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Why do firms issue callable convertible bonds ? A critique of the "backdoor equity financing" theory

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ABSTRACT

We revisit Stein (1992)'s model and demonstrate that it provides an insufficient justification for the use of callable convertible bonds as financing instruments. A standard convertible bond solves the firm's financing problem in both the simple and extended versions of the model. More generally, convertibles have little relevance within this model because the firm can finance efficiently with a package of equity and short-term straight debt, the components of which are dynamically adjusted. This package becomes a superior financing strategy in comparison to convertible debt if one relaxes the model's assumption that the firm can always force conversion.

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1. Introduction

Convertible bonds are widely used as financing instruments by firms globally. Their main characteristic resides in the presence of a conversion option, which allows the holder to convert the security into equity if the firm's value is sufficiently high. In formal terms, their payoff is a convex function of the firm's value if the firm performs well. Being the fundamental feature of convertible bonds, the conversion option must play a fundamental role in solving the firm's financing problem if the firm decides to finance its investments with these securities. If the firm can solve its financing problem alternatively by using forms of financing whose payoff function is not convex when the firm's value is high, such as equity, straight debt, or a combination of the two, then the use of convertibles makes little sense.

Many convertible bonds embed a call option, which allows the firm to force conversion if certain conditions are met. If the firm decides to exercise this option, investors will rationally opt to convert the security into equity if the conversion value exceeds the call price; otherwise, they opt for the debt contract and receive the call price. In many cases, the call option embeds a "soft" provision, in which case the company is allowed to call the convertible only if the price of the underlying stock is higher than a pre-specified trigger price, commonly expressed as a percentage of the call/conversion price. Usually, the soft call provision requires that the stock price remain above the trigger price during a given number of consecutive (or cumulative) days in a given period. The call option may also embed a "hard" provision, which stipulates that the issuer can initiate the call only after a pre-specified period after the issuance. Whether the call option embeds such additional refinements or not, the justification of the use of callable convertible bonds as financing instruments requires that *both* the conversion and call options play a fundamental role in addressing the firm's financing problem. The use of callable convertible bonds would make little sense if a standard (not callable) convertible bond could solve the firm's financing problem, and would make even less sense if the problem could be solved by issuing equity, straight debt, or a combination of the two.

The agency theory sets out a number of rationales for the use of convertible bonds as financing instruments. Previous research shows that these securities play a role for firms whose risk is difficult to assess (Brennan and Kraus, 1987; Brennan and Schwartz, 1988) or for firms that experience adverse-selection problems coupled with (1) financial distress costs (Stein, 1992) or with (2) risk-sharing costs (Kim, 1990). A convertible bond offering may allow for efficient investment by signalling the firm's quality if the issuer concomitantly retires common stock from its capital structure (Constantinides and Grundy, 1989). Chakraborty and Yilmaz (2011) show that specific optional components, such as a capped call, may neutralize the convertible bond's sensitivity to private information, thus resolving the adverse selection problem. Other theories justify the use of convertibles based on their abil-

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ity to solve moral hazard problems related to the owner's incentive to shift firm risk (Green, 1984; Jensen, 1986) or in a context of sequential financing (Mayers, 1998; Wang, 2009). Another body of literature shows that convertibles may solve moral hazard problems for entrepreneurial firms (Biais and Casamatta, 1999; Cornelli and Yosha, 2003; Schmidt, 2003; Repullo and Suarez, 2004).

The "backdoor equity financing" rationale proposed by Stein (1992), henceforth referred to as Stein, is one of the most prominent theories in the field, and has received significant attention in empirical research. Dutordoir et al. (2014)'s literature review shows that this theory belongs to the "Big Four" group of theories that are most widely studied in the empirical literature in the field, along with the "risk-shifting" theory of Green (1984), the "risk-signalling" theory of Brennan and Kraus (1987), and the "sequential financing" theory of Mayers (1998). The "backdoor equity financing" argument relies heavily on the presence of financial distress costs and advocates the use of callable convertible bonds as a financing instrument by firms of medium value. The analysis focuses on convertibles with a regular call option, without additional features such as soft or hard call protections. Stein shows that callable convertible debt sustains a separating equilibrium for medium-value firms and allows them to efficiently finance their project. Central to sustaining the separating equilibrium is that for a "bad" (low-value) firm, the expected costs of financial distress are too high in comparison to the advantage conferred to this type of firm by the presence of informational asymmetries. Separation at equilibrium and early forced conversion of the convertible debt are the main features that allow medium firms to finance and invest efficiently. Stein affirms that the call feature is *critical* for medium firms to separate; by forcing investors to convert the bond into stock early, the firm avoids financial distress costs and is, therefore, able to invest efficiently.

To support this argument, Stein considers two settings. The first one, referred to henceforth as the "benchmark" setting, assumes that the information asymmetry problem exists only at the outset of the investment. The medium-value firm separates with callable convertible debt and forces conversion when the information asymmetry disappears. Investors choose to convert the security because the firm's value, which is public knowledge at that moment, is sufficiently high. This type of financing provides a way to obtain equity "through the backdoor", at a future date when the adverse selection problem is solved. As Stein acknowledges, the problem with this simplified setting is that medium firms can also finance efficiently by issuing short-term straight debt for the first round of financing and then by issuing equity for the second round, when there are no more adverse selection problems. This financing strategy of postponing equity is no longer effective in an "extended" setting in which the information asymmetry persists at the intermediate time. Under such circumstances, the firm would have difficulty refinancing with equity. With additional assumptions, such as the presence of costs for liquidating existing assets, the strategy of postponing equity is no longer viable, which rehabilitates callable convertible debt financing.

Our paper revisits the backdoor financing theory and shows that it provides an insufficient explanation for the use of callable convertible bonds as financing instruments. The first contribution of this study is to show that a standard (not callable) short-term convertible bond can also sustain the separating equilibrium posited in Stein with the same restrictions on the model's parameters. In the benchmark setting, this security ends up being converted into equity because the firm's value is sufficiently high. High- and low-value firms will not wish to imitate medium-value firms for the same reasons as those that pertain to callable convertible debt financing. In the extended setting, in which the information asymmetry problem persists, we show that investors will also decide to convert the security when it matures. From their perspective, the firm's value is, on average, sufficiently high. It follows that the call option is an unnecessary feature, contradicting Stein's argument that this optional component *"is the only way to actually force investors to exercise their conversion option early, thereby inducing them to swap their bonds for shares of stock"*.

