AGENCY COST OF DEBT AS INCENTIVE FOR EXECUTIVE INSIDE DEBT: EVIDENCE FROM EMPIRICAL STUDY

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Abstract

The substantial holdings of inside debt cause both academia and industry to wonder about the reasons. Jensen and Meckling (1976) suggest that debt-like compensation could lower the agency cost of debt. Nevertheless, empirical evidence is still lacking for whether the management really chooses to use inside debt as mitigation of agency cost of debt. In this study, the author uses the value of non-tax-deductible deferred compensation from the ExecuComp database as the measure of inside debt, leverage as the proxy for agency cost of debt, and examines the causal effect of changes in leverage on inside debt. Using phased increases in corporate income taxes in US states between 2006 and 2016 using difference-in-differences regression, the author identifies the causal effect of tax-motivated corporate leverage on the balance of deferred compensation. Firms increase their deferred compensation balance by $85,000 with a 1% increase in leverage. This finding implies changes in the agency cost of debt as a potential reason for variations in inside debt values and provides evidence for Jensen and Meckling's (1976) theory.

Keywords: Cost of Debt, Inside Debt, Income Tax

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1. INTRODUCTION

An asset substitution, also known as a risk-shifting problem introduced by Jensen and Meckling (1976) could happen when the executives engage in unnecessarily riskier projects, thereby transferring the wealth from the creditors to maximize equity holders' value. This potential conflict between shareholders and bondholders leads to a higher agency cost of debt, which has attracted a lot of attention from scholars to assess its magnitude (Eisdorfer, 2008) and find ways to mitigate the problem (Green, 1984). One of the mitigations is based on the design of executive compensation: the debt-like compensation will provide incentives for management to act in alignment with the creditors' benefit (Jensen & Meckling, 1976; John & John, 1993). "Inside debt" is just this type of deferred cash-based compensation and is considered one of the most effective for mitigating agency cost of debt (Edmans & Liu, 2010).

On average, for the years from 2006 to 2016, each executive in the S&P 1500 firm is holding a $1.2 million annual balance of inside debt, which equals about 25% of the value of equity-based compensation. The substantial holdings of inside debt cause both academia and industry to wonder about the reasons. As predicted by the theoretical literature, empirical studies provide consistent evidence that inside debt is associated with reduced corporate riskiness and lower cost of debt (Cassell et al., 2012; Wei & Yermack, 2011; Anantharaman et al., 2013). Nevertheless, it is still unclear whether the management really chooses to use inside debt to mitigate the agency cost of debt. In other words, when the agency cost of debt increases in the first place, will the value of inside debt increase consequently? It is an empirical work to identify

the agency cost change as a determinant of inside debt. However, as an endogenous choice variable, it is challenging to test the causalities of inside debt; therefore, the literature on the determinants of inside debt is especially rare and preliminary. This paper aims to fill this gap by testing the potential causal link between agency cost of debt and inside debt.

In this study, the agency cost of debt estimate is based on corporate leverage. The most crucial concern for the studies on relations between inside debt and leverage is the simultaneous issue. A higher level of inside debt could cause leverage to increase because inside debt lowers debt financing cost and thus increases a firm's debt capacity, while high leverage could also cause the increase of inside debt in the sense that firms proactively use inside debt to facilitate debt financing when facing debt overhang problems. A proper way to address this problem is to identify a leverage increase in the first place and examine the response of inside debt balance. Prior theoretical and empirical studies show that taxes have a causal effect on capital structure (Modigliani & Miller, 1963; Heider & Ljungqvist, 2012). In addition, corporate leverage responds asymmetrically to tax increases and cuts: a tax increase will cause leverage to increase while a tax cut will not cause leverage to decrease, which is known as "leverage ratchet effects" (Admati et al., 2018). Therefore, we use staggered increases in corporate tax rates across U.S. states to identify tax-motivated leverage increases. Altogether, eight cases of state corporate tax rate increase are collected for years between 2006 and 2016. The firms in states with tax rate increases are categorized as the treatment group and those in adjacent states are categorized as the control group. By running difference-in-differences regression and placebo tests, we confirm that tax rate has a causal effect on leverage, with treatment firms having an average leverage of 1.5% higher than control firms after a tax shock.

By identifying leverage increases after the tax shock, we examine the effects of the leverage changes on deferred compensation. Only deferred compensation, the main component of inside debt, is examined here because it is not taxable. Therefore, we will not be bothered by the convoluted effects of both leverage and tax on inside debt. By performing a second-stage difference-in-differences regression, we demonstrate that leverage changes have a causal effect on deferred compensation balance, and on average, 1% increment of tax-motivated leverage will lead to $85,000 increment of deferred compensation balance, which is worth 16% of the average value of deferred compensation in my data sample.

The design of this study is a combination of two-stage instrumental variable regression and a natural experiment. Tax rate increase is comparable to an instrument to link leverage and deferred compensation. It influences the deferred compensation through its effects on leverage but has no direct impact on deferred compensation at all. The first stage is a natural experiment by studying exogenous tax increases. A difference-in-differences regression with a significantly positive coefficient of treatment and post-interactive term confirms that tax is not only relevant but also has a causal effect on leverage. The second stage runs another difference-in-differences regression to demonstrate the impact of leverage change on deferred compensation. A placebo test is also implemented to confirm that tax rate changes have no effects on deferred compensation. Therefore, the exclusion condition is also testable under this framework. In addition to this good research design, we also carefully control for firm- and/or executive-level factors for leverage and deferred compensation, time-varying state conditions, and unobservable industry- and state-level shocks, making a causal interpretation plausible.

This paper contributes to the literature in three aspects. First, it contributes to current studies on inside debt determinants. Without proper research design, prior studies mainly show an association between potential determinants and inside debt, which makes it hard to explain the marginal effects of explanatory variables on inside debt and to identify real relations between them. This is the first one to confirm the causal effects of leverage on deferred compensation. Second, it contributes to agency cost topics by providing empirical evidence for Jensen and Meckling's (1976) theory that firms can mitigate agency cost of debt by adjusting the value of inside debt. Third, it contributes to the literature on capital structure. There are very few studies to identify the causal impact of leverage on corporate activities, most of which work on commodity price-based leverage shocks for specific industries (Gilje, 2016; Gan, 2007). Following the natural setting of Heider and Ljungqvist's (2012) tax rate experiment, with our two-stage difference-in-differences model, we provide an effective framework for testing the causal effect of leverage on other variables.

The rest of the study is structured as follows. Section 2 describes the institutional background and reviews prior literature. Section 3 discusses the variable construction and research design. Section 4 describes the data. The subsequent discussion and empirical results achieved are included in Sections 5 and 6. Finally, conclusions and recommendations for further research are presented in Section 7.

2. LITERATURE REVIEW

2.1. Theoretical background

Inside debt compensation owed to executives has two forms: 1) pension benefits, and 2) deferred compensation. In general terms, both types are deferred compensation[1] — employees can choose to set aside part of their cash-based compensation (e.g., salaries and bonuses) for later dates. The main differences between pension plans and deferred compensation are flexibility and tax deductibility.

Although executives can negotiate their pensions with the board in terms of timing or form of payment, they have less discretion over annual contributions to pension funds because most contributions and accruals to pension plans are determined by formulas set by firms that typically depend on the executives' tenures and prior salaries.

[1] In other studies, "deferred compensation" could also mean deferred equity-based compensation, such as non-exercisable options and restricted stock holdings, which is not under analyses in this paper.

Annual contributions to deferred compensation plans are determined by agreements between executives and companies in annual meetings and are often invested in different portfolios of mutual funds chosen by the firms. Companies often allow executives to make frequent changes to their decisions of deferred compensation investment. However, the details of investment decisions are unobservable under current disclosure rules. The general pension plans (e.g., 401(k)) have limits set by the Internal Revenue Service (IRS) for the value of annual deferral, while the deferred compensation plans do not have such restrictions, which provides good vehicles to attract and retain effective executives (IRS, 2024).

General pension plans[2] are qualified for tax deductions in the sense that employees' income tax payments are deferred until retirement when they start receiving payouts from the pension plan. Neither firms nor employees pay taxes for the value appreciation of pension funds and firms receive current deductions for contributions to qualified pension plans. The beneficial tax treatment is not available for deferred compensation plans. Thus, these plans are named "non-qualified" plans as well.

