Capital Structure *Redux*: Maturity, Leverage, and Flexibility

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Abstract

We investigate how a firm jointly determines the amount of debt and its maturity in a dynamic capital structure. We find a firm with high volatility of earnings optimally issues debts of shorter maturity which helps it maintain its financial flexibility. Using simultaneous equations of leverage and maturity regression, we find that higher leverage is led by shorter maturity. Our results support the dynamic capital structure model in which a firm decides its leverage as a trade-off between bankruptcy costs and tax benefits, as well as optimally adjusting the maturity of its debt by taking account of their financial flexibility versus the costs of new debt issuance. These findings can explain why financial institutions with high volatility of earnings before the 2007-2009 financial crisis had higher leverage as well as huge short-term financing.

Key words: financial flexibility, debt maturity, leverage, earnings uncertainty

JEL Classification: G32, D81

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The recent financial crisis raised the question of why firms use so much short-term debt, even when this increases bankruptcy costs as well as raising refinancing risks. The expensive roll-over costs of short-term debts were accused as a culprit which amplified the 2007-2009 financial crisis. This paper takes into account the perspective that higher short-term debt financing can be an optimal outcome in a dynamic framework, once we consider the flexibility of capital structure. On top of the assumption that bankruptcy costs and tax benefits are fully incorporated within a business' leverage decision, a firm optimally balances the costs of new issuance and the associated flexibility benefits in order to choose debt maturity. We followMiltersen and Torous (2007), in creating a model of capital structure within a dynamic framework that shows how a firm determines simultaneously the optimal amount and the maturity of its debt. Dynamic and optimal debt policy of this type is traditionally considered as a trade-off between tax benefits and bankruptcy costs (Modigliani and Miller (1958),Merton (1974); Leland (1994)). A growing literature on dynamic capital structure has also paid attention to the flexible adjustment of capital structure and and its interaction with transaction costs(Ju and Ou-yang (2005), Dangl and Zechner (2006), Miltersen and Torous (2007)). These recent theoretical models provide several empirical implications that we will investigate later in an empirical section.

Short-term financing can be optimal conditional on the trade-off between the issuance costs of new debt versus the flexibility benefits. The intuition for a model of dynamic capital structure with maturity is as follows. A firm may have long-term debt that becomes due and it has to the amount and maturity of new debt as it refinance to pay the old debt. If it choose the same amount with a shorter maturity of debt, then it can receive the residuals from a trade-off between bankruptcy costs and tax benefits as much advantage as longer-term financing does, while enhancing the financial flexibility of the capital structure at the next due date. With the low issuance costs, a firm has the opportunity of optimally reorganizing the amount and maturity of its debt the next time. On one hand, this benefit remains only if the refinancing costs of short-term debts is affordable. In a frictionless world, where a firm can keep continuously adjusting its capital structure by refinancing or retiring its debt, the shortening maturity of financing turns out to be an optimal and efficient outcome. On the other hand, the key friction that leads to inefficient short-term financing and high leverage comes from the assumption of a dynamic framework in which the state variables are continuously adjusted without sudden jumps or regime-switching. The 2007-2009 financial crisis of shows a regime-switching on the costs of issuance from an affordable state to an extremely costly one. Soaring rollover costs of short-term debt made firms vulnerable and led to a socially undesirable outcome(He and Xiong (2012); Brunnermeier and Oehmke (2013)).

The recent literature of dynamic capital structure model suggests a number of interesting but unexplored questions about the determinants of financial policy(Ju and Ou-yang (2005); Dangl and Zechner (2006); Miltersen and Torous (2007)). Our empirical analysis addresses the following questions, closely relying on the following theoretical implications;

- First, what is the influence of flexibility benefits on a firm's financial policy choices? Furthermore, how do fluctuations in the earnings process affect the simultaneous decisions between the debt maturity and the leverage ratio?

- Second, observing that the trade-off between the volatility of asset dynamics and transaction costs determines the optimal maturity of debt, how do firms react to adjust their financial distress and tax shields with high volatility asset?

- Finally, does a firm with different types of debt (i.e., public debt vs private debt) behave in qualitatively different ways by adjusting its corporate financial policy (maturity and leverage)? How does the renegotiation or restructuring features of debt affect a joint determination of debt maturity and leverage?

