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Callable convertible debt under managerial entrenchment

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Abstract

This paper provides an explanation of callable convertible issue from the viewpoint of managerial entrenchment. Zweibel [American Economic Review 86 (1996)] has shown that an entrenched manager voluntarily issues straight debt in order to avoid hostile takeover. Straight debt, however, may lead the firm into bankruptcy in which a manager loses her position. We show that an entrenched manager can avoid a hostile takeover and bankruptcy at the same time by issuing well-designed callable convertible debt. Although callable convertible debt may decrease the value of the firm, an entrenched manager will prefer it over straight debt.

JEL classification: G32
Keywords: Callable convertible debt; Managerial entrenchment; Call provision

1. Introduction

Since Jensen and Meckling (1976), most of the agency literature on corporate finance has assumed that corporate financial policy is chosen in order to maximize shareholders' wealth. However, recent papers, such as those of Zweibel (1996), Novaes and Zingales (1995), and Novaes (2000), have introduced the managerial entrenchment approach to corporate finance, in which an entrenched manager determines the financial policy of the firm based on her own interests. The entrenchment approach appears to be

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appropriate for large firms in which management is separated from ownership. Several empirical studies have reported that managerial entrenchment is an important determinant of corporate financial policy.[1]

In this paper, we explain why a manager of a firm issues callable convertible debt from the viewpoint of managerial entrenchment. The framework for the analysis is the entrenchment model of Zweibel (1996). In the Zweibel model (1996), a partially entrenched manager decides the financial policy of the firm based on her own interests, which are best served by staying in control and undertaking a new project (regardless of its profitability). In the absence of a hostile takeover, the manager has no incentive to issue debt because debt may lead the firm into bankruptcy in which the manager will lose her position. In contrast, the manager of a firm under threat of a hostile takeover needs to issue debt in order to avoid her dismissal due to takeover.

By issuing straight debt and distributing cash as dividends, the manager can commit not to undertake a value-decreasing project, which would increase the probability of bankruptcy. This credible commitment raises the ex ante value of the firm so that the manager can eliminate the potential for a hostile takeover. Thus, the Zweibel model (1996) can explain why a firm's manager voluntarily issues straight debt.[2]

Straight debt, however, introduces another problem for the manager: there remains a possibility of bankruptcy even after she undertakes a value-increasing project. Since the probability is too small to cause the manager to refrain from undertaking a value-increasing project, the manager executes such a project on the equilibrium path even though she may lose her position. The existence of this problem, however, is predicated on the assumption that a firm is restricted to issuing only straight debt, under which debt level of the firm cannot be changed. In this study, we introduce callable convertible debt and show that, by using well-designed callable convertible debt, the manager can eliminate the possibility of bankruptcy attendant on a value-increasing project.

As we shall show, convertible debt may be designed so that it will not be converted after undertaking a value-decreasing project but will be converted after undertaking a value-increasing project. The former condition ensures that the manager never undertakes a value-decreasing project because debt will remain and the risk of the firm going into bankruptcy will be great. As in the case of straight debt, this credible constraint eliminates the possibility of hostile takeover. The latter condition, which stems from a prominent feature of convertible debt, ensures that default never occurs after the manager undertakes a value-increasing project because debt will be converted into equity. Thus, well-designed convertible debt can simultaneously eliminate both the threat of hostile takeover and the threat of bankruptcy. Convertible debt is thus more desirable than straight debt for a self-interested manager.

The call provision plays an important role in eliminating the possibility of bankruptcy following a value-increasing project. Note that convertible holders want to delay their conversion decisions as long as possible. If the manager does not call until the true return is realized, convertible holders may not convert their debt into equity when the realized

[1] For example, see Morck et al. (1988), Jung et al. (1996) and Berger et al. (1997).

[2] If there is no entrenchment, a manager has no incentive to use debt. See Section 3 in this paper.

return of a risky project is so small that the conversion value is less than the debt value. Thus, without the call provision, the manager is still exposed to bankruptcy risk after she undertakes a value-increasing project. The manager can eliminate this possibility by calling convertible debt before the true return is realized. Since the conversion value exceeds the debt value in the case that a value-increasing project has been undertaken but the true return is not yet realized, convertible holders are forced to convert their debt into equity.[3]

As pointed out by Stein (1992) and Mayers (1998), although convertible debt is an important source of financing, it remains uncertain why firms issue such debt. Our entrenchment hypothesis for convertible issue differs from some previous explanations based on asymmetric information (Brennan and Kraus, 1987; Constantinides and Grundy, 1989; Stein, 1992), the risk incentive problem (Jensen and Meckling, 1976 and Green, 1984), tax deductibility (Jalan and Barone-Adesi, 1995) and the sequential financing problem (Mayers, 1998). All of these explanations use the traditional efficient approach, that is, corporate financial policy is chosen to maximize shareholders' wealth. In our model, in contrast to the efficient approach, an entrenched manager voluntarily issues convertible debt in order to serve her own interests.