Some special rules for non-qualified plans provide more implications of executive incentives. Unlike qualified plans that are protected by the Employ Retirement Income Security Act of 1974 (ERISA)[3], non-qualified deferred compensation is unfunded, unsecured, and has the same priority as that of debt under bankruptcy, which aligns the executives more closely with outside creditors. In addition, non-qualified plans have been regulated under Section 409A of the Internal Revenue Code since year 2004, which prohibits early withdrawal unless under very specific conditions such as death, disability, etc. The violation of Section 409A will cause extra tax and interest penalties. Thus, the implementation of Section 409A makes non-qualified plans less flexible and more sensitive to the incidence of default.

A new disclosure rule adopted by the U.S. Securities and Exchange Commission (SEC) in 2006 required companies to report the present value of accumulated pension benefits and the aggregate balance of non-qualified deferred compensation for each executive officer and each plan in annual proxy statements DEF 14A. The new requirements enable the following research to examine annual inside debt compensation more comprehensively.

2.2. Previous studies

Jensen and Meckling (1976) point out that well-designed compensation contracts provide incentives for management to act in alignment with investors' benefit. Although they didn't incorporate "inside debt" (i.e., debt held by managers) in their analysis, Jensen and Meckling (1976) still argue that inside debt could provide an inexpensive way to mitigate the agency costs of debt derived from asset substitution. In the last three decades since their publication, the literature on equity-based compensation has experienced a boom, while the literature on debt-like compensation is still emerging. Edmans and Liu (2011) provide the first theoretical analysis to justify the use of inside debt as efficient compensation, which is a better solution to agency cost of debt than other forms of compensation (e.g., solvency-contingent bonuses and salaries). Sundaram and Yermack (2007) provide the first formal empirical tests on inside debt with respect to its existence, determinants, and influence on chief executive officer's (CEO) turnover and risk attitude.

Inside debt decreases managers' risk-seeking behaviors because it exposes managers to default risks similar to those faced by outside creditors. Consequently, there is a negative association between inside debt and corporate riskiness of investment and financial policies (Cassell et al., 2012). In particular, higher inside debt holdings go with lower future research and development (R&D) expenditures and leverage and a higher extent of diversification and asset liquidity. Meanwhile, shareholders and creditors react to inside debt differently as the managers with higher inside debt are likely to transfer value from equity to debt. With higher inside debt, bond prices rise, equity prices fall, and the volatility of both securities drops (Wei & Yermack, 2011). Moreover, inside debt helps to facilitate debt financing with lower cost of debt, fewer restrictive covenants, and more short-term debts (Anantharaman et al., 2013; Dang & Phan, 2016).

Most of the previous studies focus on the impacts of inside debt on management and the market, while the literature on determinants of inside debt is rare. Two seminal works (Sundaram & Yermack, 2007; Gerakos, 2007) lay the foundation to examine the determinants from the optimal contracting view and managerial power view. Inside debt mitigates agency cost of debt, requires cash outflows to contribute to plans, increases management sensitivity to value in bankruptcy, and is tax deductible. Therefore, Sundaram and Yermack (2007) examine leverage, cash flow constraints, growth opportunity, and tax status as determinants for accumulated pension values, and find that outside CEOs with longer tenures in larger firms with higher leverage and liquidity constraints tend to have higher pension holdings. Moreover, since inside debt holdings are not performance-based and usually with unobservable rules, it is hypothesized that inside debt provides a channel for rent extraction. Gerakos (2007) also examines the effects of CEO power and board efficiency on pension values and finds that the practice of rent extraction through pension is limited and can be detected by more transparent public disclosures.

The literature on determinants of inside debt has two major issues: data accessibility and identification. Since the SEC's new disclosure rules in 2006, it has been mandatory for firms to report present values of both accumulated pension values and balances of deferred compensation for top executives. The following literature (Cen, 2010; Lee & Tang, 2011) thus can expand the studies of Sundaram and Yermack (2007) and Gerakos (2007) to comprehensive data including both pension values and deferred compensation balances and find consistent empirical results. However, without credible instruments for inside debt,

[2] Most of the firms provide non-tax-qualified Supplemental Executive Retirement Plans (SERPs), the defined benefit part of which are also categorized as "pension plans".

[3] https://www.dol.gov/general/topic/health-plans/erisa#:~:text=The%20Employee%20Retirement%20Income%20Security,for%20individuals%20in%20these%20plans

the identification issue still exists (Edmans et al., 2017). Thus, we can only interpret the results as "associations" between factors and inside debt holdings but are unlikely to find causal effects on inside debt. Na (2014) attempts to improve the research design by a natural experiment based on a tax deductibility change for the chief financial officer (CFO) and finds causal evidence for tax motivation. More future works are expected to address the endogeneity problems on inside debt analyses with appropriate designs.

3. RESEARCH METHODOLOGY

3.1. Variables

The key explanatory variable in this study is *agency cost of debt* proxied by *leverage*. Theoretically, creditors will react positively to increasing inside debt as inside debt aligns managers' interest to debt holders. Companies could proactively increase inside debt to mitigate agency cost of debt and to facilitate debt financing. However, current empirical literature shows that the effects of leverage are not robust (Cen, 2010; Na, 2014). One possible reason derives from the difficulties of leverage interpretation. High leverage for a firm with low default risk signals less agency cost of debt than that for a firm with high default risk. In contrast, high leverage for a firm with a good financial situation could reflect the recognition from creditors. Therefore, this study introduces an interactive term between leverage and the proxy of default risk (Altman Z-score). We use book value leverage to avoid mechanical correlations with equity market values and expect to find a positive correlation between leverage and inside debt.

Altman Z-score (*Altman Z*) measures the default risk (Altman, 2000). A higher value of the Altman Z-score implies a lower default risk. Executives tend to use more inside debt when it is easier to maintain the liquidation value of the firm (Edmans & Liu, 2010). With higher default risk, all the management effort will eventually add up to the liquidation value during bankruptcy. Thus, we predict more inside debt with a lower Altman Z-score.

Deferred compensation is used as the dependent variable. Pension plan values are excluded, as a result of interest, for two reasons. First, most firms' pension plan balances in ExecuComp include two parts: 1) tax-qualified pension plan balances, and 2) non-tax-qualified SERP balances, which biases the estimation of tax effects. Second, the accruals of pension plans are mainly based on presetting formulas, which makes the values less sensitive to variations in firm financial policies. Unlike pension plan values, contributions to deferred compensation plans in ExecuComp are purely non-tax-deductible. And since executives can negotiate with firms in annual meetings to adjust the contributions to deferred compensation plans, the value of deferred compensation plans is more reflective of changes in management's attitudes and firm policies.

Other explanatory variables include *growth opportunity (3-year sales growth rate)*, financial *liquidity constraints*, and *tax status*. Prior literature avoids proxy with market value (e.g., Tobin's Q) to measure growth opportunity because of its mechanical positive correlations with executive equity holdings. Although our outcome of interest does not include equity-related components, we still avoid using such types of proxies because of the relationship between deferred compensation and stock vesting (Na, 2014). All the prior studies use the ratio of R&D expense over sales as a proxy for growth opportunities. However, a large amount of R&D expense is missing in Compustat. To maintain an adequate sample size, we use the 3-year average sales growth rate as a proxy for growth opportunity. Since executives tend to use less inside debt when it is easier to achieve solvency value (Edmans & Liu, 2010), we expect less inside debt with higher growth opportunities.

Unlike equity compensation, which provides a means to pay executives without using cash, inside debt does require cash contributions at time points set by contracts. Therefore, we expect a negative relationship between liquidity constraints and balances of inside debt. Liquidity constraints are measured using a ratio that equals "1" if total net cash flow from operating and investing activities is negative.

Section 2 states that contributions to qualified pension plans are tax deductible while those to deferred compensation plans are not. Therefore, we expect different responses from the two components of inside debt for tax-saving purposes. We measure tax status with an indicator that equals "1" if the firm has net operating loss carry-forwards on its balance sheet. We expect an insignificant association between that and the balance of deferred compensation plans.

Control variables include *firm size*, *executive age*, *executive tenure*, *non-performance-based compensation*, and *dummies of executive positions*. *Firm size* is measured by the log value of total assets. *Executive age* and *Executive tenure* are not only key determinants for pension accruals but also proxies of executives' horizons in firms. This paper is the first one to incorporate data on executives other than CEOs, and three dummy variables are constructed to identify executive positions as CEO, CFO, or other executives. *Non-performance-based compensation* includes salary, discretionary bonus, and realized values on stock vesting. As required by Internal Revenue Code Section 162(m), non-performance-based compensation paid to a covered employee[4] over $1 million is not tax deductible. Na (2014) finds that firms will defer some of the non-performance-based compensation to non-qualified deferred compensation plans to preserve tax deductibility.

