered in our study. Mean (respectively median) abnormal return at date 0 is -0.88% (respectively -0.55%). The market response one day before and one day after the announcement is also significantly negative. However, its magnitude and its statistical significance is much smaller than on the announcement date. All mean and median *CARs* are statistically significant at 1% level using the bootstrapped t-test and the wilcoxon test.

[9] The abnormal return for the issuer *i* on day *t* is the difference between its actual and expected return on day *t*. Expected returns are estimated using the standard two-parameter market model with coefficients estimated over the period of 140 trading days that end 20 days prior to the announcement date. Abnormal returns are calculated for 21 days around the CCBs issuance. Cumulative Abnormal Returns (*CAR*) are also computed to test the cumulative effect of the informational content of the CCBs offering. The null hypothesis of an abnormal return (respectively *CAR*) equal to zero is tested using the bootstrapped t-test and the Wilcoxon sum rank test.

According to Myers and Majluf (1984) model, security offerings convey information about the firm's assets in place and future investment opportunities**.** Their model implies that, under asymmetric information about the firm value, the issuance of equity conveys less favorable information about the firm's investment opportunities and assets in place than do debt offerings. The mean and median announcement period abnormal returns of the three sub-samples of CCB issues are in accordance with Myers and Majluf model. Announcements of CCB offerings with low debt component (equity- and mixed-like) are met by a statistically significant stock price decline, whereas the market response to debt-like offerings is statistically insignificant. It is interesting, however, to notice that the negative reaction for mixed issuers is more important than that observed for equity-like group, thus validating our hypothesis that mixed-like issuing firms are more prone to adverse selection costs.

Secondly, theory suggests several motivations of convertible debt offerings. We compute Wilcoxon signed rank test for paired sub-samples of issuers and p-values from Kruskal-Wallis to investigate whether there is significant difference in the characteristics of the issuing firms among the three sub-samples. If our classification measure is related to different sources of external financing costs, the factors explaining CCBs offering decision will vary according to the security design chosen by the issuing firm. Thus, we will find considerable differences between the three types of CCB issuers.

TABLE 4. MARKET RESPONSE TO THE ANNOUNCEMENT OF FRENCH CCBS ISSUES IN THE FINAL SAMPLE (1990-2010)

Event window	All issuers (N=213)		Debt-like issuers (N=24)		Mixed issuers (N=85)		Equity-like issuers (104)		Kruskal-Wallis p-value
	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)	
-1	**-0.31%****	**-0.21%****	-0.15%	-0.42%	**-0.47****	**-0.45*****	-0.18	-0.10	0.25
0	**-0.88%*****	**-0.55%*****	-0.71%	-0.69%	**-1.38*****	**-0.92*****	**-0.51****	**-0.28****	0.01
1	**-0.31%***	**-0.19%****	-0.10%	-0.12%	0.11	0.10	**-0.67*****	**-0.38*****	0.01
-1;+0	**-1.19%*****	**-0.82%*****	-0.86%	-0.96%	**-1.86*****	**-1.43*****	**-0.69****	**-0.51***	0.00
0;+1	**-1.19%*****	**-0.65%*****	-0.82%	0.36%	**-1.27*****	**-0.65*****	**-1.18*****	**-0.69*****	0.46
-1;+1	**-1.49%*****	**-1.03%*****	-0.96%	-0.17%	**-1.75*****	**-1.05*****	**-1.36*****	**-1.02*****	0.57
-2;+2	**-1.11%*****	**-1.45%*****	-0.85%	-1.55%	-0.62	**-1.47***	**-1.54*****	**-1.34*****	0.91
-5;+5	**-1.87%*****	**-1.69%*****	-1.26%	-1.09%	**-1.99****	**-2.54*****	**-1.86*****	**-1.18*****	0.62
-10;+10	**-2.71%*****	**-2.50%*****	-3.17%	-2.60%	**-2.23****	**-2.44****	**-2.87*****	**-2.54*****	0.94