Regarding the call provision, our explanation is related to that of Stein (1992) in the sense that the call provision allows a manager to force conversion to avoid bankruptcy.[4] However, while Stein (1992) predicts that the convertible call enhances the value of the firm, our model predicts that the value of the firm decreases in response to the call. In our model, a manager who prefers job retention calls convertible debt at the expense of the value of the firm. Mikkelson (1981) and Datta and Datta (1996) report empirical findings that the convertible call is not consistent with maximization of the value of the firm. Our results agree with these findings.[5]

The remainder of the paper is organized as follows. In Section 2, we present the framework based on Zweibel (1996). In Section 3, we analyze the case in which an entrenched manager is restricted to issuing only straight debt. In Section 4, we show that well-designed callable convertible debt improves the manager's payoff. In Section 5, we discuss the role of the call provision. In Section 6, we conclude the paper.

2. The entrenchment model

For our purposes, a two-period discrete stochastic form of the Zweibel (1996) model offers the desired simplicity and tractability.

[3] On the contrary, the conversion value is smaller than the debt value in the case that a value-decreasing project has been undertaken but the true return is not yet realized. In such a case, no convertible holder will convert his debt into equity against the call.

[4] Among the studies cited above, only Stein (1992) explicitly models the call provision, though Mayers (1998) points out the importance of the call provision. In other studies, little attention is focused on the call provision.

[5] Harris and Raviv (1985) provide a model that predicts the negative stock price reaction to a call event. In their model, however, the decision to issue callable convertible debt is not endogenous.

Consider an all-equity firm that operates for two periods. The number of outstanding shares of the firm is normalized to one. At the beginning of the first period, an incumbent manager runs the firm. The manager draws nontransferable private benefit $A>0$ from managing the firm for one period and $B>0$ from undertaking a new project. It is assumed that the manager has no personal fund, and no monetary incentive scheme can affect the manager's behavior.[6] Without loss of generality, it is assumed that the firm has no initial financial slack.

The assets of the firm generate a positive return, y, at the end of each period. In addition, the firm faces a new project in the middle of each period.[7] Returns from a new project depend on the manager's type, $t\in[0, 1]$, as well as on the external uncertainty as follows. Under the manager of type t, the firm faces a good (value-increasing) project with probability t and a bad (value-decreasing) project with probability $1-t$. In this sense, the manager's type reveals her management ability. If a new project is good, it generates a positive return, y, with probability p and a negative return, $-y$, with probability $1-p$ at the end of the period. If a new project is bad, it generates y with probability $1-p$ and $-y$ with probability p at the end of the period.

We suppose

$$\max\left\{\frac{A}{A+B},\frac{B}{A+B}\right\}<p<1. \tag{1}$$

It follows from Eq. (1) that $1/2<p$. A good project has a positive net present value (NPV), $(2p-1)y$, and a bad project has a negative NPV, $(1-2p)y$. Let r denote the NPV of a good project, i.e. $r\equiv(2p-1)y$. Since $1/2<p<1$, $0<r<y$ holds. In this setting, the one-period total expected return is $y+r$ if a good project is undertaken, and $y-r$ if a bad project is undertaken. Note that the probability of the total return of the firm being zero is $1-p(0<1-p<1/2)$ if a good project is undertaken, and $p(1/2<p<1)$ if a bad project is undertaken.

The timing of the events in each period, depicted in Fig. 1, is in accordance with Zweibel (1996). The incumbent manager's type, t, is publicly known. At date 1, the beginning of each period, the manager decides the financial policy of the firm in order to attain the optimal net debt level. The net debt level gives returns that must be realized at the end of the period to avoid bankruptcy. The net debt level of the firm in period j ($j=1$, 2) is denoted by D_j. The manager can attain a net debt level of D_j, for example, by issuing straight debt with face value D_j and distributing all proceeds as dividends.

