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CEO inside debt and convertible bonds

Wei-Hsien Li[1] | **S. Ghon Rhee**[2,3] | **Carl Hsin-han Shen**[1]

[1]Department of Finance, National Central University, Taoyuan City, Taiwan

[2]Shidler College of Business, University of Hawai'i, Honolulu, Hawai'i, USA

[3]Department of Finance, National Central University

Correspondence
Carl Hsin-han Shen, Department of Finance, National Central University, No. 300, Zhongda Rd., Zhongli District, Taoyuan City 32001, Taiwan.
Email: hshen@ncu.edu.tw

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Abstract

The question whether convertible bonds are issued to combat the risk-shifting problem is a subject of debate in the literature, primarily because of the unavailability of clear measures regarding managerial risk-shifting incentives. Taking advantage of recently developed inside debt-holding measures for CEOs, we find strong evidence in support of the risk-shifting hypothesis. When a CEO holds a large amount of inside debt, three distinct patterns emerge: (i) the firm exhibits a lower ratio of outstanding convertibles to total debt; (ii) the firm is less likely to issue convertibles than straight debt; and (iii) the firm devises contract terms to decrease the chance of conversion when it issues convertibles.

KEYWORDS
convertible bond, inside debt, risk shifting

1 | INTRODUCTION

Financial economists have been challenged with the task of explaining the issuance of convertible bonds because these hybrid securities do not fit perfectly into the classical capital theories on the equity-debt choice. The risk-shifting hypothesis (RSH), first introduced by Jensen and Meckling (1976), is often proposed as a reason that convertibles are issued. The RSH posits that controlling shareholders pursue a level of asset risk that is excessive from debtholders' point of view because the value of an equity claim is analogous to a call option written on asset value. Risk-shifting firms thus experience relatively strict financing constraints in the debt market.

The issuance of convertible bonds rather than straight bonds is a financing strategy that firms can use to offer assurance to their debt investors. Jensen and Meckling (1976) argue that by issuing a bond-warrant combined security, shareholders effectively share part of the proceeds of the increased asset risk with the firm's debtholders, in turn curbing shareholders' incentive to pursue risk. Green (1984) presents a theoretical model and formalizes that intuition.

However, the RSH has received limited empirical support in the literature despite its theoretical validity. The main challenge confronted by any empirical test of the RSH is the difficulty of finding clear empirical proxies for managerial risk-shifting incentives. Earlier studies use firm characteristics as their empirical proxies for the degree of risk-shifting problems. Lewis, Rogalski, and Seward (1999, 2003) propose that firms with fewer profitable investment opportunities (measured by the market-to-book ratio) and greater idiosyncratic risk have a higher degree of risk-shifting concern. In a similar vein, King and Mauer (2014) relate a firm's set of investment opportunities to the extent of its agency concerns. Although these variables are arguably associated with agency costs, they do not exclusively capture managerial risk-shifting incentives. For instance, substantial investment opportunities and high risk may occur together with high

information asymmetry, which increases both the cost of equity and the cost of debt. Convertibles may therefore be issued to resolve the informational problem associated with equity issuance (i.e., the backdoor equity hypothesis proposed by Stein (1992), rather than a problem associated with debt issuance, as suggested by the RSH.[1]

Furthermore, managerial incentive measures based on equity-based contracts, such as restricted stocks and executive stock options, are also not appropriate measures of risk-shifting incentives. The relationship between equity-based compensation and corporate decisions can be driven by both the incentive alignment effect and the risk-aversion effect (Chava & Purnanandam, 2010; Low, 2009). On the one hand, equity-based compensation helps align managers' and shareholders' interests and thus enhances risk-shifting incentives. On the other hand, if managers cannot freely adjust their equity holdings because of trading restrictions associated with their contracts (e.g., lock-up periods for restricted stocks and stock options), they are forced to hold an under-diversified portfolio and become more risk-averse than their shareholders (Brockman, Martin, & Unlu, 2010; Guay, 1999). Therefore, equity-based compensation holding might capture conflicting managerial incentives and is not an ideal variable for the purpose of testing the RSH.

Recent studies on CEO inside debt, however, present an opportunity to resolve this empirical dilemma. Because the risk-shifting problem represents a conflict between shareholders and debtholders, an appropriate proxy for managerial risk-shifting incentives should be directly related to incentive alignment between managers and debtholders. Both executive pension and deferred compensation plans represent debts that a company owes its managers, to be paid upon those managers' retirement. Sundaram and Yermack (2007) therefore denote these vehicles as 'inside debt', as opposed to financial debt owed to outsiders. These authors suggest that inside debt aligns managers' incentives with debtholders' incentives by uniting managers and debtholders in their risk of incurring losses should the company default. Edmans and Liu (2011) formally model this insight.[2]

Recent studies also find empirical evidence to support the predictions set forth above. Cassell, Huang, Sanchez, and Stuart (2012) document a positive association between inside debt holdings and corporate conservatism. Wei and Yermack (2011) document positive abnormal bond returns when companies follow the SEC rule and file their first-time disclosure of inside debt positions. Anantharaman, Fang, and Gong (2014) present evidence showing that loans issued to companies with more CEO inside debt are associated with lower promised yields and fewer covenants. Srivastav, Armitage, and Hagendorff (2014) find that the CEOs of banks with higher inside debt relative to inside equity are more likely to cut bank pay-outs and follow more conservative bank pay-out policies. Dang and Phan (2016) document a positive relation between CEO inside debt holding and short-maturity debt issuance.

This line of research provides direct evidence that inside debt is an effective mechanism for aligning managers' and debtholders' incentives. To the extent that inside debt can curb managers' risk-shifting incentives, debt investors should be reassured when they observe that a CEO holds a large amount of inside debt. We therefore expect a negative association between a CEO's inside debt holding and the firm's preference for convertibles according to the RSH. Conversely, if convertibles are issued primarily for other reasons, such as backdoor equity, inside debt holdings should have little (or weak) explanatory power regarding firms' decision to issue convertible securities.

Our empirical evidence strongly supports the RSH. Using a dataset consisting of 3,558 firm-year observations and 1,338 straight debt and convertible debt issues from 2006 to 2011, we find that firms with more CEO inside debt holdings show a significantly lower preference for convertible bonds. Specifically, firms with more CEO inside debt holdings have fewer outstanding convertible debts relative to total debts on their balance sheets, are less likely to issue convertibles than to issue straight debts, and devise contract terms that result in a lower chance of conversion when they do issue convertible bonds. The economic significance of our findings is also strong. As CEO inside debt measures increase from the first to the third quartile in our sample, we estimate that the proportion of outstanding convertible

[1] Stein (1992) theorizes that convertible bonds can be used as a mechanism to reduce the informational discount imposed by outside investors on newly issued shares. Therefore, convertibles are issued as 'backdoor' equities in the sense that they are meant to be converted if the manager performs well in pursuing shareholder interests, as promised to the stock investors.