Miltersen and Torous (2007)suggests that optimal debt maturity is determined by the trade-off between flexibility benefits versus issuing costs. The earning process underlies the value the firm. Thereby, the volatility of the earning process is a main variable of affecting interest choices for an optimal debt maturity structure. A high volatility of earnings accelerates the retirement of debt outstanding. Miltersen and Torous (2007) expects that the more volatile of the earnings, the shorter the maturity of debt in a firm's capital structure. In line with Miltersen and Torous (2007), Ju and Ou-yang (2005) suggests that optimal maturity is inversely related to the asset volatility level since the flexibility to re-balance capital structure is an option. Dangl and Zechner (2006), from

their comparative statistical analysis, also argue that the increasing cash flow risk shortens the optimal maturity of debt while the growth rate of cash flow and the transaction costs of issuing new debt (rolling over debt) lengthen the optimal maturity. We empirically investigate the relation between the maturity and the performance uncertainty of firms, closely following the existing theoretical studies. In our empirical analysis, flexibility benefits are substitute for the volatility of earnings since the greater the volatility of the earning process, the greater the flexible benefits. Moreover, uncertainty of performance becomes more important as the firm's financial health worsens, because external financing becomes more sensitive to asymmetric information(Brunnermeier and Yogo (2009); Dangl and Zechner (2006)). Voluntary debt reduction is extremely worthwhile during trouble periods, Hovakimian, Opler, and Titman (2001) empirically supports the argument that long-term debt impedes debt reductions, while losing flexibility benefits. In empirical studies of maturity decisions, Guedes and Opler (1996) takes the volatility of cash flow in a firm's accounts as a proxy for credit quality and Johnson (2003) empirically examines how short-term debt attenuates the negative effect of growth opportunities on leverage and supports our hypothesis: the greater asset maturity, the shorter maturity of debt.
A firm aims to maximize the effective maturity of its debt over several refinancing cycles, not to maximize the maturity of debts outstanding. Shortening maturity of debt gives a firm the advantage of quick readjustment in response to changes in its asset value. For instance, a short-term bond could enable the firm to finance a long-term asset optimally by initiating a rollover, when it is in good financial health, otherwise by retiring itself upon a bad performance. With long-term financing, the firm cannot react in a timely manner when it become fragile with the value of its assets suddenly falling(Brunnermeier and Yogo (2009) Dangl and Zechner (2006)). We test the hypothesis that a firm with shot-term debt quickly reduces outstanding debts when its performance turns bad while a firm with relatively long-term obligations delays a readjustment of its outstanding debts. By doing so, we look at the implications of the optimal dynamic choice of the maturity structure of debt and capital structure over several financing cycles.This analysis indicates that a firm with short-term debt can manage potential financial distress promptly while a firm with long-term debt is unable to adjust its bankruptcy risks in an efficient way.

A firm with long-term investment project optimally maintains its the financial flexibility through short-term financing. It can also manage its bankruptcy probability by shedding its debt should its performance worsens. In better times, this motivates a firm to incur more debt and leverage itself up to be optimal. On the other hand, the maturity mismatch between a long-term project and short-term financing widens as the maturity of short-term debt gets shorter, thereby increasing the occurrence of debt restructuring prior to the project's maturity. This also raises the costs of new debt at the upper bound of optimal leverage ratio. Provided that the optimal maturity is susceptible to changes in the leverage, a firm tends to lock its external financing up in the long-term at a lower leverage ratio than our previous argument may have suggested. Miltersen and Torous (2007) suggests that the maximum maturity is a declining function of the firm's leverage ratio up to some ceiling which Brunnermeier and Yogo (2009) also hypothesizes; the optimal maturity will thereby also depend on the volatility of the earning process.

In order to examine empirically the relation between the maturity of debt and the leverage ratio, it is important to account for the likelihood that these can be endogenously determined. There is a tension between the optimal maturity and the leverage ratio; the difficulty of hedging liquidity risks increases as the maturity get shorter and the leverage ratio raises. On the other hand, a firm can keeps taking advantage of the flexibility benefits as long as issuance costs are affordable and the tax benefits surpasses the bankruptcy risks.

Miltersen and Torous (2007) predicts that asset volatility shortens the maturity of debts in an optimal maturity and leverage decision; additionally, a firm with a shorter maturity of debts optimally levers itself up. The leverage ratio and the asset volatility will not interact with each other in the same manner as the maturity and asset volatility since the leverage ratio is not as sensitive as asset volatility as it is to the maturity of debts. Provided that a firm has decided the optimal maturity while fully considering the effects of asset volatility, the leverage ratio react to the trade-off between the bankruptcy costs and tax benefits as the traditional structural model suggests. Miltersen and Torous (2007) points out that the bankruptcy boundary is a decreasing function of both asset volatility and the leverage ratio. As changes in asset value becomes volatile, the bankruptcy probability increases, thereby reducing the leverage ratio. We hypothesize that a negative association between asset volatility and the leverage ratio exists once a firm has taken complete account of the volatility effects on the optimal maturity, as well as the trade-off between bankruptcy costs and tax benefits on the optimal leverage decision. The empirical finding of Johnson (2003)'s are consistent with our hypothesis: the greater the earnings volatility, the lower the leverage.

