Why Issue Mandatory Convertibles? Theory and Empirical Evidence

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Abstract

Mandatory convertibles, which are equity-linked hybrid securities that automatically convert to common stock on a pre-specified date, have become an increasingly popular means of raising capital in recent years (about $20 billion worth issued in 2001 alone). This paper presents the first theoretical and empirical analysis of mandatory convertibles in the literature. We consider a firm facing a financial market characterized by asymmetric information, and significant costs in the event of financial distress. The firm can raise capital either by issuing mandatory convertibles, or by issuing more conventional securities like straight debt, common stock, and ordinary convertibles. We show that, in equilibrium, the firm issues straight debt, ordinary convertibles, or equity if the extent of asymmetric information facing it is large, but the probability of being in financial distress is relatively small; it issues mandatory convertibles if it faces a smaller extent of asymmetric information but a greater probability of financial distress. Our model provides a rationale for the three commonly observed features of mandatory convertibles: mandatory conversion, capped (or limited) capital appreciation, and a higher dividend yield compared to common stock. We also characterize the equilibrium design of mandatory convertibles. Our model also has implications for the abnormal stock returns upon the announcement of mandatory convertibles and for the post-issue operating performance of mandatory convertible issuers. Using a sample of firms which have chosen to issue either mandatory convertibles or ordinary convertibles, we present some empirical evidence consistent with the implications of our theory.
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1 Introduction

Mandatory convertibles are equity-linked hybrid securities such as PERCS (Preferred Equity Redemption Cumulative Stock) or DECS (Debt Exchangeable for Common Stock, or Dividend Enhanced Convertible Securities), which automatically (“mandatorily”) convert to common stock on a pre-specified date. Starting from small beginnings in 1988, such mandatory convertibles have become extremely popular in recent times (see figure 4): $5 billion worth of mandatory convertibles were issued in 1996 (a quarter of the convertible market); in 2001, about $20 billion worth of mandatory convertibles were issued (about 18% of the convertible market). Mandatory convertibles have been designed with a variety of payoff structures, and carry different names depending on their payoff structure and the investment bank underwriting their issue: examples are Morgan Stanley’s PERCS and PEPS, Merrill Lynch’s PRIDES, Salomon Brothers’ DECS, and Goldman Sach’s ACES (see table 5 for illustrative examples of the various mandatory convertibles in our sample). They have been issued by a number of companies, large and small, to raise capital: these include Texas Instruments, General Motors, Citicorp, Sears, Kaiser Aluminium, Reynolds Metals, American Express, First Chicago, Boise Cascade, and All State. Two recent issuers were AT&T and Motorola, which raised $900 million and $1.2 billion, respectively, in 2001 by selling mandatory convertibles.

Even though there are differences among the above mentioned variations of mandatory convertibles in their payoff structures as well as in some other provisions, certain fundamental features are common to all of them. Three of the most important of these features are as follows. First, as discussed above, conversion to equity is mandatory at the maturity of the convertible (as against conversion to equity at the option of the security holder in the case of ordinary convertibles). Second, mandatory convertibles have either a capped or limited appreciation potential compared to the underlying common stock. Third, the dividend yield on a mandatory convertible is typically higher than that on the underlying common stock. We will discuss these three features in more detail below.
The increasing popularity of mandatory convertibles over the last decade as an instrument for raising capital by firms prompts us to raise several questions. Under what circumstances should a firm issue mandatory convertibles to raise capital, rather than issuing ordinary convertibles, or even more conventional securities such as equity or straight debt? What explains the prevalence of the three basic features (mentioned above) that are common in almost all mandatory convertible issues? How should a mandatory convertible be designed in terms of the mix of these features (e.g., the optimal cap, the number of shares of equity into which the mandatory convertible should be exchanged for upon conversion, the dividend yield on the mandatory convertible)? Unfortunately, there has been no theoretical analysis so far in the literature which enables us to answer such questions. Neither has there been a comprehensive empirical study of these securities. The objective of this paper is to develop a theoretical analysis of mandatory convertibles which allows us to answer the above and related questions, and to present some empirical evidence regarding the implications of our theory.

It is useful to illustrate the three important common features of mandatory convertibles mentioned above using two specific examples of mandatory convertible issues. The first example illustrates an issue of PERCS. In September 1991, K-Mart Corporation issued $1.012 billion worth of PERCS at $44.00 (K-Mart stock was also selling at this price on the day of issue). The PERCS paid a dividend of 7.75%, while K-Mart’s common stock was paying a dividend of only 4% at this time. Each unit of PERCS was mandatorily convertible to one share of K-Mart common stock on September 15, 1994, subject to a cap of $57.20: i.e., if the share price of K-Mart exceeded $57.20, each unit of PERCS would receive only a fraction of a share worth a total of $57.20. Figure 1(a) gives the payoff at maturity (excluding dividends) of the K-Mart PERCS, as a function of its underlying stock price.

The second example illustrates an issue of PEPS (Premium Equity Participating Securities). In June 2000, Valero Energy Corporation issued $150 million worth of PEPS at $25 per unit (which was the price of 0.85837 shares of its common stock, which was then selling at $29.125 per share). The PEPS paid a quarterly dividend of 7.75%, while the dividend on the underlying common stock was only 2.75%. The PEPS were mandatorily convertible to shares of common stock on August 18th, 2003, with the number of shares per PEPS unit given to investors upon conversion depending on the price of the companies’ common stock: if the price of the common stock was $29.125 or below (so that 0.85837 shares would be worth $25 or below), then each PEPS unit would
receive only 0.85837 shares of common stock, giving them a payoff of $25 or below. If the common was between $29.125 and $34.95, then PEPS holders would receive a variable number of shares such that their total value would remain at $25 (in other words, $25 was the “cap” value of the PEPS). If, however, the common stock price exceeded a “threshold appreciation price” of $34.95 on the mandatory conversion date, each PEPS holder would receive 0.71531 shares of common stock. Figure 1(b) gives the payoff at maturity (excluding dividends) of the Valero PEPS as a function of its underlying stock price.

Notice that, while the K-Mart PERCS value was completely capped at a price of $57.20, the Valero PEPS holders would receive a fraction of the appreciation of the underlying stock beyond the threshold appreciation price of $34.95. On the other hand, while holders of PERCS received 100% of the appreciation of the common stock between the stock price on the date of issue ($44.00) and the cap price of $57.20, the Valero PEPS holders did not receive any appreciation on their investment until the stock price exceeded the threshold appreciation price of $34.95. In other words, the PEPS holder did not share in the first 20% of the appreciation in the underlying common stock (between the stock price of $29.125 at issue and the threshold appreciation price of $34.95). However, notice that both the PERCS and the PEPS issues share the three features, common to all mandatory convertibles, that we discussed above, namely, mandatory conversion, capped (either completely, as in the case of PERCS, or partially, as in the case of PEPS) appreciation potential, and dividend yield.
significantly in excess of the underlying common stock.\footnote{Both PERCS and PEPS offerings were underwritten by Morgan Stanley. Most other mandatory convertibles, including those underwritten by investment banks other than Morgan Stanley, have a payoff structure similar to PERCS and PEPS (though these mandatory convertibles often differ from PERCS and PEPS in terms of many institutional arrangements). Thus, ACES (Automatically Convertible Equity securities), PRIDES (Preferred Redemption Increased Dividend Equity Securities), FELINE PRIDES (Flexible Equity-Linked Exchangeable PRIDES), DECS, SAILS (Stock Appreciation Income Linked Securities), MARCS (Mandatory Adjustable Redeemable Convertible Securities), and TAPS (Threshold Appreciation price Securities) are examples of mandatory convertibles with a payoff structure similar to PEPS. CHIPS (Common-linked Higher Income Participating debt Securities), EYES (Enhanced Yield Equity Securities), TARGETS (Targeted Growth Enhanced Term Securities), and YES (Yield Enhanced Stock) are examples of securities which perform like PERCS. See Morgan Stanley (1998), and Nelken (2000), for a more detailed listing.}

Our theoretical analysis of mandatory convertibles rests on two assumptions based on certain stylized facts about the mandatory convertibles market (and the securities market in general). First, firms are concerned about the misvaluation of their securities in the capital market, and would like to issue securities which would yield them the required amount of capital with the minimum dissipation in the long-term value of the equity held by the current shareholders. Second, firms are also concerned about their probability of being in financial distress (bankruptcy), and incurring financial distress costs. Thus, we consider a setting of asymmetric information, where firm insiders have more information about the intrinsic value of their firm compared to potential outside investors in the firm. In such a setting, higher intrinsic valued firms have an incentive to distinguish themselves from lower intrinsic valued firms in order to obtain their true value in the securities market. One way to accomplish this is to issue securities such as straight debt and ordinary (callable) convertibles, which have the possibility of forcing the firm into financial distress: since, for the same amount of debt issued, lower intrinsic valued firms have a higher chance of going into financial distress compared to higher intrinsic valued firms, the former would not wish to mimic such a strategy, enabling higher intrinsic valued firms to separate themselves from lower intrinsic valued firms and obtain their true valuation in the securities market.

Such signaling strategies, however, have their own pitfalls. In a world with uncertainty, higher valued firms themselves have a positive probability of being in financial distress, and when the costs related to financial distress are significant, the cost of issuing straight debt or ordinary convertibles to distinguish themselves may exceed the valuation benefits from doing so (recall that there is a significant risk of financial distress in the case of ordinary convertibles, since conversion is at the option of the convertible holder alone).\footnote{The callability feature of convertibles does not mitigate this danger of the convertibles remaining as a fixed income security and the firm incurring financial distress costs. Calling these convertibles in order to force conversion will be optimal for the firm only if the share price is high enough, in which case there is no danger of financial distress in the first place. In other words, the callability feature of convertibles only serves to expedite conversion by convertible holders in the range of share prices where it is optimal for them to convert to equity in the first place; it cannot force conversion if the stock price is low.} In such a situation,
firms have an incentive to turn to mandatory convertibles. Since conversion to equity is mandatory in the case of these securities, firms do not have to be concerned about incurring financial distress costs if such securities are issued instead of straight debt or ordinary callable convertibles.\footnote{This advantage of mandatory convertibles in avoiding the costs associated with financial distress has been noted by practitioners. For example, see a recent magazine story entitled “Tech Companies Have a New Currency, and Its Mandatory” (Red Herring, January 2002). We quote: ‘Because they are guaranteed to convert to equity, mandatory convertibles come without the potential yield and redemption hassles for their issuers that other bonds carry. “If the stock drops, you don’t get stuck with a bond that you have to continue to service” says F. Barry Nelson, senior vice president and portfolio manager of Advent Capital Management, which has $900 million invested in convertibles.’} At the same time, mandatory convertibles enable the firm to minimize the extent of undervaluation of the firm’s securities: we show that, while some undervaluation of intrinsically higher-valued firms is unavoidable if mandatory convertibles are issued, such undervaluation is lower than would be the case if the firm issued other securities (such as equity) which also do not increase the chance of the firm going into financial distress. Thus, whether a firm chooses, in equilibrium, to issue mandatory convertibles, or more conventional securities like straight debt, ordinary callable convertibles, or equity, depends on the magnitude of the above costs and benefits of issuing these different securities.

In the above setting, we develop a variety of results relevant to a firm’s choice of mandatory convertibles as a means of raising capital. First, we develop predictions regarding the kind of firms which issue mandatory convertibles rather than more conventional securities, and the situations in which such firms will issue mandatory convertibles. In particular, our model predicts that, when faced with a choice between ordinary and mandatory convertibles, firms facing a larger extent of asymmetric information, but a relatively smaller probability of financial distress will choose to issue ordinary convertibles, while those facing a smaller extent of asymmetric information, but a larger financial distress probability will issue mandatory convertibles. Thus, a larger firm, which is already highly leveraged (or facing a financial downturn) will choose mandatory convertibles over ordinary convertibles, while a smaller firm, which is relatively debt free will make the reverse choice.

Second, we develop a rationale for the prevalence of the three common features of mandatory convertibles discussed before, namely, mandatory conversion, capped (or limited) capital appreciation, and the higher dividend yield relative to equity. Third, we characterize the optimal configuration of the above three features as well as the optimal exchange ratio (fraction of a firm’s equity the mandatory convertible issue should convert into) for an issue of mandatory convertibles. Fourth, we develop implications for the abnormal returns to the firm’s equity upon the announcement of an issue of mandatory convertibles: our analysis predicts that the an-
ouncement effect of mandatory convertibles will be either zero or negative, depending upon whether mandatory convertibles are issued in a fully pooling or a partially pooling equilibrium. This prediction implies that, if we split up a sample of mandatory convertible issues by the probability of financial distress of the issuing firm at the time of issue, mandatory convertible issues of firms having a lower financial distress probability can be expected to have a less negative announcement effect. Our analysis also has predictions about the operating performance of a sample of issuers of mandatory convertibles relative to those of a matched sample of non-issuers.

Finally, we test the implications of our theory on a sample of firms which have chosen to issue either ordinary or mandatory convertibles, making use of commonly used proxies for asymmetric information (e.g., number of analysts following a firm, standard deviation of analyst forecasts, forecast error) and probability of financial distress (Altman’s Z-score, existing firm leverage). The evidence generally supports the implications of our theory. In particular, we find that it is indeed firms facing a smaller extent of information asymmetry but a larger financial distress probability that issue mandatory convertibles, while those facing a larger extent of information asymmetry and a smaller financial distress probability issue ordinary convertibles. Our evidence also supports the implications of our theory regarding the announcement effects of mandatory convertible issues and the post-issue operating performance of mandatory convertible issuers relative to that of a matched sample of non-issuers.

It is not our view here that asymmetric information and financial distress costs are the only two factors driving the issuance of mandatory convertibles. As Miller (1986) has noted, a number of financial innovations over the last twenty years have been driven by considerations of minimizing taxes: mandatory convertibles are no exception. Many mandatory convertible securities (e.g., PEPS and FELINE PRIDES) offer tax advantages: e.g., deductibility of the dividend paid, similar to the coupon paid on corporate debt. However, it is worth noting that many of the original mandatory convertible issues were not tax advantaged (i.e., the dividend paid was not tax deductible), so that it is unlikely that the financial innovation of mandatory convertibles issues was prompted purely as a means of minimizing taxes. Rather, it seems to be the case that, while originally driven by other considerations, tax advantaged structures were added to make these securities more attractive to issuers. Another motivation driving the issuance of mandatory convertibles are legal restrictions on liquidating securities faced by large shareholders in some firms. These large shareholders issue mandatory convertibles
which are convertible into the equity of their portfolio firms, thus immediately monetizing their holdings in their portfolio firms without having to sell these holdings immediately. Finally, another motivation driving the issuance of some mandatory convertibles may be “clientele” effects, i.e., driven by the desire of issuing firm’s to take advantage of institutional investors’ desire for higher dividend paying securities. In summary, similar to other securities like debt and equity, the issuance of mandatory convertibles is also probably driven by many different market imperfections: we have chosen to focus here only on asymmetric information and financial distress costs as two of the most important of these, abstracting away from other considerations for the sake of analytical tractability.4

The existing literature on mandatory convertibles is quite small. Arzac (1997) provides a good description of some mandatory convertibles such as PERCS and DECS, with some discussion of the valuation of these based on the option pricing methodology.5 As mentioned before, there have been no theoretical models of the choice of firms between mandatory convertibles and other securities in the literature so far, and almost no empirical literature. Thus, the theoretical literature closest to this paper is the literature on the issue of ordinary convertibles in an environment of asymmetric information: see, e.g., Brennan and Kraus (1987), Constantinides and Grundy (1989), and Stein (1992).6 7 In particular, the rationale for issuing ordinary convertibles in our setting is similar to that in Stein (1992); however, ordinary convertibles are not the focus of this paper. In summary, the rationale for issuing mandatory convertibles that we present here has not been previously explored in the literature.

The rest of this paper is organized as follows. Section 2 describes the model. Section 3 characterizes the

4 Note that, even if we explicitly include any tax advantages of issuing mandatory convertibles in our theoretical analysis, the equilibria studied here will continue to exist, though the parameter regions in which various equilibria arise will be modified. In other words, our qualitative results will hold even in this case.

5 There are also a few other practitioner oriented discussions and pedagogical cases on mandatory convertibles. Excellent examples include the HBS cases on Avon Products PERCS (Tiemann, 1989), Telmex PRIDES (Seasholes and Froot, 1996), Times Mirror PEPS (Tufano and Poetzscher, 1996), and Cox Communications FELINE PRIDES (Chacko and Tufano, 2000).

6 In an unpublished working paper, Brenan (1986) has also suggested a convertible security (“a reverting consol bond”) which is completely insensitive to asymmetric information. The proposed security converts to the firm’s equity at the end of a specified period of time at a conversion price dependent upon the prevailing price of the issuers common stock at that time. However, Brenan’s security relies crucially on the information asymmetry between firm insiders and outsiders resolving completely before the conversion date of the security (since the price at which the bond is converted needs to reflect the true value of the issuing firm), a requirement unlikely to be satisfied in practice by securities like mandatory convertibles (which typically have only a three year maturity). In contrast, in our setting, issuing mandatory convertibles minimizes the valuation effects of long-lived private information (which continues to exist at the time of conversion), by limiting the upside payoff of the security (thus minimizing the difference in payoffs across mandatory convertibles issued by firms of different intrinsic values).

7 See also the theoretical literature which provides rationales for issuing ordinary convertibles based on market imperfections other than asymmetric information: e.g., Green (1984) and Mayers (1998).
equilibrium of the model and develops results. Section 4 characterizes the equilibrium design of mandatory convertibles. Section 5 describes the implications of the model, and develops testable hypotheses. Section 6 describes our empirical methodology and presents the results of our empirical tests. Section 7 concludes. The proofs of all propositions are confined to the appendix.

2 The Model

The model has three dates (time 0, 1, and 2). Consider a risk-neutral entrepreneur owning an all-equity firm. To begin with, we assume that the entrepreneur owns all the equity in the firm: for simplicity, we normalize the number of shares of equity at time 0 to be one. The firm needs to raise an amount of $I$ externally to finance a new positive net present value project. We assume that the firm has no other ongoing projects, so that the cash flows received by the firm are the same as those generated by the new project. We normalize the risk-free rate of return to be zero, and assume that the investors are risk-neutral.