The data samples are grouped into seven different industries according to the Standard Industrial Classification (SIC) division structure. Executive salaries and bonuses are usually set by comparing with those of other comparable companies in the same industry. An industry dummy is controlled for each industry to absorb the industry-level shocks.

[4] Covered employee means any employee who is either the principal executive officer or whose total compensation is required to be reported by the SEC for being one of the three highest paid officers.

3.2. Panel regression model

The general form of panel regression is listed below:

Model 1

$$\begin{aligned} Deferred\ compensation_{i,j,e,t} &= Leverage_{i,t-1} + Altman\ Z_{i,t-1} + Leverage_{i,t-1} * Altman\ Z_{i,t-1} \\ &+ Growth\ opportunity_{i,t-1} + Liquidity\ constraints_{i,t-1} + Tax\ status_{i,t-1} + Control_{i,e,t} \\ &+ Industry\ dummy_j + Time\ FE_t + \varepsilon_{i,j,e,t} \end{aligned} \quad (1)$$

where, *i* denotes firms, *j* denotes industry, *e* denotes executives, and *t* denotes time. Here, the interactive terms *Leverage* and *Altman Z* are introduced to examine the conditional effect of leverage based on default risk.

Control variables include *firm size*, *executives' age*, *executive tenure*, *non-performance-based compensation*, and *dummies of executive positions*. We control for time-fixed effects and cluster firm standard errors to eliminate biases arising from correlated residuals (Petersen, 2009). Also, we control for industry dummies rather than firm-fixed effects because the main explanatory variable, leverage, is persistent across time and, hence, is mostly absorbed by firm-specific effects (Lemmon et al., 2008). The firm fixed effects sweep out the cross-sectional variation of leverage and make it harder to identify the impact of leverage changes. Section 4 notes that only about 6% (3,301 out of 51,980) of observations have missing inside debt data. Therefore, unlike previous studies on determinants of inside debt that use the Tobit model, we use linear regression due to adequate data available.

3.3. Quasi-natural experiment

The panel regression model outlined above could only establish a basic association between leverage and inside debt holdings. Because of simultaneous effects, the estimation of panel regression would be biased. Better inference can be achieved by using a natural experiment framework. This paper uses tax-motivated shocks of firm leverage to examine the impacts on inside debt holdings.

Based on the static trade-off theory of capital structure (Modigliani & Miller, 1963; Kraus & Litzenberger, 1973), a tax rate rise leads the marginal tax benefit to exceed the marginal default cost and thus changes the leverage upwardly. Meanwhile, dynamic models of trade-off theory demonstrate the "leverage ratchet effect" — shareholders resist leverage reductions no matter how large the potential gain to the total value of the firm (Leland, 1994; Admati et al., 2018). The reason is that creditors capture all benefits of lower bankruptcy from tax reductions because shareholders must pay higher post-recapitalization price for debt repurchases. Heider and Ljungqvist (2012) empirically demonstrate the first-order effect of tax on capital structure and the asymmetric firm responses to tax increases and reductions. In this paper, we follow the quasi-natural experimental design of Heider and Ljungqvist (2012) to identify tax-motivated leverage shocks.

Authorities such as IRS and the Department of Revenue for each state decide tax policy changes. Therefore, the occurrences of tax rate changes are exogenous to firm level activities. The state corporate tax change could be caused by strong union power in the state, and firms could use leverage strategically when bargaining with unions (Matsa, 2010). However, it will not be a main concern since Heider and Ljungqvist (2012) find no evidence that union strength drives tax-motivated leverage changes. Unlike country-wide, one-off tax reforms, state-level corporate tax changes provide a better setting with multiple shocks across time and more comparable treatment and control groups. Because firms resist leverage reductions when facing tax rate cuts, we documented all state corporate tax increase from 2006 to 2016 for analysis. Details are shown in Table 1.

Table 1. List of state corporate tax rises

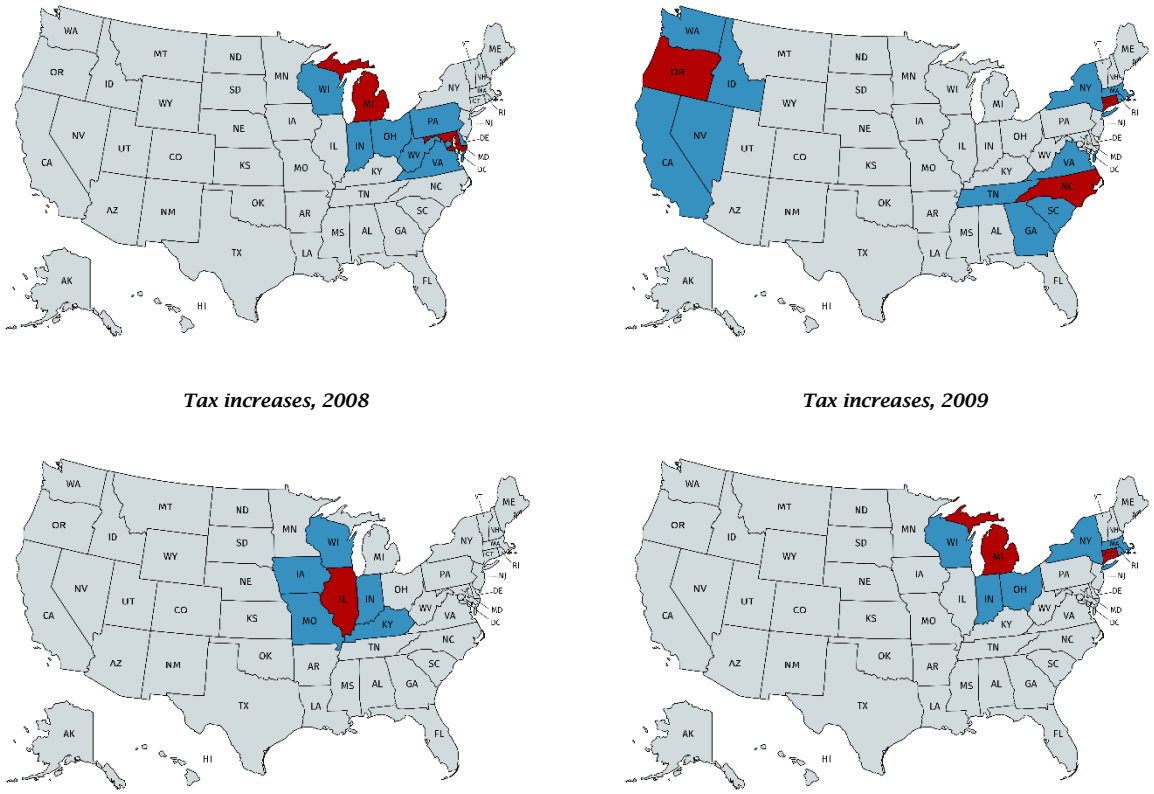
State	*Year*	*Description*
Maryland	2008	Increase in top corporate income tax rate from 7% to 8.25%.
Michigan	2008	Introduction of corporate income tax with a top rate of 4.95%; replaces a gross-receipts tax without interest deductibility.
North Carolina	2009	Introduction of 3% tax surcharge on tax liability in tax year 2009 and 2010.
Connecticut	2009	Introduction of 10% tax surcharge on tax liability for companies with revenues > $100 million in tax year 2009 and 2010.
Oregon	2009	Increase in top corporate income tax rate from 6.6% to 7.9%.
Illinois	2011	Increase in top corporate income tax rate from 4.8% to 7%.
Connecticut	2012	Introduction of 20% tax surcharge on tax liability in year 2012 and 2013.
Michigan	2012	Increase in top corporate income tax rate from 4.95% to 6%.

The firms in states with corporate tax rises are categorized as the treatment group and the firms in adjacent states are categorized as the control group because neighbouring states are exposed to similar unobserved shocks in local conditions. The economic geography literature shows that firm locations influence corporate choices in multiple aspects, such as outsourcing (Ono, 2003), acquisition (Almazan et al., 2010), innovation (Glaeser et al., 1992), and labour market (Yonker, 2016). Heider and Ljungqvist (2012) find that, by comparing immediate neighbouring counties along the state border, treatment effects of tax increases on leverage changes are improved by 30%, which also

demonstrates the existence of geographical shocks. Figure 1 displays the locations of states with corporate tax increases and their neighbouring states on maps for years in between 2006 and 2016.