Our second contribution is to show that the firm can also solve its financing problem in a more classical way, by issuing a package of equity and short-term straight debt which components are dynamically adjusted. First, we show that this strategy is more appropriate for sustaining the separating equilibrium in the benchmark setting than Stein's strategy of postponing equity. The latter indeed cannot sustain a separating equilibrium between "good" (high-value) and medium-value firms. Second, and most importantly, our strategy is proven to be fully relevant in the extended setting as well. The strategy consists in issuing as much equity as possible at the outset of the project, and just enough straight debt to dissuade bad firms from mimicking. In the second financing round, the firm refinances the project by issuing as much straight debt as possible, and a limited amount of equity. The amount of newly issued equity is sufficiently low to mitigate the adverse selection problem when the firm refunds. In formal terms, equity financing sustains a pooling equilibrium when the firm refinances its project. As a consequence, the firm can finance and invest efficiently, without incurring any additional costs.

It follows that the firm's financing problem can be solved in all settings analyzed by Stein without the need to use convertible debt. As for the call option, the conversion option is shown to be superfluous for the financing in a separating equilibrium. Moreover, our analysis demonstrates that the firm does not need all-equity financing at the intermediate time to resolve its financing problem. Quite the contrary, our strategy of combining straight debt and equity minimizes the amount of newly issued equity when the firm refunds, thereby alleviating the adverse selection problem at that time.

The third contribution of this study is to show that the efficiency of convertible debt financing in Stein's model is highly sensitive to the assumption that the firm's value is stable during the first round of financing. We show that convertible debt, whether callable or not, may become problematic if the value of the medium firm changes during this period by receiving fundamental new information about its project. In this situation, the firm may struggle to refund the project if the new information is negative. If the firm cannot force conversion, it will be left with a huge debt burden that needs to be refinanced. Refinancing exposes the firm to adverse selection and financial distress problems, a similar situation to the one that prevailed when the project was launched. The firm may even decide to abandon the project if these problems weigh heavily. Standard convertible debt would also be ineffective for the same reasons. In contrast, the firm would still be able to finance and invest efficiently by issuing a combination of straight debt and equity. The main advantage of this financing strategy is to inject equity into the firm's capital structure at the outset of the project, thereby diminishing the amount to be refinanced later. As the amount to be refinanced is lower, the firm incurs less adverse selection and financial distress problems when it refunds than with convertible debt.

We deduce that a strategy combining short-term straight debt and equity is more robust than the use of convertible debt in Stein's setting. The firm has no valid reason to use convertibles and should even *avoid* them if there is some risk that the security cannot be converted, a common situation in the real world. In particular, our analysis shows that the call option does not play a fundamental role in mitigating financial distress costs. Stein affirms that the backdoor equity financing theory *"differs from other models of convertible bond issuance in that it emphasizes the importance of the call provision"*. The author discusses existing empirical evidence

suggesting that firms use call options to force prompt conversion as soon as possible, evidence which is considered to support the theory[3]. The argument that the call feature is essential to avoid the costs of financial distress is put forward in related theories in the field (e.g., Mayers, 1998; Wang, 2009; Chakraborty and Yilmaz, 2011, among others) and analyzed in many empirical studies and surveys. In particular, some empirical studies focus on specific aspects derived directly from the backdoor equity financing theory, such as the mimicking behavior of callable convertible debt issuers (e.g., Bhabra and Patel, 1996) or the design of callable convertible bonds (e.g., Lewis et al., 1998).

In addition to the inferences related to the role of the call provision, the backdoor equity financing theory has a wide range of implications related to managers' reasons for using convertibles, issuers' characteristics, and the market's reaction to a convertible debt offering announcement. Such inferences, which have been analyzed by a significant number of existing empirical studies, as shown by Dutordoir et al. (2014), must be interpreted cautiously in light of our analysis showing that firms have no valid reasons to use convertibles within Stein's framework.

A financing strategy combining straight debt and equity is already proven to provide an alternative to the use of convertibles in some existing models (e.g., Green, 1984; Kim, 1990; Biais and Casamatta, 1999; Schmidt, 2003). However, this becomes problematic if the argument for the use of these securities is heavily based on their optional components, as in Stein. Our objective is not to provide a new explanation for the use of convertibles, but simply to show that their optional components are not fundamental in Stein and may in fact be detrimental. According to Dutordoir et al. (2014), existing empirical studies on convertibles, which focus almost exclusively on the "Big Four" theories, do not provide a *"clear pattern of evidence"*, which suggests that these theories are *"incomplete"*. Likewise, as *"financial executives are much less likely to follow the academically proscribed factors and theories when determining capital structure"*, Graham and Harvey (2001) conclude that the *"relatively weak support for many capital structure theories indicates that it is time to critically reevaluate the assumptions and implications of these mainline theories"*. For these reasons, we believe this study is important as it emphasizes the need for additional research in the specific area of convertible debt financing.

This paper is structured as follows. Section 2 provides an overview of the benchmark and extended settings analyzed in Stein and shows that a standard convertible bond solves the firm's financing problem in both settings. Section 3 examines a separating equilibrium with a financing strategy that combines short-term straight debt and equity. Section 4 analyzes a more general version of the benchmark and extended settings by considering the arrival of new, fundamental information about the firm during the first period. This analysis shows that a combination of straight debt and equity *dominates* both callable and standard convertible debt as efficient financing. Section 5 discusses the study's conclusions.

2. Standard convertible debt as "backdoor equity financing"

This section reviews several parts of Stein's original model and proves that standard convertible debt is a perfect substitute for callable convertible debt financing in both the benchmark and extended settings analyzed in the original model.

2.1. The benchmark setting in the original model

Stein considers a setting with rational and risk-neutral agents. The discount rate is zero. There are three time periods (0, 1, and 2) and three types of owner-managed firms defined as "good", "medium", and "bad". Each type of firm has access to a profitable investment opportunity requiring an initial outlay of I and with a positive net present value of N. The investment ends at time 2 and generates at this time a gross cash-flow of either X_H or X_L, with $X_H > I > X_L$. The probabilities of the better outcome for the good, medium, and bad firms are 1, p, and q, respectively, with $1 > p > q$. The firm's type is private information held by the owner-manager at time 0. This information becomes public knowledge at time 1. At this intermediate time, new public information arrives *exclusively* about the bad firm : the updated probability of the better outcome falls to 0 with probability z, and increases to p with probability $(1-z)$, $q = (1-z)p$. In this better scenario, the bad firm becomes a medium one.