2.1 Cash Flow and Information Structure

There are three types of firms: good (type G hereafter), medium (type M hereafter), or bad (type B hereafter). The cash flows from the new investment are realized at time 2. Each firm receives a gross cash flow of $x_H$ (the high cash flow) or $x_L$ (the low cash flow) at this date, $x_H > I > x_L$. The differences between the three types of firms are characterized by their probabilities of receiving the high and low cash flows at time 2. Further, at time 1, these firms “deteriorate” with a certain probability. In the event of deterioration, the firm realizes the low cash flow $x_L$ with probability 1. Thus, the type G and type M firms deteriorate with a probability $\phi_1$, while the type B deteriorates with a probability $\phi_2 > \phi_1$. In the event there is no deterioration at time 1, the type G receives the high cash flow with probability 1, while both the type M and type B firms have a probability $1 - \delta$ of receiving the high cash flow $x_H$ and $\delta$ of receiving the low cash flow $x_L$. In summary, the ex ante (time 0) probability of receiving the low cash flow of the type B firm, $\phi_2 + (1 - \phi_2)\delta$, will be greater than that of the type M firm, $\phi_1 + (1 - \phi_1)\delta$, which in turn will be greater than that from the type G firm, $\phi_1$. Thus, the expected cash flow to the type G firm is greater than that to the type M, which in turn is greater than that to the type B. Since any type of firm’s project has positive NPV, $[\phi_2 + \delta(1 - \phi_2)]x_L + (1 - \delta)(1 - \phi_2)x_H \geq I$.

The cash flow structure of the three types of firms is depicted in figure 2.
Firm types are private information to the entrepreneur at time 0, with outsiders having only a prior probability distribution over firm types. The outsiders’ prior of any given firm being of type G, M or B are $\gamma_1$, $\gamma_2$, and $\gamma_3$ respectively, $\gamma_1 + \gamma_2 + \gamma_3 = 1$. At time 1, however, outsiders observe whether a firm has deteriorated or not. Based on this additional information, they engage in Bayesian updating about the type of the firm. At time 2, all asymmetric information is resolved. The sequence of events is depicted in figure 3.

### 2.2 Menu of Securities

The entrepreneur can issue one of four different securities to raise the required external financing $I$: straight risky debt (“straight debt” hereafter), ordinary callable convertible debt (“ordinary convertible” hereafter), mandatory convertibles, or equity.

If the entrepreneur chooses to issue debt, he receives an amount $I$ up-front at time 0, and promises to pay an amount $P_d$ to the debt holder at time 2. If he chooses to issue ordinary callable convertible debt, he determines the face value $P_c$ (payable to the convertible holders at time 2), the conversion ratio $n_c$, and the call price $K$ at time 0. At time 1, he has the right to redeem (“call”) the convertibles at the call price $K$. If the investors convert, they receive a ratio $n_c$ of the total equity. If the convertible is not called, it is equivalent to a debt
Entrepreneur, with private information about the firm type (G, M, or B), chooses among debt, ordinary convertibles, mandatory convertibles, or equity to finance the new project.

- Firm invests in the new project.
- The firm may deteriorate with a certain probability.
- Investors observe the deterioration of the firm and update their prior beliefs about the firm type.
- The firm has the right to call ordinary convertibles at this date; ordinary convertible-holders may choose to convert to equity.
- All cash flows are realized and distributed according to the sharing rules specified by the securities issued.
- All asymmetric information is resolved.
- Mandatory convertibles automatically convert to equity.

Figure 3: Sequence of Events

contract, with the firm obligated to pay $P_c$ to the investors at time 2. In other words, $P_c$ is the sum of the principal and coupon if the convertible remains as straight debt. Alternatively, if the entrepreneur chooses to issue equity, he exchanges a fraction $n_e$ of the total equity to the investors for an amount $I$.

Finally, if the entrepreneur chooses to finance the amount $I$ by issuing the mandatory convertible, these convertibles mandatorily convert to the firm’s equity in two periods (prior to the resolution of information asymmetry at time 2). In this case, investors are promised a fraction $n_m$ (“the exchange ratio”) of the firm’s equity upon conversion, provided the market value of this equity exchanged is less than a “cap” amount $U_m$. Here, we assume $n_m \leq \bar{n}$, where $\bar{n}$ is the maximal possible exchange ratio, $\bar{n} \leq 1$. $\bar{n} = 1$ implies that the entrepreneur is willing to allow his entire equity holding in the firm to be exchanged for mandatory convertibles upon conversion; $\bar{n} > 1$ implies that the entrepreneur chooses to retain a certain fraction of equity for himself (perhaps due to incentive reasons or due to considerations of maintaining control in the firm). If the market value of the promised fraction of equity at time 1 is greater than $U_m$, then investors receive only shares worth the amount $U_m$. In addition, mandatory convertible holders receive an aggregate amount $D$ of dividends over the life of the convertible.\(^8\) For analytical simplicity, we will assume that the actual payment of this amount $D$ takes place at time 2.\(^9\) We also assume that $D \leq \bar{d}x_L$, where $\bar{d}$ is the maximum possible fraction of the firm’s

\(^8\) In practice, the dividend paid on mandatory convertibles is greater than that on common equity. For simplicity, we assume here that the dividend paid on common equity is zero. Thus, one can think of this dividend $D$ paid to mandatory convertible holders in our model as the dividend amount paid in excess of that paid to common equity.

\(^9\) This assumption is made only to minimize the complexity of our analysis. Since the discount rate is zero, assuming that the
sure cash flow that can be paid out as dividends.\textsuperscript{10} Clearly, \( \overline{d} \leq 1; \overline{d} = 1 \) implies that the firm is free to pay out its entire cash flow to investors as dividends when the cash flow realized is low, and \( \overline{d} < 1 \) implies that the firm needs to retain part of its realized cash flows (perhaps to cover other operational expenses or implement other projects), and pay only the rest as dividends. In our model, both the cap \( U_m \) and the dividends paid \( D \) of the mandatory convertible are determined endogenously in equilibrium.

If straight debt is issued by the entrepreneur, or if ordinary convertibles are issued and the firm does not force conversion at time 1 (in which case, the ordinary convertible is equivalent to straight debt), costly financial distress may occur at time 2. If the firm’s cash flow at this date is not sufficient to pay the promised payment to the debt holders in full, the firm will be forced into financial distress (bankruptcy). In this case, an exogenous deadweight cost of financial distress \( C > 0 \) is imposed on the entrepreneur. Remember that since \( x_L < I < x_H \), financial distress occurs if and only if the cash flow at time 2 turns to be low. Thus, the ex-ante (time 0) probability of financial distress is the same as the ex-ante probability of earning a low cash flow, which is \( \phi_1 \) for a type G firm, \( \phi_1 + \delta(1 - \phi_1) \) for a type M firm, and \( \phi_2 + \delta(1 - \phi_2) \) for a type B firm.

Of the above menu of contracts, the security actually issued by the firm will be determined in equilibrium: i.e., not all securities will be offered in all situations. We assume that the firm first chooses the security to be issued from the above menu (at time 0). Further, in the case where an ordinary convertible is issued, the firm chooses at time 1 whether or not to force conversion by calling the convertible; also, investors choose whether or not to convert these convertibles to equity at this date.

### 2.3 The Objective of the Firm and Outside Investors

The firm’s objective is to maximize the expected long-term (time 2) value of the equity held by the entrepreneur (or equivalently, the expected cash flows to current shareholders, net of any costs associated with the external financing of the amount \( I \)). The firm has four options to finance the new project: straight debt, ordinary convertibles, mandatory convertibles, or common equity. Thus, at time 0, the firm strategically chooses

\textsuperscript{10} We use the term dividends here only to refer to sure (certain) cash flows proposed to investors, which is why we assume that dividends can at most equal \( x_L \) (which happens only when \( \overline{d} = 1 \)). We will see later that it is the sure cash flow promised to investors that is important in the design of mandatory convertibles. Of course, in practice, firms can promise additional (uncertain) cash flows to investors over and above this amount. But investors see this as no different from other cash flows available at time 2. We therefore choose to refer only to the sure cash flow promised to investors as dividends, clubbing all uncertain cash flows available to investors together as the “distribution of residual project cash flows” at time 2.
the type of security to issue and then prices the security optimally to maximize its objective. And at time 1, in the case of ordinary convertibles, the firm chooses to force conversion (by calling the convertibles) only when the value of the equity foregone in exchange for the convertibles is less than the sum of the promised payment on the convertibles, and the expected financial distress cost (since there is some probability of financial distress if the convertibles are not called).

The objective of investors is to maximize the expected value of the cash flows they obtain from the firm. Thus, holders of ordinary convertibles choose to convert to equity only when the value of equity obtained through the exchange exceeds the fixed payment promised by the convertibles.

3 The Equilibrium

Definition of equilibrium. An equilibrium in this model consists of (i) the firm’s choice at time 0 about the security to be issued to the investors (including the various terms of the security issued, such as the promised payment to be paid at time 2 for debt, and the promised payment and the conversion ratio in the case of convertibles, and the cap in the case of mandatory convertibles, etc.); (ii) a choice by the investors on whether to convert or not in the case of the ordinary convertibles. Each of the above choices by the firm and by the investors should satisfy the following requirements: (a) the choice of each type of firm maximizes its objective, given its equilibrium beliefs about the choices of the other party; (b) the beliefs of all three types of firm are rational, given the equilibrium choices of the others; along the equilibrium path, these beliefs are formed using Bayes’ rule; (c) equilibrium beliefs as well as the beliefs of investors in response to off-equilibrium moves by any firm are such that they satisfy the Cho-Kreps intuitive criterion (see Cho and Kreps (1987)); (d) whenever there are multiple equilibria satisfying the Cho-Kreps intuitive criterion, the prevailing equilibrium is that which minimizes the dissipative costs incurred by the higher type firms. In summary, the equilibrium concept we use is essentially that of a Pareto-efficient Perfect Bayesian Equilibrium which survives the Cho-Kreps intuitive criterion.11

In the following analysis, we define \( a \equiv \frac{x_H}{x_L} \). Thus, \( a \) can be viewed as a factor measuring the degree of

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11 Thus, our equilibrium definition is based on the Perfect Bayesian Equilibrium (PBE) concept, first formally defined for dynamic games with incomplete information by Fudenberg and Tirole (1991). See Milgrom and Roberts (1986), Engers (1987), or Cho and Sobel (1990) for a detailed discussion of why the notion of a Pareto-efficient PBE is the appropriate equilibrium concept here.
asymmetric information in the market: the larger the value of \( a \), the greater the difference in intrinsic value between the three types of firms, and therefore the greater the extent of asymmetric information facing the firm. Also, we assume throughout that the deadweight cost of financial distress, \( C \), is a constant and greater than a certain minimum level \( C \). Further, we assume that the outsiders’ prior that a firm is of type B, \( \gamma_3 \geq \gamma \), and \( \gamma \) are explicitly defined in the appendix. Finally, we assume that the outsiders’ prior that a firm is of type B, \( \gamma_3 \geq \gamma \).12

We first consider the case where the extent of asymmetric information in the capital market is high, while the ex-ante probability of financial distress of the firm is not too large. Proposition 1 characterizes the equilibrium in this situation.14

**Proposition 1 (Ordinary Convertibles in a Separating Equilibrium)** If any one of the following two conditions hold:

(a) The probability of deterioration of the type G and the type M firms, \( \phi_1 \), is smaller than a certain threshold value \( \phi \); or
(b) The extent of asymmetric information is large, so that \( a \geq \pi \).

Then the equilibrium is separating, and involves the following:

**The type G firm:** It issues straight debt at time 0, with a face value \( P_d = \frac{I - \phi_1 x_L}{1 - \phi_1} \), maturing at time 2.

**The type M firm:** It issues an ordinary convertible at time 0, with a call price \( K < I \), and a face value \( P_c, x_L < P_c < \frac{1 - \phi_1 x_L}{1 - \phi_1}, \) which is convertible to a fraction \( n_c = \frac{I - \phi_1 x_L}{(1 - \phi_2)(1 - \delta)(1 - \phi_1)x_L} \) of the firm’s equity. It calls back the convertible at time 1, if its conversion value at that time is above the call price \( K \).15

**The type B firm:** At time 0, it raises the amount \( I \) by issuing new equity equal to a fraction \( \frac{I}{(1 - \delta)(1 - \phi_2)x_H + (1 - (1 - \delta)(1 - \phi_2)x_L)} \) of the firm’s total equity outstanding.

Recall that the ex ante probability of realizing the low cash flow (i.e., the probability of financial distress if debt is issued) for the type G and type M firms is a function of both the probability of deterioration \( \phi_1 \), and the probability of the low cash flow in the event of no deterioration (0 for the type G firm, and \( \delta \) for the type M).

The above proposition thus states that, if the ex ante probability of financial distress of the two types of firms is low enough, or the extent of asymmetric information they face is high enough, these two types of firms find it optimal to distinguish themselves from the type B firm (and from each other) by issuing straight debt and

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12 These parametric assumptions ensure that the type G and type M firms are better off by separating themselves from the type B, and are able to deter mimicking by the type B.

13 Note that this assumption in this section affects the range of the parameters in which various equilibria occur but will not change the qualitative nature of these equilibria.

14 The intuition driving this equilibrium is similar to that driving the separating equilibrium in Stein (1992), involving the issuance of ordinary convertibles. While ordinary convertibles are not the focus of this paper, this proposition is useful for our analysis of firms’ choice between ordinary and mandatory convertibles.

15 The conversion value of a convertible is defined as the market value of the equity obtained upon conversion. Given \( x_L < I \), the conversion value of the convertible in the case of no deterioration is \( n_c[(1 - \delta)x_H + \delta x_L] > I > K \), and that in the case of deterioration is \( n_c x_L < x_L < K \).
ordinary convertible debt respectively. The type B firm, on the other hand, does not find it optimal to mimic
the type M and type G firms by issuing similar securities, since its probability of financial distress is greater
than the above two types. It therefore funds its project by issuing equity, thereby fully revealing its type as
well. We now discuss in detail the optimization problem faced by each type of firm in choosing the security to
issue in equilibrium.16

The Type G Firm’s Problem

The type G firm issues debt instead of the other securities since it wants to distinguish itself from the type
M and the type B firms. The type M and type B firms have an incentive to mimic the type G by issuing debt
because, if they could be perceived as the type G, their securities would be overvalued. However, in equilibrium,
they choose not to do so since they know that, if they mimic, they are more likely to incur a financial distress
cost. Such a greater expected financial distress cost exceeds the benefit of mimicking the type G (arising from
the overpricing of their securities) to these firms. Similar to the type M and type B, the type G also may incur
a financial distress cost with some probability if it issues debt. However, issuing debt allows the type G to
separate itself from the type M and type B, thus avoiding the undervaluation of its security which would arise
if it pooled with the other two types. Further, the extent of such undervaluation faced by the type G is larger
as the extent of asymmetric information faced by the firm in the security market is larger. Thus, when the
probability of financial distress of the type G is small enough, or when the extent of asymmetric information
it faces in the security market is severe enough (so that the benefit of separation from the other types is large
enough), then the type G firm prefers to issue debt in equilibrium.

In summary, the type G firm’s decision to issue debt in equilibrium arises from the following optimization
problem:

\[ \max \Pi_G = (1 - \phi_1)(x_H - P_d) - \phi_1 C, \]

16 The equilibrium beliefs of outsiders is as follows: If a firm issues straight debt, they infer that the firm is of type G with
probability 1; if a firm issues an ordinary convertible, they infer that the firm is of type M with probability 1; they convert to equity
at time 1 if the firm does not deteriorate at time 1, and calls back the convertible. If a firm issues equity, they infer that the firm
is of type B with probability 1.
subject to the incentive compatibility (IC) constraints (2) and (3) and the break-even constraint (4):

\[
\Pi_B = [(1 - \delta)(1 - \phi_2)x_H + (1 - (1 - \delta)(1 - \phi_2))x_L](1 - n_c) \tag{2}
\]

\[
\geq \Pi_{B|G} = (1 - \delta)(1 - \phi_2)(x_H - P_d) - [1 - (1 - \delta)(1 - \phi_2)]C,
\]

\[
\Pi_M = (1 - \phi_1)[(1 - \delta)x_H + \delta x_L](1 - n_c) - \phi_1 C \tag{3}
\]

\[
\geq \Pi_{M|G} = (1 - \delta)(1 - \phi_1)(x_H - P_d) - [1 - (1 - \delta)(1 - \phi_1)]C,
\]

\[
I \leq \phi_1 x_L + (1 - \phi_1)P_d. \tag{4}
\]

Here, the IC constraint (2) guarantees that the type B firm will issue the equity in equilibrium instead of issuing debt. \( \Pi_B \) is the value of equity owned by the entrepreneur in the type B firm if the type B does not mimic. \( \Pi_{B|G} \) is the expected cash flow to the entrepreneur if the type B mimics the type G by issuing debt. It equals the residual cash flow after paying \( P_d \) to the investors at time 2, net of the expected financial distress cost, \( [1 - (1 - \delta)(1 - \phi_2)]C \). Similarly, the IC constraint (3) guarantees that the type M firm will issue ordinary convertibles in equilibrium instead of issuing debt. Here, \( n_c \) is the ratio of the total equity to exchange for the convertibles when the convertibles are redeemed at time 1; \( \Pi_M \) is the expected cash flows to the entrepreneur if the type M issues the ordinary convertibles, which equals the value of equity after the redemption of the convertibles net of the expected financial distress cost, \( \phi_1 C \). \( \Pi_{M|G} \) is the expected cash flow to the entrepreneur if the type M mimics the type G by issuing the debt. It equals the residual cash flow after paying the investors at time 2 net of the expected cost of financial distress, \( [1 - (1 - \delta)(1 - \phi_1)]C \). Finally, constraint (4) ensures that the promised payment to the investors at time 2, \( P_d \), should be such that investors at least break-even from their investment in the type G firm.

The Type M Firm’s Problem

As discussed before, the type M firm chooses to separate itself from the type B by issuing convertible debt, rather than issuing equity and pooling with the type B. Such pooling would result in the type M’s securities being undervalued, with the extent of undervaluation increasing in the extent of asymmetric information faced by the firm in the securities market.