The effects of state tax changes are supposed to stop at the border. However, Heider and Ljungqvist (2012) do find the spillover effects that controlled firms in untreated neighbours will reduce their leverage, which could be explained by product market competition between treated and untreated firms (Brander & Lewis, 1986). To mitigate the biases caused by these spillover effects, we do not use the same state as a control group for different treated states across two years. For example, if Virginia is used as the controlled state for Maryland in 2008, it will not be used as the controlled state for North Carolina in 2009; otherwise, ongoing spillover effects could bias the treatment effects of the tax increases.

Figure 1. Geography of state corporate tax rate changes from 2006 to 2016



Tax increases, 2008 ***Tax increases, 2009***

Tax increases, 2011 ***Tax increases, 2012***

Note: This figure displays the locations of states with corporate tax increases and their neighbouring states on maps for years in between 2006 and 2016. The states in red are states with corporate tax increases, and those in blue are adjacent states.

Our quasi-natural experiment is implemented in two stages. The first stage is running difference-in-differences regression to identify the existence of leverage changes one period after the shock of tax increases. The second stage is running difference-in-differences regression again to identify the treatment effects of leverage changes on deferred compensation. This method is comparable to the two-stage regression of instrumental variables. The tax rate increase can be considered as an instrument that influences deferred compensation through its effect on leverage, but the tax rate itself has no impact on deferred compensation. Since contributions to deferred compensation plans are not tax deductible, the second-stage treatment effects cannot be influenced by tax rate changes in the first stage. Placebo tests on deferred compensation in subsection 5.2 were also conducted to show that the tax increase shock does not affect changes in the balance of deferred compensation. Thus, this method is better than instrumental variable two-stage regression in the sense that the exclusion condition is testable.

The first stage regression model is shown below:

Model 2

$$Leverage_{i,j,t,s} = \alpha + \beta_1 Post_{t,s} + \beta_2 Treatment_{t,s} + \beta_3 Treatment_{t,s} * Post_{t,s} + \gamma X_{i,t-1} + \delta Z_{s,t-1} + Industry\ dummy_j + State\ dummy_s + \varepsilon_{i,j,t,s} \quad (2)$$

where, *i* denotes firm, *j* denotes industry, *t* denotes time and *s* denotes state. *Post* is an indicator that equals "1" for both treated and controlled states if at least one state has increased the corporate tax rate in the previous year. *Treatment* is an indicator that equals "1" if a state has increased its corporate tax rate in the previous year. Once a state has been recognized as treated, it will not be used as a controlled state even if its adjacent states also increase tax rates in the following years. *X* denotes firm-level control variables. We will include variables that are commonly used as drivers of leverage in other empirical studies (Frank & Goyal, 2009): profitability (ROA), firm size (log value of total assets), tangibility (the ratio of fixed to total assets), investment opportunity (Tobin's Q), and default risk (Altman Z). *Z* denotes time-varying state-level variables, including the return of gross domestic product (GDP) per capita and unemployment rate. The *Industry dummy* is controlled to absorb industry-level shocks. The *State dummy* controls for other unobserved characteristics of states. Standard errors are clustered at the state level to account for the presence of serial correlation in the data (Bertrand et al., 2002).

The second stage regression model is listed below:

Model 3

$$\begin{aligned} Deferred\ compensation_{i,j,e,t,s} &= \alpha' + \beta'_1 Post_{s,t-1} + \beta'_2 Treatment_{s,t-1} + \beta'_3 Treatment_{s,t-1} \times Post_{s,t-1} + \gamma' X'_{i,t-1} \\ &+ \theta Y_{et} + \delta' Z_{s,t-1} + Industry\ dummy_j + State\ dummy_s + \varepsilon_{i,j,e,t,s} \end{aligned} \quad (3)$$

where, *i* denotes firm, *j* denotes industry, *e* denotes executive, *t* denotes time, and *s* denotes state. *X'* and *Y* controls firm-level and executive-level variables that contribute to deferred compensation changes, which are the same as the variables for the panel regression in Model 1 discussed in subsection 3.2. *Post*, *Treatment*, *Z*, *Industry dummy*, and *State dummy* are defined the same as those in Model 2. Because the impact test occurs two years after the tax rate change, the subscripts for *Post* and *Treatment* are now *t* - 1. Standard errors are also clustered at the state level. We expect to find significant positive coefficients of the interactive term between *Treatment* and *Post* for models on both stages, which implies that tax-motivated leverage increases will lead to increments of deferred compensation balance. It will provide empirical evidence to support Jensen and Meckling's (1976) theory that firms will mitigate the agency cost of debt by increasing inside debt.

4. DATA COLLECTION AND ANALYSIS

Executive compensation data comes from ExecuComp and firm fundamental data comes from Compustat. The data sample in this study includes all the current S&P 1500 component companies plus running companies that were in S&P 1500 excluding companies in financial and utility industries. Because of the new SEC disclosure rules in 2006 requiring mandatory reporting of pension values and deferred compensation in the annual proxy statement (SEC Form DEF 14A: Definition and Information for Shareholder Use), the data sample covers the period from the year 2006 to 2016. By omitting observations with missing variables and winsorizing all variables at levels 1% and 99%, we obtain a final data sample with 48,322 observations covering 1,524 firms, 13,521 executives, and 14,055 firm-executive entities from the year 2006 to 2016. Table 2 shows the details of data losses in data cleaning. The main data tailor is the variable *Tax status*, which has more than 22,014 missing variables (because some observations can have multiple missing variables, the total amount of missing values for variable *Tax status* can be larger than what is presented in Table 2). However, since *Tax status* is an important and unique explanatory variable for inside debt, we must keep it with the cost of shrunken sample size. Compared with other studies on inside debt, this study has a much more adequate sample size, and the analysis of data from non-CEO executives makes this study unique.

Table 2. Process of data cleaning

Variables	*# of firms*	*# of executives*	*# of firm-executives*	*# of firm-exec.-year*
Original ExecuComp	2,517	26,884	28,756	120,314
Financial industry	(482)	(4,732)	(5,087)	(23,114)
Utility industry	(104)	(1,113)	(1,214)	(5,549)
Merge with Compustat	(54)	(684)	(818)	(2,996)
Missing variables				
Altman Z	(66)	(962)	(1,125)	(5,860)
Book value leverage	-	(6)	(7)	(114)
Liquidity constraints	-	-	(1)	(41)
3-year sales growth rate	(18)	(281)	(324)	(1,701)
Tax status	(214)	(3,588)	(3,970)	(22,014)
Deferred compensation	(17)	(264)	(291)	(3,301)
Pension value balance	-	(1)	(1)	(14)
Executive age	-	(458)	(459)	(511)
Winsorization				
Inside leverage	(8)	(705)	(784)	(3,432)
Deferred compensation	(1)	(62)	(63)	(557)
Pension value balance	-	(51)	(53)	(445)
Inside debt	-	(1)	(1)	(17)
Altman Z	(20)	(217)	(239)	(1008)
Book value leverage	(3)	(78)	(89)	(430)
3-year sales growth rate	(6)	(160)	(175)	(888)
Final data sample	**1,524**	**13,521**	**14,055**	**48,322**

Note: This table shows how the final data sample was obtained step by step.

Table 3. Descriptive statistics

Variables	*Observation*	*Mean*	*SD*	*Min*	*p50*	*Max*
Dependent variables						
Deferred compensation	48,322	519.2	1,317	0	0	11,787
Explanatory variables						
Book value leverage	9,813	0.212	0.183	0	0.19	0.93
Altman Z	9,813	4.456	3.498	-4.26	3.59	23.80
3-year sales growth rate	9,813	0.106	0.145	-0.19	0.08	0.98
Liquidity constraints	9,813	0.305	0.460	0	0	1
Tax status	9,813	0.794	0.405	0	1	1
Control variables						
Firm size	9,813	7.526	1.486	2.54	7.44	12.91
Executive tenure	48,322	6.634	7.351	0	4	67
Executive age	48,322	52.74	7.287	0	53	94
CEO dummy	48,322	0.181	0.385	0	0	1
CFO dummy	48,322	0.194	0.396	0	0	1
Other executives dummy	48,322	0.625	0.484	0	1	1
Non-performance-based compensation (thousand)	48,322	1,396	2,737	0	712.1	180,746

Table 3 presents descriptive statistics of the main variables. For the 11-year data sample from 2006 to 2016, the average annual balance of *Deferred compensation* plans is $519.2 thousand. The medians of *Deferred compensation* balance are zeros because it is highly skewed. The mean of the *Altman Z* is 4.456, which implies that the firms in the sample are not in financial distress on average. The mean value of *Liquidity constraints* implies that 30.5% of the data sample has negative net cash flow from operating and investing activities. The mean value of *Tax status* implies that 79% of the data sample has net operating loss carry-forwards. The mean values of *executive dummies* imply that, for my data sample, 18% percent of the executives are CEOs, 19% are CFOs, and 62.5% are other executives.