[2] Some theoretical models on compensation design also focus on improving incentive alignment between CEOs and debtholders. Bolton, Mehran, and Shapiro (2015) suggest that excess risk-taking in the banking industry can be addressed by a compensation contract based on both stock price and credit default swap (CDS) spreads. Walther and Klein (2015) suggest that the impact of contingent convertible bonds (CoCo bonds) on excessive risk-taking can be neutralized once CoCo bonds are considered in the compensation contract.

debt to total debt decreases by approximately 15%. In addition, our documented effect of inside debt on convertibles is more prominent among firms with greater default risk, which is consistent with the notion that the value of inside debt is particularly high when a firm's creditworthiness is called into question.

We contribute to the literature in the following three ways. First, to the best of our knowledge, we provide the most direct empirical evidence in the literature in favour of the RSH. We find that bond investors' preference for convertibles decreases when they feel reassured by the manager's inside debt holding. Two related studies use different approaches to provide evidence that supports the RSH. In a survey of European managers, Bancel and Mittoo (2004) find that more than 70% of the respondents report that resolving risk-shifting concerns is an important reason to issue convertibles. Dorion, François, Grass, and Jeanneret (2014) define shareholders' risk-shifting incentives (RSI) as a measure of the sensitivity of shareholder value to a change in firm volatility, showing a positive association between RSI and convertible issuance. Our study contributes to the literature because to the extent that a CEO's behaviour is affected by the composition of her compensation portfolio, inside debt holding is a direct measure of personal risk-taking incentive.

Second, we document another favourable debt market reception for firms that use pension and deferred compensation programmes. Extant studies examining the manner in which inside debt affects a firm's access to debt markets, such as Wei and Yermack (2011) and Anantharaman et al. (2014), typically exclude convertibles and focus on straight debts. We extend this investigation to the convertible bond market. Our evidence indicates that firms can offer less valuable conversion options and obtain a lower cost of debt when their CEOs have more inside debt holdings.

Third, this study adds to the literature on the substitution effect between executive compensation and other corporate governance mechanisms. Lippert and Moore (1995) indicate a negative relation between shareholder monitoring (measured by voting rights and board independence) and compensation incentives. Cheng and Indjejikian (2009) document that compensation contracts provide a weaker incentive after the enactment of anti-takeover laws. Brockman et al. (2010) show that the delta (vega) of CEO compensation portfolios is positively (negatively) related to debt maturity, consistent with the notion that debt investors prefer short-term debt when a risk-shifting concern is present. Adding to these studies, we show that inside debt and conversion clauses are two substitutional mechanisms that firms can use to reduce the informational cost of debt.

The paper is organized as follows. Section 2 describes the sample and variable definitions. The results are presented in Section 3. Section 4 concludes the paper.

2 | SAMPLE AND VARIABLES

2.1 | Inside debt variable

We define CEO inside debt as the sum of the present values of a CEO's accumulated pension benefits and deferred compensation, as reported in Execucomp. Specifically, for a CEO in a given year, pension is the present value of the accumulated pension benefits under the company's pension plans, and deferred compensation is the aggregate balance in non-tax-qualified deferred compensation plans.

Sundaram and Yermack (2007) and Edmans and Liu (2011) demonstrate that managerial incentives vary with the relative weight of debt- versus equity-based compensation in the executive pay structure, not with the absolute level of debt-like compensation. Therefore, following Wei and Yermack (2011), we use the relative ratio of the CEO's inside debt-to-equity ratio to the firm's debt-to-equity ratio (*CEO-firm D/E*) as our first measure of inside debt incentives. Specifically, we calculate the CEO-to-firm debt-to-equity ratio as follows:

$$CEO\text{-}firm\ D/E = \frac{CEO\ D/E}{Firm\ D/E},$$

where *CEO D/E* is the CEO's debt-to-equity ratio, defined as the sum of the present value of accumulated pension benefits and deferred compensation (D_{CEO}) divided by the value of the CEO's equity holding portfolio (E_{CEO}). We define CEO equity holdings as the total value of stocks and stock options held by the CEO in a year. *Firm D/E* is a firm's debt-to-equity ratio, defined as the sum of long-term and short-term debts (D_{Firm}) divided by the market value of equity (E_{Firm}).

Edmans and Liu (2011) provide a theoretical model showing that under certain conditions, firm value is optimized when the CEO's inside leverage coincides with the firm's financial leverage.

Our second measure of inside debt incentives is the relative incentive ratio (*CEO-firm* $\Delta D/\Delta E$) developed by Wei and Yermack (2011). Instead of taking aggregate amounts of debt and equity as inputs, Wei and Yermack suggest that these sensitivity measures better capture the inside debt incentive and define the so-called relative incentive ratio using the sensitivities of debt and equity to a one-unit change in firm value. Specifically, we calculate the relative incentive ratio as follows:

$$\textit{CEO-firm}\ \Delta D/\Delta E = \frac{\textit{CEO}\ \Delta D/\Delta E}{\textit{Firm}\ \Delta D/\Delta E},$$

where *CEO* $\Delta D/\Delta E$ is the sensitivity of the CEO's inside debt divided by the sensitivity of his equity portfolio holding given a one-unit change in firm value, and *Firm* $\Delta D/\Delta E$ is the sensitivity of total debt divided by the sensitivity of equity given a one-unit change in firm value. This measure aims to capture the dynamics of a CEO's relative incentive in response to changes in firm value.

Following the procedures in Wei and Yermack (2011), we obtain the estimate of *CEO* $\Delta D/\Delta E$ through an approximation approach. First, we compute the CEO equity delta and the firm equity delta as the changes in the value of the CEO's equity portfolio and the value of equity portfolio issued by the firm (including stock and stock options), respectively, given a 1% change in the stock price. To calculate the firm's approximated delta, we use the total number of employee stock options outstanding and the average exercise price of the outstanding options as the inputs for the Black–Scholes valuation formula and assume a remaining life of four years for all options. Second, because it is challenging to estimate the sensitivity of the value of CEO inside debt holding to firm value (*CEO* ΔD) and the sensitivity of total debt value to firm value (*Firm* ΔD), we substitute (D_{CEO}/D_{Firm}) for (*CEO* ΔD/*Firm* ΔD).[3] Finally, we compute *CEO Delta* and *CEO Vega* as the measures of equity incentive, where *CEO Delta* measures the increase in the value of the CEO's equity portfolio when the stock price increases by 1% and *CEO Vega* measures the increase in the value of the CEO's equity portfolio when the stock volatility increases by 1%. The Appendix provides details about the variable calculation.

2.2 | Sample

We begin the sample construction with all firm-year observations in the Execucomp database from 2006 to 2011 because the disclosure of values accrued under pension benefits and deferred compensations became mandatory only in 2006.[4] We require all variables to have no missing values after merging the initial sample with the observations in Compustat and CRSP, exclude all financial and utility firms, and omit those observations with zero outstanding debt. This screening process results in 3,558 firm-year observations of 898 unique firms. We denote this sample as the balance sheet sample, which allows us to examine the amount of outstanding convertible debt relative to that of accumulated straight debt. Specifically, we compute the ratio of outstanding convertible debt relative to total debt (*CVT/TD*), which measures the extent to which a firm relies on convertible debt as a source of debt financing.