The type M firm prefers to separate itself by issuing ordinary convertible debt rather than straight debt. By doing so, it separates itself not only from the type B, but from the type G firm as well, even though mimicking
the type G would have enabled it to obtain a higher price for its securities (since pooling with the type G would allow its securities to be overvalued, while separating from both type G and type B would only allow the firm’s security to be correctly priced). The type M chooses to issue ordinary convertibles rather than straight debt due to the fact that issuing convertibles allows it to reduce the probability of financial distress. This is because, in the event the firm does not deteriorate at time 1, the type M firm’s share price will go up at that time, so that the firm will be able to force conversion to equity by calling back the convertible, thereby avoiding incurring financial distress costs in this scenario. Note, however, that issuing ordinary convertibles does not completely eliminate the probability of financial distress for the type M firm: if the firm deteriorates at time 1, the convertible remains as straight debt, since the conversion value of the convertible will be below the call price $K$ in this case, and the firm is unable to call back the convertible.\footnote{A deteriorated firm, whether it is type M or type B, will not only be unable to use the call provision to force conversion, but will also be unable to use this provision to exchange the convertible for cash. Since $x_L < K$, the call price exceeds the market value of the firm upon deterioration, so that the firm will not be able to raise the cash at time 1 to pay the call price $K$.} However, as long as the reduction in expected costs of financial distress achieved by issuing ordinary convertible debt is greater than the benefit of mimicking the type G by issuing straight debt, the firm prefers to issue the former, thus separating itself from the type G and the type B firms in equilibrium.

In summary, the type M chooses to issue ordinary convertible debt as the solution to the following optimization problem:

$$\text{Max } \Pi_M = (1 - \phi_1)((1 - \delta)x_H + \delta x_L)(1 - n_c) - \phi_1 C,$$

subject to the IC constraints of the type G and type B respectively:

$$\Pi_G \geq \Pi_G|M = (1 - \phi_1)(1 - n_c)x_H - \phi_1 C; \quad (5)$$

$$\Pi_B \geq \Pi_B|M = (1 - \phi_2)((1 - \delta)x_H + \delta x_L)(1 - n_c) - \phi_2 C; \quad (6)$$

and the break-even constraint of investors:

$$n_c(1 - \phi_1)((1 - \delta)x_H + \delta x_L) + \phi_1 x_L \geq I. \quad (7)$$

Here, $\Pi_G|M$ and $\Pi_B|M$ are the expected cash flows that would accrue to the type G and the type B firms respectively if they issue ordinary convertibles, and equal to the value of equity after the redemption of the
convertibles net of their expected costs of financial distress.\(^{18}\)

The Type B Firm’s Problem

The type B’s probability of attaining the low cash flow \(x_L\) is significantly greater than that of the type G and the type M. This means that, if it mimics the type G or the type M by issuing straight debt or ordinary convertibles, the type B firm will face a significantly higher probability of financial distress compared to the above two types. Thus, as long as the deadweight cost of financial distress is significant (so that \(C \geq \frac{\bar{C}}{\bar{c}}\)), the cost of mimicking the type G and type M is larger than the benefit of doing so (arising from the ability to overprice its securities). The type B firm therefore issues equity, revealing its type in equilibrium. In summary, the type B maximizes its objective \(\Pi_B\) given in (2), subject to the type G and type M’s incentive compatibility constraints and the investors’ break-even constraint.

We now study the situation where the extent of asymmetric information in the securities market is small compared to the situation characterized in proposition 1, but the ex ante probability of financial distress facing the issuing firm is larger. Mandatory convertibles emerge as the security issued in equilibrium in this situation. There are two scenarios under which mandatory convertibles are issued. In the first scenario (characterized in proposition 2), mandatory convertibles are issued in a partially pooling equilibrium. In the second scenario (proposition 3), they are issued in a fully pooling equilibrium.

In the following proposition, we denote by \(V_{0MB}^0\) the expected value of a firm which issues mandatory convertibles at time 0, in a partially pooling equilibrium where both the type M and type B firms issue mandatory convertibles; and by \(V_{1MB}^1\) the expected time 1 value of a firm which issues mandatory convertibles at time 0, in the same partially pooling equilibrium, provided the firm does not deteriorate at time 1.

**Proposition 2 (Mandatory Convertibles in a Partially Pooling Equilibrium)** If any one of the following two conditions hold:\(^{19}\)

(a) The probability of deterioration of the type G and type M firms, \(\phi_1\), is larger than a threshold value \(\bar{\phi}\), and \(\delta \geq \bar{\delta}\), so that the type G firm’s low cash flow probability is significantly smaller than that of the type M; or

(b) The extent of asymmetric information facing the issuing firm is moderate, so that \(a \in [\underline{a}, \bar{a}]\).

Then the equilibrium is partially pooling, and involves the following:

**The type G firm:** It issues straight debt at time 0, with face value \(P_d = \frac{1-\phi_1 x_L}{1-\phi_1},\) maturing at time 2.

**The type M and the type B firm:** Both types of firm issue mandatory convertibles at time 0. Upon maturity, the convertibles will be converted to a fraction \(n_m^* \geq \frac{1-x_L}{\sqrt{V_{0MB}} - x_L}\) of the firm’s equity mandatorily, but the value of equity exchanged will be no greater than a cap amount \(U_m^* = \frac{1-x_L}{\sqrt{V_{0MB}} - x_L} V_{MB}^1\). The dividends \(D^*\) on these

\(^{18}\) Note that the IC constraint of the type G firm is satisfied trivially here, since the type G firm does not benefit at all from mimicking the type M.

\(^{19}\) Note that the IC constraint of the type G firm is satisfied trivially here, since the type G firm does not benefit at all from mimicking the type M.
mandatory convertibles will be set equal to $x_L$.

In this equilibrium, the type G still prefers to issue debt and thereby distinguish itself from the type M and type B, while the type M firm prefers to pool with the type B by issuing mandatory convertibles. Remember that, if the type M were to choose to separate from the type B, it can eliminate the potential financing cost arising from asymmetric information (i.e., the undervaluation of securities relative to their intrinsic value), but may incur a cost of financial distress in the future. Thus, when the type M’s expected cost of financial distress is sufficiently large (as in the case $\phi_1 \geq \phi$ and $\delta \geq \delta$), or when the extent of asymmetric information in the market is small enough (as in the case $a \leq \pi$), the cost of separating exceeds the benefit of doing so. The type M therefore chooses to pool with the type B.

The type M will not choose to issue straight debt or ordinary convertible to pool, since these securities may cause the firm to go bankrupt at time 2 if the firm deteriorates at time 1 (recall that the type M’s low cash flow probability is significantly greater than that of the type G). In contrast, in the case of mandatory convertibles, there is no such danger of financial distress, since conversion to equity is mandatory. Further, the type M prefers to issue mandatory convertibles to issuing equity as well. This is because, unlike equity, mandatory convertibles provide a “cap” on the “upside” cash flow paid to security holders, compensating them for this cap with an incremental dividend payment, $D \leq x_L$. The effect of this cap is to reduce the difference in the cash flow obtained by investors in the high and the low cash flow scenarios. This, in turn, means that the difference between the intrinsic (true) values of mandatory convertibles issued by the type M and type B firms is less than the corresponding difference in the intrinsic values of the equity issued by these two types of firms. Thus, the subsidization of the type B firm by the type M is lower if the type M issues mandatory convertibles, so that the undervaluation of the type M firm’s securities due to asymmetric information is less if it issues mandatory convertibles rather than equity (in other words, the market value of mandatory convertibles is less sensitive to asymmetric information compared to that of equity).

Thus, in equilibrium, the type M firm maximizes:

$$\Pi_M = \phi_1(1 - n_m)(x_L - D) + (1 - \phi_1)(1 - \frac{U_m}{V_{MB}})(1 - \delta)x_H + \delta x_L - D], \quad (8)$$

Outside investors infer that a firm is of type G with probability 1, if the firm issues straight debt. If the firm issues a mandatory convertible, they infer that the firm is of type M with probability $\frac{21}{72+73}$ or type B with probability $\frac{72}{72+73}$. 

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subject to the IC constraint (9) ensuring that the type G has no incentive to mimic, and the break-even
constraint of investors (10):

\[ \Pi_G \geq \Pi_{G|MB} = \phi_1(1 - n_m)(x_L - D) + (1 - \phi_1)(1 - \frac{U_m}{V^1_{MB}})(x_H - D), \quad (9) \]

\[ I \leq n_m(x_L - D)\frac{\gamma_3 \phi_2 + \gamma_2 \phi_1}{\gamma_2 + \gamma_3} + \frac{U_m}{V^1_{MB}}(V^1_{MB} - D)(1 - \frac{\gamma_3 \phi_2 + \gamma_2 \phi_1}{\gamma_2 + \gamma_3}) + D. \quad (10) \]

Here, \( \Pi_G \) is given in (1) and \( \Pi_{G|MB} \) is the cash flow accruing to the type G if it mimics the type M and type B;
\( n_m(x_L - D) \) is the value of equity received by the investors if the firm deteriorates; and \( \frac{U_m}{V^1_{MB}}(V^1_{MB} - D) \) is the value of the equity received by the investors if the firm does not deteriorate.

In equilibrium, the type G firm still chooses to issue debt and separate from the type M and type B, since, as long as \( \delta \geq \tilde{\delta} \), its benefit from separating, namely, avoiding the undervaluation of its securities due to asymmetric information, is greater than the cost of doing so (namely, incurring a financial distress cost with a certain probability). Recall that, the financial distress (low cash flow) probability is always lower for the type G than for the type M, so that the expected cost of issuing debt is always lower for the type G than for the type M. At the same time, since \( \delta \geq \tilde{\delta} \), the difference in the low cash flow probability between the type G and type M (as well as the type B) firm is significant. Therefore, the difference in the intrinsic values of these types of firms is large enough that pooling with the other two firm types imposes large costs on the type G firm. As a result, the type G firm finds it advantageous to separate from the other firm types by issuing straight debt.

In the following proposition, we denote by \( V^0_{GMB} \) the expected value of a firm at time 0 if all three types of firms pool by issuing mandatory convertibles at time 0; and by \( V^1_{GMB} \) the expected value of a firm at time 1 if all three types issue mandatory convertibles at time 0, and the firm does not deteriorate at time 1.

**Proposition 3 (Mandatory Convertibles in a Fully Pooling Equilibrium)** If any one of the following two conditions hold:

(a) If the probability of deterioration of the type G and type M firms, \( \phi_1 \), is larger than a certain threshold value \( \tilde{\phi} \), or if \( \delta < \tilde{\delta} \); or (b) If the extent of asymmetric information facing the issuing firm is small, so that \( \alpha \leq \tilde{\alpha} \).

Then all three types of firms issue mandatory convertibles at time 0. Upon maturity, the convertibles will be converted to a fraction \( n^*_m \geq \frac{1 - x_L}{V^*_GMB - x_L} \) of the firm’s equity mandatorily, with the value of the equity exchanged subject to a cap amount \( U^* = \frac{1 - x_L}{V^*_GMB - x_L}V^1_{GMB} \). The dividends \( D^* \) on these mandatory convertibles will be set equal to \( x_L \).\(^{20}\)

\(^{20}\) Outsiders’ beliefs regarding the probability of the three types of firm remains the same as their prior probability even after the announcement of the mandatory convertible issue.
When $\phi_1 \geq \bar{\phi}$, the probability of financial distress of the type G is large enough that the cost to the type G of separating from the type M and the type B (and thus ensuing that it is correctly valued in the securities market) is overwhelmed by the expected cost of financial distress it incurs by issuing debt. At the same time, if $\delta < \bar{\delta}$, the difference in the low cash flow probability between the type G and type M firms is small enough so that their intrinsic values are also close. This, in turn, means that the cost to the type G of pooling with the type M is not too large. As a result, the type G firm finds it advantageous to pool with the type M and the type B by issuing mandatory convertibles, rather than separating from the other two types by issuing debt. Further, the type G firm prefers to issue mandatory convertibles rather than equity to pool with the other two types. The intuition underlying this preference is the same as that discussed in detail in the context of the type M pooling with the type B in the previous proposition, and arises from the fact that the cap of the mandatory convertible makes its market value less sensitive to asymmetric information than that of equity. Thus, the type G maximizes:

$$\Pi_G = (1 - n_m)\phi_1(x_L - D) + (1 - \phi_1)(1 - \frac{U_m}{V^1_{GMB}})(x_H - D),$$

subject to the break-even constraint of investors:

$$n_m(x_L - D)\text{Prob(deterioration)} + \frac{U_m}{V^1_{GMB}}(V^1_{GMB} - D)\text{Prob(no deterioration)} + D \geq I.$$

The type M’s problem is similar to that discussed under the previous proposition; it also prefers to pool with the type G and the type B in equilibrium by issuing mandatory convertibles, for the reasons discussed under proposition 2.

**Proposition 4 (Announcement Effects of Mandatory Convertibles)** The abnormal equity return upon announcement of an issue of mandatory convertibles is zero or negative. In particular, when mandatory convertibles are issued as part of a fully pooling equilibrium, the abnormal equity return upon announcement of issuing mandatory convertibles is zero; it is negative when mandatory convertibles are issued as part of a partially pooling equilibrium.\(^{21}\)

As we saw before, mandatory convertibles are issued as part of either a fully pooling or a partially pooling equilibrium. In the case of a fully pooling equilibrium, no information about firm type is conveyed to the market by the issue of a mandatory convertible, so that the announcement effect is zero. In the case of a partially pooling equilibrium, only the type M and type B issue mandatory convertibles, so that the market re-values the firm

\(^{21}\) It can be shown that, when $\gamma_3 < \pi$, issuing ordinary convertibles results in a negative abnormal equity return upon announcement of the issue. Given that ordinary convertibles are not the focus of this paper, we choose not to discuss this in detail.
(and its equity) downward to reflect this new information (recall that the market value of the firm prior to the issue would be the average of the values of the type G, type M and type B firms).

4 Equilibrium Design of Mandatory Convertibles

In this section, we will analyze in detail the equilibrium design of mandatory convertibles. Due to space considerations, we discuss here only the case of a fully pooling equilibrium. However, the analysis is similar in the case of a partial pooling equilibrium. In this section, we relax our earlier assumption that $\pi = 1$ and $\bar{d} = 1$; we now allow for $\pi \leq 1$ and $\bar{d} \leq 1$.

**Proposition 5 (Equilibrium Design of Mandatory Convertibles)** In a fully pooling equilibrium where all three types of firms issue mandatory convertibles:

(a) The type G firm sets the exchange ratio $n_m$ such that $n_m^* = \pi$ (i.e., the highest possible); the dividend $D$ such that $D^* = \bar{d}x_L$ (the highest possible); and the cap on the mandatory convertible $U_m^*$ is such that it is the lowest possible.

(b) $U_m^*$ is a function of $\pi$ and $\bar{d}$ (given in the appendix). It is decreasing with $\bar{d}$ and $\pi$.

(c) In particular, if $\bar{d} = 1$ and $\pi = 1$, then $D^* = x_L$, and $U_m^* = V_{GB} \frac{1-x_L}{x_m V_{GB} - x_L}$, and $n_m^* \geq \frac{1-x_L}{x_m V_{GB} - x_L}$.

In the fully pooling equilibrium, the type G firm designs the mandatory convertible optimally to minimize its cost of pooling with the type M and the type B firms. The pooling cost arises because investors are not aware of the type of the firm and thus price the firm according to their prior beliefs. Therefore, to minimize this pooling cost, the mandatory convertible is designed to be minimally affected by the asymmetric information in the securities market. This is accomplished by lowering the cap $U_m$ of the mandatory convertible and raising the exchange ratio $n_m$. When this is done, the difference in the expected payment to investors in the high and the low cash flow scenarios is reduced. This reduces the difference between the intrinsic values of the mandatory convertibles issued by the three types of firms so that the market value of the mandatory convertible become less sensitive to the effects of asymmetric information. Of course, when the investors’ upside is capped, they have to be compensated for this through a higher dividend, so that they break even on their investment in the firm (i.e., constraint (10) is satisfied). Since, as long as $D \leq \bar{d}x_L$, the firm is able to pay investors the promised amount with probability 1 regardless of firm type, dividends are unaffected by asymmetric information, so that the net effect of setting the cap $U_m$ as low as possible, and the exchange ratio $n_m$ and the dividend $D$ as high as possible.

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\[22\] Details of this analysis is available to interested readers upon request.
is to minimize the sensitivity of the market value of the convertible to the effects of asymmetric information.\textsuperscript{23}

In other words, lowering the cap $U_m$ and raising $n_m$ reduces the subsidization of the type M and the type B firms by the type G, thereby reducing the extent of undervaluation of the type G firm’s mandatory convertibles due to asymmetric information.\textsuperscript{24}

5 Implications and Testable Hypotheses

Our model generates several testable implications. We will now describe four of these implications and the testable hypotheses generated by them, which we will test in the empirical section of this paper.

1. Choice between ordinary versus mandatory convertibles and the probability of financial distress: Our model implies that, in a sample of firms issuing either ordinary or mandatory convertibles, those firms with a larger ex-ante probability of financial distress (bankruptcy probability) are more likely to issue mandatory convertibles, while those with a smaller probability of financial distress are more likely to issue ordinary convertibles.\textsuperscript{25} As we saw from propositions 2 and 3, when their probability of financial distress is high, higher-valued firms prefer to pool with lower-valued firms by issuing mandatory convertibles, for the reasons discussed under proposition 2. In contrast, when their probability of financial distress is low, higher-valued firms prefer to distinguish themselves from lower-valued ones by issuing other securities, such as ordinary convertibles or straight debt (as discussed under proposition 1). Therefore, in a sample of firms issuing either mandatory or ordinary convertibles, those

\textsuperscript{23} For analytical simplicity, we focus only on the case where $D < \bar{d}x_L$ so that the dividends are sure cash flows and therefore unaffected by asymmetric information. As long as there is no uncertainty associated with dividends, lowering the cap and increasing the dividends unambiguously reduces the sensitivity of the market value of the mandatory convertible to asymmetric information. Of course, firms can lower the cap on the mandatory convertible even more by promising investors additional (uncertain) cash flows as dividends, i.e., they can set $D > \bar{d}x_L$. However, in this case, the additional dividends are affected by asymmetric information, so that the effect of doing this on the sensitivity of the market value of the mandatory convertible to asymmetric information is ambiguous.