The firm has access to three types of financing: equity, straight long-term debt maturing at $t = 2$, and a long-term callable convertible debt that also matures at $t = 2$. The parameters of these financings are, in order, the fraction of the firm's assets apportioned to stockholders, the face value of the debt, and, for the callable convertible debt, the conversion ratio (α), its face value (F) and its call price (K). Importantly, the firm bears an exogenous fixed cost of c if it cannot meet its debt obligations. This cost, which is relatively high, $c > I - X_L$, is considered as a non-pecuniary bankruptcy cost. It encompasses the time and efforts expended by the owner-manager to solve problems related to the firm's default, such as litigation.

In the above setting, the medium firm separates by issuing a callable convertible bond with a face value of $F > X_L$, a conversion ratio of I/V_m, where $V_m = (pX_H + (1-p)X_L)$ is the firm's expected value, and a call price $K \in (X_L, I)$. The good firm separates by issuing straight debt with a face value of I and the bad firm separates by issuing a fraction $I/(qX_H + (1-q)X_L)$ of equity.

Stein discusses the incentives of each type of firm. In particular, the analysis shows that the bad firm does not imitate the medium one because to do so would incur an expected cost of financial distress of zc, which is higher than the benefit $z(I - X_L)$ of selling an overpriced security. The good firm will also refuse to imitate the medium firm to avoid the adverse selection problem generated by the equity component of the convertible. The medium firm is, therefore, able to separate with callable convertible bonds, thereby avoiding adverse selection problems, and will force conversion at $t = 1$ to prevent potential financial distress costs at $t = 2$.

2.2. Separation with a standard convertible in the benchmark setting

Consider now that the firm has access to equity and long-term debt with the same parameters as in the original model, and to a *standard* (not callable) convertible bond that matures at time $t = 1$. The convertible has a conversion ratio of $\alpha = I/V_m$ and a face value of $F \in (X_L, I)$. We show that this security maintains a separating equilibrium for the medium firm, with the good (bad) firm separating with straight debt (equity) financing.

The analysis of the incentives associated with equity and straight debt financing is identical to the one proposed by Stein and as such, will not be outlined here. However, we must verify that the bad and good firms have no incentives to imitate the medium one by issuing standard convertible debt with the parameters specified above. The bad firm has no reason to act this

[3] In general, firms do not call convertibles as soon as they are able to force conversion. However, as Stein points out, the empirical evidence shows that firms call the convertibles within a short time after the expiration of the call protection period if the call has no negative cash-flow consequences. This result holds, in particular, for firms offering lower dividends than after-tax interest payments. More recently, Grundy and Verwijmeren (2016) find that most current convertible bond issues are dividend protected and document that the call delay is almost zero for such convertible bonds.

way because, as with the callable convertible, the standard convertible would generate expected financial distress costs that are too high. Assume the bad firm does imitate. In the worse state at time 1, the face value of the convertible is higher than the conversion value, $F > X_L > \alpha X_L$. Under such circumstances, the firm would have to redeem the bond but has insufficient resources to do so. It follows that the convertible generates, at $t = 0$, an expected cost of financial distress of zc from this firm's perspective. On the other hand, the convertible would be overvalued by an amount of $z(I - X_L)$, which is the difference between the amount raised I and the true value of the security, $(1 - z)I + zX_L$. (The latter is the expected value of the security's future payoff. The security generates a payoff of I in the better state at $t = 1$, because in this state the bad firm becomes a medium type of firm, while the payoff generated in the worse scenario equals X_L.) Considering the high financial distress costs, $c > I - X_L$, the convertible would generate more costs than benefits for the bad firm. It follows that the bad firm does not imitate, contradicting the initial assumption.

The argument that the good firm does not imitate is immediate. This firm only bears the negative effect of selling an overvalued security because the convertible has an equity component, which generates adverse selection problems for this type of firm.

The separating equilibrium is formalized in the following proposition:

Proposition 1. *In the setting described above, the following is a separating equilibrium:*

(i) *the good firm issues long-term straight debt with a face value of I and invests;*
(ii) *the bad firm issues a fraction of $I/(qX_H + (1 - q)X_L)$ of equity and invests;*
(iii) *the medium firm issues and invests with standard convertible debt that matures at $t = 1$, has a face value of $F \in (X_L, I)$, and is convertible into a fraction of $I/(pX_H + (1 - p)X_L)$ of the firm's equity.*

The proof comes from the preceding discussion. This proposition shows that it is possible to obtain equity "through the backdoor" by issuing a standard convertible bond. Investors will naturally decide to swap their bond for shares of stock at $t = 1$ because by doing so they obtain more than they would by being reimbursed at the face value F[4]. We conclude that the call option is an unnecessary feature for solving the financing problem posited in Stein's benchmark setting.

2.3. Separation with standard convertible debt in the extended setting

The justification of convertible debt financing in the benchmark setting is challenged by the fact that the firm can also finance efficiently in a more classical way by issuing, at time 0, short-term straight debt with a face value of I, and then by issuing equity to repay the debt at time 1. The bad firm will not imitate by using this financing strategy because the expected financial distress cost generated by the use of short-term debt is too high.

Stein shows that the situation changes if there is new *private* information at $t = 1$ about the medium firm's project. In this scenario, a time 1 equity issue becomes problematic because the firm faces adverse selection problems. This situation is formalized by assuming that the firm will be in two potential states at $t = 1$. In the good state, designated "M_G", the probability of receiving X_H increases from p to $p_G > p$. In the bad state, designated "M_B", the probability of receiving X_H falls to $2p - p_G < p$.

[4] The firm can also set the face value at I, without destroying the separating equilibrium. In this case, investors would be neutral between converting or being redeemed at $F = I$. If investors opt to be redeemed, the firm can refinance efficiently by issuing equity because there are no informational asymmetries at $t = 1$.

If the firm is in the better state, it will be reluctant to issue equity because it is undervalued by the market. It has two alternative financing options to avoid this undervaluation effect: refinance by issuing straight debt, in which case the firm incurs the cost of financial distress c with probability $(1 - p_G)$; or refinance by liquidating some of its assets, which reduces the net value of the firm by an amount L as a result. The firm will opt to issue equity if the undervaluation effect is not too strong in relation to these costs. If the firm is in the worse state (M_B), then it will issue equity. It follows that a pooling equilibrium arises if the adverse selection problem at $t = 1$ is not too strong, which makes the "delayed equity financing" solution viable.