To construct the issuance sample, we subsequently search for all debt offers (straight and convertible) of the 898 firms covered in the balance sheet sample in two databases: the SDC's Global New Issues Database (SDC) and the Fixed Investment Securities Database (FISD). Both databases provide a comprehensive collection of bond issuance data. The FISD focuses on publicly offered bonds in the United States, and the SDC covers various types of issuances, public offerings or private placements in the global market. The search yields 1,346 new debt issues of 497 unique firms, where 447 issues are drawn from the FISD and 899 issues are drawn from the SDC. The issuance sample allows us to examine the choice between issuing straight and convertible debts when a firm raises debt capital.

[3] Wei and Yermack (2011) note that estimating *CEO* ΔD and *Firm* ΔD is problematic for two reasons. First, because most firms in their (and in our) sample are not financially distressed, *CEO* ΔD and *Firm* ΔD are small and difficult to estimate. Second, companies provide little information about the maturity structure of their debt, which adds complexity to the estimation of these two quantities.

[4] The universe of the Execucomp database covers the firms that are part of the S&P 1500 index.

TABLE 1 Summary statistics

Panel A. Balance Sheet Sample ($N = 3,558$)					
Variable	**Mean**	**Std Dev.**	**Q1**	**Median**	**Q3**
CVT/TD	0.077	0.208	0.000	0.000	0.000
CEO-firm D/E	2.766	7.863	0.186	0.590	1.611
CEO-firm ΔD/ΔE	4.156	7.901	0.191	0.847	3.209
(CEO-firm D/E > 1)	0.362	0.481	0.000	0.000	1.000
(CEO-firm ΔD/ΔE > 1)	0.470	0.499	0.000	0.000	1.000
CEO Delta ($mm)	0.495	0.635	0.091	0.239	0.614
CEO Vega ($mm)	0.135	0.154	0.019	0.073	0.193
Market-book	1.692	0.832	1.170	1.449	1.951
Net Income/Assets	0.048	0.091	0.025	0.052	0.087
ΔAssets	0.058	0.250	−0.039	0.023	0.096
Long-term Debt/Assets	0.226	0.158	0.119	0.211	0.306
Assets ($mm)	10823.5	24108.0	1271.1	3288.7	9483.0
Slack	0.102	0.111	0.023	0.062	0.144
Volatility	1.166	0.612	0.719	1.008	1.467
Prior Return	0.085	0.374	−0.167	0.062	0.299
Z-Score	3.342	1.873	1.943	3.013	4.367
Panel B. Issuance Sample ($N = 1,346$)					
Variable	**Mean**	**Std Dev.**	**Q1**	**Median**	**Q3**
CVT Issue	0.226	0.418	0.000	0.000	0.000
CEO-firm D/E	1.211	3.315	0.140	0.442	1.142
CEO-firm ΔD/ΔE	1.588	4.485	0.082	0.256	0.995
(CEO-firm D/E > 1)	0.279	0.448	0.000	0.000	1.000
(CEO-firm ΔD/ΔE > 1)	0.249	0.433	0.000	0.000	0.000
CEO Delta ($mm)	0.720	0.912	0.163	0.374	0.853
CEO Vega ($mm)	0.235	0.274	0.036	0.140	0.331
Market-book	1.629	0.709	1.163	1.418	1.877
Net Income/Assets	0.042	0.075	0.020	0.048	0.080
ΔAssets	0.110	0.359	−0.026	0.038	0.122
Long-term Debt/Assets	0.287	0.148	0.189	0.260	0.356
Assets ($mm)	23046.6	38505.1	3523.9	9028.5	25575.0
Slack	0.085	0.097	0.020	0.050	0.115
Volatility	0.374	0.228	0.215	0.307	0.459
Prior Return	0.002	0.160	−0.076	−0.004	0.065
Z-score	1.619	1.024	0.829	1.556	2.245

The balance sheet sample consists of 3,558 firm-year observations from 2006 to 2011, and the issuance sample consists of 1,346 straight debt and convertible debt issues by 497 firms from 2006 to 2011. See Appendix for a detailed definition of the variables.

Table 1 reports the summary statistics of the balance sheet and the issuance samples. For the balance sheet sample, the mean and median of *CVT/TD* are 7.7% and zero, respectively, indicating that only a relatively small portion of firms in our sample have outstanding convertible debt. The means of *CEO-firm D/E* and *CEO-firm ΔD/ΔE* are 2.77 and 4.16, respectively, which are in line with the statistics reported in prior studies (e.g., Campbell, Galpin, & Johnson, 2016;

Cassell et al., 2012; Phan, 2014).[5] We also find that 36.2% and 47% of our sample firms have *CEO-firm D/E* and *CEO-firm* $\Delta D/\Delta E$ greater than one, respectively, which is considered an excessively high level of inside debt from a theoretical perspective (Edmans & Liu, 2011). For the issuance sample, the mean of *CVT Issue* (an indicator variable that takes a value of one for a convertible debt issue) is 22.6%; in other words, 304 of the 1,346 debt issues are convertibles. The means of *CEO-firm D/E* and *CEO-firm* $\Delta D/\Delta E$ are 1.21 and 1.59, respectively, and 27.9% and 24.9% of our sample firms have a *CEO-firm D/E* and *CEO-firm* $\Delta D/\Delta E$ greater than one.

3 | RESULTS

3.1 | Outstanding convertible debt

We begin our investigation by examining the proportion of outstanding convertible debt relative to total debt. To the extent that inside debt holdings mitigate the risk-shifting problem, firms with greater CEO inside debt should rely less on convertible bond issuance as their financing method. We estimate the following regression model.

$$\begin{aligned} CVT/TD_{i,t} = {} & \beta_0 + \beta_1 Inside\ Debt\ Variable_{i,t} + \beta_2 Market\text{-}book_{i,t} + \beta_3 (Net\ Income/Assets)_{i,t} + \beta_4 \Delta Assets_{i,t} \\ & + \beta_5 (Long\text{-}term\ Debt/Assets)_{i,t} + \beta_6 Log(Assets)_{i,t} + \beta_7 Slack_{i,t} + \beta_8 Volatility_{i,t} + \beta_9 Prior\ Return_{i,t} \\ & + Industry\ and\ Year\ Dummies + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

where subscripts *i* and *t* refer to firm and year and *Inside Debt Variable* is either the logarithm of one plus the relative leverage ratio, *Ln(1 + CEO-firm D/E)*, or the logarithm of one plus the relative incentive ratio, *Ln(1 + CEO-firm* $\Delta D/\Delta E$*)*. As the proportion of convertible debt relative to total debt must be a positive value, we estimate model (1) with the Tobit model, in which the dependent variable is censored at zero as the lower limit.

Our choice of control variables largely follows Lewis et al. (2003). *Market-book* (computed as the market value of assets divided by the book value of assets) and changes in total assets (Δ*Assets*) are proxies for the level of investment opportunities. Net income divided by assets (*Net Income/Assets*) estimates the profitability of the asset-in-place. We use long-term debt divided by assets (*Long-term Debt/Assets*) and *Volatility* (the annualized standard deviation of monthly returns over the previous fiscal year) to proxy for the cost of risk-shifting (Green, 1984). Firm size is measured by the natural logarithm of the book value of assets (*Assets*), which can be a proxy for financial distress costs and the magnitude of information asymmetry problems.[6] *Slack* (cash holdings scaled by assets) measures internally available financial slack. Firms with higher slack may engage in wasteful investments. Finally, we include *Prior Return* (the buy-and-hold return of the monthly returns over the previous fiscal year) to control for the possible market-timing pattern in convertible issuance decisions.