\textsuperscript{24} The following numerical example demonstrates parts (a), (b), and (c) of the above proposition. Set $\delta$, the probability of the low cash flow if there is no deterioration at time 1, equal to 0.5; the probabilities of deterioration of the type G and M, $\phi_1 = 0.5$ and that of type B $\phi_2 = 0.8$; the prior beliefs $\gamma_1 = 0.5$, $\gamma_2 = 0.3$, and $\gamma_3 = 0.2$; the cash flows $x_H = $100 and $x_L = $20; and the investment $I = $20. Further, let $\bar{d} = 0.5$ and $\bar{p} = 1$. In this case, all three types of firms pool by issuing mandatory convertibles, selling it to investors at $20, thus raising the full investment amount. The mandatory convertibles will be designed optimally such that the exchange ratio $n_m^*$ is 1; the cap $U_m^* = $31.2; and the dividends $D^*$ is $10$ (thus maximizing the expected time 2 payoff of the type G firm; this payoff is $27.33$). Consider now a second example, with $\bar{d} = 0.75$, and keeping all other parameters the same as before. Then, all three types of firms would pool by issuing mandatory convertibles, optimally designed such that the exchange ratio $n_m^*$ is 1; the cap $U_m^* = $23.68; and the dividends $D^* = $15. In this case, the type G firm’s expected payoff is $28.02$. Finally, consider a third example where $\bar{d} = 1$, with all other parameters remaining the same as before. In this case, the equilibrium design of the mandatory convertibles issued by the firm is such that the exchange ratio $n_m^*$ is 1; the cap $U_m^* = $15; and the dividends $D^* = $20. In this case, the type G firm’s expected payoff is $33.14$. Notice from the above three examples that as the cash constraint $\bar{d}$ on the firm is relaxed (so that the firm is able to pay out more and more of its time 2 lower cash flow as dividends), it optimally sets a lower and lower cap on the mandatory convertible. Further, notice that, as the firm sets a lower cap, the subsidization of the lower firm types by the type G firm is reduced, thus increasing the expected payoff to type G firm insiders.

\textsuperscript{25} While our model has implications for other pairs of securities as well, we focus our empirical tests on a sample of firms which have chosen to issue either mandatory or ordinary convertibles.

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with a smaller ex-ante financial distress probability on average will issue ordinary convertibles and those with a larger financial distress probability will issue mandatory convertibles. This will be the first hypothesis (H1) we test later. We will use standard proxies for the financial distress probability such as the Altman’s Z-score to test this hypothesis: firms with a larger Z-score (smaller financial distress probability) are more likely to issue ordinary convertibles while those with a smaller Z-score (larger financial distress probability) are more likely to issue mandatory convertibles.26

2. Choice between ordinary versus mandatory convertibles and the extent of asymmetric information: In a sample of firms issuing either ordinary convertibles or mandatory convertibles, those firms facing a smaller extent of asymmetric information are more likely to issue mandatory convertibles, and those facing a greater extent of asymmetric information are more likely to issue ordinary convertibles. This implication also follows directly from propositions 1, 2, and 3. This will be the second hypothesis (H2) we test later. To test this hypothesis, we will make use of standard proxies for asymmetric information such as firm size, number of analysts following a firm, standard deviation of analysts forecasts, forecast error, etc.27

3. The announcement effect of mandatory convertibles: The abnormal equity return upon the announcement of an issue of mandatory convertibles will be zero (in a fully pooling equilibrium) or negative (in a partially pooling equilibrium). Further, this announcement effect will be, on average, decreasing (i.e., more negative), with the ex-ante probability of financial distress of the issuing firm. The first implication above follows directly from proposition 4. The second implication follows from proposition 2 and 3. We know from these propositions that, as the difference in the ex-ante financial distress probability between higher and lower intrinsic value firms becomes larger, mandatory convertibles are more likely to be issued in a partially pooling equilibrium (negative announcement effect) rather than in a fully pooling equilibrium (zero announcement effect). Further, whenever the average financial distress probability across firm types increases, the financial distress probability of lower intrinsic-value firms is likely to increase faster than that of higher intrinsic-value firms, resulting in a larger

26 It is worth noting that the private information assumed in our setting does not preclude the use of the Altman’s Z-score as the measure of bankruptcy probability in our empirical tests. Conceptually, in our setting, one can think of a firm’s bankruptcy probability as consisting of two parts: a publicly observable component (common to all firm types and therefore reflecting the average bankruptcy probability across firm types) and a second component which is private information to firm insiders. Since proxies such as the Altman’s Z-score are computed using only publicly available information, they will capture only the first component, namely, the average bankruptcy probability across firm types. Thus, since our predictions relate only to the average bankruptcy probability of a sample of mandatory convertible or ordinary convertible issues, we need to make use only of this average Z-score, which can indeed be computed.

27 We will discuss these proxies of asymmetric information in detail in the next section.
difference between the financial distress probabilities of higher and lower intrinsic-value firms.\textsuperscript{28} Thus, the likelihood of mandatory convertibles being issued in a partially pooling (rather than fully pooling) equilibrium (and therefore a more negative announcement effect) will be increasing in the average ex-ante financial distress probability of a sample of firms issuing mandatory convertibles (as measured by standard proxies like the Altman’s z-score). This is the third hypothesis ($H_3$) we test later.

4. \textit{The operating performance of mandatory convertible issuers:} If mandatory convertibles are issued in a fully pooling equilibrium (where all three types of firms issue mandatory convertibles) as characterized in proposition 3, then the long-term operating performance of mandatory convertible issuers will not be poorer than that of a sample of comparable non-issuers. On the other hand, if mandatory convertibles are issued as part of a partially pooling equilibrium, as characterized in proposition 2 (where only lower quality firms issue mandatory convertibles), then mandatory convertible issuers will underperform in terms of long-term operating performance, compared to a sample of non-issuers.\textsuperscript{29} Therefore, the fourth hypothesis ($H_4$) we test is whether the long-term operating performance of mandatory convertible issuers is significantly different from that of a matched sample of non-issuers.

6 \hspace{1em} \textbf{Empirical Evidence}

6.1 \hspace{1em} \textbf{Data and Sample Selection}

We identify new issues of mandatory convertibles and ordinary convertibles between 1991 to 2001 from Securities Data Corporation’s (SDC Platinum) New Issues Database. Our initial sample includes 151 issues of mandatory convertibles and 650 issues of ordinary convertibles. Figure 4 presents the time distribution of the issues of ordinary and mandatory convertibles, as well as the dollar value of the ordinary and mandatory convertible market over the years in our sample period. As can be seen, both the number of mandatory convertible issues, as well as the value of the mandatory convertible market grew over the years in our sample period.

\textsuperscript{28} When economic conditions worsen, so that the average bankruptcy probability across firms increases, lower intrinsic value firms will be affected much more than higher intrinsic value firms, since the latter are likely to have a larger cash cushion which would prevent them from facing financial difficulties under a wider range of economic conditions.

\textsuperscript{29} Note that if mandatory convertible issuers indeed have private information at the time of issue about their firms’ future performance, this negative prediction will be realized over the coming years in terms of poor operating performance relative to a matched sample of non-issuers.
We first obtained the firm specific characteristics of the issuer from the firm’s annual report data on the Compustat database.\textsuperscript{30} This leaves us with a sample of 325 ordinary convertibles and 124 mandatory convertibles which are covered by Compustat. Details of each convertible issue are then hand-collected from its prospectus; prospectuses are obtained from the Global Access database. We eliminate issues of ordinary and mandatory convertibles where the primary motive for these issuances is to obtain tax benefits.\textsuperscript{31} We also eliminate those mandatory convertibles that are synthetically created by investment banks and those involving secondary distribution of equity (i.e., where the equity offered upon conversion belonged to a firm other than the issuer).\textsuperscript{32} After eliminating these issues, we have a sample of 78 mandatory convertible issues and 220 ordinary convertible issues. In our sample, there are 12 different variations of mandatory convertibles: ACES, DECS, EQUITY SECURITY UNITS, FELINE PRIDES, MARCS, MEDS, PEPS, PERCS, PIES, PRIDES, TAPS, and TRACES. We provide detailed descriptions of these mandatory convertible variations in table 5. Even though these mandatory convertibles are designed by various investment banks and differ in their specific payoff structures, they share the same three features described in the introduction; mandatory conversion, capped (or limited) capital appreciation, and higher dividend yield compared to common stock.

In section 6.2, we will first empirically investigate the impact of information asymmetry and bankruptcy probabilities on the firm’s choice between mandatory and ordinary convertibles. In this part of study, we further require the issuing firms in our sample to be covered by the IBES database. We also remove from our sample those issues that are associated with extreme values due to data reporting or recording errors. Thus, our final sample in this part consists of 41 mandatory convertibles and 153 ordinary convertibles.\textsuperscript{33}

\textsuperscript{30} The annual report data from Compustat was matched in the following manner. For a given issue date we linked up that firm’s annual report data for the fiscal year end immediately preceding the issue date. For example, if the issue date was March 1995, and the firm’s fiscal year end was December, we matched this firm to its annual report of December 1994.

\textsuperscript{31} An example of ordinary convertibles that are designed primarily to provide tax benefits to issuers is Liquid Yield Option Notes (LYONs), and an example of mandatory convertibles designed for tax benefits is Participating Hybrid Option Note Exchangeable Securities (PHONES).

\textsuperscript{32} Examples of synthetic mandatory convertibles are the Structured Yield Products Exchangeable for Stock (STRYPES) designed by Merrill Lynch. These convertible issues are typically undertaken by investment banks using special-purpose financing vehicles such as a trust. Shares of such issues mandatorily convert to the portfolio of securities held by the investment bank. On the other hand, mandatory convertibles involving secondary distributions of equity typically involve firms issuing mandatory convertibles which convert into shares of another firm whose equity is held by them. An example of a mandatory convertible issue involving secondary distribution of equity was the DECS issue undertaken by American Express on October 1993, which mandatorily converted to shares of FDC common stock held by American Express on October 1996. (See, McDonald (2003) for an excellent discussion of mandatory convertibles involving secondary distribution of equity). We choose to eliminate both of these types of mandatory convertibles since our focus here is on mandatory convertibles involving primary distribution of equity.

\textsuperscript{33} Out of the ordinary convertibles in our sample, we have 123 issues of ordinary convertible debt and 30 issues of convertible preferred stock. In our empirical analysis, we will club them together and refer to them as ordinary convertibles.
In section 6.3, we will study the announcement effects of mandatory convertibles. In this part of our analysis, we will require the issuing firms in our sample to be covered by the CRSP database, which leaves us with a final sample consisting of 70 issues of mandatory convertibles and 200 issues of ordinary convertibles.

6.2 Choice between Mandatory and Ordinary Convertibles

In this section, we first discuss variable constructions, and then present the results of our empirical tests on a firm’s choice between issuing mandatory and ordinary convertibles, i.e., hypotheses H1 and H2.

6.2.1 Measurement of Information Asymmetry, Financial distress Probability, and Control Variables

Following Christie (1987), Krishnaswami and Subramaniam (1999), and Clarke and Shastri (2001), we construct four different measures of information asymmetry based on the analyst forecasts in the final month of the fiscal year prior to the announcement date of each convertible. The first measure is the number of analysts following the firm, NUMA. Firms with higher analyst following can be expected to have a lower degree of information asymmetry. The second measure is the error in the earnings forecast, FORERR. We measure forecast error as the absolute difference between the average forecasted earnings and the actual earnings per share divided by the price per share at the end of the fiscal year. Firms with a higher forecast error can be expected to have a greater extent of information asymmetry. Our third measure of information asymmetry is the standard deviation of analyst forecasts, STDEV, and our fourth measure is the coefficient of variation of analyst forecasts, COVAR, which is defined as the ratio of STDEV to the absolute value of the average of analyst forecasts. Both STDEV and COVAR measure the dispersion in analyst earnings forecasts for a firm; a higher STDEV or a higher COVAR represents greater disagreement among the analysts, and therefore a greater extent of information asymmetry.

We measure the issuing firm’s probability of financial distress at the time of the security issue by Z-score, ZSCR, based on Altman’s (1968) bankruptcy prediction model. In particular, we follow MacKie-Mason (1990) and define ZSCR as (3.3*EBIT/SALE + 1.0*SALE/TA + 1.4*RE/TA + 1.2*WC/TA + 0.6*MKVALF/DT) where EBIT is earnings before interest and taxes, SALE is total sales, RE is the retained earnings, WC is working capital, and DT is book value of debt. Firms with higher Z-scores are expected to have a lower probability of financial distress, while those with lower Z-scores are expected to a higher probability of financial distress. We
also use firm leverage at the time of issue as an additional proxy for bankruptcy to check the robustness of our empirical results. Leverage, \( \text{LEVG} \), is defined as book value of debt divided by market value of assets which is equal to the book value of assets minus the book value of common equity plus the market value of common equity.

In addition to measures of information asymmetry and financial distress probability, we use four control variables in our empirical tests regarding a firm’s choice between issuing mandatory versus ordinary convertible securities. First, we control for firm size, \( \text{FSZE} \), defined as the log of market value of total assets.\(^{34}\) Note that firm size can also be viewed as a proxy for information asymmetry, since more information is usually available to outsiders about larger firms (see, e.g., Ritter, 1984). Second, we control for the market-to-book ratio of the issuing firm (\( \text{MKBK} \)), which is defined as the ratio between the market value and the book value of total assets. Firms with higher market-to-book ratios have more growth opportunities, which should be associated with a greater extent of information asymmetry. Third, we control for a dummy variable, \( \text{SYND} \), which is equal to 1 if the issue was syndicated by a group of underwriters, and 0 otherwise. While we use \( \text{SYND} \) as a control variable, whether or not a security issue is syndicated is likely to have an effect, among other things, on the extent of information asymmetry facing the firm in the securities market.\(^{35}\) Finally, we control for financial institutions in our sample that have issued ordinary or mandatory convertibles. We construct a dummy variable, \( \text{FIN} \), which is equal to 1 if the issuer was a financial institution, and 0 otherwise.

### 6.2.2 Univariate Analysis

In our univariate tests, we study the differences in the mean and median firm characteristics between mandatory convertible issuers and ordinary convertible issuers. Based on H1, we expect that firms issuing mandatory convertibles have a smaller \( \text{ZSCR} \) and higher \( \text{LEVG} \) (higher financial distress probability), compared to firms issuing ordinary convertibles. Based on H2, we expect that firms issuing mandatory convertibles have a smaller extent of asymmetric information, i.e., lower \( \text{FORERR}, \text{STDEV}, \text{COVAR} \), and \( \text{MKBK} \), and a higher value for \( \text{NUMA}, \text{FSZE} \), and \( \text{SYND} \), compared to firms issuing ordinary convertibles.

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\(^{34}\) We also have conducted our empirical tests using alternate measures for firm size, e.g. log of book value of assets or log of sales. Our results remain invariant to the different choice of the firm size measures.

\(^{35}\) See, e.g., the analysis of Chemmanur and Fulghieri (1994), who demonstrated that, as the reputation of an underwriter is greater, the more credibly he is able to communicate the firm’s value to the securities market, thereby lowering the extent of information asymmetry facing the firm. It is reasonable to expect that a syndicate of investment banks serving as underwriters would have greater reputation and would therefore be able to communicate with the securities market more effectively.
Panel A of table 1 reports the results from the univariate tests of H1. As expected, we find that, on average, ZSCR for mandatory convertible issuers is nearly four times smaller than that of ordinary convertible issuers (3.23 versus 12.02), and mandatory convertible issuers have a LEVG 33% higher than that of ordinary convertible issuers (25.8% versus 19.4%). Both differences are significant at the 1% level in both the t-test and the Wilcoxon rank-sum test.\(^{36}\) This result is consistent with hypothesis H1, suggesting that firms issuing mandatory convertibles have a higher ex-ante probability of financial distress than firms issuing ordinary convertibles.

Panel B of table 1 reports the results from the univariate tests of H2. We find that NUMA is significantly higher for mandatory convertible issuers than for ordinary convertible issuers at the 1% level according to both the t-test and the Wilcoxon rank-sum test. Firms that issued mandatory convertibles had on average 17 analysts following them compared to 10 analysts following ordinary convertible issuers. We also find that the mean and median differences of forecast error, \textit{FORERR}, are significantly negative at the 1% level in both the t test and the Wilcoxon test. Similarly, the median difference of coefficient of variation of analyst forecasts, \textit{COVAR}, is negative and significant at the 1% level in the Wilcoxon test. These two results suggest that analysts make less errors and disagree with each other less often on the earnings forecasts of mandatory convertible issuers than on the forecasts of ordinary convertible issuers. All of the above findings are consistent with H2, suggesting a lower degree of information asymmetry for firms issuing mandatory convertibles compared to ordinary convertible issuers.

Panel C of table 1 reports the univariate comparisons of the control variables. We find that the average firm issuing mandatory convertibles is 22% larger than that issuing ordinary convertibles. Further, the average market to book ratio, \textit{MKBK}, for mandatory convertible issuers is about 36% lower than that of ordinary convertible issuers. Finally, mandatory convertibles are more likely issued by financial institutions compared to ordinary convertibles, and their issues are more likely to be syndicated (about 63.4% of mandatory convertible issues are syndicated compared to 21.6% of ordinary convertible issues). All the above results are significant at the 1% level in both the t-test and the Wilcoxon test, except the result on \textit{FIN}, which is significant only in the Wilcoxon test. Since an issuer with larger size, less growth options (i.e., smaller market to book ratio),

\(^{36}\) We use the \textit{t}-test for the difference in means and the Wilcoxon rank-sum test (z-statistic) for the difference in the distributions of the two samples of convertible issues. We also conducted a Chi\(^2\) test for the difference in medians, which is not reported in Table 1 for space reasons. The significance level of these variables remain unaltered when using the Chi\(^2\) test.
or with its securities issued through a syndicate is likely to face less asymmetric information, our findings are consistent with hypothesis H2, suggesting that mandatory convertibles issuers face a lower degree of information asymmetry than ordinary convertible issuers.