Table 4. Comparisons between firm-executives with/without deferred compensation

Variables	*With deferred compensation (N = 22,477)*	*Without deferred compensation (N = 25,845)*	*Difference*	*p-value*
Book value leverage	0.23	0.19	0.04	0.00
Altman Z	4.04	4.82	-0.78	0.00
3-year sales growth rate	0.09	0.12	-0.04	0.00
Liquidity constraints	0.27	0.34	-0.07	0.00
Tax status	0.79	0.80	-0.00	0.27
Firm size	8.01	7.10	0.91	0.00
Executive age	53.59	52.00	1.59	0.00
Executive tenure	7.27	6.08	1.19	0.00
Non-performance-based compensation	1,601.59	1,216.44	385.15	0.00

Table 4 compares the firm-executive entities with or without deferred compensation plans. There are more firm-executive entities without deferred compensation plans than those with deferred compensation plans, which is consistent with the zero medians for the variable. The two-sample t-tests show that firm-executives with deferred compensation plans have significantly larger average *Book value leverage*, *Firm size*, *Executive age*, *Executive tenure*, and *Non-performance-based compensation* while having significantly smaller average *Altman Z*, *3-year sales growth rate*, and *Liquidity constraints*. The firm-executives with deferred compensation plans have a smaller *Tax status*, but the difference is insignificant. All the results are consistent with theoretical predictions.

Table 5. Correlation coefficients

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
(1) Deferred compensation	1									
(2) Altman Z	-0.02	1								
(3) Book value leverage	0.04	-0.54	1							
(4) Liquidity constraints	-0.07	-0.15	0.14	1						
(5) 3-year sales growth rate	-0.04	0.19	-0.06	0.15	1					
(6) Tax status	0.02	-0.24	0.16	0.07	-0.03	1				
(7) Firm size	0.29	-0.26	0.32	-0.06	-0.04	0.1	1			
(8) Executive age	0.19	-0.03	0.02	-0.02	-0.07	-0.02	0.07	1		
(9) Executive tenure	0.21	0.06	-0.04	-0.03	-0.01	-0.06	-0.01	0.39	1	
(10) Non-performance-based compensation	0.2	-0.03	0.06	-0.03	0.01	0.05	0.3	0.1	0.14	1

Table 5 shows the correlation coefficients between the main variables. No collinearity problems were found between the explanatory variables, and the orientation of the coefficients between the dependent variables and independent variables was consistent with theoretical predictions. *Altman Z*, *Liquidity constraints*, and *Growth opportunity* (i.e., *3-year sales growth rate*) are negatively correlated with dependent variables. *Book value leverage*, *Firm size*, *Executive age*, and *Executive tenure* are positively correlated with dependent variables.

5. RESULTS

5.1. Results of panel regression model

This section presents the results of estimating a panel regression with the explanatory variables defined in subsection 3.1 and *deferred compensation* balance as the dependent variable. Table 6 presents the results of panel regression models with time-fixed effects and cluster standard errors by firms. Column 1 displays the results with industry dummies controlled, while column 2 displays the results with firm fixed effects controlled.

For the results in column 1, the coefficients of *Book value leverage* are significantly negative, while the coefficients of the interaction between *Book value leverage* and *Altman Z* are significantly positive.

Considering that the average value of Altman Z-score in sample is 4.46 (see Table 3), for firms in each industry in sample, one standard deviation (18%) increment of book value leverage is associated with a $30 thousand increment of deferred compensation balance. It is consistent with theoretical prediction and implies that inside debt is positively associated with agency cost of debt when the default risk is low. For a specific industry with higher default risk (i.e., lower Altman Z-score), the positive correlations between inside debt and leverage can be reversed. In particular, for data sample, when the Altman Z-score is lower than 3.45, leverage will have a negative association with total inside debt value. It implies that firms in each industry do not have incentives to hold inside debt when facing high leverage in financial distress. It is reasonable in the sense that when a firm is about to go bankrupt, even if the inside debt has the highest priority, the value of inside debt will be impaired in the costly liquidation process. It is more reasonable to withdraw the inside debt before bankruptcy.

Considering that the average value of *Book value leverage* in sample is 0.21 (see Table 3), for firms in each industry in my sample, one unit increment of *Altman Z* is associated with a $41 thousand increment of deferred compensation balance. It implies that when the default risk is getting lower, the executives will hold more inside debt.

The *CEO dummy* is positively related to the *deferred compensation* balance, while the *Other executives dummy* is negatively related to the *deferred compensation* balance, which implies that CEOs hold more inside debt than other executives. The *Tax status* is insignificant, which is consistent with the non-tax-deductibility of contributions to deferred compensation plans. For other explanatory variables, the results are all consistent with theoretical predictions.

Column 2 checks the result with a firm fixed effect controlled for robustness. Most of the explanatory variables (i.e., *Altman Z*, *Book value leverage*, *Liquidity constraints*, and *3-year sales growth rate*) are no longer statistically significant in association with the dependent variable. However, the interactive term between *Book value leverage* and *Altman Z* keeps statistical significance for deferred compensation balance. The magnitude of the coefficient of the interactive term is much smaller because firm-specific effects mostly absorb the variations of capital structure. The panel regression models demonstrate the consistency of relevant theories with empirical data. However, it cannot be used to quantify the marginal effects of explanatory variables on deferred compensation or identify the real relation between them. A better inference from a quasi-natural experiment in subsection 5.2 can achieve that target.

Table 6. Results of panel regression models

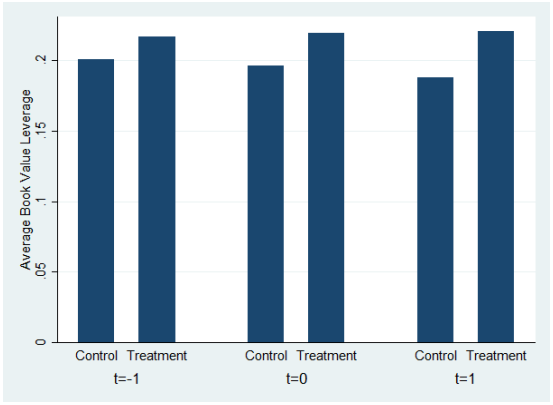
Variable	*Deferred compensation balance*	
	(1)	*(2)*
Altman Z	6.852	3.079
	(0.189)	(0.370)
Book value leverage	-561.898***	-140.417
	(0.000)	(0.158)
*Altman Z * Book value leverage*	162.969***	53.002*
	(0.000)	(0.093)
3-year sales growth rate	-409.196***	55.755
	(0.000)	(0.328)
Liquidity constraints	-80.203***	-6.602
	(0.000)	(0.496)
Tax status	73.151	73.123
	(0.126)	(0.105)
Firm size	245.605***	84.811***
	(0.000)	(0.001)
Executive age	17.944***	12.503***
	(0.000)	(0.000)
Executive tenure	24.661***	29.423***
	(0.000)	(0.000)
Non-performance-based compensation	0.034***	0.040***
	(0.000)	(0.000)
CEO dummy	241.498***	279.314***
	(0.000)	(0.000)
Other executives dummy	-49.832**	-38.137**
	(0.010)	(0.044)
Constant	-2,358.073***	178.894
	(0.000)	(0.380)
Observations	48,322	48,322
R-squared	0.166	0.458
Industry fixed effects	Yes	No
Firm fixed effects	No	Yes
Time fixed effects	Yes	Yes
Cluster by firm	Yes	Yes

*Note: Significance at the 10%, 5%, and 1% level is denoted by *, **, and *** respectively.*

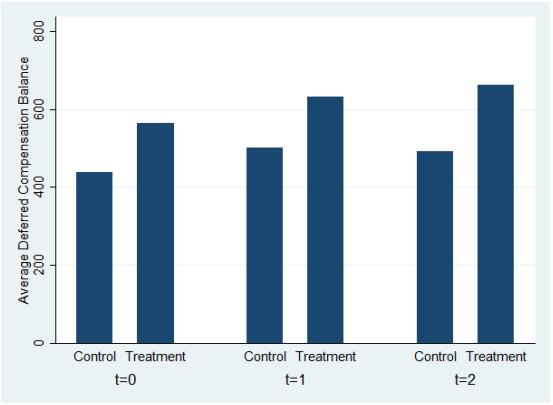
5.2. Natural experiment

Based on the trade-off theory of capital structure, we expect to find a positive treatment effects of tax increases on leverage. And the consequential leverage shocks will lead to deferred compensation changes. The result in Figure 2 shows that the discrepancy of unconditional averages of leverage between treated and controlled groups is widened in the year after the shocks of tax increases, and that of deferred compensation between two groups is widened in the year after the leverage changes (i.e., two years after the tax shocks).