Table 2 presents the results. In the first two columns, we estimate model (1) and find significantly negative coefficients for both inside debt variables. The estimated coefficient of *CEO-firm D/E* is −0.178 and the estimated coefficient of *CEO-firm* $\Delta D/\Delta E$ is −0.11. Both coefficients are statistically significant at the 1% level. This negative relation between inside debt incentive and reliance on convertible debt is consistent with the RSH, whereby the conversion option is added to the debt contract to reduce the risk-shifting concern. To further control the equity incentive, in the last two columns of Table 1, we include *CEO Delta* and *CEO Vega* in the model. Consistent with the conflicting effects of equity compensation on managerial risk-taking incentive, we do not find significant coefficients for *CEO Delta* and *CEO Vega*. More importantly, the explanatory power of the inside debt variable remains intact even after we control for equity compensation variables. The estimated coefficients of *Ln(1 + CEO-firm D/E)* and *Ln(1 + CEO-firm* $\Delta D/\Delta E$*)* in the models of columns (3) and (4) are −0.198 and −0.122, respectively.

[5] Wei and Yermack (2011) developed the procedure on a sample of 299 firms in 2006. Thus, we compare our statistics to those obtained in studies applying Wei and Yermack's procedure on broader samples.

[6] We use the book value of assets instead of the market value of equity used in Lewis et al. (2003) to measure firm size because the book value of assets should be less affected by capital structure. Nonetheless, our results are qualitatively similar to both firm-size measures.

TABLE 2 Inside debt incentive and outstanding convertible debt

Independent Variable	Dependent Variable = *CVT/TD*			
Ln(1 + CEO-firm D/E)	−0.178***		−0.198***	
	(− 4.27)		(− 4.62)	
Ln(1 + CEO-firm ΔD/ΔE)		−0.110***		−0.122***
		(− 3.13)		(− 3.41)
Ln(1 + CEO Delta)			−0.193**	−0.154
			(− 1.97)	(− 1.54)
Ln(1 + CEO Vega)			0.082	0.050
			(0.30)	(0.19)
Market-book	−0.086	−0.119*	−0.059	−0.099
	(−1.46)	(−1.91)	(−1.00)	(−1.61)
Net Income/Assets	−0.765***	−0.869***	−0.755***	−0.871***
	(−3.64)	(−4.12)	(−3.59)	(−4.14)
ΔAssets	0.082	0.080	0.091*	0.086*
	(1.60)	(1.53)	(1.79)	(1.65)
Long-term Debt/Assets	0.481***	0.607***	0.406**	0.552***
	(2.90)	(3.70)	(2.40)	(3.29)
Log(Assets)	0.021	−0.009	0.036	−0.001
	(0.99)	(−0.40)	(1.49)	(−0.05)
Slack	1.793***	1.772***	1.803***	1.780***
	(6.91)	(6.81)	(6.94)	(6.85)
Volatility	0.113***	0.122***	0.108***	0.119***
	(2.67)	(2.89)	(2.58)	(2.84)
Prior Return	0.008	0.004	0.011	0.005
	(0.18)	(0.10)	(0.26)	(0.13)
Log Pseudolikelihood	−1625.91	−1638.06	−1621.45	−1635.17
Goodness-of-fit Test				
F-Statistics	9.84***	9.59***	8.79***	8.55***

The sample consists of 3,558 firm-year observations from 2006 to 2011. *CVT/TD* is the ratio of outstanding convertible debt relative to total debt. *CEO-firm D/E* is the CEO-to-firm relative debt-to-equity ratio, and *CEO-firm ΔD/ΔE* is the CEO-to-firm relative incentive ratio. *CEO Delta* is the change in the CEO's compensation portfolio value from a 1% change in the stock price; and *CEO Vega* is the change in the CEO's compensation portfolio value from a 1% change in the annualized stock volatility. Since *CVT/TD* must be positive, we estimate a Tobit model with dependent variables truncated at zero. See Appendix for a detailed definition of the variables. Two-digit SIC code industry dummies and year dummies are included. The *z*-value based on White's robust standard error is reported in parentheses. The coefficient of the intercept term is not reported to save space. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The economic significance of our finding is substantial. Based on our estimation in the third column of Table 1, a back-of-the-envelope calculation reveals that as the relative leverage ratio, *CEO-firm D/E*, increases from the first quartile (0.186) to the third quartile (1.611) in our sample, the proportion of outstanding convertible debt to total debt decreases by 15.6%.[7] A similar calculation of economic significance based on the estimated coefficient of the relative incentive ratio (*CEO-firm ΔD/ΔE*) in the fourth column is 14.64%. Accordingly, we find a strong pattern indicating that when a firm has a large amount of CEO inside debt, it has a significantly lower level of outstanding convertibles recorded on its balance sheet.

[7] With the estimated coefficient of *Ln(1 + CEO-firm D/E)* as −0.198, we compute the change in *CVT/TD* in response to the increase in *CEO-firm D/E* as (Ln(1 + 1.611) − Ln(1 + 0.186)) * (−0.198) = −15.6%.

With respect to control variables, the significantly negative coefficient of *Net Income/Assets* implies that profitable companies prefer straight debts because they experience no difficulties in paying interest (Dutordoir, Strong, & Ziegan, 2014; Lewis et al., 1999). The coefficients of *Long-term Debt/Assets*, *Volatility*, and *Slack* are significantly positive. These results are consistent with the notion that firms' preference for convertible debt is positively related to the cost they incur when there is a risk-shifting problem. The effects of investment opportunity proxies are mixed. This result could be attributable to the conflicting effects of investment opportunity on external financing decisions. On the one hand, firms with more profitable opportunities face a lower external financing cost. On the other hand, high-growth firms could suffer from a more severe information asymmetry problem (Myers, 1977) than low-growth firms and thus face a higher cost of external financing.

3.2 | Debt issuance

The amount of outstanding debt is derived by accumulating all prior debt issuances and retirements and therefore is significantly related to firm history (Kayhan & Titman, 2007). This feature of the outstanding debt variable presents a challenge to researchers because it is difficult to thoroughly control for a firm's entire history in an empirical investigation. To circumvent this difficulty, we examine debt issuance decisions, which (like marginal financing decisions) should depend more on the concurrent situation. Specifically, we examine whether a firm's choice between issuing straight or convertible debt is explained by the level of inside debt holdings.