6.2.3 Multivariate Analysis

In this part, we examine the firm characteristics that influence an issuer’s choice between ordinary and mandatory convertibles, using a multinomial logistic regression framework. We categorize firms according to the type of convertible securities they issued, and construct a dependent variable, TYPE, which takes the value of 1 if the security issued by the firm is a mandatory convertible, or 0 if the security issued is an ordinary convertible. The independent variables used are firm specific proxies of information asymmetry, financial distress probability, and other control variables discussed in the preceding sub-section. The general form of the regression model is presented below:

\[
\ln \left( \frac{\Pr (TYPE = 1)}{1 - \Pr (TYPE = 1)} \right) = \beta_0 + \beta_1 [INFO] + \beta_2 ZSCR + \beta_3 FSZE + \beta_4 MKBK + \beta_5 SYND + \beta_6 FIN + \varepsilon, \quad (13)
\]

where INFO is the set of variables measuring the degree of information asymmetry associated with the issuing firm, i.e., it consists of NUMA, FORERR, STDEV, and COVAR. Based on H1, firms with higher financial distress probabilities (smaller values of ZSCR) are more likely to issue mandatory convertibles than issuing ordinary convertibles. Thus, we predict that the coefficient of ZSCR be negative. Based on H2, firms facing a smaller degree of information asymmetry are more likely to issue mandatory convertibles. Thus, we expect the coefficients of NUMA, FSZE, and SYND to be positive, and the coefficients of FORERR, STDEV, COVAR, and MKBK to be negative.

The results of this multivariate analysis are presented in Table 2. Given the possibility that the information asymmetry proxies are correlated with each other, we introduce them one by one in regressions 1 through 5, together with ZSCR (the proxy for the financial distress probability), while controlling for FSZE, MKBK, SYND, and FIN in all the different specifications. As expected, we find that the coefficient of ZSCR is negative and significant in all five regressions. We also find that the coefficients of all the four information asymmetry measures have the expected signs. However, the coefficient of NUMA is negative and insignificant in the first
regression, which may result from the correlation between NUMA and FSZE. Thus, in regression 2, we exclude FSZE from the regression, and the coefficient of NUMA becomes positive and significant at the 1% level, as expected. The coefficients of FORERR and COVAR are significant at the 5% and 10% levels, respectively in all the specifications, while the coefficient of STDEV is insignificant.

In regression 6, we introduce all the asymmetric information proxies together.\(^37\) Our results show that the coefficient of ZSCR is negative and significant at the 10% level. This result is consistent with H1, suggesting that firms facing a higher financial distress probability are more likely to issue mandatory convertibles, rather than ordinary convertibles. The financial distress probability is also economically significant: a reduction in ZSCR (increase in financial distress probability) by one standard deviation leads to an increase in the sample average probability of issuing a mandatory convertible by 35%.\(^38\) Our results also show that the coefficients of FORERR and COVAR are negative and significant at the 1% and 5% level respectively, suggesting that firms facing a lower extent of information asymmetry are more likely to issue mandatory convertibles. A reduction in FORERR (decrease in information asymmetry) by one standard deviation leads to an increase in the sample average probability of issuing a mandatory convertible by 4.5%. These results are consistent with our hypothesis H2. However, we find that the coefficient of NUMA is insignificant. As we discussed before, this insignificance may be caused by the multicollinearity between NUMA and FSZE; NUMA has the expected sign when FSZE is excluded. A one standard deviation increase in NUMA (decrease in information asymmetry) increases the sample average probability of issuing a mandatory convertible by 4.2%, similar to the economic impact of the other information asymmetry proxies.

The coefficients of FSZE, FIN, and SYND are significantly positive in all the specifications. An increase in FSZE by one standard deviation leads to an increase in the sample average probability of issuing a mandatory convertible by 8.8%. Consistent with our findings in the univariate tests, this suggests that firms issuing mandatory convertibles are likely to be larger, that the probability of issuing a mandatory rather than an

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\(^{37}\) We include only one of STDEV and COVAR in the regression, since they both measure the level of dispersion in analyst forecasts. The results are similar in both cases.

\(^{38}\) As a robustness check, we also use LEVG as a proxy for the probability of bankruptcy. In this test, since LEVG may be systematically related to information asymmetry and other firm specific characteristics in the model, we first use an instrumental variable approach in endogenizing LEVG. We then re-estimate all the regressions using the endogenized LEVG as the proxy for bankruptcy probability. The results are similar to those presented in Table 2. The coefficient of LEVG is positive and significant in all the regression specifications, which is consistent with hypothesis H1.
ordinary convertible is greater for financial firms, and that an issue of mandatory convertibles is more likely to be syndicated than an issue of ordinary convertibles.\footnote{We have also conducted our empirical analysis separately for each category of ordinary convertibles, i.e., convertible debt and convertible preferred stock. The results obtained for each category are qualitatively similar to the ones that are reported in this paper.}

### 6.3 Announcement Effects of Mandatory Convertibles

In this sub-section, we test our hypothesis H3 and present the results on the announcement period abnormal returns of mandatory convertible issues. We use the filing date as recorded by SDC as the announcement date for each issue.\footnote{In nearly all the cases, the first public announcements of these issues in either The Wall Street Journal, the Lexis-Nexis database, or the Dow Jones Newswire coincide with the filing dates of the issues as recorded by the SDC database. However, one advantage of using the filing date as the announcement date (consistent with prior empirical studies of several other securities; see e.g., Best (1994)) is that we are able to keep those issues that were not reported on in either The Wall Street Journal, the Lexis-Nexis database, or the Dow Jones Newswire.} To compute the cumulative abnormal returns, we employ the standard event-study methodology. We obtain parameter estimates for the market model over a period of 250 trading days, starting from 296 days prior and ending on the 46th day prior to the announcement date of the convertible issue. We then calculate the cumulative abnormal returns for firm $i$ in the different event windows ranging from 3 days before, to 3 days after the announcement day. For example, the cumulative abnormal return of the $i^{th}$ firm, $CAR_i$, over the $[-1, +1]$ event window is defined as: $CAR_i = AR_{i,-1} + AR_{i,0} + AR_{i,+1}$, i.e., the sum of the abnormal returns for firm $i$ for the day prior to the announcement day, the announcement day, and the day after the announcement day.

Based on our hypothesis H3, we expect that the average $CAR$ for mandatory convertible issuers upon announcements (i.e., the announcement effect) will be either zero (in a fully pooling equilibrium) or negative (in a partially pooling equilibrium). This implies that, for the reasons detailed in section 5, the announcement effect will be more negative as the financial distress probability increases. Thus, if we split our sample based on financial distress probability ($ZSCR$), the sub-sample with issuers having greater financial distress probabilities (low $ZSCR$s) is predicted to have a more negative announcement effect, while the sub-sample with issuers having smaller financial distress probabilities (high $ZSCR$s) is predicted to have a less negative, or zero, announcement effect. In order to test this hypothesis, we first conduct a $t$-test for the null hypothesis that the announcement effect of mandatory convertible issuers is equal to zero. Then, we split our sample of mandatory convertible issues by their $ZSCR$ (financial distress probability) at the announcement dates of the issues, and compare the
announcement effects between two sub-samples.

Table 3 reports the announcement effect, averaged across all firms. As shown in the first column of Panel A, the announcement effect on the announcement date (event window [0]) is -0.7% and significant at the 5% level. The announcement effects are insignificant in the other event windows, although the average CARs in these windows are negative and around -0.4%.\footnote{In results not reported, we have also calculated the abnormal returns experienced upon the announcement of ordinary convertible issues in our sample. We find that firms issuing ordinary convertibles have a significantly negative announcement effect (around -1.1%) for all the event windows. For the first three event windows, the abnormal returns are significant at the 1% level, while for the last two they are significant at the 5% level. These results are consistent with announcement effect of ordinary convertibles as documented in the previous literature (see, e.g., Dann and Mikkelson (1984), Eckbo (1986), and Mikkelson and Partch (1986)).} These results are consistent with H3.

The other columns of panel A in table 3 report the announcement effects of mandatory convertible issuers after we split the mandatory convertible sample into two groups: those with high ZSCRs (above median) and those with low ZSCRs (below median). As shown in table 3, the sub-sample of firms with high ZSCR (low financial distress probability) has on average zero (i.e., insignificant) announcement effect for all the event windows, while the sub-sample of firms with low ZSCRs (high financial distress probability) has on average a significantly negative announcement effect for all event windows except [-3, 0]. In particular, the mean CAR of issuers with low ZSCRs in event window [0], [-1, 0], [-1, +1], and [-3, +3] are -0.9%, -1.2%, -1.7% and -1.9% respectively, and all these CARs are significant at the 1% level. In comparison, the mean CAR of issuers with high ZSCRs in these event windows are all insignificant in any meaningful significance levels. Further, our results also show that the difference in the average abnormal returns between the high ZSCR and the low ZSCR samples is significant for event windows [-1, 0], [-1 +1], and [-3, +3] at either the 5% or the 10% level. These results again support our hypothesis H3.

As a test of robustness, we also split our sample of mandatory convertible issuers into 3 groups: those with high ZSCRs (top 1/3rd), medium ZSCRs (middle 1/3rd), and low ZSCRs (bottom 1/3rd), with the results presented in panel B of table 3. In general, the announcement effect is zero for the firms with high ZSCRs (low financial distress probabilities) and significantly negative for the firms with low ZSCRs (high financial distress probabilities), while, for firms with medium ZSCRs (medium financial distress probabilities), it is either zero or significantly negative. Thus, as expected, the announcement effect becomes more negative as the financial distress probability increases. Specifically, in event window [-1, 0], the mean CAR is 0.5% for issuers with high
ZSCRs; it is -0.4% for issuers with medium ZSCRs; and it is -1.4% for issuers with low ZSCRs. The difference in announcement effects for the high ZSCR sample and the low ZSCR sample in event window [-1, 0] is significant at the 10% level. Thus, the results here are similar to those presented in panel A of table 3, and are consistent with hypothesis H3.

As a further test of robustness, since some mandatory convertible issuers in our sample have concurrent equity or debt issues, we also present our results on hypothesis H3 in panel C of table 3 by excluding these firms. As shown in panel C, after excluding all concurrent issues, the announcement effect (the average CAR) for the entire sample becomes more negative for most of the event windows. However, after we split this sample by ZSCR, the results are similar to those presented in panels A and B. As expected, the average CAR are significantly negative in most event windows for firms with low ZSCRs, while it is less negative or zero (insignificant) for firms with high ZSCRs. In summary, the results presented in table 3 are consistent with hypothesis H3, suggesting the announcement effect experienced by a firms issuing mandatory convertibles is more negative if the firm’s financial distress probability is greater.42

6.4 The Operating Performance of Mandatory Convertible Issuers

In this sub-section we empirically study the operating performance of firms that have issued mandatory convertibles relative to a matched set of firms which have not issued mandatory convertibles (i.e., we test our hypothesis H4). We study the operating performance in the year of issue (year 0), four years prior to the offering (years -4, -3, -2, and -1), and two years subsequent to the offering (years +1, and +2).43 The results of our study are presented in Table 4. Several data restrictions are present in this study. To be included in the sample the mandatory convertible issuing firm must be present on Compustat for the fiscal year prior to the offering, and data on assets, sales, net income, and operating income must be available for the firms for this year. This reduced our sample of mandatory convertible issues to 32.44 We follow the matching algorithm suggested by

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42 We have also classified the mandatory convertible issuers into four equal groups (quartiles) based on ZSCR. Again, we find that, the announcement effect becomes less negative and ultimately zero as financial distress probability declines. The magnitude and significance of the announcement effects also follow the same pattern as in panel B of table 3. Furthermore, the results of table 3 are similar even if we use LEVG as a proxy for financial distress probability instead of ZSCR.

43 We also studied the operating performance for two additional years subsequent to the offering (years +3, and +4). We do not report the results for those two years as our sample size for those two years decreases considerably. Our results for the operating performance of mandatory convertible issuers for those two years are similar to the results presented here as well.

44 Due to our already restricted sample size, we do not eliminate multiple offerings by the same firm. However, in results not reported here we also conducted our operating performance study after eliminating subsequent offerings by the same firm, which
Barber and Lyon (1996), and Loughran and Ritter (1997) to select the matched control firms. In the fiscal year prior to the issue, defined as year -1, each issuing firm is matched with a Compustat listed non-issuing firm chosen on the basis of industry, asset size, and operating income. In particular, we match the mandatory convertible issuing firm to those firms that have the same two-digit SIC code and whose asset size lies between 25% and 200% of the issuer in the year prior to the offering. These matching firms are then ranked by their year -1 operating income (OIBD) relative to total assets (AT). The firm with the closest OIBD/AT ratio is selected as the matching firm.

To conduct our empirical analysis on the operating performance of mandatory convertible issues we construct the following accounting ratios: profit margin, defined as net income/sales; ROA, defined as net income/assets; OIBD/AT, defined as (operating income before depreciation + interest income)/assets; OIBD/SA, defined as (operating income before depreciation + interest income)/sales; and MKBK. The medians of the accounting ratios are estimated from four years before until two years after the announcement. The medians of the operating performance measures for issuers and non-issuers are reported in Panel A and Panel B of Table 4 respectively.

Panel C of Table 4 reports the Z-statistics obtained for the Wilcoxon matched-pairs signed rank tests of the hypothesis that the yearly distributions of the mandatory convertible issuer and matched non-issuer ratios are identical. The Z-statistics suggest that the post operating performance of issuers and non-issuers are identical with respect to all the accounting ratios except MKBK which is statistically significant. Thus consistent with our hypothesis H4 firms issuing mandatory convertibles do not underperform a matched sample of non-issuers.

Panel D of Table 4 reports the Wilcoxon matched-pairs signed rank tests of the equality of distributions between the change in the issuer and non-issuer ratios over the post-issue period. The changes are calculated for three sub-periods measured over fiscal year -1 to 0, -1 to +1, and -1 to +2. The results show that the changes are not statistically significant, which is again consistent with our hypothesis H4 that mandatory convertible issuers do not underperform.

45 Barber and Lyon (1996) suggest matching on prior performance to account for the mean-reversion in accounting ratios. Candidate matching firms belong to the universe of Compustat firms that have never issued a mandatory convertible security.

46 We also require that the matching firm has not issued any kind of securities within a one-month window of the mandatory convertible offer date.

47 This is in contrast to operating performance measures of equity issuers and ordinary convertible issuers which generally decline in the post issue period as documented by numerous studies in the literature. For example, for operating performance of equity issuers see Loughran and Ritter (1997), for operating performance of ordinary convertible issuers see Lewis et. al. (2001), and for operating performance of floating-priced convertibles see Hillion and Vermaelen (2003).
not underperform non-issuers in terms of long-term operating performance.

Our model does not have any predictions in terms of operating performance of mandatory convertible issuers in the years prior to the issuance of the mandatory convertible. However, in Panel C of Table 4 we also test whether the operating performance of mandatory convertible issuers in the years prior to the issue is significantly poorer to that of matched non-issuers. It is interesting to note from Table 4 that mandatory convertible issuers do not underperform non-issuers in the years prior to the issue, indicating that firms issuing mandatory convertibles are not those which have deteriorated in performance prior to the security issue.48 49

7 Conclusion

Mandatory convertibles are equity-linked hybrid securities that automatically convert to common stock on a pre-specified date, and which have become an increasingly popular means of raising capital in recent years. In this paper, we have presented the first theoretical and empirical analysis of mandatory convertibles in the literature. We considered a firm facing a financial market characterized by asymmetric information, and significant costs in the event of financial distress. The firm could raise capital either by issuing mandatory convertibles, or by issuing more conventional securities like straight debt, common stock, and ordinary convertibles. We showed that, in equilibrium, the firm issues straight debt, ordinary convertibles, or equity if the extent of asymmetric information facing it is more severe, but the probability of financial distress is relatively small; it issues mandatory convertibles if it faces a smaller extent of asymmetric information but a greater probability of being in financial distress. Our model provides a rationale for the three commonly observed features of mandatory convertibles: mandatory conversion, capped (or limited) capital appreciation, and a higher dividend yield compared to common stock. We also characterized the equilibrium design of mandatory convertibles. In addition to its implications for the choice of firms between mandatory convertibles and other securities, our model also

48 This provides an interesting contrast to studies of other kinds of securities (e.g. floating-price convertibles) which document a deterioration in firm performance prior to the security issuance. See, Hillion and Vermaelen (2003) who document this for floating-price convertibles.

49 We also conducted an empirical analysis of the long-term equity performance of mandatory convertible issuers relative to a matched sample of non-issuers, and relative to the CRSP value-weighted index. Our study indicates that issuers of mandatory convertibles do not exhibit long-term stock return underperformance. This is consistent with our results from this sub-section, which document that mandatory convertible issuers do not underperform a matched sample of non-issuers in terms of post-issue operating performance. Further, the long-term stock return performance of mandatory convertible issuers seems to be in marked contrast with the significant long-term post issue stock return underperformance of ordinary convertible and equity issuers that has been documented in the literature. Given that our theoretical analysis does not have any direct predictions for the long-term stock return performance of mandatory convertible issuers, we have chosen not to include the results of our long-term stock return study here. However, details of this study are available to interested readers upon request.
has implications for the abnormal stock returns upon the announcement of mandatory convertibles, and for the post-issue operating performance of mandatory convertible issuers.