If the undervaluation effect is too strong in state M_G, then the firm refinances by issuing straight debt or by liquidating some of its assets, whichever strategy is less costly. A separating equilibrium arises at $t = 1$ in which the firm opts for such alternative strategies in the better state, while opting to issue equity in the worse state. In this case, the pooling equilibrium is destroyed and the financing is no longer efficient as it imposes, at $t = 0$, additional expected costs on the owner-manager. The firm may even decide to abandon the project at $t = 0$ if its net present value is too low in comparison to these costs.

It follows that the delayed equity financing strategy is not always viable in the extended setting, rehabilitating callable convertible debt financing. The firm separates with this type of financing and forces conversion whatever its state at $t = 1$, good or bad. Investors perceive the firm's value as being, on average, high enough and therefore decide to convert the security. They cannot infer the firm's state at $t = 1$ by observing the firm's actions because the owner-manager always chooses to force conversion to extinguish an otherwise valuable conversion option.

While the extended model rehabilitates callable convertibles, it still does not provide a solid justification for the use of this type of security. A standard convertible with the parameters specified in Section 2.2 remains a simpler and still perfectly viable alternative. Despite the presence of informational asymmetries at $t = 1$, investors will choose to convert this security when it matures at $t = 1$ because they perceive the firm's value as being, on average, sufficiently high: $\alpha(V_m^G + V_m^B)/2 = \alpha(V_m) = I > F$, where V_m^G and V_m^B designate the firm's value in states M_G and M_B, respectively.

We conclude that Stein's model cannot explain the use of the call option, neither in its simple nor in its extended version, because the firm can achieve efficient financing and investment in all situations using standard convertible debt.

3. Signalling with a mix of short-term straight debt and equity

This section demonstrates that use of convertible debt has, in general, a weak justification in Stein's framework because the firm can achieve an efficient outcome with a classical financing strategy combining short-term straight debt and equity.

3.1. Separation in the benchmark setting

Stein argues that a strategy of issuing short-term straight debt at $t = 0$ and refinancing with equity at $t = 1$ maintains a separating equilibrium for the medium firm in the benchmark setting. This statement requires nuance; the equilibrium is not entirely separating because the good firm can mimic the medium one. However, the separating equilibrium is entirely restored if the medium firm adds some equity to its straight debt issuance at $t = 0$. For the good firm, this equity component would be undervalued, discouraging this firm from mimicking the medium one.

It is straightforward to demonstrate that the medium firm can separate by issuing, at $t = 0$, short-term straight debt with a face value of $X_L + E < I$, $E > 0$, and the remaining amount with equity

giving the right to obtain a fraction $\alpha_1 = (I - (X_L + E))/(V_m - (X_L + E))$ of the firm's assets. The value of debt issued at $t = 0$ has to be higher than X_L to prevent the bad firm from mimicking. At $t = 1$, the medium firm refinances the project by issuing equity granting the right to obtain a fraction $\alpha_2 = (X_L + E)/V_m$ of the firm's assets. A time 1 equity financing is not problematic because there are no more informational asymmetries at this stage.

We conclude that the medium firm cannot fully separate in the benchmark setting using the delayed equity financing strategy proposed by Stein. The correct delayed equity financing strategy rather consists in issuing a package of short-term straight debt and equity at $t = 0$, and refinancing by issuing equity at $t = 1$.

3.2. Separation in the extended setting

This section shows that a package of short-term straight debt and equity also offers an efficient financing solution in the extended setting. The strategy is as follows. At $t = 0$, the firm issues a combination of short-term straight debt and equity with the parameters specified as above, the only additional assumption being that E is sufficiently low. The logic is to issue as much equity as possible along with sufficient debt to dissuade the bad firm from mimicking. At $t = 1$, the firm reimburses the debt for an amount $X_L + E < I$ by issuing an amount X_L of *new* (short-term) straight debt and an amount E of equity giving the right to obtain a fraction $\alpha_2 = E/(V_m - X_L)$ of the firm's assets. The logic is to issue as much debt as possible, without being exposed to financial distress, and a limited amount of equity, thereby mitigating the adverse selection problem at $t = 1$.

The bad firm will not imitate by adopting this financing strategy. If it were to do so, it would incur an expected financial distress cost of zc because the debt's face value at $t = 1$ is higher than the total cash-flow generated by this firm in the worse scenario, $X_L + E > X_L$. The firm would obtain the benefit of selling an overvalued package of straight debt and equity, which true value, $(1 - z)I + zX_L$, is lower than the amount obtained I. Thus, the bad firm would issue a package that is overvalued by an amount $z(I - X_L)$. As the overpricing amount is lower than the expected costs of distress, $zc > z(I - X_L)$, the bad firm will not mimic.

The good firm will also refuse to mimic. The package includes an equity component that is under-priced from this firm's perspective, with no compensating benefit.

A separating equilibrium arises, which is summarized as follows:

Proposition 2. *In the setting described above, the following is a separating equilibrium:*

(i) *the good firm issues long-term straight debt with a face value of I and invests;*
(ii) *the bad firm issues a fraction $I/(qX_H + (1 - q)X_L)$ of equity and invests;*
(iii) *the medium firm issues short-term straight debt maturing at $t = 1$ and having a face value of $X_L + E$, with E being sufficiently low, together with a fraction $\alpha_1 = (I - (X_L + E))/(V_m - (X_L + E))$ of equity. At $t = 1$, the firm reimburses the debt by issuing new short-term straight debt with a face value of X_L and a fraction $\alpha_2 = E/(V_m - X_L)$ of equity.*

Proving this proposition requires two steps. The first is to analyze all incentives related to the three types of financing considered by the proposition. The analysis of the incentives related to equity and long-term straight debt financings is identical to Stein's and therefore will not be outlined here. The incentives related to the financing strategy of combining equity and straight debt have already been analyzed above.

The second step is to check that the financing strategy adopted by the medium firm allows for a pooling equilibrium in which the firm issues equity for an amount E at $t = 1$ *whatever* its type (M_G or M_B) at that moment. To verify this, we must check that firm M_G will not opt at $t = 1$ for alternative strategies such as issuing straight debt or liquidating assets. The assumption that the amount of equity E issued at $t = 1$ is low enough is central here. In a pooling equilibrium, firm M_G would issue equity that is overvalued by an amount of $E(p_G - p)(X_H - X_L)/(pX_H + (1 - p)X_L)$. If E is sufficiently low, this amount becomes inferior to $Min\{L, (1 - p_G)c\}$. In this situation, firm M_G will optimally choose to issue equity rather than issuing straight debt or liquidating some of its assets. As the equilibrium at the time 1 sub-game is pooling, the costs of financial distress and asset liquidation are avoided. Therefore, the owner-manager can finance and invest efficiently at $t = 0$.