At date 2, a potential raider decides whether or not to launch a takeover. If there is sufficient inefficiency under the incumbent manager, a takeover occurs and a new manager (hereafter, replacement manager) replaces the incumbent manager. Let $V_j(t, D_j)$ represent the value of the firm at the takeover stage under the incumbent manager of type t and net

[6] The manager's utility from job retention is explained in Stulz (1988). See Jensen (1986), Stulz (1990) and Hart and Moore (1995) for the manager's utility from a new project. For explanations of this type of manager running a firm from the start, see Zweibel (1996, footnote 12).

[7] A new project is assumed to require no initial investment as in Zweibel (1996, p.1199 and footnote 8).

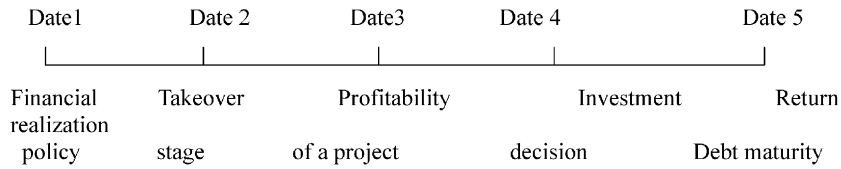

Fig. 1. Timing of the events.

debt D_j. Similarly, let $V_j(D_j)$ represent the value of the firm under a replacement manager. It is assumed that a replacement manager cannot initiate new projects. Hence, $V_1(D_1)=2y$ and $V_2(D_2)=y$. Formally, a takeover succeeds if and only if $V_j(D_j)-V_j(t, D_j)>e$, where e is a positive number.[8] The positive number e is a measure of the incumbent manager's entrenchment. The strong entrenchment makes a hostile takeover difficult. We assume $0<e<r$, and define $E\equiv e/r$. It is clear that $0<E<1$.

If a takeover does not happen, the incumbent manager continues to run the firm. At date 3, the quality of a new project (good or bad) is publicly learned. Then, at date 4, the manager decides whether or not to undertake the project. This decision is assumed to be noncontractable.

At date 5, the end of each period, the total return of the period is realized. The subsequent processes are somewhat different between both periods. If all debt is not met at date 5 in the first period, the firm is liquidated and the manager loses her position.[9] For simplicity, the liquidation value is considered equal to the value of the assets in place, y. Otherwise, the incumbent manager continues to run the firm and the second period begins. At date 5 in the second period, the firm stops its activity and all cash is distributed to security holders in order of seniority. There is no informational asymmetry in the model. All participants are risk-neutral and the interest rate is zero.

3. The case of straight debt

In this section, it is assumed that the manager is restricted to issuing only one-period straight debt. We focus our attention on type $t\in[(1-E)/2, (2-E)/4)\equiv T$, because no other type has incentive to issue debt in the equilibrium.[10]

[8] Alternatively, we can use the difference of equity values following Zweibel (1996). The result is identical in the case of straight debt. In the case of convertible debt, while the value of equity at the takeover stage depends upon the convertible holders' behavior, the value of the firm is independent of it. For this reason, the difference in values of the firm is more tractable in the model. However, even if we use the difference of equity values, the same result can be derived. See footnote 14.

[9] Liquidation is assumed only for tractability. Alternatively, one can consider the situation in which an efficient reorganization is agreed upon, as in Zweibel (1996).

[10] We can follow the same argument as in Zweibel (1996) for type $t\notin T$. For $t<(1-E)/2$, a takeover occurs in the first period and the incumbent manager is removed. For $(2-E)/4\le t$, no takeover occurs under zero net debt level. It is not necessary for the incumbent manager to issue straight debt that may cause default. This type of manager undertakes all projects in both periods.

First, suppose that an incumbent manager of type $t \in T$ faces a new project at date 3 in the second period. The manager undertakes a new project regardless of its quality because she obtains the positive benefit without any sacrifice. Given this, at date 2 in the second period, $V_2(D_2) - V_2(D_2,\ t) = (1-2t)r \leq e$ for $t \in T$, so that a takeover does not happen under any debt level. In the first period, however, the manager is dismissed by a hostile takeover if she chooses zero net debt level.

To see this, consider the incumbent manager's investment decision in the first period. In the absence of debt, she undertakes all projects because default never occurs. Then, at the takeover stage, the value of the firm under the incumbent is given by

$$V_1(D_1 = 0, t) = 2[t(y+r) + (1-t)(y-r)] = 2[y + (2t-1)r].$$

Since the value of the firm under a replacement manager, $V_1(D_1 = 0)$, is $2y$, a hostile takeover succeeds if and only if

$$V_1(D_1 = 0) - V_1(D_1 = 0, t) = -2(2t-1)r > e \Leftrightarrow t < (2-E)/4.$$

Thus, in the absence of net debt, the manager of type $t \in T$ is replaced through a hostile takeover.