Using the issuance sample, we consider the following probit regression model:

$$\begin{aligned} Prob(CVT\ Issue_{i,t} = 1) = F(&\beta_0 + \beta_1\, Inside\ Debt\ Variable_{i,t} + \beta_2 Market\text{-}book_{i,t} + \beta_3(Net\ Income/Assets)_{i,t} + \beta_4 \Delta Assets)_{i,t} \\ &+ \beta_5(Long\text{-}term\ Debt/Assets)_{i,t} + \beta_6 Log(Assets_{i,t}) + \beta_7 Slack_{i,t} + \beta_8 Volatility_{i,t} + \beta_9 Prior\ Return_{i,t} \\ &+ Year\ Dummies + \varepsilon_{i,t}), \end{aligned} \tag{2}$$

where *CVT Issue* is a dummy variable that equals one if a convertible debt rather than a straight debt is issued; hence, the dependent variable is the probability that a convertible debt is issued. *F* is the cumulative normal distribution function.

Table 3 reports the results. Our findings are consistent with those in Table 2. Significantly negative coefficients of *Ln(1 + CEO-firm D/E)* and *Ln(1 + CEO-firm ΔD/ΔE)* indicate that firms with greater CEO inside debt holdings are less likely to issue convertible debts when they raise debt capital. The computation of the marginal effects of *Ln(1 + CEO-firm D/E)* and *Ln(1 + CEO-firm ΔD/ΔE)* based on the estimates in the models of columns (3) and (4), where the estimated coefficients are −0.31 for *Ln(1 + CEO-firm D/E)* and −0.257 for *Ln(1 + CEO-firm ΔD/ΔE)*, reveals that a one-unit increase in the inside debt variable from the sample mean reduces the probability of issuing convertible debt by 4.3% to 3.5%. Accordingly, our investigation of debt issuance decisions confirms the findings of outstanding debt investigations, that there is a negative relation between the level of inside debt and firms' preference for issuing convertible debt.

Comparing convertible debt issuers and straight issuers, we find that firms with lower profitability and higher financial slack are more likely to be convertible debt issuers. These results are consistent with our previous findings regarding the proportion of outstanding convertible debt relative to total debt. In addition, the significantly negative coefficients on *Long-term Debt/Assets* and *Log(Assets)* are consistent with the findings in De Jong, Duca, and Dutordoir (2013) that convertible issuers in the United States have a lower leverage ratio and smaller firm size than straight debt issuers.

3.3 | Probability of conversion

The analyses presented thus far examine the choice between straight and convertible debts. However, Lewis et al. (1999) note that researchers might overlook subtle specifications in the design of convertible bonds if they compare only the amounts of straight and convertible debts. For instance, a convertible bond with a low likelihood of being converted is, in reality, similar to straight debt. Therefore, the statement that such a convertible bond is a security 'different' from straight debt is not entirely accurate.

TABLE 3 Inside debt incentive and convertible debt issuance

Independent Variable	Dependent Variable = Prob(CVT Issue = 1)			
Ln(1 + CEO-firm D/E)	−0.325**		−0.310*	
	(−2.15)		(−1.85)	
Ln(1 + CEO-firm ΔD/ΔE)		−0.303**		−0.257**
		(−2.57)		(− 1.99)
Ln(1 + CEO Delta)			−0.403	−0.370
			(−1.25)	(−1.14)
Ln(1 + CEO Vega)			−0.372	−0.442
			(−0.54)	(−0.64)
Market-book	−0.002	−0.072	−0.027	−0.089
	(−0.02)	(−0.70)	(−0.25)	(−0.84)
Net Income/Assets	−6.567***	−6.936***	−5.517***	−5.870***
	(−5.53)	(−5.77)	(−4.85)	(−5.04)
ΔAssets	0.413**	0.394**	0.374*	0.361*
	(2.41)	(2.27)	(1.81)	(1.73)
Long-term Debt/Assets	−2.437***	−2.424***	−2.084***	−2.031***
	(−4.03)	(−4.01)	(−3.26)	(−3.20)
Log(Assets)	−0.700***	−0.787***	−0.592***	−0.664***
	(−10.66)	(−10.42)	(−7.21)	(−7.50)
Slack	3.617***	3.646***	4.224***	4.254***
	(5.45)	(5.51)	(5.91)	(5.99)
Volatility	−0.319	−0.285	0.805	0.819
	(− 0.69)	(− 0.62)	(1.51)	(1.54)
Prior Return	0.484	0.483	0.423	0.421
	(1.07)	(1.05)	(0.92)	(0.91)
Log Pseudolikelihood	−581.55	−580.34	−557.35	−557.00
Goodness-of-fit Test				
χ^2 Statistic	201.14***	198.67***	225.51***	224.27***

The sample consists of 1,346 straight debt and convertible debt issues offered by 497 firms from 2006 to 2011. *CVT Issue* is an indicator variable that equals one when the issue is convertible debt and zero otherwise. *CEO-firm D/E* is the CEO-to-firm relative debt-to-equity ratio, and *CEO-firm ΔD/ΔE* is the CEO-to-firm relative incentive ratio. *CEO Delta* is the change in the CEO's compensation portfolio value from a 1% change in the stock price; *CEO Vega* is the change in the CEO's compensation portfolio value from a 1% change in the annualized stock volatility. A probit model is estimated to explain the probability of issuing convertible debt. See Appendix for the detailed definition of the variables. Year dummies are included, and the *z*-value based on White's robust standard error is reported in parentheses. The coefficient of the intercept term is not reported to save space. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

For this reason, Lewis et al. (1999) propose the probability of conversion as a 'catch-all' measure, which estimates, on the issuing date, the probability that a convertible debt is to be converted at maturity. Specifically, under the assumption that the stock price follows a geometric Brownian motion, the probability of conversion (i.e., the probability that the stock price will be higher than the conversion price at maturity) is described by the term $N(d_2)$ in the Black–Scholes formula, and

$$d_2 = \frac{\ln \frac{S}{X} + \left(r - div - \frac{\sigma^2}{2}\right) T}{\sigma \sqrt{T}} \tag{3}$$

where S is the current stock price, X is the conversion price, r is the 10-year US Treasury yield, *div* is the average dividend yield of the issuing firm across the past three years, σ is the annualized stock volatility calculated over the three-year horizon prior to convertible debt issuance, and T is the number of years until maturity.

Such a conversion probability measure is advantageous in that all relevant parameters are considered to determine the extent to which a convertible bond resembles straight debt. For instance, a convertible bond with a conversion price that is only slightly higher than the stock price at the issuance date may still be considered quite 'debt-like' (i.e., the likelihood that the stock price will become greater than the conversion price at maturity remains low) if the time to maturity is relatively short. Therefore, utilizing this measure, we can measure the probability of conversion (i.e., the value of the conversion option) that a firm is willing to offer when designing a convertible security.[8] We thus expect those convertibles issued by firms with higher inside debt holdings to have a lower chance of being converted, and therefore to be more 'debt-like', because these firms face a lower informational cost of debt.