The strategy proposed here reveals three notable aspects. First, the firm can achieve efficient financing and investment without issuing sophisticated financings such as convertible bonds, whether callable or not. Second, the firm does not need an *all equity* financing at $t = 1$ to achieve an efficient outcome. With the mix strategy proposed here, the firm issues straight debt in the second round of financing, which is an important aspect for alleviating the adverse selection problem at $t = 1$. Lastly, this strategy injects equity into the firm's capital structure from the beginning. Consequently, the firm is not left with a huge amount to be refinanced at $t = 1$. This is crucial for the resilience of this type of financing in a more general situation in which the medium firm's value is unstable during the first period, as shown in the following section.

4. When convertible debt becomes problematic

A fundamental assumption in Stein's original model is that the value of the medium firm is stable during the first period; only the bad firm receives new public information at $t = 1$. This absence of variability is a key ingredient for achieving forced conversion with a probability of 1. Under the reasonable assumption that there is new publicly available information about the medium firm's project as it progresses, the value of the firm will fluctuate, in which case the firm is no longer certain that it can always force conversion. Our analysis shows that convertible debt financing, whether callable or not, may become problematic under these circumstances, while financing with a mixture of short-term straight debt and equity will remain efficient, thus proving to be a superior strategy.

4.1. New public information

Consider that new *public* information about the medium firm's project arrives at $t = 1$. Formally, this firm will be either in state M_G or M_B, which are observable by the market, with a probability of 1/2 each. (These notations are those employed in the original model to designate privately-known states. For convenience, we use them henceforth to designate publicly-known states.) In state M_G (resp. M_B), the probability of obtaining the cash-flow X_H at the end of the project, denoted p_G (resp. p_B), is higher (resp. lower) than at $t = 0$, $p_G > p$ (resp. $p_B = 2p - p_G < p$). Consistency requires $p = (p_G + p_B)/2$. The firm's expected value is designated V_m and its value in states M_G and M_B is designated V_m^G and V_m^B, respectively. To simplify the analysis, we assume that the value of the firm in state M_B is higher than I, indicating that the project remains profitable in this state.

The information and technology structures for the good and bad firms are preserved. The good firm is insensitive to information and generates the highest cash-flow X_H with certainty. The bad firm receives the following new information: with a probability of $1 - z$ it becomes a medium-type firm, therefore it may be either in state M_G or M_B with probability 1/2; with a probability of z its

project deteriorates, in which case the firm's value becomes equal to X_L.

In the following analysis, we assume that the medium firm's value at $t = 1$ in state M_B is sufficiently low, specifically $I(V_m^B/V_m) < X_l$. This is not a strong assumption; it simply ensures that, if the firm decides to issue callable convertible debt, then it cannot force conversion in the bad state, which is a common situation in reality. To separate with callable convertible debt, the call price K must be higher than X_L to dissuade the bad firm from mimicking. To separate *efficiently*, two conditions must be met. First, the call price cannot be higher than the initial investment, otherwise, the security would be overvalued. Second, the firm should always exercise the call option at $t = 1$. Otherwise, it would be exposed to financial distress costs at $t = 2$. Under these conditions, if the firm decides to finance with callable convertible debt, it cannot force conversion in state M_B and will therefore have to redeem the security in this state[5].

We deduce that, to raise the amount I with a callable convertible bond, and assuming the firm separates efficiently with this type of security, the convertible should have a conversion ratio of $\alpha = (2I - K)/V_m^G$, a call price $K \in (X_L, I]$, and a face value $F > X_L$. To ensure coherency with Stein's original model, we will consider henceforth that the call price is strictly lower than I[6]. In the appendix, we show that it is always in the firm's interest to exercise the call option. The appendix also provides a numerical illustration for this. In the better state M_G, in which the convertible behaves like equity, the main justification of this decision is to extinguish a valuable conversion option. In the worse state M_B, in which the convertible behaves like debt, the main justification is to avoid financial distress costs at $t = 2$. The assumption that the latter are high, $c > I - X_L$, ensures that the firm prefers to call the security in this state.

It is straightforward to demonstrate that the medium firm separates at $t = 0$ by issuing the callable convertible bond specified above. The firm calls the security at $t = 1$, with the latter being converted into equity in the better state and being redeemed at K in the worse one. If the security is redeemed, the firm refinances efficiently at $t = 1$ by issuing a fraction K/V_m^B of equity.

The discussion of the incentives to imitate is similar to the one outlined previously. The most important aspect is that the bad firm will not imitate the medium one. If it did, it would incur an expected financial distress cost of zc under the scenario in which the project deteriorates. At the same time, the firm would obtain the benefit of selling an overvalued convertible. If the project deteriorates, which occurs with probability z, the convertible generates a payoff of X_L. If the bad firm becomes a medium-type one, which occurs with probability $1 - z$, the firm may be either in state M_G, in which case the security is converted, or in state M_B, in which case the security is redeemed. Hence, if the bad firm becomes a medium-type one, the expected value of the convertible becomes equal to I, as for the medium firm. Taking all these factors into consideration, the expected value of the convertible from the perspective of the bad firm will be $(1 - z)I + zX_L$, which is less than the amount obtained I. As the overpricing amount is lower than the expected cost of distress, $zc > z(I - X_L)$, the bad firm will not mimic.

It is also easily verified that the medium firm would achieve the same efficient outcome if it finances with standard convertible debt. The parameters of this type of security must be fixed accordingly. The convertible matures at $t = 1$, has a conversion ratio of $\alpha = (2I - F)/V_m^G$ and a face value $F \in (X_L, I)$. This security is converted into equity in the better state and is redeemed at F in the worse one. In the latter scenario, the firm refinances by issuing a fraction F/V_m^B of equity.