Notes: Abnormal returns are computed as follows: $AR_{it} = R_{it} - E(R_{it})$ where R_{it} and $E(R_{it})$ denote respectively the continuously compounded return and the expected return of security *i* on day *t*. $E(R_{it})$ is estimated using the standard two-parameter market model as follows: $E(R_{it}) = \hat{\alpha} + \hat{\beta} \times R_{m,t}$ with $R_{m,t}$ the continuously compounded rate of return for the SBF 250 equally weighted index on day *t*. The coefficients $\hat{\alpha}$ and $\hat{\beta}$ are ordinary least squares estimates of security *i*, estimated over the period of 140 trading days that end 20 days prior to the announcement date. The statistical significance of mean abnormal returns is tested using the bootstrapped t-test, with bootstrapped standard errors based on 1000 replications. The median test is based on the Wilcoxon sum rank test statistics. ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 respectively.

Table 5 evidences different factors describing the features of each group deduced from total conversion probability. Total assets variable, used as a proxy for information asymmetry and financial distress costs, does not show the hypothesized pattern and the difference across groups is not statistically different from zero at conventional levels of significance. In addition, equity-like issuers exhibit more profitable investment opportunities (as proxied by market-to-book ratio and price-earning ratio) than debt-like issuers do, although differences are not statistically significant. The profitability measured by the return on assets is significantly higher for equity-like issuers, indicating that debt-related costs of external finance are less likely to be an important concern for this category of issuing firms. In accord with hypothesis *H2*, we find, in line with US-based studies (e.g., Lewis et al. (1999 and 2003)), that the level of pre-announcement market run-up is high for equity-like issuers (Kruskal-Wallis p-value < 5 percent), indicating a strong evidence of low adverse selection. However, the relative issue size failed to show any discriminant power to distinguish among the three classes of issuers. The volatility as well as the ratio of intangibles are significantly lower for equity-like issuers compared to other groups, suggesting, as hypothesized, these firms face low debt-related costs of financing.

Consistent with our predictions in hypothesis *H3*, mixed-like convertible debt issuers exhibit more informational asymmetry than debt- and equity-like issuers do. The level of financial slack is abnormally and significantly high for mixed-like issuers compared to other issuers, and the difference among the three groups is statistically significant at 10 percent level. Furthermore, the market run-up, which acts as an inverse proxy of adverse selection costs, is significantly lower for this group compared to equity- and debt-like issuers. With regard to the ratio of intangibles, we observe that mixed-like issuing firms show a significantly high value of this ratio, which results in high debt-related agency and financial distress costs. This result is also consistent with the interpretation of the level of intangible assets as a proxy of information asymmetry. Indeed, Barth et al. (2001) argue that firms with substantial intangible assets have more adverse selection costs and more inherent uncertainty about firm value than do other firms.

Lastly, debt-like CCBs issuers have comparatively high financial leverage, but the differences among groups lack statistical significance. Nevertheless, as predicted by hypothesis *H1*, the profitability of assets in place, as measured by the return on assets, is economically and statistically low for debt-like issuers (Kruskal-Wallis p-value < 5 percent). Moreover, the volatility, used as a metric of risk shifting incentives, shows a significantly high level for this class, signifying these issuers face high debt agency costs. This result is, however, not consistent with our expectations in hypothesis *H1*.

Overall, the empirical results reported here seem to validate our three hypotheses, suggesting these firms adapt the design of CCBs to multidimensional financial side effects.

CONCLUSION

This paper makes two main contributions. First, we know that convertible debt includes many features, the call feature being the most common one and exists in almost all French offering contracts. To define CCB type, we suggest the use of an adapted conversion probability based on the valuation formula of an adjusted American capped call option. This probability integrates the call feature, and hence provides more accurate approximation of the CCB design.

Second, relying on this new conversion probability to characterize the design of CCBs, this paper suggests that the use of CCBs is a response to external-financing costs generated by the existence of adverse selection and financial distress costs. A suitable design of CCBs may mitigate these costs.