To test our prediction empirically, we limit our attention to the 304 convertible debt issues and estimate the following model with a Tobit model in which the dependent variable is censored at zero and one:

$$\begin{aligned} Conv\ Prob_{i,t} = {} & \beta_0 + \beta_1 Inside\ Debt\ Variable_{i,t} + \beta_2 Market\text{-}book_{i,t} + \beta_3 (Net\ Income/Assets)_{i,t} + \beta_4 \Delta Assets_{i,t} \\ & + \beta_5 (Long\text{-}term\ Debt/Assets)_{i,t} + \beta_6 Log(Assets_{i,t}) + \beta_7 Slack_{i,t} + \beta_8 Volatility_{i,t} + \beta_9 Prior\ Return_{i,t} \\ & + Year\ Dummies + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

where *Conv Prob* is the probability of conversion. A high (low) value of conversion probability indicates that the nature of a convertible security is similar to that of equity (debt).

Table 4 reports the results. There is a significantly negative relation between the probability of conversion and the level of inside debt holding. The estimated coefficients of *Ln(1 + CEO-firm D/E)* and *Ln(1 + CEO-firm ΔD/ΔE)* in the models of columns (3) and (4) are −0.031 and −0.018, respectively. Our results indicate that even conditional on the issuance of convertible bonds, firms with higher inside debt holdings still design the security so that conversion is less likely to occur. In other words, the convertible bonds issued by high inside-debt-holding companies are more similar to debt than they are to equity. This finding provides additional support for the notion that companies with high inside debt do not 'sweeten' their debt offers by adding conversion clauses so that they can reduce the cost of their debt. Furthermore, consistent with Myers (1977), who suggests that firms with high investment opportunities are less likely to finance with debt, we find that *Market-book* is positively and significantly related to the probability of conversion. The significantly negative coefficient of *Slack* is consistent with the notion that the adverse selection cost in debt financing decreases with financial slack (Myers & Majluf, 1984).[9]

3.4 | Addressing sample selection bias

One caveat of our findings is that they might be subject to sample selection bias. Because we use compensation data from the Execucomp database, our sample is composed of firms listed on the S&P 1500 index. However, S&P 1500 firms are relatively large firms in the US capital market, whereas convertible issuers are typically relatively small firms (De Jong et al., 2013). A concern about sample selection bias therefore arises because our sample observations might be non-randomly selected.[10]

To address this issue, we first show that our findings are not affected by firm size. We create the *Large Firm Dummy*, which takes the value of one when the value of a firm's total assets is above the sample median and zero otherwise. We

[8] Notably, certain limitations are associated with this conversion probability measure. For instance, the measure is constructed with the risk-neutral (not physical) probability, its construction does not consider possible early conversion, and its construction relies on geometric Brownian motion assumptions about equity price dynamics. We thank the anonymous reviewer for sharing these insights with us.

[9] We also find a negative coefficient of *Volatility*. As a measure of risk, *Volatility* could be related to both the cost of equity and the cost of debt, and its empirical relation to conversion probability is ambiguous. Lewis et al. (1999) find a significantly negative coefficient on stock return volatility in two out of four specifications in their probability of conversion regressions.

[10] We thank Norman Strong, the associate editor, for noting this issue.

TABLE 4 Inside debt incentive and probability of conversion

Independent Variable	Dependent Variable = Conv Prob			
Ln(1 + CEO-firm D/E)	−0.032***		−0.031***	
	(−3.02)		(−2.99)	
Ln(1 + CEO-firm ΔD/ΔE)		−0.025***		−0.018***
		(−4.02)		(−2.96)
Ln(1 + CEO Delta)			−0.027	−0.016
			(−1.61)	(−0.94)
Ln(1 + CEO Vega)			−0.035	−0.059
			(−0.66)	(−1.05)
Market-book	0.035***	0.031***	0.031***	0.026***
	(5.80)	(5.32)	(4.80)	(4.07)
Net Income/Assets	0.077	0.049	0.148***	0.122**
	(1.37)	(0.90)	(2.69)	(2.26)
ΔAssets	0.015	0.014	0.016	0.016
	(1.02)	(0.97)	(1.40)	(1.35)
Long-term Debt/Assets	−0.049	−0.051	−0.021	−0.014
	(−1.21)	(−1.31)	(−0.56)	(−0.39)
Log(Assets)	−0.005	−0.012**	0.005	−0.001
	(−0.96)	(−2.25)	(0.89)	(−0.11)
Slack	−0.122***	−0.120***	−0.097**	−0.093**
	(−3.09)	(−3.10)	(−2.39)	(−2.33)
Volatility	−0.206***	−0.203***	−0.114***	−0.114***
	(−8.93)	(−8.90)	(−5.01)	(−5.02)
Prior Return	0.029	0.034	0.023	0.026
	(1.12)	(1.29)	(0.93)	(1.06)
Log Pseudolikelihood	290.15	291.94	321.60	321.17
Goodness-of-fit Test				
F-Statistic	20.85***	22.67***	23.72***	23.86***

The sample consists of 304 convertible issues offered during the period from 2006 to 2011. Following Lewis et al. (1999), we estimate the probability of converting bond to equity (*Conv Prob*) as $N(d_2)$; $N(.)$ is the cumulative probability under a standard normal distribution, and $d_2 = ln(S/X) + [(r\text{-}div\text{-}\sigma^2/2)T]/(\sigma T^{1/2})$, where S is the current share price, X is the conversion price, r is the 10-year US Treasury yield, *div* is the average dividend yield that the issuing firm has during the three-year period prior to the issuance date, σ is the annualized stock volatility calculated over the three-year period prior to the issuance date, and T is the number of years until maturity. Since the conversion probability is bounded between zero and one, we estimate a Tobit model with dependent variables truncated at zero and one. See Appendix for the detailed definition of the variables. Year dummies are included. The *z*-value based on White's robust standard error is reported in parentheses. The coefficient of the intercept term is not reported to save space. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

then add an interaction term between the CEO inside debt measure and the *Large Firm Dummy* into our regressions of outstanding convertible debts, convertible issuance, and probability of conversions. We find that the coefficients of the interaction terms are all statistically insignificant, whereas the negative coefficients of CEO inside debt measures remain significant. These results suggest that our findings are not affected by firm size.

To further investigate this issue, we re-estimate our empirical models as part of a Heckman selection model (Heckman, 1976, 1979). For the analysis of outstanding convertible debts, we gather a sample of 23,903 firm-year observations from 2006 to 2011 from Compustat, 3,558 of which are also covered in Execucomp. The Heckman model consists of two equations: a selection equation and a regression equation. In the selection equation, we specify a set

of variables that explain the probability of a firm being included in the S&P 1500 index. In the regression equation, we estimate the relation between outstanding convertible debts and CEO inside debt holdings while simultaneously correcting for potential selection bias.

We refer to the methodology manual published by the S&P Dow Jones Indices to specify the selection equation. We select four firm characteristic variables that are emphasized by S&P for index construction. These variables are market capitalization, market liquidity (measured by Amihud's illiquidity ratio), the year-end share price, and financial viability (measured by one-year lagged ROA). The selection equation is then specified as a probit model in which the probability of a firm being covered in Execucomp is a function of these four firm characteristics. After performing the estimation of the two-equation Heckman model, we continue to find a significantly negative relation between inside debt holdings and outstanding convertible debts.