Another equivalent financing option is to use a combination of short-term straight debt and equity. In this case, the firm issues, at $t = 0$, short-term straight debt with a face value of $X_L + E < I$, $E > 0$, and the balance with equity giving the right to obtain a fraction $(I - (X_L + E))/(V_m - (X_L + E))$ of the firm's assets. At $t = 1$, the medium firm refinances the project by issuing an amount of equity that depends on its situation at this time. In state M_G, the firm issues a fraction of $(X_L + E)/V_m^G$ of equity, while in state M_B the fraction of equity issued equals $(X_L + E)/V_m^B$.

We conclude that, in this more general setting, the firm can use any of these three strategies to finance and invest efficiently. Justification for the use of convertible debt financing, whether callable or not, is, again, weak because the firm can finance efficiently with a mixture of short-term straight debt and equity[7].

4.2. New public and private information

This study now shows that convertible debt financing becomes problematic if the firm receives both public and private information at $t = 1$. Specifically, we consider that the owner-manager knows that the project can do better or worse than market expectations in state M_B. We designate these two states M_{BG} and M_{BB}, respectively. Each one of these two privately-known states occurs with a probability of 1/2. The states M_{BG} and M_{BB} are characterized by the probability of obtaining the higher cash-flow (X_H) at $t = 2$. These probabilities are designated p_{BG} and p_{BB}, respectively, with $p_{BG} > p_B > p_{BB} > 0$. To make the presentation as simple as possible, we consider that there is no private information in state M_G. Consistency requires $p = (2p_G + p_{BG} + p_{BB})/4$, $p_B = (p_{BG} + p_{BB})/2$. We also preserve the assumption that the project remains profitable in all states.

As in the previous sub-section, the firm's value in state M_B is assumed to be sufficiently low, thus investors opt to be paid K when the firm calls the convertible because they perceive that the firm's value is not high enough to make conversion profitable. Investors are not able to infer the firm's type by observing its decision to call; the firm always calls the convertible for the reason explained above, that is, to avoid financial distress costs at $t = 2$.

Assume that the owner-manager knows that the firm is in the better state, M_{BG}. We adopt the same line of reasoning as Stein and consider that the firm can refund by issuing equity or liquidate some of its assets at a cost of L. The problem is that equity cannot sustain a pooling equilibrium in the time 1 sub-game if the adverse selection problem is too strong, $K(p_{BG} - p_B)(X_H - X_L)/(p_B X_H + (1 - p_B)X_L) > L$. In this scenario, the firm prefers to liquidate some of its assets because it loses less than by issuing undervalued equity. Another option is to issue straight debt, but this alternative strategy generates an expected financial distress cost of $(1 - p_{BG})c$.

[5] This statement is easily proved by contradiction. Assuming the firm can force conversion in this state, it can also force conversion in the good state, which implies that the firm can always force conversion. The conversion ratio would therefore equal I/V_m. The conversion value in state M_B would be lower than X_L, $(I/V_m)V_m^B < X_l$, therefore it would be lower than the call price K. Consequently, the investor would prefer receiving the amount K rather than converting, which contradicts the initial assumption.

[6] If the call price equals the initial investment, $K = I$, investors will be neutral between converting or receiving K if the firm is in the good state at $t = 1$. If investors prefer redemption, the firm can refinance efficiently by issuing equity because there are no information asymmetry problems at $t = 1$ in the setting studied in this section.

[7] The main qualitative conclusions presented here would not change if the firm's value is lower than I in the bad state. In this case, the parameters of the financing strategies considered in our study must change accordingly. In particular, a callable (resp. standard) convertible debt should exhibit a call price (resp. face value) in the interval $(X_L, Min\{V_m^B, I\})$ to avoid costs of financial distress in state M_B. A strategy combining straight debt and equity would still be a perfect substitute for convertible debt financing, whether callable or not.

If the firm is in state M_{BB}, it prefers to issue equity rather than liquidating assets or issuing straight debt.

We deduce that, if the adverse selection problem in state M_B weighs heavily, then a separating equilibrium is sustained in which the firm liquidates some of its assets or issues straight debt in state M_{BG}, and issues equity in state M_{BB}. Backward induction implies that the firm incurs, at $t = 0$, an ex-ante expected cost of $1/4Min\{L; (1 - p_{BG})c\}$. It follows that the firm cannot finance and invest efficiently by issuing callable convertible debt and refinancing with equity in state M_B. The "backdoor equity financing" argument is no longer viable.

Standard convertibles are inconvenient for the same reasons. This type of security is not converted in state M_B, when it matures, and will generate a huge debt burden of F that must be refinanced. The firm will therefore be confronted with the same problem as with a callable convertible debt financing.

In contrast, a package of equity and straight debt offers an efficient financing solution. The reason is identical to that developed in Subsection 3.2. Consider that the firm issues at $t = 0$ short-term straight debt with a face value of $X_L + E$, where E is sufficiently low, and the balance with equity. If the firm is in state M_B, then it will refund by issuing an amount X_L of straight debt and an amount E of equity. The amount E is calibrated in a way that preserves a pooling equilibrium at the time 1 sub-game. If E is sufficiently low, the overvaluation effect at $t = 1$ will be lower than any of the costs associated with asset liquidation or potential financial distress: $E(p_{BG} - p_B)(X_H - X_L)/(p_B X_H + (1 - p_B)X_L) < Min\{L; (1 - p_{BG})c\}$. Backward induction implies that this financing strategy is not affected by additional costs, allowing the firm to finance and invest efficiently at $t = 0$.

4.3. Discussion and related empirical evidence

The (reasonable) assumption that the medium firm's value changes during the first round of financing by receiving new fundamental information about its project has important consequences on the relevancy of convertible debt as a financing vehicle. If the firm cannot force conversion at $t = 1$, then it must refund an amount of K. In practice, the call price is typically close to I. It follows that the firm will again be in a situation similar to the outset of the project, with a large amount to refinance in a context with adverse selection problems and potential financial distress costs. If the adverse selection problem weighs heavily, then the separating equilibrium (if any) is no longer efficient. Pushing this reasoning further, the firm may even decide to abandon the project at $t = 0$ if its net present value is not sufficiently high relative to the additional costs to which the firm is exposed, that is, if $N < 1/4Min\{L; (1 - p_{BG})c\}$. The situation would obviously be similar if the firm uses standard convertible debt to finance its investment.