Figure 2. Outcomes of interest between treated and controlled groups at different time stages



(a) Average book value leverage



(b) Average deferred compensation balance

Note: This figure displays comparisons of leverage (deferred compensation balance) between treated and controlled groups. Firms in states with tax increases are categorized as the treated group while firms in adjacent states are categorized as the controlled groups. The year when tax increases happen is denoted as "t = 0", and for any positive integer n, "t = n" means n years after tax increases, and "t = -n" means n years before tax increases.

Difference-in-differences regressions are implemented with control variables and settings as discussed in subsection 3.3. Table 7 displays the mean values of all the variables for control and treatment groups for three-time stages (i.e., one year before the shock, one year after the shock, and two years after the shock) and compares the differences between the control and treatment groups by t-tests. To help explain the leverage changes, we also add the rate of change of leverage to the table.

According to the results of t-tests, there is no significant difference of leverage between the control and treatment group before tax increases; the difference becomes significant one period after the shock and becomes insignificant again two periods after the shock. It was noted that the average leverage values before and after shock are unchanged. However, the average change rate of leverage for treated firms increases dramatically. By checking other descriptive statistics of treated firms' leverage before and after the shock, it is found that the median of leverage for treated firms becomes larger after the shock, and firms with small values of leverage are more sensitive to tax increases. This helps to explain why the change rate of leverage can become so large. For example, with an initial leverage of 0.001, the after-shock leverage becomes 0.2, which will make a change rate of 199.

Although there are preexisting significant differences in deferred compensation balances between control and treatment groups one period before and after the shock of tax increases, the differences are relatively constant across time, which implies that both groups' deferred compensation balances are changing similarly. But in two periods after the shock (i.e., one period after the leverage change), the significance of the difference has been raised to a higher level.

Most of the other control and explanatory variables have no significant differences between the two groups, which makes the two groups good counterfactuals to each other in terms of leverage and deferred compensation changes.

Table 8 displays the results of difference-in-differences regressions on leverage. The model in column 1 compares the changes in average leverage before and after the real shock of tax increases between treatment and control groups. The coefficient of the difference-in-differences term is significantly positive, which means that the average leverage of treated firms after-tax shock is 1.5% larger than that of controlled firms. The model in column 2 runs the difference-in-differences regression around a placebo shock that "happens" two years before the real tax shock. The insignificant coefficient of the interactive term demonstrates parallel trends between the two groups before the tax shock. Thus, the causal effect of tax increases on the increase in leverage can be interpreted. Column 3 displays the results of another test for placebo shock two years after the real tax shock. The insignificant coefficient of the interactive term implies that the parallel trend continues after the real tax shock.

Table 9 displays the results of difference-in-differences regressions on deferred compensation. The model in column 1 compares the changes in deferred compensation balances before and after the shock of tax-motivated leverage increases between treatment and control groups. The difference-in-differences term is significantly positive, the value of which means that the average deferred compensation balance of treated firms is $127,504 higher than that of controlled firms. Considering the difference in mean leverage between the two groups after the tax shock in Table 8, it is inferred that a 1% increment of tax-motivated leverage can lead to a $85,000 increment in deferred compensation balance for next year. The model in Column 3 tests the effects of tax shock on deferred compensation. The insignificant coefficient of the difference-in-differences term implies that tax increases have no effects on variations of deferred compensation in the next year, nor do the firms react to foreseeable future leverage changes caused by tax increases. The tests for placebo shocks two years before and after the real leverage shock also generate insignificant coefficients of difference-in-differences terms. It demonstrates that treated and controlled firms start off and continue with parallel trends before and after the leverage shock, which confirms the causal effects of leverage changes on increments of deferred compensation balance.

Table 7. T-tests

Variable	*Control* (1)	*Treatment* (2)	*Difference* (1) - (2)	*p-value*
Pre-treatment (t = -1)				
Book value leverage	0.20	0.22	-0.02	0.36
Δ Leverage	0.80	0.15	0.65	0.23
Deferred compensation (thousand)	477.13	583.52	-106.40	0.04**
Altman Z	4.91	4.60	0.31	0.39
Tobin's Q	1.71	1.61	0.10	0.34
ROA	0.07	0.05	0.02	0.05*
Tangibility	0.22	0.24	-0.02	0.29
Liquidity constraints	0.26	0.21	0.05	0.22
Growth opportunity (3-year sales growth rate)	0.12	0.07	0.05	0.00***
Firm size	7.33	7.58	-0.25	0.09*
Executive age	52.61	52.17	0.43	0.18
Executive tenure	6.93	6.06	0.87	0.01**
CEO dummy	0.18	0.18	-0.00	0.94
CFO dummy	0.19	0.19	-0.00	0.90
Other executives dummy	0.63	0.63	0.00	0.87
Non-performance-based compensation (thousand)	1,113.25	1,346.71	-233.46	0.01**
Post-treatment (t = 1)				
Book value leverage	0.19	0.22	-0.03	0.02**
Δ Leverage	0.26	141.37	-141.11	0.06*
Deferred compensation (thousand)	498.18	630.97	-132.79	0.02**
Altman Z	4.28	4.20	0.08	0.79
Tobin's Q	1.45	1.37	0.08	0.39
ROA	0.04	0.05	-0.02	0.13
Tangibility	0.22	0.23	-0.01	0.52
Firm size	7.39	7.74	-0.35	0.02**
Liquidity constraints	0.25	0.30	-0.04	0.28
Growth opportunity (3-year sales growth rate)	0.09	0.09	0.00	0.77
Executive age	52.88	52.75	0.13	0.66
Executive tenure	7.14	6.29	0.84	0.01**
CEO dummy	0.18	0.18	0.00	0.89
CFO dummy	0.20	0.19	0.01	0.76
Other executives dummy	0.62	0.63	-0.01	0.72
Non-performance-based compensation (thousand)	1,290.65	1,429.37	-138.72	0.14
Post-treatment (t = 2)				
Book value leverage	0.20	0.23	-0.02	0.13
Δ Leverage	1.54	16.87	-15.33	0.09*
Deferred compensation (thousand)	490.63	662.08	-171.45	0.00***
Altman Z	4.72	4.27	0.45	0.19
Tobin's Q	1.64	1.55	0.09	0.36
ROA	0.06	0.05	0.01	0.22
Tangibility	0.21	0.23	-0.01	0.49
Firm size	7.46	7.82	-0.36	0.01*
Liquidity constraints	0.18	0.28	-0.10	0.01*
Growth opportunity (3-year sales growth rate)	0.07	0.09	-0.02	0.10
Executive age	53.33	52.89	0.43	0.16
Executive tenure	7.33	6.08	1.25	0.00***
CEO dummy	0.18	0.17	0.01	0.53
CFO dummy	0.19	0.20	-0.00	0.96
Other executives dummy	0.63	0.64	-0.01	0.65
Non-performance-based compensation (thousand)	1,462.55	1,692.16	-229.61	0.06*

*Note: Δ Leverage is the change rate of leverage, Δ Leverage = (Leverage$_t$ – Leverage$_{t-1}$) / Leverage$_{t-1}$. Firm size is the log value of total asset. Tangibility is the tangibility ratio constructed as the ratio of fixed to total assets. Growth opportunity is measured by average growth rate of sales for last three years. Liquidity is a dummy that equals to one if total net cash flow from operating and investing activities is negative. The year when tax increases happen is denoted as "t = 0", and for any positive integer n, "t = n" means n years after tax increases, and "t = -n" means n years before tax increases. Significance at the 10%, 5%, and 1% level is denoted by *, **, and *** respectively.*