The manager can avoid a takeover by setting a net debt level that credibly commits not to undertake a bad project. This is accomplished by issuing straight debt whose face value D_1 satisfies

$$0 < D_1 \leq y, \tag{2}$$

and distributing all proceeds as dividends. Under this financial policy, the first-period net debt level is equal to D_1.

Suppose that the manager faces a bad project at date 3 after choosing debt level satisfying Eq. (2). If she undertakes the project, the firm will be liquidated with probability p (the total return is zero) and continue with probability $1-p$ (the total return is $2y$). Hence, the manager's expected utility is $(2-p)(A+B)$. On the other hand, the firm avoids bankruptcy and the manager continues to run the firm with certainty if she decides not to undertake a bad project. In this case, the manager's expected utility is $2A+B$. The manager facing a bad project refrains from investing in it if and only if

$$2A + B > (2-p)(A+B) \Leftrightarrow p > B/(A+B),$$

which is satisfied under Eq. (1).

Next, suppose that the manager faces a good project. The manager's expected utility is now $(1+p)(A+B)$ if she undertakes the project and $2A+B$ if not. The manager undertakes a good project if and only if

$$2A + B < (1+p)(A+B) \Leftrightarrow p > A/(A+B),$$

which is satisfied under Eq. (1). Thus, the manager can commit herself to undertaking only a good project by issuing straight debt whose face value satisfies Eq. (2).

Given the above results, the value of the firm at the takeover stage is given by

$$V_1(D_1 \in (0,y], t \in T) = t[(y+r) + p(y + (2t-1)r) + (1-p)y] + (1-t)[y + (y + (2t-1)r)].$$

The first bracket gives the expected value of the firm conditional on a good project being undertaken. This occurs with probability t. Since the manager undertakes a good project, the first-period expected return is $y+r$. With probability p, the firm is run by the incumbent manager under whom the second-period expected return is $y+(2t-1)r$. With probability $1-p$, the firm is liquidated at the liquidation value, y. The second bracket gives the expected value conditional on a bad project not being undertaken. This occurs with probability $1-t$. In this case, the first-period return is y and the second-period expected return is $y+(2t-1)r$.

Since $(2t-1)r<0$ for $t \in T$, we obtain

$$V_1(D_1 \in (0,y], t \in T) > t[(y+r) + p(y + (2t-1)r) + (1-p)(y + (2t-1)r)] + (1-t)[2y + (2t-1)r] = 2y + (3t-1)r.$$

Now a takeover does not happen because

$$V_1(D_1 \in (0,y]) - V_1(D_1 \in (0,y], t \in T) < (1-3t)r \leq [1 - 3(1-E)/2]r < e.$$

The second (weak) inequality follows from $t \geq (1-E)/2$, and the last inequality follows from the assumption of $e<r$. These results are summarized in the following proposition.[11]

Proposition 1. *Suppose only straight debt is possible. For $t \in T$, the manager issues straight debt whose face value satisfies* Eq. (2) *and distributes all proceeds. Only a good project is undertaken in the first period and all projects in the second period. No takeover occurs in either period. The firm goes into bankruptcy with probability $1-p$ conditional on a good project being revealed in the first period.*

The manager of type $t \in T$ can avoid the first-period takeover by setting net debt level determined in Eq. (2). Under this net debt level, however, the manager will lose her position with positive probability $1-p$ after undertaking a good project. In the next section, we will show that the manager can eliminate this possibility by issuing well-designed callable convertible debt.

It should be stressed that no manager has an incentive to use debt in order to credibly constrain her future investment decision when she is not entrenched ($e=0$). In fact, the set

[11] If the incumbent manager can raise external funds against future earnings, her commitment to refrain from a bad project may not be credible so that she may be replaced by a takeover. To eliminate this possibility, the manager has to commit not to raise external funds by using debt covenants that restrict further debt finance (Zweibel, 1996, p. 1209) and restriction of the number of authorized shares.

of T is empty in this case. For $t \geq 1/2$, an incumbent manager is never dismissed by a takeover because she is more efficient than a replacement manager. For $t < 1/2$, an inefficient incumbent manager will be dismissed by the second-period takeover when $e = 0$. A manager can no longer obtain any benefit from managing the firm during the second period, so there is no reason to refrain from undertaking a bad project in the first period. As a result, an inefficient manager is replaced by the first-period takeover under any net debt level.