We tested the implications of our theory on a sample of firms which have chosen to issue either ordinary or mandatory convertibles, making use of commonly used proxies for asymmetric information (e.g., firm size, the number of analysts following a firm, standard deviation of analyst forecasts, analyst forecast error) and the probability of financial distress (Altman’s Z-score, firm leverage at the time of issue). The evidence is consistent with the implications of our theory. In particular, we find that it is indeed firms facing a smaller extent of information asymmetry but a larger probability of financial distress that issue mandatory convertibles; those facing a larger extent of information asymmetry and a smaller probability of financial distress issue ordinary convertibles. An increase in the probability of financial distress by one standard deviation leads to an increase in the probability of issuing a mandatory convertible by 35%, while a decrease in the level of information asymmetry by one standard deviation leads to an increase in the probability of issuing a mandatory convertible by 4.5%. Our empirical evidence also supports the implications of our theory regarding the announcement effects of mandatory convertible issues and the post-issue operating performance of mandatory convertible issuers relative to that of a matched sample of non-issuers.
References


Appendix

Proof of Proposition 1. In this equilibrium, the type G maximizes \( \Pi_G \) subject to (4), (2), and (3); the type M maximizes \( \Pi_M \) subject to (7), (6), and (5); and the type B maximizes \( \Pi_B \) subject to:

\[
n_c[(1-\delta)(1-\phi_2)x_H + (1-(1-\delta)(1-\phi_2))x_L] \geq I, \tag{A1}
\]

and the non-mimicry constraint for the type G and the type M firms:

\[
\Pi_G \geq \Pi_{G|B} = [(1-\phi_1)x_H + \phi_1x_L](1-n_c), \tag{A2}
\]

\[
\Pi_M \geq \Pi_{M|B} = [(1-\delta)(1-\phi_1)x_H + (1-(1-\delta)(1-\phi_1))x_L](1-n_c). \tag{A3}
\]

In equilibrium, if constraints (A2) and (A3) are satisfied (we will solve the condition for both constraints to be satisfied later), the type B firm sets \( n_c^* = \frac{I}{[(1-\delta)(1-\phi_2)x_H + (1-(1-\delta)(1-\phi_2))x_L]} \) such that constraint (A1) holds as an equality. Now, consider the case where the type G sets \( P_d^* = \frac{I-\phi_1x_L}{1-\phi_1} \) so that constraint (4) is satisfied as an equality and the type M sets \( n_c^* = \frac{I-\phi_1x_L}{(1-\phi_1)(1-\phi_2)x_L + \delta x_L} \) so that constraint (7) is satisfied as an equality. Under these equilibrium choices, constraint (6) becomes \( I - x_L \leq \frac{\phi_2(1-\phi_1)C}{\phi_2-\phi_1} \); constraint (2) becomes \( I - x_L \leq \frac{[1-(1-\delta)(1-\phi_2)](1-\phi_1)}{(1-\phi_1)(1-\phi_2)}C \); constraint (3) becomes \( I - x_L \leq (1-\phi_1)C \). Define \( C \equiv \frac{I-x_L}{1-\phi_1} \). Then, under our parametric assumption \( C \geq C \), constraints (6), (2), and (3) are satisfied. Now consider constraints (A2) and (A3). (A2) is satisfied if (A3) is satisfied, and from (A3), we have:

\[
\phi_1 C \leq \frac{(1-\delta)(\phi_2-\phi_1)(x_H - x_L)I}{V_B}, \tag{A4}
\]

where \( V_B = (1-\delta)(1-\phi_2)x_H + [1-(1-\delta)(1-\phi_2)]x_L \). In summary, when (A4) is satisfied, a separating equilibrium exists satisfying part (a) and (b) in the definition of equilibrium.

In this separating equilibrium, the expected payoff to the type G \( \Pi_G^S = (1-\phi_1)x_H + \phi_1x_L - I - \phi_1C \); the expected payoff to the type M \( \Pi_M^S = (1-\phi_1)(1-\delta)x_H + \delta x_L + \phi_1x_L - I - \phi_1C \), and the expected payoff to the type B \( \Pi_B^S = (1-\phi_2)(1-\delta)x_H + \delta x_L + \phi_2x_L - I \). Alternatively, for the type M firm, if it issues mandatory convertible to pool with the type B while the type G issues debt, its expected payoff is \( \Pi^P_M \) (which we will solve for in the proof of proposition 2). For the type G firm, if it issues mandatory convertible to pool with the type M and type B, its expected payoff is \( \Pi^P_G \) (which we will solve for in the proof of proposition 3). \( \Pi^P_M < \Pi_M^S \)
(detailed derivation is in the proof of proposition 2) when
\[ I - x_L > \frac{\phi_1 [\gamma_2 (1 - \phi_2) (1 - \delta) + \gamma_3 (1 - \phi_2) (1 - \delta)] C}{(1 - \delta) (\phi_2 - \phi_1) \gamma_3}. \]  
(A5)

Define \( \gamma = \frac{\phi_1 \gamma_2 (1 - \phi_1) (1 - \delta)}{(1 - \delta) (\phi_2 - \phi_1) \phi_3 (1 - \phi_2) (1 - \delta)}, \phi = \frac{\gamma_3 \phi_1 (1 - x_L)}{(1 - \delta) (\phi_2 - \phi_1) \gamma_3 (1 - \delta) (1 - x_L)}, \) \( \sigma = \frac{(1 - \delta) (\phi_2 - \phi_1) \gamma_3 x H}{(1 - \delta) (\phi_2 - \phi_1) \gamma_3 (1 - \delta) (1 - x_L)}. \)

Then, given \( C \leq C \) and \( \gamma_3 \geq \gamma \), if \( \phi_1 \leq \phi \) or \( a \geq \sigma \), (A5) is satisfied. It can be proved as well that, in this case, (A4) is satisfied and \( \Pi^S_G \geq \Pi^P_G \). Thus, if \( \phi_1 \leq \phi \) or \( a \geq \sigma \), the equilibrium is separating. \( \blacksquare \)

**Proof of Proposition 2.** In this equilibrium, the type G maximizes \( \Pi_G \) given in (1), subject to (4), and the following IC constraints:
\[ \Pi_M \geq \Pi_{M|G} = (1 - \phi_1) (1 - \delta) (x_H - P_d) - [1 - (1 - \delta) (1 - \phi_1)] C, \]  
(A6)
\[ \Pi_B \geq \Pi_{B|G} = (1 - \phi_2) (1 - \delta) (x_H - P_d) - [1 - (1 - \delta) (1 - \phi_2)] C. \]

\( P_d = \frac{I - \phi_1 x_L}{1 - \phi_1} \) in equilibrium and the type G’s equilibrium payoff \( \Pi^P_G = \Pi^S_G \). The type M maximizes \( \Pi_M \) given in (8) and the type B maximizes \( \Pi_B = (1 - n_m) \phi_2 (x_L - D) + (1 - \phi_2) (1 - \frac{U_m}{V^1_{MB}}) (\delta x_H + \delta x_L - D) \), subject to the IC constraints (9), where \( V^1_{MB} = \frac{1}{1 - \rho_2} [\gamma_2 (1 - \phi_1) \delta x_H + \delta x_L + \gamma_3 (1 - \phi_2) \delta x_H + \delta x_L] \) and \( \rho_2 = \frac{\gamma_3 \phi_2 + \gamma_3 \phi_1}{\gamma_2 + \gamma_3} \).

(\( \rho_2 \) is the probability of deterioration at time 1 for the firm issuing mandatory convertibles). In addition, the design of mandatory convertibles, \( n_m, D, U_m \), satisfy (7) and
\[ U_m \geq n_m V^1_{MB}. \]  
(A7)

First, consider the case where (7) holds as an equality. Thus, if we write (7) in terms of \( n_m \) and incorporate it into \( \Pi_M \), we have:
\[ \Pi_M = U_m (1 - \phi_L) \frac{V^1_{MB} - x_H}{V^1_{MB} - x_L} + (P_M - I) \frac{\phi_1 - \rho_2}{\rho_2} - \frac{U_m - V^1_{MB} \phi_1 - \rho_2}{\rho_2} D. \]  
(A8)

\( \frac{\partial \Pi_M}{\partial n_m} < 0 \) and \( \frac{\partial \Pi_M}{\partial D} > 0 \), which, together with (A7), implies that \( D^* = x_L, U_m^* = \frac{I - x_L}{V^1_{MB} - x_L} V^1_{MB}, n_m^* \geq \frac{I - x_L}{V^0_{MB} - x_L}. \)

and \( \Pi^P_M = \Pi_M = (1 - \delta) (V^0_{MB} - I) \frac{1 - \phi_1}{1 - \rho_2}, \) where \( \rho_2 = \frac{\gamma_2 (1 - \phi_1) \delta + \gamma_2 \phi_1 + \gamma_3 (1 - \phi_2) \delta + \gamma_3 \phi_2}{\gamma_2 + \gamma_3} \) (\( \rho_2 \) is the probability of the firm issuing mandatory convertibles at time 0 and earning a low cash flow at time 2) and \( V^0_{MB} = P_2 x L + (1 - \rho_2) x H \) (\( V^0_{MB} \) is the expected value at time 0 of the firm issuing mandatory convertibles). The IC conditions are satisfied when
\[ \frac{(1 - \rho_2) \phi_1}{\rho_2 - \phi_1} C \leq I - x_L < \frac{(1 - \phi_1) (1 - \phi_2)}{(1 - \phi_1) (1 - \phi_2) (x_H - P_d) - \Pi_M} C. \]

Now consider the case where (7) is not binding. Then, when \( I - x_L \geq \frac{(1 - \rho_2) \phi_1}{\rho_2 - \phi_1} C, \) the equilibrium design of mandatory convertibles is the same as above. On the other hand, when \( I - x_L \leq \frac{(1 - \rho_2) \phi_1}{\rho_2 - \phi_1} C, \) (7) cannot hold.
as an equality, and \( P_d \) will be set to satisfy (4) as an equality. In summary, there exists a partially pooling equilibrium satisfying parts (a) and (b) of our definition of equilibrium when

\[
I - x_L < \frac{1 - (1 - \delta)(1 - \phi_1)}{(1 - \phi_1)(1 - \delta)(x_H - P_d) - \Pi^+_M C}. \tag{A9}
\]

Now we derive the conditions under which the type G and the type M will not issue securities other than debt and mandatory convertibles respectively. If the type M issues equity to pool with type B in a partially pooling equilibrium, then its expected payoff is \( (1 - \frac{I}{V_{MB}})[(1 - \delta)(1 - \phi_1)(x_H - x_L) + x_L] \), which equals \( \Pi_M(D = 0, U_m = n_mV^1_{MB}) \) and less than \( \Pi^{PP}_M = \max_{D,U_m,n_m} \Pi_M \). If the type M issues an ordinary convertible to separate itself from the type B, its payoff is \( \Pi^+_M \); \( \Pi^{PP}_M > \Pi^+_M \) when \( \phi_1 C > [(1 - \phi_1)(1 - \delta)x_H + \delta x_L] + \phi_4 x_L - I - (1 - \delta)(V^0_{MB} - I)\frac{\phi_1}{1 - \delta} \), i.e., \( I - x_L > \frac{\phi_1(1 - \phi_2)(\gamma_2 + \gamma_3)C}{(1 - \delta)(\phi_2 - \phi_1)\gamma_3} \). \( \Pi^{PP}_M \geq \Pi^+_M \) when \( \phi_1 \geq \bar{\phi} \) or \( a \leq \bar{\alpha} \). Further, if the type G offers mandatory convertibles to pool with the type M and the type B, its expected payoff is \( \Pi^{EP}_G ; \Pi^{PP}_G \geq \Pi^{EP}_G \) when \( \delta \geq \bar{\delta} \) and \( \alpha \geq \bar{\alpha} \) (we will prove this in the proof of proposition 3). Thus, when \( \phi_1 \geq \bar{\phi} \) and \( \delta \geq \bar{\delta} \), or when \( a \in [\bar{a}, \bar{\alpha}] \), a partial pooling equilibrium satisfying our equilibrium definition occurs. Note that (A9) is satisfied under the above equilibrium conditions.

**Proof of Proposition 3.** If mandatory convertibles are issued, then the type G maximizes (11), subject to (12) and

\[
U_m \leq n_mV^1_{GMB}, \tag{A10}
\]

where \( V^1_{GMB} = \frac{1}{n_1}(\gamma_1(1 - \phi_1)x_H + \gamma_2(1 - \phi_1)(1 - \delta)x_H + \delta x_L) + \gamma_3(1 - \phi_2)(1 - \delta)x_H + \delta x_L \) and \( \rho_1 = \gamma_1 \phi_1 + \gamma_2 \phi_1 + \gamma_2 \phi_2 \) (\( \rho_1^* \) is the probability of firm deteriorating at time 1).

If we write (12) in terms of \( n_m \) and incorporate it into (11), we have:

\[
\Pi_G = U_m(1 - \phi_1)\frac{V^1_{GMB} - x_H}{V^1_{GMB}} + (P_M - I)\frac{\phi_1 - \rho_1^*}{\rho_1^*} - \frac{U_m - V^1_{GMB} \phi_1 - \rho_1^*}{V^1_{GMB}} D. \tag{A11}
\]

\( \frac{\partial \Pi_G}{\partial n_m} < 0 \) and \( \frac{\partial \Pi_G}{\partial D} > 0 \), which, together with (A10), implies that \( D^* = x_L, U^*_m = \frac{I - x_L}{V^1_{GMB} - x_L}V^1, n^*_m \geq \frac{I - x_L}{V^1_{GMB} - x_L} \) and \( \Pi^{EP}_G = \Pi^*_G = (V^0_{GMB} - I)\frac{1 - \phi_1}{1 - \delta_1} \).

If equity is issued in the fully pooling equilibrium, then the type G firm’s expected payoff would be \( (1 - \frac{I}{V^0_{GMB}})[(1 - \phi_1)x_H + \phi_1 x_L] \), where \( V^0_{GMB} \) is the expected firm value at time 0, \( V^0_{GMB} = (1 - \rho_1)x_H + \rho_1 x_L \). Here, \( \rho_1 \) is the investors’ belief of a pooling firm earning a low cash flow at time 2; \( \rho_1 = \gamma_1 \phi_1 + \gamma_2 (1 - \phi_1) \delta + \gamma_2 \phi_1 + \gamma_3 (1 - \delta) \frac{I - x_L}{V^1_{GMB} - x_L} \).
\( \phi_2 \delta + \gamma_3 \phi_2 \). This payoff equals \( \Pi_G(D=0, U_m = n_m V_1) \), which is smaller than \( \Pi_{GP} \), which equals \( \max_{D,U_m,n_m} \Pi_G \).

If debt is issued in the fully pooling equilibrium, the type G’s payoff would be \( (1 - \phi_1)(x_H - L_{x_H}) - \phi_1 C \).

If an ordinary convertible is issued in the fully pooling equilibrium with call price \( K \in (x_L,I) \), the type G’s payoff would be \( (1 - \phi_1)(1 - \frac{L_{x_L}}{I})x_H - \phi_1 C \). It is easy to show that \( \Pi_{GP} \) is the highest among all the above payoffs as long as \( C > 0 \). Thus, the type G prefers to issue a mandatory convertible when pooling with both the type M and the type B firms.

If the type G issues debt to separate itself from the other types, it earns a payoff of \( \Pi_{GP}^C \), \( \Pi_{GP} \geq \Pi_{GP}^C \) if

\[
I - x_L < \frac{(1 - \rho_1)\phi_1 C}{\rho_1 - \phi_1}.
\]

Define \( \bar{\phi} = \arg(I - x_L = \frac{(1 - \rho_1)\phi_1 C}{\rho_1 - \phi_1}) \), \( \bar{\delta} = \arg(I - x_L = \frac{(1 - \rho_1)\phi_1 C}{\rho_1 - \phi_1}) \), and \( \bar{\alpha} = \frac{(\rho_1 - \phi_1)x_H}{(\rho_1 - \phi_1)(1 - \rho_1)\phi_1 C} \). Then, when \( \phi_1 \geq \bar{\phi}, \delta \leq \bar{\delta}, \text{ or } \alpha \leq \bar{\alpha} \), (A12) is satisfied and the equilibrium is fully pooling. ■

**Proof of Proposition 4.** Before time 0, the market value of the equity of a pooling firm is \( \gamma_1[(1 - \phi_1)x_H + \phi_1 x_L] + \gamma_2[(1 - \phi_1)((1 - \delta)x_H + \delta x_L) + \phi_1 x_L] + \gamma_3[(1 - \phi_2)((1 - \delta)x_H + \delta x_L) + \phi_2 x_L] \). If a firm issues debt, the market revalues the firm at \( (1 - \phi_1)x_H + \phi_1 x_L \). If a firm issues equity, the market values it at \( (1 - \phi_2)((1 - \delta)x_H + \delta x_L) + \phi_2 x_L \). If a firm issues an ordinary convertible, the market revalues it at \( (1 - \phi_1)((1 - \delta)x_H + \delta x_L) + \phi_1 x_L \), which is greater than the market value of equity before time 0 if \( \gamma_3 < \bar{\gamma} \equiv \frac{\delta(1 - \phi_1)}{(1 - \phi_2)(1 - \phi_1)} \). ■

**Proof of Proposition 5.** Let \( n_m \leq \bar{\pi}, D \leq \bar{d}x_L \). Then following the proof of Proposition 3, \( \frac{\partial \Pi_G}{\partial m} > 0 \) for any given \( D \leq x_L \), and \( \frac{\partial \Pi_G}{\partial D} > 0 \) for any \( n_m \leq 1 \). Thus, \( n_m^* = \bar{\pi}, D^* = \bar{d}x_L \), and \( U_m^* = \frac{L_{x_L} - x_L}{V_{GMB}x_L} V_{GMB}^{t=1} \frac{x_L V_{GMB} - x_L}{V_{GMB}^{t=1}} \). It is easy to show that \( \frac{\partial U^*_m}{\partial d} > 0 \) and \( \frac{\partial U^*_m}{\partial a} < 0 \). ■
Figure 4
The following figure depicts the value of ordinary and mandatory convertibles in our sample, issued for different years during our sample period from 1991 to 2001 in millions of dollars. The numbers on top of each bar denotes the number of mandatory and ordinary convertibles issued in that year, which are in our sample. The graph depicts new issues of both ordinary and mandatory convertibles during our sample period that were identified from Securities Data Corporation’s (SDC) New Issues Database. In 1998 the number and value of mandatory convertibles issued was nearly equal to that of ordinary convertibles issued in that year. Some of the most common mandatory convertibles in our sample are Morgan Stanley’s PERCS and PEPS, Merrill Lynch’s PRIDES, Salomon Brothers’ DECS, and Goldman Sachs’ ACES.
Table 1
Tests of differences in mean and median characteristics of firms issuing ordinary and mandatory convertibles. 
NUMA is the number of analysts, FORERR is the error in analysts’ forecast estimates, STDEV is the standard deviation in analysts’ forecasts, COVAR is the coefficient of variation in analysts’ forecasts, FSZE is the firm size defined as \( \ln(100 \times (TA + MKVALF - CEQ)) \) where TA is the book value of total assets, MKVALF is the market value of equity of the firm at fiscal year end, and CEQ is the book value of common equity. MKBK is the market-to-book ratio defined as \( (TA + MKVALF - CEQ) / TA \), ZSCR is defined as \( (3.3 \times \text{EBIT}/\text{Sales} + 1.0 \times \text{Sales}/TA + 1.4 \times \text{RE}/TA + 1.2 \times \text{WC}/TA + 0.6 \times \text{MKVALF}/\text{DT}) \), where EBIT is earnings before interest and taxes, RE is retained earnings, WC is working capital, and DT is book value of debt. LEVG is firm leverage defined as \( \text{DT}/(TA + MKVALF - CEQ) \), SYND is a dummy variable taking the value of 1 if the issue is syndicated and 0 otherwise, and FIN is a dummy variable which takes the value of 1 if the issuing firm is a financial firm and 0 otherwise. The results of \( t \)-tests for difference in means and the Wilcoxon rank-sum test (z-statistic) for the difference in distribution of the various firm characteristics between firms issuing ordinary and mandatory convertibles are reported. ***, **, and * denotes significance at the 1, 5, and 10 percent levels respectively.