Table 8. Difference-in-differences regressions on leverage

Variable	*Real tax shock*	*Placebo shock*	
	t = 0	*t = -2*	*t = 2*
	(1)	*(2)*	*(3)*
Post-treatment	-0.009**	0.027**	0.017**
	(0.047)	(0.017)	(0.015)
Treatment	-0.077***	0.077***	-0.001
	(0.000)	(0.001)	(0.932)
Difference-in-differences	0.015***	0.012	0.003
	(0.003)	(0.414)	(0.811)
ROA	-0.065	-0.112	-0.012
	(0.363)	(0.291)	(0.798)
Tangibility	0.073*	-0.009	0.079**
	(0.093)	(0.892)	(0.018)
Tobin's Q	0.052***	0.047***	0.048***
	(0.000)	(0.001)	(0.000)
Altman Z	-0.030***	-0.027***	-0.030***
	(0.000)	(0.000)	(0.000)
Firm size	0.021***	0.020***	0.024***
	(0.000)	(0.002)	(0.000)
Change in state GDP per capita	0.352***	-0.159	0.164
	(0.004)	(0.582)	(0.324)
State unemployment rate	-0.005***	-0.009***	-0.003
	(0.002)	(0.000)	(0.282)
Constant	0.105**	0.124**	0.048
	(0.018)	(0.028)	(0.180)
Observations	1,258	909	1,489
R-squared	0.427	0.391	0.431
Industry fixed effects	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes
Cluster by state	Yes	Yes	Yes

*Note: The year when tax increases happen is denoted as "t = 0", and for any positive integer n, "t = n" means n years after tax increases and "t = -n" means n years before tax increases. Robust p-value in parentheses: *** p < 0.01, ** p < 0.05, * p < 0.1*

Table 9. Difference-in-differences regressions on deferred compensation

Variable	*Real leverage shock*	*Placebo shock*		
	t = 1	*t = -1*	*t = 0*	*t = 3*
	(1)	*(2)*	*(3)*	*(4)*
Post-treatment	-23.783	11.330	11.971	1,156.435***
	(0.419)	(0.821)	(0.665)	(0.000)
Treatment	335.419***	-59.431	320.584***	-29.265
	(0.000)	(0.103)	(0.000)	(0.284)
Difference-in-differences	127.504**	-66.475	31.052	-8.228
	(0.043)	(0.120)	(0.597)	(0.850)
Altman Z	11.748	11.051	11.277	11.156
	(0.222)	(0.262)	(0.304)	(0.379)
Liquidity constraints	-121.681***	-167.473***	-71.530	-145.291**
	(0.010)	(0.002)	(0.188)	(0.021)
3-year sales growth rate	-408.505**	-490.432***	-369.770**	-469.846***
	(0.013)	(0.004)	(0.017)	(0.003)
Firm size	235.213***	232.136***	228.707***	264.680***
	(0.000)	(0.000)	(0.000)	(0.000)
Executive age	21.487***	21.234***	21.407***	21.763***
	(0.001)	(0.000)	(0.000)	(0.000)
Executive tenure	22.189***	19.293***	23.929***	25.524***
	(0.000)	(0.000)	(0.000)	(0.000)
CEO dummy	302.857***	337.170***	315.359***	280.033***
	(0.002)	(0.001)	(0.000)	(0.004)
Other executives dummy	-11.272	-14.573	-2.406	-40.998
	(0.680)	(0.497)	(0.925)	(0.298)
Non-performance-based compensation	0.038*	0.044*	0.050**	0.024**
	(0.062)	(0.058)	(0.039)	(0.034)
Change in state GDP per capita	572.639	1,132.198**	-167.055	-219.275
	(0.199)	(0.020)	(0.661)	(0.688)
State unemployment rate	-21.774***	-31.555***	-15.668***	-13.158
	(0.001)	(0.000)	(0.000)	(0.338)
Constant	-2,367.934***	-2,166.910***	-2,381.547***	-2,564.966***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	5,612	6,111	6,284	6,495
R-squared	0.189	0.195	0.191	0.191
Industry fixed effects	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
Cluster by state	Yes	Yes	Yes	Yes

*Note: The year when tax increases happen is denoted as "t = 0", and for any positive integer n, "t = n" means n years after tax increases, and "t = -n" means n years before tax increases. Robust p-value in parentheses: *** p < 0.01, ** p < 0.05, * p < 0.1*

In untabulated results, we also test the robustness of difference-in-differences regressions with firm fixed effects, subsamples with different periods (one with tax increases from 2008 to 2009, another with tax increases from 2011 to 2012), and control groups of all the other states without tax increases. All of them also generate significant and positive coefficients of the difference-in-differences terms, which implies that the positive impact of tax-motivated leverage increases on deferred compensation balances still holds when we change the settings of the tests.

6. DISCUSSION

This paper's findings contribute to the literature on the determinants of inside debt. Current literature mainly focuses on the impact of inside debt on corporate investment and financing and market reactions. Whereas studies on the determinants of inside debt are relatively rare. Nowadays, the increasing holding of inside debt causes scholars and managers to wonder about the potential reasons. This paper examines the inside debt holdings of all executives (including the CEO, CFO, and others) from 2006 to 2016 and provides the first plausible causal link between corporate leverage and the cost of inside debt.

Among all the potential determinants for inside debt, the agency cost of debt is the most appealing one based on Jensen and Meckling's (1976) theory. All the studies use leverage as the proxy, which, however, is confronted with several challenges for the analyses. First, there are simultaneous effects between leverage and inside debt. Theoretically, firms can choose to use inside debt to mitigate agency cost of debt (Jensen & Meckling, 1976; Edmans & Liu, 2010). Meanwhile, the utilization of inside debt will also alter the management risk attitude and creditors' perception of firms' risk-bearing capacity (Cassell et al., 2012; Wei & Yermack, 2011; Anantharaman et al., 2013). In addition, leverage has multiple drivers such as tax motivation, bankruptcy costs, liquidity, and profitability (Miller, 1977; Heider & Ljungqvist, 2012; Leland, 1994; Hennessy & Whited, 2005; Strebulaev, 2007). It is hard to disentangle the effects of leverage from those of other possible variables.

Therefore, without a good research method design, leverage by itself as a measure of agency cost of debt is ambiguous and oversimplified. Some empirical studies provide skeptical views on the effects of leverage on inside debt holdings: Cen (2011) documents a nonlinear relation between CEO inside debt holdings and firm leverage; Na (2014) finds no significant relation between leverage and deferred compensation contributed by the executive. Theoretical and empirical studies demonstrate that the post-default value of debts for creditors plays an important role in debt-overhang effects, which are determined by leverage, default probabilities, and lender recoveries in default (Hennessy, 2004; Hennessy et al., 2007). Inspired by previous studies, we introduce an interactive term between leverage and default risk as a proxy for agency cost of debt in panel regressions.

To get better inferences between leverage and other outcomes of interest, prior studies attempt to employ quasi-natural experiments on leverage to reduce the endogeneity issues. Prior literature on the identification of leverage is scarce and mainly based on exogenous shocks of specific commodity prices (Gan, 2007; Gilje, 2016). As a result, it is hard to generalize the results from a specific industry to other industries. This study, based on Heider and Ljungqvist (2012), examines a setting of tax-motivated shocks of leverage, which provides more comprehensive analyses of firms in multiple industries.

7. CONCLUSION

This paper empirically demonstrates that when corporate leverage increases in the first place, the balance of inside debt increases consequently. It implies that managers choose to increase the level of inside debt as one of the mitigations for enhanced agency cost of debt. This result provides one of the potential reasons why the balance of the inside debt is reaching a high level nowadays and helps us understand the managerial solutions for agency costs. The creditors could consider the management with higher inside debt is more likely to act in alignment with their benefits. For finance scholars, it provides empirical support for Jensen and Meckling's (1976) prediction that debt-like compensation could be used to mitigate agency cost of debt. And what's more important, it contributes to the scarce literature on the determinants of inside debt.