4. The case of callable convertible debt

Consider callable convertible debt whose total face value, D, satisfies

$$0 < D \leq y, \tag{3}$$

and the conversion ratio is determined such that each convertible holder (hereafter CB holder) will be forced to convert conditional on a good project being undertaken and will not convert after observing a bad project. If the manager of type $t \in T$ can issue this kind of convertible debt, she can avoid the first-period takeover and bankruptcy at the same time in the following way.

First, the manager can commit not to undertake a bad project, because remaining debt will lead the firm into bankruptcy with large probability p if she undertakes it. As in the case of straight debt, this commitment raises the ex ante value of the firm so that a hostile takeover does not occur. Second, since debt will be converted into equity after a good project is undertaken, the bankruptcy risk attendant on a good project disappears. Compared to the case of straight debt, the manager's utility increases. We will show that this kind of callable convertible debt exists in the present model.

Let n be the number of convertibles issued by the firm. For simplicity, it is assumed that one CB holder holds one unit of convertible debt. It will be shown later that this assumption can be relaxed. An individual convertible debt has a face value D/n, and gives its holder the right to convert into N/n shares of the firm, where N is a positive real number. The conversion ratio, α, is defined by $\alpha \equiv N/(1+N)$, where $0 < \alpha < 1$. Since there exists the one-to-one relationship between α and N, we will use α in this paper.

Without loss of generality, we can assume that the call price is equal to the face value D/n. Maturity is at the end of the first period. We also assume that the firm is liquidated at the fundamental value when some CB holders tender their debt for cash against the call but the firm cannot meet them.[12,13] It follows from these assumptions that the value of an individual convertible is equal to its face value when the holder does not convert. This result simplifies our analysis.

[12] For the same reason as in footnote 11, we assume that the manager can commit herself not to raise external funds.

[13] One can consider the alternative scenario that a new manager is hired to run the firm if the firm cannot meet its liability. In both scenarios, the incumbent manager cannot obtain a benefit of A in the first period.

Lemma 1. *A CB holder's payoff is D/n if he does not convert his debt.*

Proof. It is clear when the firm can meet all debt. Even when the firm cannot meet all debt, the liquidation value is larger than y in the first period. Since the total face value satisfying Eq. (3) is less than y, all debt can be repaid. □

Suppose that, for any D satisfying Eq. (3), the conversion ration, α, is determined by

$$\frac{D}{2y+2tr} < \alpha < \frac{D}{2y}. \tag{4}$$

We claim that the manager of type $t \in T$ can avoid both the first-period takeover and bankruptcy at the same time by issuing callable convertible debt whose face value and conversion ratio satisfy Eqs. (3) and (4), and distributing all proceeds as dividends. To show this, we analyze the manager's call policy and CB holders' behavior.

We start to consider the manager's call policy before the date-2 takeover stage. If any debt remains, the firm is liquidated. If all debt is converted into equity, a hostile takeover occurs because the manager's commitment not to undertake a bad project is not credible. Therefore, the manager never calls before date 2.

To analyze the manager's call policy after date 2, it is necessary to examine each CB holder's behavior against the call. Each CB holder chooses to convert if and only if the conversion value exceeds the debt value, which is equal the face value from Lemma 1. The next lemma compares the conversion value and the face value after date 2.

Lemma 2. *Suppose the conversion ratio satisfies* Eq. (4)*. At the end of the first period (date 5), the conversion value is larger than the face value when the true return is 2y, and smaller than the face value when the return is zero. Between date 2 and date 5, the conversion value exceeds the face value if a good project is undertaken. Otherwise, the conversion value is smaller than the face value.*

Proof. See Appendix A. □

Suppose that the manager, who has issued callable convertible debt satisfying Eqs. (3) and (4), faces a good project. From the above lemma, if the manager undertakes the project and calls debt before date 5, all CB holders convert their debt into equity. Since no debt remains, there is no possibility of bankruptcy so that the manager can continue to run the firm in the second period with certainty. This is the best outcome for the manager. Thus, when the quality of a new project is good, the manager will choose to undertake the project and call debt before the true return is realized.

On the other hand, as in the case of straight debt, the manager never undertakes a bad project because there remains large probability of bankruptcy. Note that, from Lemma 2, the manager cannot force the CB holders to convert after undertaking a bad project. This result ensures that the manager can commit not to undertake a bad project and a hostile takeover does not occur in the first period. These results are summarized in the next proposition.