In theory, one option to refund K in an efficient manner in state M_B would be to issue an amount X_L of straight debt and to complete the remaining amount of $K - X_L$ by issuing a fraction of equity. The latter can be calibrated to enable a pooling equilibrium at the time 1 sub-game. This requires assigning a low value for K, sufficiently close to X_L. However, this strategy would be unreasonable for at least two reasons. First, the call price should be fixed at unrealistically low levels. For example, if $X_L = 0$, the call price would be close to 0, a level that is uncommon among convertible securities. Second, it would not make sense to use callable convertible debt if the firm will ultimately issue a mixture of equity and short-term straight debt for its second round of financing. It would be more natural to adopt such a strategy from the beginning.

The strategy of combining equity and short-term straight debt is superior because it injects equity in the firm's capital structure at the start of the project. This is an advantage relative to convertible debt under the presence of financial distress costs. The amount to be refunded later will be lower, therefore the firm will be able to solve the financing problems under better conditions. It is also noteworthy that this strategy does not act as "backdoor equity financing". The adverse selection problem that prevails at the intermediate time pushes the firm to *minimize* the amount of newly issued equity when it refunds.

In contrast to what Stein's model seems to infer, our analysis suggests that firms affected by information asymmetry problems have no valid reasons to use convertibles under the presence of financial distress costs, and should even *avoid* them, especially if their activities are risky. A risky activity exposes the firm to the scenario of not being able to force conversion, in which case the firm would have to manage a huge debt burden in difficult conditions. Yet, the empirical evidence related to the U.S. market suggests that convertible debt issuers tend to be firms with a risky profile. The typical convertible issuer in this market has focused activities (Mayers, 1998), higher stock return variance than straight debt and equity issuers (Lewis et al., 1999), high R&D ratios, and high levels of intangible assets (Stein discusses existing empirical evidence in this sense). In light of this evidence, the value of convertible debt issuers is vulnerable to fluctuations as new fundamental information is learned about their investments. This is precisely the kind of situation that increases the firm's risk to redeem the security, which is problematic when high financial distress costs are present.

Some explanations may conciliate our analysis with the observation that convertible debt issuers in the U.S. tend to have risky activities. The first may be that the costs of financial distress are not so important in practice and, hence, do not influence managers' convertible debt decisions in a significant way. Mayers (1998) analyzes the U.S. convertible debt market and finds a substantial financing activity when firms exercise the call option. Interestingly, this activity mainly takes the form of issuing straight debt, a result that is difficult to reconcile with the notion that firms use the call option to force conversion into equity to avoid potential costs of financial distress. More generally, the survey conducted by Graham and Harvey (2001) shows that financial distress costs do not appear to significantly influence the firm's decision to finance its investments with debt.

An alternative explanation for the use of callable convertibles by risky firms is simply that managers are too confident regarding the possibility to force conversion. Stein uses the example of MCI Communications Corporation to illustrate the backdoor equity financing argument. Between 1978 and 1983, this firm has financed a period of continued growth with callable convertible securities with a soft call provision. This provision stipulated that the firm could call the securities only if the common stock price exceeded the conversion price by a specified percentage. The firm has been able to force conversion several times thanks to high stock prices in a period of strong growth. However, the firm has not been able to force conversion for two large consecutive issues realized in 1983 because of a stock price decline in a period of strong product market competition. This generated a large debt burden that resulted in the firm liquidating a significant portion of its assets. While this example does not concern the regular call option studied in Stein and in our analysis, it illustrates the difficulties that firms may encounter with convertible debt financing if they cannot force conversion. Cases of firms that are unable to force conversion are common in reality, with many convertibles being out-of-the-money at the time when the firm has the possibility to call (Cowan et al., 1993; Bhabra and Patel, 1996).

The "backdoor equity financing" argument has been extensively analyzed by surveys in the field. This argument may appear to be endorsed by the "delayed common stock" rationale that is put forward by many firms to justify the use of convertible debt financing.

In the survey of Graham and Harvey (2001), as in other surveys carried out on the U.S. and European markets (e.g. Bancel and Mittoo, 2004; Billingsley and Smith, 1996; Brounen et al., 2006; Dutordoir et al., 2022), convertibles appear to act mainly as an "inexpensive way" to issue "delayed common stock". This rationale corroborates the adverse selection hypothesis. However, a careful analysis of the motives put forward by corporate managers reveals that these motives may differ from Stein's arguments. In particular, these surveys are not conclusive regarding the role of these securities in avoiding financial distress costs. Dong et al. (2019) analyze the survey of Graham and Harvey (2001) and argue that the *"delayed equity perception on convertible bonds is a necessary, but not a sufficient condition for the Stein (1992) theory to hold"*. The delayed equity statement appears to be too concise to corroborate Stein's theory, as it is not considered concurrently with the problem of financial distress. As pointed out by Dutordoir et al. (2022) (page 3, footnote 8), an important problem is that the finesses of this theory are difficult to implement in a survey. Dong et al. (2018) provide an in-depth empirical analysis of Stein's theory by conducting semi-structured interviews with top executives in several countries. The analysis of interviews' transcripts shows that managers' answers do not support several key dimensions of Stein's theory. In particular, they find that the use of the call feature is not related to the flexibility to convert the bond into equity.

Another empirical evidence in favor of our analysis concerns managers' reasons to use a call feature. Existing surveys concerning U.S. and European firms find moderate support for the argument that convertibles are used because of the ability to call or force conversion (e.g. Graham and Harvey, 2001; Bancel and Mittoo, 2004). Furthermore, according to the survey of Dong et al. (2018), most firm executives argue that they exercise the call option to issue debt at a lower cost in the future or to enhance the firm's debt capacity to finance future investments, such as acquisitions. The fact that many firms call convertibles to refinance with debt is in line with Mayers (1998)'s finding of a substantial debt financing activity when firms exercise the call option. This evidence is in contradiction with the logic of the backdoor equity financing theory, as this theory predicts that firms call convertibles to refinance with equity. Furthermore, while this theory was developed at a time when the call feature was the norm, Grundy and Verwijmeren (2018) find that only a minority of post-2005 U.S. convertibles are callable. They argue (page 92) that *"In a world with long-term convertibles, the backdoor equity rationale for issuing a convertible could hold without call provisions if firms can induce voluntary conversion by paying sufficiently high dividends"*.[8] Our analysis shows that the call provision is in all cases unnecessary in Stein.

It is also noteworthy that the typical convertible debt issuer in Europe is a large, mature firm, with a solid financial situation and low debt-related financing costs (Dutordoir and Van de Gucht, 2009). This evidence is also difficult to reconcile with the argument that financial distress costs are important in justifying the use of convertible debt financing.