We perform similar analyses to correct the selection bias in the models of convertible issuance and probability of conversion. For the analysis of convertible issuance probability, we gather a sample of 6,536 straight and convertible debt issues from the SDC and FISD. In the abovementioned sample, 1,346 issues are offered by the firms covered in Execucomp. For the analysis of conversion probability, we use a sample of the 889 convertible issues, 304 of which are offered by the firms covered in Execucomp. We then re-examine how inside debt holdings affect convertible issuance and the probability of conversion, respectively, by performing analyses using Heckman's approach. We again find that high inside-debt-holding firms are less likely to issue convertible debts and provide lower conversion probability.[11] Taken together, we conclude that our results are robust against the potential sample selection bias.

3.5 | Role of default risk

We have established from various angles, including the investigations of outstanding debt, debt issuance decision, and security design, that firms with large inside holdings indeed prefer straight debt to convertible debt. We interpret this finding as consistent with the hypothesis that the holding of inside debt reduces a CEO's risk-shifting incentives. Thus, with regard to debtholders, the value of the risk-curbing function of inside debt holding should vary with the level of existing default risk.

Galai and Masulis (1976) and Green (1984) show that shareholders' risk-shifting incentive is higher when default is likely. Eisdorfer (2008) and Dorion et al. (2014) provide empirical evidence that the risk-incentive problem is stronger for financially distressed and highly leveraged firms. Edmans and Liu (2011) suggest that when default is likely, CEO inside debt holdings could be desired to produce a beneficial outcome (e.g., managerial effort to increase liquidation value). This argument implies that inside debt has a more beneficial effect among firms with greater default risk. Placing this prediction of Edmans and Liu's theory into our context, we conjecture that the negative association between inside debt holding and the preference for convertible debt is stronger for firms with higher existing default risks.

To test our conjecture, we measure the existing default risk with the one-year-lagged Altman's *Z* score (Altman, 1968). Firms with a previous-year *Z* score below the sample median are defined as firms with high existing default risk, and those above the median are defined as firms with low existing default risk. We then estimate models (2) and (4) with *CEO Delta* and *CEO Vega* included for each of the subsamples separately, depicting the results in Panels A and B of Table 5.

The results are consistent with our conjecture. We find a negative association between inside debt and a corporation's preference for convertible debt only when the firm's financial health is relatively fragile. When the default risk is high, the likelihoods of both the issuance and conversion of convertible bonds are negatively related to the amount of CEO inside debt. Conversely, when the default risk is low, this relationship weakens. Therefore, there is a decreasing marginal effect in the risk-reducing function of inside debt, and the value of inside debt to outside debt investors is highest when a corporate default is imminent. This corroborative evidence provides further support for the proposition that inside debt proxies for the degree of the risk-shifting problem.

[11] To save space, we do not report these results in the paper. The results are available from the authors upon request.

TABLE 5 Subsample analysis: default risk

Panel A. Probability of Convertible Debt Issuance				
Independent Variable	**Dependent Variable = Prob(CVT Issue = 1)**			
	High Default Risk	**Low Default Risk**	**High Default Risk**	**Low Default Risk**
Ln(1 + CEO-firm D/E)	−0.743**	0.075		
	(− 2.32)	(0.34)		
Ln(1 + CEO-firm ΔD/ΔE)			−0.458*	−0.051
			(−1.92)	(−0.28)
Ln(1 + CEO Delta)	−0.298	−0.286	−0.210	−0.382
	(−0.58)	(−0.69)	(−0.40)	(−0.89)
Ln(1 + CEO Vega)	−0.981	0.391	−1.034	0.374
	(−0.90)	(0.44)	(−0.94)	(0.42)
Market-book	0.070	−0.070	−0.090	−0.054
	(0.24)	(−0.53)	(−0.32)	(−0.43)
Net Income/Assets	−4.150***	−6.445***	−4.342***	−6.472***
	(−2.71)	(−3.85)	(−2.79)	(−3.92)
ΔAssets	0.677***	−0.565	0.667***	−0.599
	(2.99)	(−1.38)	(2.90)	(−1.47)
Long-term Debt/Assets	−1.906**	−2.003*	−1.688**	−2.224**
	(−2.27)	(−1.78)	(−2.01)	(−1.98)
Log(Assets)	−0.397***	−0.901***	−0.525***	−0.905***
	(−3.64)	(−6.19)	(−4.39)	(−6.24)
Slack	8.030***	2.458***	8.128***	2.517***
	(7.07)	(2.59)	(7.10)	(2.64)
Volatility	0.193	0.973	0.219	0.959
	(0.37)	(1.44)	(0.43)	(1.42)
Prior Return	0.207	0.355	0.225	0.360
	(0.28)	(0.51)	(0.30)	(0.52)
N	672	674	672	674
Log Pseudolikelihood	−286.70	−249.34	−287.56	−249.35
Goodness-of-fit Test				
χ^2 Statistic	130.21***	126.47***	130.08***	127.10***
Panel B. Probability of Conversion				
	Dependent Variable = Conv Prob			
Independent Variable	**High Default Risk**	**Low Default Risk**	**High Default Risk**	**Low Default Risk**
Ln(1 + CEO-firm D/E)	−0.069***	0.005		
	(−3.55)	(0.43)		
Ln(1 + CEO-firm ΔD/ΔE)			−0.038***	−0.004
			(−3.75)	(−0.50)
Ln(1 + CEO Delta)	−0.067***	0.049	−0.052***	0.038
	(−4.21)	(1.20)	(−3.31)	(1.00)
Ln(1 + CEO Vega)	−0.089	−0.106	−0.119	−0.105
	(−1.16)	(−1.07)	(−1.42)	(−1.06)

(Continues)

TABLE 5 (Continued)

Panel B. Probability of Conversion				
	Dependent Variable = Conv Prob			
Independent Variable	High Default Risk	Low Default Risk	High Default Risk	Low Default Risk
Market-book	0.067***	0.020**	0.054***	0.022**
	(4.27)	(2.23)	(3.14)	(2.48)
Net Income/Assets	0.152**	0.189**	0.133*	0.189**
	(2.10)	(2.27)	(1.83)	(2.27)
ΔAssets	0.018*	−0.018	0.018	−0.027
	(1.72)	(−0.35)	(1.61)	(−0.53)
Long-term Debt/Assets	−0.203***	0.201***	−0.189***	0.184***
	(−4.66)	(3.27)	(−4.45)	(3.09)
Log(Assets)	0.007	−0.002	−0.003	−0.002
	(1.15)	(−0.17)	(−0.39)	(−0.21)
Slack	−0.160**	−0.095**	−0.138*	−0.086*
	(−2.07)	(−2.08)	(−1.73)	(−1.91)
Volatility	−0.085**	−0.106***	−0.087***	−0.108***
	(−2.59)	(−2.97)	(−2.63)	(−2.99)
Prior Return	0.062**	0.014	0.069**	0.010
	(1.99)	(0.38)	(2.22)	(0.26)
N	153	151	153	151
Log Pseudolikelihood	186.12	156.25	184.46	156.28
Goodness-of-fit Test				
F-Statistic	23.32***	17.70***	22.54***	17.26***

This table presents the estimation of conversion probability for the high- and low-default risk subsamples. We proxy the existing default risk with the one-year lagged Altman's *Z* score and define those firms for which the previous year's *Z*-score is below the sample median as the high-default risk firms, and those firms for which the previous year's *Z*-score is above the sample median as the low-default risk firms. The issuance model in Panel A is estimated with a probit model explaining the probability of issuing convertible debt. The conversion probability model in Panel B is estimated using a Tobit model with the dependent variables censored at zero and one. See Appendix for the detailed definition of the variables. Year dummies are included. To save space, the coefficient of the intercept term is not reported. The *z*-value based on White's robust standard error is reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4 | CONCLUSIONS

The question of why corporations issue convertible bonds is one of the most intriguing issues in the finance literature. The RSH suggests that a convertible bond is issued as an alternative to a straight bond because debt investors worry that managers may pursue high-risk projects at debtholders' expense. However, although the RSH is theoretically sound, the literature has offered limited direct supporting evidence for it, primarily because a direct measure of managerial risk-shifting incentives has been unavailable.