Proposition 2. *Suppose the firm issues callable convertible debt whose face value and conversion ratio satisfy* Eqs. (3) and (4)*, and pays all proceeds as dividends. The manager of type t∈T undertakes only a good project so that a takeover does not occur in*

the first period. After undertaking a good project, the manager calls convertible debt and forced conversion then takes place. The firm never defaults at the end of the first period, and the manager continues to run the firm in the second period with certainty.

Proof. From the above arguments, the manager undertakes the project and calls if a new project is good one. Also, she never undertakes a bad project. Given this investment policy, the value of the firm with proposed convertible debt at the first-period takeover stage, $V_1(D, \alpha, t)$, is given by

$$\begin{aligned} V_1(D,\alpha,t) &= [t(y+r)+(1-t)y]+[y+(2t-1)r] \\ &= 2y+(3t-1)r. \end{aligned}$$

The first term is the first-period expected value and the second term is the second-period expected value. The first-period takeover succeeds if and only if

$$2y - V_1(D_1,\alpha,t) = -(3t-1)r > e \Leftrightarrow t < (1-E)/3,$$

which does not hold for $t \in [(1-E)/2, (2-E)/4] \equiv T$. □

Proposition 2 states that the manager of type $t \in T$ can avoid the threat of both takeover and bankruptcy by using well-designed callable convertible debt.[14] She cannot attain the same outcome by using straight debt.

There are several points worth discussing. First, the above results still hold without the assumption of one convertible/one investor. One can easily check that Lemma 2 holds even when one CB holder retains some units of convertible debt. Therefore, Proposition 2 holds without the one-convertible one-investor restriction.

Second, the manager may be able to attain the same outcome by issuing callable (non-convertible) debt whose face value, F, satisfies

$$2[y+(2t-1)r] < F < 2y+(2t-1)r,$$

and executing adequate equity-for-debt swap at any time between date 4 and date 5.[15] However, in the situation in which flotation costs exist, convertible debt has an advantage of economizing flotation costs, as emphasized by Mayers (1998). If it is assumed that the manager's utility has a positive relationship to the value of the firm (but it is sufficiently smaller than A and B), callable convertible debt is still more desirable for the manager.

Third, our model predicts that the future operating performance of the convertible issuer becomes worse than that of the non-issuer on average. In the model, the first-period expected return of the convertible issuer, $y+tr$, is larger than the second period expected return, $y+(2t-1)r$. It can be shown that both are the same for a firm that does not issue

[14] Even if the difference between the value of equity under the incumbent and that under the replacement is considered as the takeover condition, it can be shown that the first-period takeover does not occur as long as α is sufficiently close to $D/(2y-2tr)$.

[15] The formal argument is available on request.

convertible debt ($t \notin T$).[16] Lee and Loughran (1998) report empirical findings consistent with our prediction.

5. The role of the call provision

In this section, we discuss the call provision. In our model, if the manager undertakes a good project but does not call debt, each CB holder postpones the conversion decision until the true return is realized. Then, from Lemma 2, no debt is converted and the firm is liquidated when the true return is zero. The manager can avoid this risk by forcing conversion. Thus, in our model, a self-interested manager calls convertible debt in order to avoid the potential loss of her position, which may be associated with bankruptcy. This explanation for the convertible call is different from previous explanations based on the interests of existing shareholders (Brennan and Schwartz, 1977 and Stein, 1992) and on the informational asymmetry (Harris and Raviv, 1985).

Regarding the relationship between the convertible call and the firm value, our model predicts a negative relationship. Note that, for $t \in T$, the non-liquidation value at the end of the first period, $y+(2t-1)r$, is smaller than the liquidation value, y. This implies that the convertible call by which the incumbent manager can keep her position decreases the firm value. Mikkelson (1981) and Datta and Datta (1996) report that there exists a significant negative relationship between convertible calls and firm's values. Our result supports their findings.

As observed in the real world, callable convertible debt usually comes with an initial call protection period. In our model, since the manager does not call until date 3 on the equilibrium path, she can obtain the same outcome by using convertible debt with a call protection period until date 3.

Further, in the case in which the manager succeeds in calling and forcing conversion between date 2 and date 3, a call protection period plays an important role in avoiding a takeover. For example, suppose that, at any time between date 2 and date 3, the market is temporarily subjected to a positive noise, and the stock price of the firm is thereby raised so that the conversion value exceeds the face value. The incumbent manager will then succeed in calling and forcing conversion during this noisy period, after which she will undertake all projects. In this case, however, the manager is dismissed by a hostile takeover because she can no longer commit to refraining from undertaking a bad project. By attaching an initial call protection period until date 3, the manager can promise not to call before date 3 and resolve the problem.