With comprehensive control variables and quasi-natural experiment research design, we mitigate biases caused by potential confounds of firm- and executive-level observable factors and unobserved industry-, state-, and even firm-level shocks. We also control each state's economic conditions and unemployment risk and attempt to mitigate the effects of unobservable geographic conditions by using adjacent states as a control group in the quasi-natural experiment. The remaining challenges to a causal interpretation, if any, are some omitted variables that change simultaneously with tax rate and deferred compensation. This is left for future work to verify. There are several limitations of this study. Since only changes in deferred compensation are taken into account here, the overall variations in inside debt and internal leverage (i.e., the ratio of inside debt over equity-based compensation) relative to changes in leverage are still unclear. Moreover, leverage has multiple sources, the results of this paper based on tax-motivated leverage changes cannot be easily generalized to other types of leverage.

REFERENCES

Admati, A. R., DeMarzo, P. M., Hellwig, M. F., & Pfleiderer, P. (2018). The leverage ratchet effect. *The Journal of Finance, 73*(1), 145–198. https://doi.org/10.1111/jofi.12588

Almazan, A., De Motta, A., Titman, S., & Uysal, V. (2010). Financial structure, acquisition opportunities, and firm locations. *The Journal of Finance, 65*(2), 529–563. https://doi.org/10.1111/j.1540-6261.2009.01543.x

Altman, E. I. (2000). *Predicting financial distress of companies: Revisiting the Z-score and ZETA models.* Stern School of Business, New York University. https://pages.stern.nyu.edu/~ealtman/Zscores.pdf

Anantharaman, D., Fang, V. W., & Gong, G. (2013). Inside debt and the design of corporate debt contracts. *Management Science, 60*(5), 1260–1280. https://doi.org/10.1287/mnsc.2013.1813
Bertrand, M., Duflo, E., & Mullainathan, S. (2002). *How much should we trust difference-in-difference estimates?* (NBER Working Paper No. 8841). National Bureau of Economic Research. https://doi.org/10.3386/w8841
Brander, J. A., & Lewis, T. R. (1986). Oligopoly and financial structure: The limited liability effect. *The American Economic Review, 76*(5), 956–970. https://idv.sinica.edu.tw/kongpin/teaching/io/BranderLewis.pdf
Cassell, C. A., Huang, S. X., Sanchez, J. M., & Stuart, M. D. (2012). Seeking safety: The relation between CEO inside debt holdings and the riskiness of firm investment and financial policies. *Journal of Financial Economics, 103*(3), 588–610. https://doi.org/10.1016/j.jfineco.2011.10.008
Cen, W. (2010). *The determinants of CEO inside debt and its components.* https://doi.org/10.2139/ssrn.1716306
Dang, V. A., & Phan, H. V. (2016). CEO inside debt and corporate debt maturity structure. *Journal of Banking & Finance, 70*, 38–54. https://doi.org/10.1016/j.jbankfin.2016.05.009
Edmans, A., & Liu, Q. (2011). Inside debt. *Review of Finance, 15*(1), 75–102. https://doi.org/10.1093/rof/rfq008
Edmans, A., Gabaix, X., & Jenter, D. (2017). *Executive compensation: A survey of theory and evidence* (ECGI Working Paper No. 514/2016). European Corporate Governance Institute. https://doi.org/10.2139/ssrn.2992287
Eisdorfer, A. (2008). Empirical evidence of risk shifting in financially distressed firms. *The Journal of Finance, 63*(2), 609–637. https://doi.org/10.1111/j.1540-6261.2008.01326.x
Frank, M. Z., & Goyal, V. K. (2009). Capital structure decisions: which factors are reliably important? *Financial Management, 38*(1), 1–37. https://doi.org/10.1111/j.1755-053X.2009.01026.x
Gan, J. (2007). Collateral, debt capacity, and corporate investment: Evidence from a natural experiment. *Journal of Financial Economics, 85*(3), 709–734. https://doi.org/10.1016/j.jfineco.2006.06.007
Gerakos, J. (2007). *CEO pensions: Disclosure, managerial power, and optimal contracting* (Pension Research Council Working Paper No. WP2007-5). The Wharton School University of Pennsylvania. https://doi.org/10.2139/ssrn.982180
Gilje, E. P. (2016). Do firms engage in risk-shifting? Empirical evidence. *The Review of Financial Studies, 29*(11), 2925–2954. https://doi.org/10.1093/rfs/hhw059
Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1992). Growth in cities. *Journal of Political Economy, 100*(6), 1126–1152. https://doi.org/10.1086/261856
Green, R. C. (1984). Investment incentives, debt, and warrants. *Journal of Financial Economics, 13*(1), 115–136. https://doi.org/10.1016/0304-405X(84)90034-5
Heider, F., & Ljungqvist, A. (2012). As certain as debt and taxes: Estimating the tax sensitivity of leverage from exogenous state tax changes (NBER Working Paper No. 18263). National Bureau of Economic Research. https://doi.org/10.3386/w18263
Hennessy, C. A. (2004). Tobin's Q, debt overhang, and investment. *The Journal of Finance, 59*(4), 1717–1742. https://doi.org/10.1111/j.1540-6261.2004.00677.x
Hennessy, C. A., & Whited, T. M. (2005). Debt dynamics. *The Journal of Finance, 60*(3), 1129–1165. https://doi.org/10.1111/j.1540-6261.2005.00758.x
Hennessy, C. A., Levy, A., & Whited, T. M. (2007). Testing Q theory with financing frictions. *Journal of Financial Economics, 83*(3), 691–717. https://doi.org/10.1016/j.jfineco.2005.12.008
Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, 3*(4), 305–360. https://doi.org/10.1016/0304-405X(76)90026-X
John, T. A., & John, K. (1993). Top-management compensation and capital structure. *The Journal of Finance, 48*(3), 949–974. https://doi.org/10.1111/j.1540-6261.1993.tb04026.x
Internal Revenue Service (IRS). (2024, April 15). *401(k) plan overview*. https://www.irs.gov/retirement-plans/plan-sponsor/401k-plan-overview#:~:text=A%20401(k)%20plan%20is,or%20a%20rural%20cooperative%20plan
Kraus, A., & Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The Journal of Finance, 28*(4), 911–922. https://doi.org/10.1111/j.1540-6261.1973.tb01415.x
Lee, G., & Tang, H. (2011). *CEO pension and deferred compensation* (Unpublished Working Paper). Seton Hall University. https://doi.org/10.2139/ssrn.1787479
Leland, H. E. (1994). Corporate debt value, bond covenants, and optimal capital structure. *The Journal of Finance, 49*(4), 1213–1252. https://doi.org/10.1111/j.1540-6261.1994.tb02452.x
Lemmon, M. L., Roberts, M. R., & Zender, J. F. (2008). Back to the beginning: persistence and the cross-section of corporate capital structure. *The Journal of Finance, 63*(4), 1575–1608. https://doi.org/10.1111/j.1540-6261.2008.01369.x
Matsa, D. A. (2010). Capital structure as a strategic variable: Evidence from collective bargaining. *The Journal of Finance, 65*(3), 1197–1232. https://doi.org/10.1111/j.1540-6261.2010.01565.x
Miller, M. H. (1977). Debt and taxes. *The Journal of Finance, 32*(2), 261–275. https://doi.org/10.1111/j.1540-6261.1977.tb03267.x
Modigliani, F., & Miller, M. H. (1963). Corporate income taxes and the cost of capital: A correction. *The American Economic Review, 53*(3), 433–443. https://www.jstor.org/stable/1809167
Na, K. (2014). *Why is executive compensation deferred? Evidence from a natural experiment* [PhD Thesis, University of Rochester]. William E. Simon Graduate School of Business Administration. http://hdl.handle.net/1802/29211
Ono, Y. (2003). Outsourcing business services and the role of central administrative offices. *Journal of Urban Economics, 53*(3), 377–395. https://doi.org/10.1016/S0094-1190(03)00006-8
Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies, 22*(1), 435–480. https://doi.org/10.1093/rfs/hhn053
Strebulaev, I. A. (2007). Do tests of capital structure theory mean what they say? *The Journal of Finance, 62*(4), 1747–1787. https://doi.org/10.1111/j.1540-6261.2007.01256.x
Sundaram, R. K., & Yermack, D. L. (2007). Pay me later: Inside debt and its role in managerial compensation. *The Journal of Finance, 62*(4), 1551–1588. https://doi.org/10.1111/j.1540-6261.2007.01251.x
Wei, C., & Yermack, D. (2011). Investor reactions to CEOs' inside debt incentives. *The Review of Financial Studies, 24*(11), 3813–3840. https://doi.org/10.1093/rfs/hhr028
Yonker, S. E. (2016). Geography and the market for CEOs. *Management Science, 63*(3), 609–630. https://doi.org/10.1287/mnsc.2015.2319