Recent studies on inside debt help elucidate this issue by offering a clear measure of a CEO's inclination to pursue debtholder interests. Inside debt aligns managers' incentives with debtholders' incentives by placing managers and debtholders in the same position of incurring losses should the company default. Outside debt investors should thus be reassured when a company is managed by a CEO who holds a large amount of inside debt. Accordingly, companies with high CEO inside debt holdings do not need to 'sweeten' their debt offers with convertible clauses to lower their cost of debt.

Our empirical evidence provides strong support for the RSH. When a firm's CEO holds a large amount of inside debt, we find that the firm has a lower level of outstanding convertible debt relative to total debt, is less likely to issue convertible debt than straight debt, and designs the issued convertible in such a way that it is unlikely to convert. With this robust negative association between inside debt and corporations' preference for convertibles, we provide direct evidence for the RSH and conclude that issuing convertible bonds is indeed an effective mechanism for mitigating debt investors' concerns about excessive managerial risk-taking behaviour.

Although our analyses are based on US data, we believe that an interesting avenue for future research would be to extend our approach to the global debate on whether the RSH explains convertible bond issuance, especially now that detailed executive and employee compensation data in countries other than the United States are increasingly accessible to researchers. Similar to the findings in the US market, Dutordoir and Van de Gucht (2009) and Dutordoir et al. (2014) find quantitative evidence in favour of the RSH among Western European companies using stock return volatility to measure the cost of risk-shifting. As qualitative evidence is garnered from analysing the surveys of CFOs, prior researchers have found that 72% of Western European CFOs consider convertibles to be less expensive than straight debts, which is consistent with the implications of the RSH. Conversely, only 41% of US CFOs hold this belief (Bancel & Mittoo, 2004; Graham & Harvey, 2001). Kabir, Li, and Veld-Merkoulova (2013) document a negative relation between defined benefit pensions and bond yield spreads among UK industrial firms. Dasgupta, Lin, Yamada, and Zhang (2016) explore the relation between employee inside debt and firm risk-taking behaviours using a sample of 2,104 Japanese firms, and they obtain evidence to support the RSH. Considering all the recent progress in this line of research, we believe that studying this issue in a global setting would be a promising direction for future research.

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ORCID

Carl Hsin-han Shen http://orcid.org/0000-0003-1982-6673

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APPENDIX: VARIABLE DEFINITION

Variable	Definition
CVT/TD	The ratio of outstanding convertible debt (Compustat item: DCVT) to total straight debt (Compustat item: DLC plus DLTT).
CVT Issue	An indicator variable that equals one when the issue is convertible debt and zero otherwise.
CEO D/E	CEO's debt-to-equity ratio, defined as D_{CEO}/E_{CEO}, where D_{CEO} is the sum of the present value of accumulated pension benefits and deferred compensation; E_{CEO} is the value of the CEO's equity holding portfolio.
Firm D/E	The firm's debt-to-equity ratio, defined as D_{Firm}/E_{Firm}, where D_{Firm} is the sum of long-term and short-term debts and E_{Firm} is the market value of equity.
CEO-firm D/E	The relative ratio of the CEO debt-to-equity ratio to the firm debt-to-equity ratio, defined as *(CEO D/E)/(Firm D/E)*.
CEO-firm ΔD/ΔE	The relative incentive ratio developed by Wei and Yermack (2011), calculated as *(CEO ΔD/ΔE)/(Firm ΔD/ΔE)*, where *CEO ΔD/ΔE* is set equal to D_{CEO} (as defined above) divided by the delta of the equity portfolio held by a CEO (the change in the value of the CEO's equity portfolio in response to a 1% change in stock price); and *Firm ΔD/ΔE* is set equal to total debt (D_{Firm}) divided by the approximated delta of the equity portfolio (including stock and stock options) issued by the firm. To calculate a firm's approximated delta, we use the total number of employee stock options outstanding (Compustat item: OPTOSEY) and the average exercise price of outstanding options (Compustat item: OPTPRCBY) as the inputs for the Black–Scholes valuation formula and assume a remaining life of four years for all options.
(CEO-firm D/E > 1)	An indicator variable that equals one if the CEO-to-firm relative debt-to-equity ratio (*CEO-firm D/E*) is greater than one and zero otherwise.
(CEO-firm ΔD/ΔE > 1)	An indicator variable that equals one if the CEO-to-firm relative incentive ratio (*CEO-firm ΔD/ΔE*) is greater than one and zero otherwise.
CEO Delta	The change in the CEO's equity holding portfolio (in million dollars) when the price of the underlying stock increases by 1%.
CEO Vega	The change in the CEO's equity holding portfolio (in million dollars) when the annualized volatility of the underlying stock increases by 1%.
Market-book	Market-to-book ratio of assets, defined as total assets minus the book value of equity plus the market value of equity, divided by total assets (Compustat item: AT).
Net Income/Assets	Net income (Compustat item: NI) divided by total assets.
ΔAssets	Changes in total assets, defined as the difference between total assets in year t and $t-1$ divided by the total assets in year $t-1$.
Long-term Debt/Assets	Long-term leverage, defined as long-term debt (Compustat item: DLTT) divided by total assets.

Variable	Definition
Log(Assets)	Firm size, defined as the natural logarithm of the book value of assets.
Slack	Internally available financial slack, defined as cash holdings (Compustat item: CHE) scaled by total assets.
Volatility	The annualized standard deviation of monthly returns in the previous fiscal year for the balance sheet sample and the annualized standard deviation of daily returns over the 75-day period prior to the issuance date for the issuance sample.
Prior Return	The buy-and-hold return over the previous fiscal year for the balance sheet sample; and the buy-and-hold return over the 75-day period prior to the issuance date for the issuance sample.
Z-Score	Altman's *Z*-Score, computed as 3.3**(EBIT/A)* + *(Sale/A)* + 1.4**(RE/A)* + 1.2**(WC/A)* + 0.6**(MVE/TL)*, where *EBIT/A* is earnings before interest and tax scaled by total assets, *Sale/A* is sales scaled by total assets, *RE/A* is retained earnings scaled by total assets, *WC/A* is working capital scaled by total assets, and *MVE/TL* is the ratio of the market value of equity to total liability.