6. Conclusion

In this paper, we propose a motivation for an entrenched manager to issues callable convertible debt. Callable convertible debt can change the net debt level by forced

[16] For $t<(1-E)/2$, both the first-period performance and the second-period performance are equal to y. For $t \geq (2-E)/4$, both are equal to $y+(2t-1)r$.

conversion, which is impossible under any capital structure composed of straight debt and equity only. This prominent feature of callable convertible debt is especially useful for an entrenched manager to eliminate the possibility of bankruptcy.

While callable convertible debt is an effective financial instrument for an entrenched manager, it is not desirable from the standpoint of the value of a firm. In our model, convertible debt issue decreases the value of a firm because the probability of an inefficient manager being replaced decreases (note that $t<1/2$ for $t\in T$). In the case of straight debt, a more efficient replacement manager is found. This implies that corporate financial policy itself creates a conflict between the objectives of management and the owners, as noted by Zweibel (1996) and Novaes and Zingales (1995).

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Appendix A. Proof of Lemma 2

The conversion value is dependent on how many bonds are converted. Let $c_s(h)$ be the conversion value per bond provided that h ($0 \le h \le n$) bonds are converted in event $s\in\{u, g, b, r, 2y, 0\}$. $s=u$ represents the event in which the quality of a new project is unknown, that is, before date 3. $s=g$ ($s=b$) represents the event in which a good (bad) project has been undertaken but the true return is not yet realized. $s=r$ represents the event in which the manager has not undertaken any new project and the true return is not yet realized. $s=2y$ ($s=0$) represents the state in which the true return of $2y$ (zero) has already been realized.

First, consider the event in which the true return of $2y$ has already been realized ($s=2y$). In this case, the firm can meet all debt and the incumbent manager continues to manage the firm in the second period. Since the value of the firm is given by $3y+(2t-1)r$,

$$c_{2y}(h) = \frac{N/n}{1+h(N/n)}\left[3y+(2t-1)r-(n-h)\frac{D}{n}\right]$$
$$= \gamma[3y+(2t-1)r-D+(h/n)D],$$

where,

$$\gamma \equiv \frac{\alpha}{(1-\alpha)n+\alpha h}.$$

Then, for $1 \le h \le n$, we obtain

$$c_{2y}(h)-c_{2y}(h-1) = \lambda[D-\alpha\{3y+(2t-1)r\}],$$

where,

$$\lambda \equiv \frac{\alpha}{[(1-\alpha)n+\alpha h][(1-\alpha)n+\alpha(h-1)]} > 0.$$

Note that $3y+(2t-1)r>2y+2tr$. Then, it follows from Eq. (4) that $c_{2y}(h-1)>c_{2y}(h)$ and

$$c_{2y}(n) = \frac{\alpha}{n}[3y+(2t-1)r] > \frac{D}{n}.$$

These imply

$$c_{2y}(0) > c_{2y}(1) > \ldots\ldots > c_{2y}(n) > D/n.$$

Therefore, the conversion value is larger than the face value regardless of the number of converted bonds.

Next consider the event in which the true return of zero has already been realized ($s=0$). In this case, the firm goes into default if $0 \le h \le n-1$. Since the liquidation value is y, the conversion value is $c_0(h)=\gamma[y-(n-h)D/n]$ for $0 \le h \le n-1$. It follows from Eq. (4) that, for $1 \le h \le n-1$,

$$c_0(h) - c_0(h-1) = \lambda(D-\alpha y) > 0,$$

and

$$\frac{D}{n} - c_0(n-1) = \frac{D-\alpha y}{n-\alpha} > 0.$$

Hence, we obtain

$$c_0(0) < c_0(1) < \ldots\ldots < c_0(n-1) < D/n. \tag{A.1}$$

If all bonds are converted ($h=n$), no default occurs and the incumbent manager continues to run the firm. The value of the firm is $y+(2t-1)r$. It follows from Eq. (4) that, for $h=n$,

$$c_0(n) = \frac{\alpha}{n}[y+(2t-1)r] < \frac{D}{n}. \tag{A.2}$$

Eqs. (A.1) and (A.2) show that the conversion value is smaller than the face value in the zero return state.