<table>
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<th>Convertible Security Type</th>
<th>Observations</th>
<th>Means</th>
<th>t-statistics (difference in means)</th>
<th>Medians</th>
<th>Wilcoxon rank-sum (Mann-Whitney) test</th>
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<tr>
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<td><strong>Panel C: Univariate comparison of control variables</strong></td>
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<td>7.198***</td>
<td>6.925</td>
<td>5.787***</td>
</tr>
<tr>
<td>Market to Book Ratio (MKBK)</td>
<td>Mandatory</td>
<td>41</td>
<td>1.413</td>
<td></td>
<td>1.195</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ordinary</td>
<td>153</td>
<td>1.918</td>
<td>-3.650***</td>
<td>1.529</td>
<td>-3.340***</td>
</tr>
<tr>
<td>Syndication Dummy (SYND)</td>
<td>Mandatory</td>
<td>41</td>
<td>0.634</td>
<td></td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ordinary</td>
<td>153</td>
<td>0.216</td>
<td>5.033***</td>
<td>0.000</td>
<td>5.159***</td>
</tr>
<tr>
<td>Financial Firm (FIN)</td>
<td>Mandatory</td>
<td>41</td>
<td>0.073</td>
<td></td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ordinary</td>
<td>153</td>
<td>0.007</td>
<td>1.598</td>
<td>0.000</td>
<td>2.660***</td>
</tr>
</tbody>
</table>
This table reports multinomial logit regressions relating the firm’s choice of the convertible security type to various measures of information asymmetry, and the bankruptcy probability. The dependent variable TYPE takes the value of 1 if the firm issues a mandatory convertible, and 0 if the firm issues an ordinary convertible. NUMA is the number of analysts, FORERR is the error in analysts’ forecast estimates, STDEV is the standard deviation of analysts’ forecasts, COVAR is the coefficient of variation of analysts’ forecasts, FSZE is the firm size defined as $\ln(100*(TA+MKVALF-CEQ))$, MKBK is the market-to-book ratio defined as $(TA+MKVALF-CEQ)/TA$, ZSCR is defined as $(3.3*EBIT/Sales+1.0*Sales/TA+1.4*RE/TA+1.2*WC/TA+0.6*MKVALF/DT)$, SYND is a dummy variable taking the value of 1 if the issue is syndicated and 0 otherwise, and FIN is a dummy variable which takes the value of 1 if the issuing firm is a financial firm and 0 otherwise. We introduce the different measures of information asymmetry one at a time in the regressions 1 through 5. In regression 6 we incorporate all the measures of information asymmetry together. Due to the high correlation between FSZE and NUMA, and due to the fact that FSZE also proxies for information asymmetry, we omit FSZE in the second specification. The $z$-statistics are in parentheses and ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively. Z-statistics are calculated using White’s (1980) method.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Reg 1</th>
<th>Reg 2</th>
<th>Reg 3</th>
<th>Reg 4</th>
<th>Reg 5</th>
<th>Reg 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Analysts (NUMA)</td>
<td>-0.005</td>
<td>0.078</td>
<td></td>
<td></td>
<td></td>
<td>-0.031</td>
</tr>
<tr>
<td></td>
<td>(-0.13)</td>
<td>(3.31)***</td>
<td></td>
<td></td>
<td></td>
<td>(-0.81)</td>
</tr>
<tr>
<td>Forecast Error (FORERR)</td>
<td></td>
<td>-33.697</td>
<td>(-2.50)**</td>
<td>(-2.67)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Dev. Of Estimate (STDEV)</td>
<td></td>
<td>-2.238</td>
<td>(-1.55)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeff. Of Var of Estimate (COVAR)</td>
<td>-0.095</td>
<td>-0.131</td>
<td>-0.121</td>
<td>-0.106</td>
<td>-0.105</td>
<td>-0.131</td>
</tr>
<tr>
<td></td>
<td>(-2.03)***</td>
<td>(-2.09)**</td>
<td>(-1.78)*</td>
<td>(-2.01)**</td>
<td>(-2.04)**</td>
<td>(-1.72)*</td>
</tr>
<tr>
<td>Z-Score (ZSCR)</td>
<td>-0.095</td>
<td>-0.131</td>
<td>-0.121</td>
<td>-0.106</td>
<td>-0.105</td>
<td>-0.131</td>
</tr>
<tr>
<td></td>
<td>(-2.03)***</td>
<td>(-2.09)**</td>
<td>(-1.78)*</td>
<td>(-2.01)**</td>
<td>(-2.04)**</td>
<td>(-1.72)*</td>
</tr>
<tr>
<td>Firm Size (FSZE)</td>
<td>0.800</td>
<td>0.748</td>
<td>0.799</td>
<td>0.823</td>
<td>0.939</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.67)***</td>
<td>(4.97)***</td>
<td>(5.02)***</td>
<td>(5.04)***</td>
<td>(4.08)***</td>
<td></td>
</tr>
<tr>
<td>Market to Book Ratio (MKBK)</td>
<td>-0.685</td>
<td>-0.421</td>
<td>-0.863</td>
<td>-0.781</td>
<td>-0.707</td>
<td>-0.983</td>
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<tr>
<td></td>
<td>(-1.30)</td>
<td>(-0.88)</td>
<td>(-1.29)</td>
<td>(-1.29)</td>
<td>(-1.29)</td>
<td>(-1.41)</td>
</tr>
<tr>
<td>Syndication Dummy (SYND)</td>
<td>1.300</td>
<td>1.495</td>
<td>1.359</td>
<td>1.203</td>
<td>1.318</td>
<td>1.462</td>
</tr>
<tr>
<td></td>
<td>(2.86)***</td>
<td>(3.55)***</td>
<td>(2.83)***</td>
<td>(2.63)***</td>
<td>(2.81)***</td>
<td>(2.90)***</td>
</tr>
<tr>
<td>Financial Firm (FIN)</td>
<td>5.593</td>
<td>5.790</td>
<td>6.237</td>
<td>5.810</td>
<td>5.857</td>
<td>6.506</td>
</tr>
<tr>
<td></td>
<td>(3.82)***</td>
<td>(3.10)***</td>
<td>(3.02)***</td>
<td>(3.58)***</td>
<td>(3.74)***</td>
<td>(2.83)***</td>
</tr>
<tr>
<td>Constant</td>
<td>-6.633</td>
<td>-1.828</td>
<td>-5.634</td>
<td>-6.240</td>
<td>-6.710</td>
<td>-6.398</td>
</tr>
<tr>
<td></td>
<td>(-4.73)***</td>
<td>(-2.52)**</td>
<td>(-4.16)***</td>
<td>(-4.97)***</td>
<td>(-5.16)***</td>
<td>(-4.06)***</td>
</tr>
<tr>
<td>No. of observations</td>
<td>194</td>
<td>194</td>
<td>194</td>
<td>188</td>
<td>187</td>
<td>187</td>
</tr>
<tr>
<td>Wald Chi²</td>
<td>45.64***</td>
<td>29.00***</td>
<td>44.29***</td>
<td>43.76***</td>
<td>43.01***</td>
<td>42.28***</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.351</td>
<td>0.280</td>
<td>0.384</td>
<td>0.352</td>
<td>0.363</td>
<td>0.401</td>
</tr>
</tbody>
</table>
Table 3
This table reports the abnormal equity returns upon the announcement of mandatory convertible issues. The abnormal returns are reported for five different event windows around the announcement date (day 0) of the security issue. In Panel A, mandatory convertible issuers are separated into two groups based on the median value of Z-Score (ZSCR), in Panel B the firms are separated into three equal groups based on the value of ZSCR, while in Panel C the abnormal returns for mandatory convertible issuers excluding concurrent issuers of equity or debt are presented. For each category of firms, and for each event window, the cumulative abnormal returns are then tested for significant differences from zero (t-statistics in parentheses). In addition, t-statistics for the difference in abnormal returns between the high and low ZSCR samples of mandatory convertible issuers are also reported. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

### Panel A

<table>
<thead>
<tr>
<th>Event Window</th>
<th>All firms</th>
<th>High ZSCR firms</th>
<th>Low ZSCR firms</th>
<th>t-statistics (difference between high and low ZSCR samples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0]</td>
<td>-0.007</td>
<td>-0.006</td>
<td>-0.009</td>
<td>(0.35)</td>
</tr>
<tr>
<td></td>
<td>(-2.22)**</td>
<td>(-0.80)</td>
<td>(-4.20)***</td>
<td></td>
</tr>
<tr>
<td>[-1, 0]</td>
<td>-0.004</td>
<td>0.004</td>
<td>-0.012</td>
<td>(2.21)**</td>
</tr>
<tr>
<td></td>
<td>(-1.26)</td>
<td>(0.60)</td>
<td>(-4.20)***</td>
<td></td>
</tr>
<tr>
<td>[-1, +1]</td>
<td>-0.004</td>
<td>0.005</td>
<td>-0.017</td>
<td>(1.94)*</td>
</tr>
<tr>
<td></td>
<td>(-1.03)</td>
<td>(0.51)</td>
<td>(-4.26)***</td>
<td></td>
</tr>
<tr>
<td>[-3, 0]</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.006</td>
<td>(0.58)</td>
</tr>
<tr>
<td></td>
<td>(-0.35)</td>
<td>(-0.14)</td>
<td>(-1.01)</td>
<td></td>
</tr>
<tr>
<td>[-3, +3]</td>
<td>-0.004</td>
<td>0.006</td>
<td>-0.029</td>
<td>(1.82)*</td>
</tr>
<tr>
<td></td>
<td>(-0.54)</td>
<td>(0.36)</td>
<td>(-3.87)***</td>
<td></td>
</tr>
</tbody>
</table>

### Panel B

<table>
<thead>
<tr>
<th>Event Window</th>
<th>High ZSCR firms</th>
<th>Medium ZSCR firms</th>
<th>Low ZSCR firms</th>
<th>t-statistics (difference between high and low ZSCR samples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0]</td>
<td>-0.008</td>
<td>-0.007</td>
<td>-0.009</td>
<td>(0.12)</td>
</tr>
<tr>
<td></td>
<td>(-0.66)</td>
<td>(-2.40)**</td>
<td>(-2.95)**</td>
<td></td>
</tr>
<tr>
<td>[-1, 0]</td>
<td>0.005</td>
<td>-0.004</td>
<td>-0.014</td>
<td>(1.79)*</td>
</tr>
<tr>
<td></td>
<td>(0.53)</td>
<td>(-0.97)</td>
<td>(-3.31)***</td>
<td></td>
</tr>
<tr>
<td>[-1, +1]</td>
<td>0.011</td>
<td>-0.016</td>
<td>-0.013</td>
<td>(1.49)</td>
</tr>
<tr>
<td></td>
<td>(0.75)</td>
<td>(-2.60)**</td>
<td>(-2.73)***</td>
<td></td>
</tr>
<tr>
<td>[-3, 0]</td>
<td>-0.002</td>
<td>-0.001</td>
<td>-0.006</td>
<td>(0.37)</td>
</tr>
<tr>
<td></td>
<td>(-0.25)</td>
<td>(-0.22)</td>
<td>(0.43)</td>
<td></td>
</tr>
<tr>
<td>[-3, +3]</td>
<td>0.008</td>
<td>-0.014</td>
<td>-0.028</td>
<td>(1.45)</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(-0.90)</td>
<td>(-2.96)**</td>
<td></td>
</tr>
</tbody>
</table>

### Panel C

<table>
<thead>
<tr>
<th>Event Window</th>
<th>All firms excluding Concurrent Stock and Debt Issuers</th>
<th>High Z-Score firms excluding Concurrent Stock and Debt Issuers</th>
<th>Low Z-Score firms excluding Concurrent Stock and Debt Issuers</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0]</td>
<td>-0.012</td>
<td>-0.013</td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td>(-2.87)***</td>
<td>(-1.15)</td>
<td>(-3.03)***</td>
</tr>
<tr>
<td>[-1, 0]</td>
<td>-0.010</td>
<td>-0.011</td>
<td>-0.012</td>
</tr>
<tr>
<td></td>
<td>(-3.38)***</td>
<td>(-1.50)</td>
<td>(-2.79)***</td>
</tr>
<tr>
<td>[-1, +1]</td>
<td>-0.011</td>
<td>-0.020</td>
<td>-0.012</td>
</tr>
<tr>
<td></td>
<td>(-2.51)**</td>
<td></td>
<td>(-2.40)***</td>
</tr>
<tr>
<td>[-3, 0]</td>
<td>-0.005</td>
<td>-0.011</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(-1.35)</td>
<td></td>
<td>(-0.00)</td>
</tr>
<tr>
<td>[-3, +3]</td>
<td>-0.011</td>
<td>-0.021</td>
<td>-0.020</td>
</tr>
<tr>
<td></td>
<td>(-1.59)</td>
<td></td>
<td>(-2.21)**</td>
</tr>
</tbody>
</table>
Table 4
This table reports the operating performance of firms in the years prior to and after a mandatory convertible issue. Panel A reports median ratios for the issuing firms from 2 years prior to the issue year until 2 years afterwards. Panel B reports the same ratios for the non-issuing matching firms. Matching non-issuing firms are chosen by matching each issuing firm with a firm that has not ever issued mandatory convertibles, and that has not issued any security within a one month window of the issue date using the following algorithm. The non-issuer had to be in the same two-digit industry with end-of-year -1 assets within 25% to 200% of the issuing firm, and then the non-issuer with the closest operating income before depreciation, amortization, and taxes, plus interest income was chosen. The data items used to calculate the ratios are Profit margin (net income/sales), ROA (net income/assets), OIBD/assets (operating income before depreciation + interest income)/assets, OIBD/sales (operating income before depreciation + interest income)/sales, and market-to-book ratio (market value of equity/book value of equity). Panel C reports the difference in the medians between the mandatory convertible issuers and the matching non-issuers. Panel D tests whether, in a given year, the distribution of these ratios is significantly different for issuers and non-issuers. Panel E tests whether, in a specific period relative to the pre-issue year, the change in the distribution of these ratios is significantly different between issuers and non-issuers. Z-statistics are reported from the Wilcoxon matched pairs signed-ranks test, and ***, **, and * denotes significance at the 1, 5, and 10 percent levels, respectively.

<table>
<thead>
<tr>
<th>Fiscal Year Relative to Offering</th>
<th>Profit Margin</th>
<th>ROA</th>
<th>OIBD/Assets</th>
<th>OIBD/Sales</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Issuer Medians</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td>5.39%</td>
<td>2.90%</td>
<td>9.04%</td>
<td>14.02%</td>
<td>28</td>
</tr>
<tr>
<td>-1</td>
<td>4.79%</td>
<td>2.71%</td>
<td>8.37%</td>
<td>15.99%</td>
<td>32</td>
</tr>
<tr>
<td>0</td>
<td>4.28%</td>
<td>1.66%</td>
<td>7.75%</td>
<td>13.83%</td>
<td>29</td>
</tr>
<tr>
<td>1</td>
<td>6.45%</td>
<td>1.79%</td>
<td>9.91%</td>
<td>14.30%</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>6.93%</td>
<td>2.34%</td>
<td>8.80%</td>
<td>17.56%</td>
<td>23</td>
</tr>
<tr>
<td><strong>Panel B: Non-Issuer Medians</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td>5.16%</td>
<td>2.43%</td>
<td>8.44%</td>
<td>17.65%</td>
<td>28</td>
</tr>
<tr>
<td>-1</td>
<td>4.87%</td>
<td>2.83%</td>
<td>8.76%</td>
<td>13.31%</td>
<td>32</td>
</tr>
<tr>
<td>0</td>
<td>3.50%</td>
<td>1.30%</td>
<td>7.35%</td>
<td>10.86%</td>
<td>29</td>
</tr>
<tr>
<td>1</td>
<td>3.00%</td>
<td>2.94%</td>
<td>9.83%</td>
<td>12.16%</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>4.84%</td>
<td>3.76%</td>
<td>10.45%</td>
<td>15.47%</td>
<td>23</td>
</tr>
<tr>
<td><strong>Panel C: Difference in Medians Between the Issuers and Matching Non-Issuers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td>0.23%</td>
<td>0.47%</td>
<td>0.60%</td>
<td>-3.64%</td>
<td>28</td>
</tr>
<tr>
<td>-1</td>
<td>-0.08%</td>
<td>-0.12%</td>
<td>-0.39%</td>
<td>2.69%</td>
<td>32</td>
</tr>
<tr>
<td>0</td>
<td>0.78%</td>
<td>0.36%</td>
<td>0.39%</td>
<td>2.97%</td>
<td>29</td>
</tr>
<tr>
<td>1</td>
<td>3.44%</td>
<td>-1.15%</td>
<td>0.08%</td>
<td>2.14%</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>2.10%</td>
<td>-1.43%</td>
<td>-1.65%</td>
<td>2.09%</td>
<td>23</td>
</tr>
<tr>
<td><strong>Panel D: Z-statistics Testing the Yearly Equality of Distributions Between the Issuers and Matching Non-Issuers Using the Wilcoxon Matched-Pairs Signed-Ranks Test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td>-0.330</td>
<td>0.649</td>
<td>0.928</td>
<td>-0.837</td>
<td>28</td>
</tr>
<tr>
<td>-1</td>
<td>-0.323</td>
<td>0.049</td>
<td>-0.382</td>
<td>-0.402</td>
<td>32</td>
</tr>
<tr>
<td>0</td>
<td>-0.171</td>
<td>-0.057</td>
<td>-0.377</td>
<td>-1.077</td>
<td>29</td>
</tr>
<tr>
<td>1</td>
<td>-0.672</td>
<td>-0.815</td>
<td>0.262</td>
<td>-0.916</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>-0.747</td>
<td>-1.495</td>
<td>-0.436</td>
<td>-1.134</td>
<td>23</td>
</tr>
<tr>
<td><strong>Panel E: Z-statistics Testing the Equality of Distributions Between the Change in the Ratios from the Pre-Issue Year to Various Years After the Issue Using the Wilcoxon Matched-Pairs Signed-Ranks Test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year -1 to 0</td>
<td>-0.057</td>
<td>-0.604</td>
<td>-0.996</td>
<td>-0.027</td>
<td>29</td>
</tr>
<tr>
<td>Year -1 to +1</td>
<td>-0.986</td>
<td>-1.072</td>
<td>-0.262</td>
<td>0.131</td>
<td>25</td>
</tr>
<tr>
<td>Year -1 to +2</td>
<td>-1.235</td>
<td>-1.040</td>
<td>-0.523</td>
<td>-0.089</td>
<td>23</td>
</tr>
<tr>
<td>Security &amp; Underwriter</td>
<td>Illustrative Example</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatically Convertible Equity Securities (ACES)</td>
<td><strong>Illustration:</strong> Apache Corp. issued 140,000 shares of ACES on 05/12/99. Each unit of ACES comprised of 50 depository shares which was offered to the public at $31 per share. The market price of the firm’s common stock at that time was $31.0625 per share. The mandatory conversion date for each depository share was May 15th 2002. Each unit of ACES paid a dividend at the rate of 6.5% per annum, payable quarterly. Upon mandatory conversion each depository share of the ACES will be converted into a variable number of shares of Apache common stock. If the common stock price is below the issue price of $31 then for each depository share of ACES the holder will receive 1 share of Apache common stock (i.e., each unit of ACES will convert to 50 shares of common stock). If the price is between $31 and $37.82 then the number of common shares per depository share will be such that the value equals the issue price of $31. If the stock price is above $37.82 then the holder shall receive 0.8197 ($31/$37.82) shares of common stock per depository share of the ACES. Hence the cap on the depository shares of the ACES is at the issue price of $31. The holders of ACES also have an option to convert prior to May 15th 2002 in which case the holder will receive 0.8197 of Apache common stock per depository share of the ACES.</td>
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<tr>
<td>Investment Bank:</td>
<td>Goldman Sachs &amp; Co.</td>
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| Debt Exchangeable for Common Stock (DECS) | **Illustration:** Cendant Corporation issued 15,000,000 units of DECS on 07/20/01 at $50 per share. The market price of the firm’s common stock at that time was $21.53 per share (defined as the reference price). The DECS will be mandatorily convertible to shares of the firm’s common stock on August 17th 2004. Each DECS includes a forward purchase contract which obligates the holder to mandatorily convert to the common stock of the company on the mandatory conversion date, and also includes senior notes of the company bearing a principal amount of $50 which are due on August 17th 2006. Each unit of DECS pays a dividend of 7.75% per year, which comprises of an interest of 6.75% from the senior notes and a 1% contract adjustment fee. The interest on the senior notes will be reset on the mandatory conversion date. Each holder of DECS will receive a variable number of shares on the mandatory conversion date which will be determined as follows. If the stock price is less than or equal to the reference price of $21.53, then the number of shares will be 2.3223 ($50/$21.53). If the stock price is less than $28.42 (a 32% appreciation from the reference price) but greater than the reference price of $21.53, then the holder will receive a number of shares having a value equal to $50. If the average price equals or exceeds $28.42, each holder will receive 1.7593 ($50/$28.42) shares of common stock. Hence the cap of the DECS is at the issue price of $50. Holders of DECS also have an option to convert prior to the mandatory conversion date in which case they will receive 1.7593 shares of Cendant common stock per unit of DECS. |
| Investment Bank: | Salomon Smith Barney Inc. |