Taken as a whole, the results obtained in this paper are in line with convertible debt financing theories. Using a set of 213 CCBs completed by French firms over the period 1990-2010, we document that, due to high information asymmetries, the announcements of mixed like CCBs are met by a statistically significant stock price decline, whereas the market response to debt-like offerings is statistically insignificant. We also find that equity-like CCBs issuers present moderate informational asymmetries and high investment opportunities, while debt-like CCBs issuers exhibit a high level of financial risk and simultaneously present low investment opportunities. Finally, firms with higher levels of firm-specific information asymmetry and large costs of financial distress issue mixed-like convertibles in order to mitigate adverse selection costs of equity-like securities and the costs associated with debt-like securities.

The main limit of this paper is that our security choice model does not include standard financing instruments, such as straight debt and common equity. Thus, one avenue for further research is the extension of our sample to incorporate these standard instruments in our analysis. This will enable us to directly test whether CCBs are structured by French companies to provide a financing alternative that mitigates the adverse selection (respectively debt costs) of a sale of common equity (respectively straight debt).

TABLE 5. SUMMARY STATISTICS FOR CCB ISSUERS IN THE FINAL SAMPLE

	Full sample (N=213)	Debt-like (N=24)	Mixed (N=85)	Equity-like (104)	Z-wilcoxon			Kruskal-Wallis
					Debt vs mixed	Debt vs equity	Mixed vs equity	p-value
(a) TA	11 163.01	7 129.01	6 938.01	15 727.72	-1.62	-1.09	1.08	0.17
	(833.47)	(339.49)	(1 408.00)	(685.11)				
(b) P/E	31.37	16.83	24.05	41.04	-0.04	-0.53	-0.77	0.71
	(16.93)	(16.43)	(15.67)	(17.46)				
(c) M/B	3.21	1.32	3.15	3.70	0.29	0.01	-0.78	0.75
	(1.96)	(2.01)	(1.80)	(2.00)				
(d) Slacks/TA	13.51	11.47	15.97	11.87	**-1.73***	-0.38	**2.14****	**0.06**
	(10.08)	(8.99)	(11.70)	(8.80)				
(e) % intangibles	18.93	15.28	26.60	13.19	**-2.04****	1.41	**4.51*****	**0.00**
	(13.43)	(13.93)	(24.33)	(7.66)				
(f) ROA	3.55	-1.61	2.61	5.56	-0.13	-1.36	**-2.66*****	**0.03**
	(4.28)	(4.43)	(3.47)	(4.89)				
(g) Leverage	25.29	28.43	25.50	24.39	0.73	1.09	0.59	0.52
	(23.20)	(25.94)	(23.30)	(22.59)				
(h) Volatility	0.42	0.51	0.44	0.37	0.79	**2.88*****	**3.86*****	**0.00**
	(0.36)	(0.43)	(0.40)	(0.31)				
(i) Market run-up	0.09	0.12	0.04	0.13	1.37	-0.17	**-2.54****	**0.03**
	(0.12)	(0.12)	(0.05)	(0.15)				
(j) Issue size	0.27	0.27	0.26	0.28	0.22	-0.38	-0.66	0.78
	(0.20)	(0.19)	(0.20)	(0.21)				

Notes: Values are for the fiscal year before the offering unless stated otherwise. (a) Book value of total assets (Worldscope item #02999). (b) Market capitalization divided by the net profit (Worldscope item #07250). (c) Market capitalization (Worldscope item #08001) divided by the book value of equity (Worldscope item # 05491). (d) Cash and short term investments (Worldscope item #02001) scaled by the book value of total assets (Worldscope item #02999). (e) Total intangible assets (Worldscope item #02649) divided by the book value of total assets (Worldscope item #02999). (f) Net profit (Worldscope item #07250) as a percent of the book value of total assets (Worldscope item #02999). (g) Total debts (*Worldscope item* #03255) divided by the book value of total assets (Worldscope item #02999). (h) Annualized historical volatility estimated over the 250-trading-day period preceding the offering announcement date. (i) The return over the SBF index, cumulated over the 250 trading days prior to the announcement date. (j) Gross proceeds of the issue standardized by the market capitalization (Worldscope item #02999).

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