5. Conclusion

This paper has revisited the "backdoor equity financing" theory, which is one of the most influential theories to explain the use of callable convertible bonds as financing instruments. Our results emphasize three main aspects. First, the call feature plays no role in solving the firm's financing problem because a standard convertible fulfills the same functions. Second, this theory does not provide a sufficient justification for convertible debt financing in general because a strategy that combines short-term straight debt and equity is a perfect substitute. Third, and most importantly, the possibility to sustain an efficient separating equilibrium with convertible debt financing is shown to be highly sensitive to the assumptions of the original model. With reasonable assumptions about their parameters, both callable and standard convertible debt fail to satisfy the conditions for efficient financing and investment if one relaxes the assumption that the firm is always able to force conversion. With new fundamental information about its project, the firm may need to redeem the convertible if the news is not promising. In this scenario, the firm will be in a similar situation to the one it experienced at the beginning of its project, with a large amount to be refinanced in a difficult context. In contrast, a package of equity and short-term straight debt proves resilient to the flow of new information as it injects equity into the firm's capital structure from the beginning, thereby alleviating the adverse selection problem when it refunds.

These findings challenge the conventional view that the call option embedded in convertible bonds is essential to circumvent financial distress costs in a context of adverse selection, a common view in theoretical and empirical studies in the field. The analysis also calls into question the validity of the other empirical implications inherent to the backdoor equity financing theory about managers' motivations for using convertibles, the characteristics of firms issuing convertibles, and the market's reaction to convertible debt offerings.

Stein argues that callable convertible debt provides *"an attractive middle ground between the high expected costs of distress associated with a debt issue and the large negative announcement impact associated with an equity issue"*. Rather than acting as a middle ground between straight debt and equity, we prove that convertible debt places the firm in two "extreme" situations. If it is converted, the entire security turns into equity, thereby avoiding any risk of incurring financial distress costs. However, if conversion fails, the security turns entirely into debt, a situation that fully exposes the firm to additional costs. The case of MCI Corporation sharply illustrates this point. Stein uses the example to defend the "backdoor equity financing" argument, but it can also be used to illustrate the difficulties that firms may encounter with convertibles if the market receives unfavorable information.

We conclude that the relevant "middle ground" between straight debt and equity in Stein's framework is ultimately a combination of these two traditional securities. The usefulness of callable convertible debt financing in a context in which the adverse selection problem faced by the firm coexists with problems of financial distress remains to be proved. The robustness of such a rationale would depend on the extent to which the two optional components of this security, the conversion and call options, are indispensable in solving the firm's financial problem.

Declaration of Competing Interest

None.

CRediT authorship contribution statement

Radu Burlacu: Formal analysis, Supervision, Funding acquisition, Conceptualization, Writing – original draft, Writing – review & editing, Conceptualization, Writing – original draft, Writing – review & editing. **Sonia Jimenez-Garcès:** Conceptualization, Validation, Methodology, Writing – review & editing, Funding acquisition.

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[8] As it concerns straight debt financing, Robbins and Schatzberg (1986) show that short-term non-callable debt maturing after the resolution of the information asymmetry problem can be an alternative solution to callable long-term debt financing.

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To demonstrate that it is always in the firm's interest to exercise the call option, we compare the value of the callable convertible bond conditional on calling at $t = 1$ with its value conditional on not calling. If the firm is in state M_G, then the value of the convertible conditional on calling equals the value of its equity component (αV_m^G) because the security is converted. The value of the convertible conditional on *not* calling, $p_G \alpha X_H + (1 - p_G)X_L$, is higher than the value of the convertible conditional on calling, thereby the firm will decide to call. By exercising the call option, the firm extinguishes an otherwise valuable conversion option.

In state M_B, the value of the security conditional on calling equals K because the investor prefers to receive K than to convert. If the firm decides *not* to call, the expected value of the security becomes equal to $p_B \alpha X_H + (1 - p_B)X_L$. In this scenario, the owner-manager will be exposed to significant financial distress costs. Based on the condition $c > I - X_L$, we prove that the owner-manager's wealth conditional on calling the security and paying K to investors is higher than her/his wealth conditional on pursuing the project without calling,

$$V_m^B - K > p_B(1 - \alpha)X_H - (1 - p_B)c.$$

This inequality is true if

$$V_m^B - K > p_B(1 - \alpha)X_H - (1 - p_B)(I - X_L).$$

We replace α by $(2I - K)/V_m^G$ and obtain that this latter inequality is equivalent to

$$I(2p_B X_H/V_m^G + 1 - p_B) > K(1 + p_B X_H/V_m^G).$$

Since $I > K$, this inequality holds if

$$2p_B X_H/V_m^G + 1 - p_B > 1 + p_B X_H//V_m^G,$$

which is equivalent to $X_H > V_m^G$, which is true. It follows that it is *always* in the firm's interest to call, even in state M_B.

As an illustration, consider the following parameters: $I = 100$, $X_H = 150$, $X_L = 90$, $p = 0.5$, $p_G = 0.8$, $p_B = 0.2$. With these parameters, the firm has an expected value of $V_m = 120$ and the project has a net value of $N = 20$. The firm's value at $t = 1$ is either $V_m^G = 138$ or $V_m^B = 102$. The project is therefore profitable in the "bad" state M_B. We assume that the convertible has a call price close to I, for example $K = 99$, which is a reasonable assumption. The conversion ratio equals $\alpha = 0.73$. In state M_G, the value of the convertible bond conditional on calling equals $\alpha V_m^G = 101$, while its value conditional on *not* calling equals $p_G \alpha X_H + (1 - p_G) * X_L = 105.82$. The owner-manager decides to call the security in order to extinguish the conversion option, which value equals 4.82.

In state M_B, the value of the convertible bond conditional on calling equals the call price, 99, because investors prefer to be redeemed rather than to convert (the conversion value would be $0.73 * 102 = 74.65$, which is lower than 99). The value of the convertible bond conditional on *not* calling would be lower, $p_B \alpha X_H + (1 - p_B)X_L = 93.96$. In the absence of financial distress costs, the firm would decide to pursue the project without calling because this decision diminishes the value of the convertible bond, thereby increasing the wealth of the owner-manager. The problem is that in the setting studied here, the owner-manager incurs an expected financial distress cost of minimum $(1 - p_B)(I - X_L) = 8$, which is too high in comparison to the benefit of not calling, which amounts to $99 - 93.96 = 5.04$. Consequently, the firm decides to exercise the call option in state M_B as well.

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