Consider the event in which the quality of a new project is unknown ($s=u$). If $0 \le h \le n-1$, the firm cannot meet its debt and is liquidated. The liquidation value is $2y$. On the other hand, the conversion value, $c_u(h)$, is given by $\gamma[2y-(n-h)D/n]$. It follows from Eq. (4) that

$$c_u(h) - c_u(h-1) = \lambda(D-2\alpha y) > 0,$$

$$\frac{D}{n} - c_u(n-1) = \frac{D-2\alpha y}{n-\alpha} > 0.$$

Then, we obtain

$$c_u(0) < c_u(1) < \ldots\ldots < c_u(n-1) < D/n. \tag{A.3}$$

If $h=n$, all bonds are converted and net debt becomes zero. In this case, the manager undertakes all projects and the firm value is $2[y+(2t-1)r]$. Hence,

$$c_u(n) = \frac{\alpha}{n}[2y + 2(2t-1)r] < \frac{\alpha}{n}(2y) < \frac{D}{n}. \tag{A.4}$$

The first inequality follows from $t<1/2$ for $t\in T$, and the second follows from Eq. (4). It follows from Eqs. (A.3) and (A.4) that $c_u(h)<D/n$ for $0 \le h \le n$.

In the event that a good project has already been undertaken but the true return is not yet realized ($s=g$), the firm is liquidated and its liquidation value is $2y+r$ for $0 \le h \le n-1$. Then, the conversion value, $c_g(h)$, is given by $\gamma[2y+r-(n-h)D/n]$. It follows from Eq. (4) that, for $1 \le h \le n-1$,

$$c_g(h) - c_g(h-1) = \lambda[D - \alpha(2y+r)] < 0, \text{ for } 1 \le h \le n-1,$$

and

$$\frac{D}{n} - c_g(n-1) = \frac{D-\alpha(2y+r)}{n-\alpha} < 0.$$

Hence, we obtain

$$c_g(0) > c_g(1) > \ldots\ldots > c_g(n-1) > D/n. \tag{A.5}$$

If $h=n$, the firm is not liquidated and the incumbent manager runs the firm in both periods. The value of the firm is $2y+2tr$. It then follows from Eq. (4) that

$$c_g(n) = \frac{\alpha}{n}(2y + 2tr) > \frac{D}{n}. \tag{A.6}$$

Both Eqs. (A.5) and (A.6) show that $c_g(h)>D/n$, for $0 \le h \le n$. The conversion value is larger than the face value.

Consider the event that the manager has already decided to refrain from undertaking a good project but the true return is not yet realized ($s=r$). The firm is liquidated and its liquidation value is $2y$ for $0 \le h \le n-1$. Using the same argument to derive Eq. (A.3), we obtain $c_r(h)<D/n$, for $0 \le h \le n-1$. If $h=n$, the firm is not liquidated and the incumbent manager continues to manage. Since the value of the firm is $2y+(2t-1)r$,

$$c_r(n) = \frac{\alpha}{n}[2y + (2t-1)r] < \frac{\alpha}{n}(2y) < \frac{D}{n}.$$

The first inequality follows from $t<1/2$ for $t\in T$, and the second follows from Eq. (4). Hence, we determine that $c_r(h)<D/n$, for $0 \le h \le n$. The conversion value is smaller than the face value. Note that this result can also be applied to the case in which the manager has refrained from undertaking a bad project.

Finally, consider the case in which the quality of a new project has already been revealed to be bad, but the true return is not yet realized. In this case, the conversion value is smaller than the face value regardless of the manager's decision. If the manager refrains from undertaking a bad project, the conversion value $c_r(h)$ is smaller than the face value from the above argument. If the manager undertakes a bad project, the value of the firm is $2y-r$ so that $c_b(h)=\gamma[2y-r-(n-h)\mathrm{D}/n]$ for $0 \le \mathrm{h} \le n-1$. It follows from Eq. (4) that, for $1 \le h \le n-1$,

$$c_b(h) - c_b(h-1) = \lambda[D - \alpha(2y-r)] > 0,$$

and

$$\frac{D}{n} - c_b(n-1) = \frac{D-\alpha(2y-r)}{n-\alpha} > 0.$$

Since the value of the firm is $2y+(2t-2)r$, for $h=n$, it follows from Eq. (4) that

$$c_b(n) = \frac{\alpha}{n}[2y + (2t-2)r] < \frac{D}{n}.$$

These results imply that the conversion value is smaller than the face value if a bad project is undertaken.

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