<p>| Equity Security Units | <strong>Illustration:</strong> Motorola Inc. issued 21,000,000 units of Equity Security Units on 10/26/2001 at $50 per unit. The market price of the firm’s common stock at that time was $17.28 per share (defined as the reference price). The mandatory conversion date for the Equity Security units is November 16th 2004. Each unit consists of two parts, a purchase contract which obligates the holder to mandatorily purchase the common stock of the company and a senior note due November 16th, 2007 with a principal amount of $50. Each unit earned a dividend of 7% per year payable quarterly, while the dividend on the common stock of the company was only about 0.95%. Upon mandatory conversion, each unit would be converted into a variable number of shares of Motorola common stock. If the stock price is less than or equal to $17.28 a holder will receive 2.8935 ($50/$17.28) shares of the company’s common stock. If the stock price is between $17.28 and $21.08 a holder will receive 2.3719 ($50/$21.08) shares of the company’s common stock. Hence the cap of the Equity Security Units is at the issue price of $50. A holder does not benefit from the first 22% appreciation in the market value of the common stock, however if the stock price rises above $21.08, the holders receive a fraction of any additional appreciation in the market value of the common stock. The holders have the option to settle the purchase contract early at any time prior to the seventh business day of the mandatory conversion date. In such cases the holder receives 2.3719 shares of the company’s common stock regardless of the market price of the shares on that date. |
| Investment Banks: | Joint issue by Goldman, Sachs &amp; Co., J P Morgan, Salomon Smith Barney |</p>
<table>
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<tr>
<th>Flexible Equity-Linked Exchangeable Preferred Redemption Increased Dividend Equity Securities (FELINE PRIDES)</th>
<th>Lincoln National Corp. issued 8,000,000 FELINE PRIDES units on 08/10/1998. The FELINE PRIDES consisted of two separately traded units; 7,000,000 units of Income PRIDES with an issue price of $25 per unit, and 1,000,000 units of Growth PRIDES with an issue price of $25 per unit. The market price of the common stock was $92.875 (defined as the reference price) at the time of issue of the PRIDES. The mandatory conversion date for the FELINE PRIDES was August 16th, 2001. Each Income PRIDES unit consists of a stock purchase contract which obligates the holders to convert mandatorily to the firm’s equity, and ownership of a preferred security having a liquidation value of $25. Each Growth PRIDES unit also consists of a stock purchase contract, and a 1/40th interest in a zero-coupon U.S. Treasury security with a principal amount at maturity equal to $1000 and maturing on August 15th, 2001. Each unit of Income PRIDES pays a dividend of 7.75% per year payable quarterly, which consists of a 6.4% interest on the preferred security and a contract payment of 1.35% per unit. Each unit of Growth PRIDES pays a contract payment of 1.85% per year, payable quarterly. Upon mandatory conversion each purchase contract of the FELINE PRIDES will receive a certain number of shares depending on the market price of the underlying common stock. If the stock price is less than or equal to $92.875, then the holder will receive 0.2692 ($25/$92.875) shares for each purchase contract. If the average price is between $92.875 and $111.45 (a 20% appreciation from the reference price), then the holder will receive a number of shares that produces a value equal to $25. If the average closing price equals or exceeds $111.45, then the holder will receive 0.2243 ($25/$111.45) shares per purchase contract. Hence the cap on both the components of the FELINE PRIDES is at $25, which is the issue price per unit of both Income and Growth PRIDES. It is possible for the holders of Income PRIDES to convert their holdings to Growth PRIDES and vice-versa.</th>
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<tr>
<td>Investment Bank:</td>
<td>Merrill Lynch &amp; Co. Inc.</td>
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<tr>
<td>Mandatory Adjustable Redeemable Convertible Securities (MARCS)</td>
<td>Coeur d'Alene Mines Corporation offered 6,588,235 shares of MARCS on 03/08/96 at $21.25 which was also the selling price of the common stock of the company at that time. The mandatory conversion date for the MARCS was March 15th, 2000. Holders of MARCS were entitled to receive cumulative dividends payable quarterly at 7% per annum. This dividend rate was significantly higher than the rate at which dividends historically have been paid on the common stock of the company. Upon mandatory conversion each unit of MARCS will receive a certain number of shares depending on the market price of the underlying common stock. If the stock price is below $21.25 (the issue price), each unit of MARCS will be converted into 1.111 shares of common stock plus the right to receive cash in an amount equal to all accrued or unpaid dividends on the mandatory conversion date. If the stock price is between $21.25 and $25.713 then the holder will receive a number of shares that produces a value of $21.25. If the stock price exceeds $25.713, then for each share of MARCS the holder will receive 0.826 ($21.25/$25.713) shares of the common stock. Hence the cap of these MARCS is the same as the issue price of $21.25. The holder also has the option to convert prior to the mandatory conversion date (subject to certain limitations), in which case he will receive 0.826 shares of common stock per share of MARCS which is equivalent to a conversion price of $25.713. The holders of MARCS have the same voting right as the holders of common stock. The shares of MARCS rank prior to the common stock as to payments of dividends and distribution of assets upon liquidation.</td>
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<td>Investment Bank:</td>
<td>UBS Securities LLC</td>
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<td>Mandatory Enhanced Dividend Securities (MEDS)</td>
<td>Heller Financial issued 7,000,000 MEDS units on 04/26/01 at $25 per unit, and the market price of their class A common stock was $32.15 (defined as the reference price) per share at that time. The mandatory conversion date for the MEDS is May 18th, 2004. Each MEDS consists of two components: (1) A contract to purchase shares of the issuing company’s class A common stock on the mandatory conversion date (i.e., the MEDS holders are obligated to convert mandatorily to the firm’s equity), and (2) A trust preferred security issued by HFI Trust I, due May 2nd 2006. Each unit of MEDS pays a dividend of 7% per year payable quarterly from the trust preferred unit until the mandatory conversion date, after which the distribution rate will be reset. This is substantially greater than the dividend yield of 1.2% per year on the common stock. Upon mandatory conversion each unit of MEDS will receive a certain number of shares depending on the market price of the underlying common stock. If the stock price is less than or equal to $32.15, then the holder will receive 0.7776 ($25/$32.15) shares for each MEDS unit. If the average price is between $32.15 and $38.58 (a 20% appreciation from the reference price), then the holder will receive a number of shares that produces a value of $25. If the average closing price equals or exceeds $38.58, then the holder will receive 0.6480 ($25/$38.58) shares per MEDS unit. Hence the cap on the MEDS units is at $25 which is its issue price. A MEDS holder does not benefit from the first 20% appreciation in the market value of</td>
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<td>Investment Bank:</td>
<td>J.P.Morgan Securities Inc</td>
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<tr>
<td><strong>Premium Equity Participating Security (PEPS)</strong></td>
<td>Valero Energy Corp issued 6,000,000 units of PEPS on 06/22/00 at $25 per unit. The market price of the firm’s common stock at that time was $29.125 per share (defined as the reference price). Each PEPS consists of two parts, a purchase contract which obligates the holder to mandatorily convert to the common stock of the company and a trust preferred security issued by VEC trust. Each PEPS unit earns a dividend of 7.75% per year payable quarterly while the dividend on the common stock of the company is only 1.10%. Upon mandatory conversion each unit of PEPS will be converted into a variable number of shares of Valero common stock. If the stock price is less than or equal to $29.125 a holder of PEPS will receive 0.85837 ($25/$29.125) shares of the company’s common stock. If the stock price is between $34.95 (a 20% appreciation from the reference price) and $29.125 then the holder will receive a number of shares having a value equal to $25. If the average price equals or exceeds $34.95 each PEPS holder will receive 0.71531 ($25/$34.95) shares of the company’s common stock. Hence the cap of the PEPS is at the issue price of $25. A PEPS holder does not benefit from the first 20% appreciation in the market value of the common stock, however if the stock price rises above $34.95, the PEPS holders receive a fraction of any additional appreciation in the market value of the common stock. The PEPS holders have the option to settle the purchase contract early at any time prior to the seventh business day of the mandatory conversion date. In such cases the holder receives 0.71531 shares of the company’s common stock regardless of the market price of the shares on that date.</td>
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<td><strong>Investment Bank:</strong></td>
<td>Morgan Stanley Dean Witter</td>
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| **Premium Equity Redemption Cumulative Security (PERCS)** | Kmart Corp. issued 5,750,000 shares of PERCS on 08/16/1991. Each unit of PERCS comprised of 4 depository shares which was offered to the public at $44 per share which was also the market price of the firm’s common stock at that time. The mandatory conversion date for each depository share was September 15th 1994. Each unit of PERCS paid a dividend at the rate of 7.75% per annum payable quarterly, while the dividend rate on the common stock was only 4%. Upon mandatory conversion each depository share of the PERCS will be converted into 1 share of Kmart common stock as long as the stock price is less than or equal to the cap price of $57.20 (an appreciation of 30% above the issue price). If the common stock price is above the cap price of $57.20 then the number of common shares per depository share will be such that the value equals the cap price of $57.20. The PERCS rank senior to the company’s common stock upon liquidation and holders of PERCS have the same voting rights as the holders of common stock. |
| **Investment Bank:** | Morgan Stanley Dean Witter |

| **Premium Income Equity Securities (PIES)** | Tesoro Petroleum Corporation issued 9,000,000 PIES units on 06/26/1998 at $15.9375 per unit, which was also the selling price of the common stock of the company at that time. The mandatory conversion date for the PIES was July 1st, 2001. Each unit of PIES represents 1/100th of a share of 7.25% mandatorily convertible preferred stock of the company. Holders of PIES were entitled to receive cumulative dividends payable quarterly at 7.25% per annum. Upon mandatory conversion each unit of PIES will receive a certain number of shares depending on the market price of the underlying common stock. If the stock price is less than or equal to $15.9375 (the issue price), each unit of PIES will be converted into 1 share of common stock. If the stock price is between $15.9375 and $18.85 then the holder will receive a number of shares that produces a value of $15.9375. If the stock price exceeds $18.85, then for each share of PIES the holder will receive 0.8455 ($15.9375/$18.85) shares of the common stock. Hence the cap of the PIES is set at the issue price of $15.9375. At any time after July 26th, 1998 and prior to the mandatory conversion date the holder also had the option to convert to equity, in which case he received 0.8455 shares of common stock per share of PIES which is equivalent to a conversion price of $18.85. The holders of PIES however were not entitled to any voting rights. |
| **Investment Bank:** | Lehman Brothers Inc. |

<p>| <strong>Preferred Redemption Increased Dividend Equity Securities (PRIDES)</strong> | MCN Corp issued 5,100,000 shares of PRIDES on 04/22/1996 at $23 per share, which was also the selling price of the common stock of the company at that time. The mandatory conversion date of the PRIDES was April 30th, 1999. Each security consists of (1) a stock purchase contract under which the holders are obligated to convert mandatorily to the firm’s equity on the mandatory conversion date and a commitment from the company to pay yield enhanced payments of 2.25% to the holders of the PRIDES and (2) 6.50 % U.S. Treasury notes having a principal amount equal to the issue price and maturing on the mandatory conversion date. Thus each unit of PRIDES pays a dividend of 8.75% per annum payable semi-annually, whereas historically the average dividend on the common stock... |</p>
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<tr>
<th>Investment Bank: Merrill Lynch &amp; Co. Inc.</th>
<th>has been around 5%. Upon mandatory conversion each security was to be converted to a variable number of shares of common stock of the company. If the common stock price is less than or equal to the issue price of $23, then for each unit of PRIDES the holder will get 1 share of the company’s common stock. If the stock price is between $23 and $27.60 (a 20% appreciation from the issue price) then the holder will receive a number of shares that produces a value of $23. If the stock price is greater than $27.60, then the holder will receive 0.833 ($23/$27.60) shares of common stock per PRIDES unit. Hence the cap of the PRIDES is set at the issue price of $23. Holders of PRIDES also have an early settlement option, in which case they will receive 0.833 shares of common stock per unit of PRIDES regardless of the market price of the common stock. Holders of PRIDES have no voting rights, unlike the common shareholders.</th>
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<tr>
<td>Threshold Appreciation Price Securities (TAPS) MedPartners Inc. issued 18,929,577 shares of TAPS on 09/15/97 at $22.1875 per share, which was also the selling price of the common stock of the company at that time. The mandatory conversion date of the TAPS was August 31st 2000. Each security consists of (1) a stock purchase contract under which the holders are obligated to convert mandatorily to the firm’s equity on the mandatory conversion date and a commitment from the company to pay yield enhanced payments of 0.25% to the holders of the TAPS and (2) 6.25 % U.S. Treasury notes having a principal amount equal to the issue price and maturing on the mandatory conversion date. Thus each unit of TAPS pays a dividend of 6.5% per annum payable semi-annually, whereas historically the common stock of the company has not paid any dividends at all. Upon mandatory conversion each security was to be converted to a variable number of shares of common stock of the company. If the common stock price is less than or equal to the issue price of $22.1875, then for each unit of TAPS the holder will get 1 share of the company’s common stock. If the stock price is between $22.1875 and $27.0678, then the holder will receive a number of shares having a value equal to $22.1875. If the stock price is greater than $27.0678, then the holder will receive 0.8197 ($22.1875/$27.0678) shares of common stock per TAPS unit. Hence the cap of the TAPS is set at the issue price of $22.1875. Holders of TAPS also have an early settlement option, in which case they will receive 0.8197 shares of common stock per unit of TAPS regardless of the market price of common stock. Holders of TAPS have no voting rights, unlike the common shareholders.</td>
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<td>Investment Bank: Smith Barney Inc.</td>
<td>Estee Lauder Inc. issued 1,734,104 units of TRACES on 2/17/1999 at $86.50 per unit, which was also the selling price of the common stock of the company at that time. The mandatory conversion date for the TRACES is February 23rd 2002. The TRACES were issued by a trust formed by the Company solely for this purpose, and the trust terminates automatically 10 business days after the mandatory conversion date. Each TRACES unit earns a dividend of 6.25% per year payable quarterly while the dividend on the common stock of the company is only about 0.45%. Upon mandatory conversion, each unit of TRACES will be converted into a variable number of class A common stock of Estee Lauder Inc. If the stock price is less than $86.50 a holder will receive 1 share of class A common stock. If the stock price is between $102.07 (a 18% appreciation from the reference price) and $86.50, then the holder will receive a number of shares having a value equal to $86.50. If the average price equals or exceeds $102.07, each holder will receive 0.8475 ($86.50/$102.07) shares of the company’s class A common stock. Hence the cap of the TRACES is at the issue price of $86.50. A holder does not benefit from the first 18% appreciation in the market value of the common stock. However, if the stock price rises above $102.07, the holders of TRACES receive a fraction of any additional appreciation in the market value of the common stock. The holders of TRACES have voting rights with regard to matters of the Trust fund issuing the securities only till the mandatory conversion date, after which they have the same rights as the holders of class A common stock of the company.</td>
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