If a firm can have debts of multiple maturities outstanding at the same time, richer financing strategies are possible. We test whether the presence of multiple types of debts affects the optimal dynamic choice of maturity and leverage. To do so, we test whether the behavior of bank debt differs from that of bonds. Private debt is different from public debt in several ways. First, the maturity of bank debt tends to be shorter than public bonds. The average time to maturity of public bonds in our sample is seven years, while the maturity of bank debt is four years. Second, the renegotiation of bank debts is more frequent than it is with public debts, whereby a firm can manage its financial flexibility by renegotiating its contracts with creditors. In contrast, such renegotiation rarely occurs for bond holders. Diamond (1992) notes that short-term private debt is senior to long-term debt, following from difficulties in restructuring and renegotiating bonds are held by the public. Diamond (1992) also proposes that bank debt will not lead to any concessions even in the case of a borrower's financial distress. Therefore, we expect that private debt through its capital structure results in a weaker association between shorter maturity debt and flexibility of leverage, while firms with public debt are more likely to readjust and optimize the maturity of bond and the amount of debt at the time of issuance.

The remainder of the paper is organized as follows. Section 1 overview the related literature. Section 2 presents the theoretical background on the joint determination of leverage and debt maturity in a dynamic capital structure framework. Section 3 discusses our sample and provides some evidence on how the maturity of long-term bond issuance has changed since 1990. Section 4 provides our empirical results on benchmark specification. Section 5 presents our empirical methods in a Simple Capital Structure framework. Further, Section 6 extends our analysis using a mix of bank-debt and public bonds. Finally, Section 7 concludes.

1 Literature Review

Optimal dynamic debt policy is examined in a modeling framework, in which trade-offs between bankruptcy costs and tax benefits lead to an optimal capital structure. Most such studies assume that a firm issues debt with infinite maturity (Leland (1994); Goldstein, Ju, and Leland (2000); Fisher, Heinkel, and Zechner (1989)). However, Kane, Marcus, and McDonald (1984) and Leland and Toft (1996) study the optimal capital structure with a finite maturity of debt. Leland and Toft (1996) uses a stationary aggregated debt structure, in which the initial equity holders choose the coupon, par value and maturity to maximize firm value, with this debt structure remaining fixed over time. Thus, they find that the optimal maturity is perpetual if it is only determined by a trade-off between tax shields and bankruptcy costs. A growing literature on dynamic capital structure pays attention to extra factors, including trade-offs between financial flexibility and transaction costs as well as between financial distress and tax shields in order to determine leverage and debt maturity. Ericsson (2000) also develops a capital structure model in which firms consider the interrelated mechanisms of bankruptcy costs, tax benefits and the agency costs associated with debt financing in order to determine the maturity and leverage ratio. He predicts the leverage ratio is reduced and debt maturity gets shorter for managers aiming to minimize the agency costs of asset substitution. Childs, Mauer, and Ott (2005) examines the joint choice of leverage and maturity under the stockholder-bondholder conflicts framework. They find that financial flexibility stimulates taking on short-term debt, resulting in a reduction in the agency costs of investment. Ju and Ou-yang (2005) presents a dynamic model in which an optimal capital structure and an optimal maturity time frame are simultaneously decided under stochastic interest conditions. Dangl and Zechner (2006) and Miltersen and Torous (2007) investigates debt maturity in a dynamic capital structure model. Both studies examine the joint choice of debt maturity and leverage in a dynamic capital structure model and find that short-term debt motivates the reduction of debt levels in response to poor firm performance. Previous literature on the joint choice of debt maturity and leverage explore debt maturity where firms can only change their leverage after the existing debt has matured(Ju and Ou-yang (2005); Childs, Mauer, and Ott (2005)) On the other hand, in the models of Dangl and Zechner (2006); Miltersen and

Torous (2007), firms can issue more debt or reduce debt at any point in time. Assuming a lack of renegotiation or co-ordination problems, these theories focus on the rigidity of long-term debt as well as on the flexibility of short-term financing. Those recent models provide several empirical implications that shouldbe examined empirically.

Our paper also contributes to strands of the literature on empirical studies of corporate leverage ratio and debt maturity. The choice of short-term debt with high or low leverage ratio was inconsistent in empirical analysis. Barclay, Marx, and Smith (2003) finds that maturity decreases with leverage while Johnson (2003) and MacKay (2003) find that maturity increases with leverage. How the volatility of assets or earnings influences short-term debt was also inconsistent in empirical work. Based on theories of agency costs, Childs, Mauer, and Ott (2005) and Stohs and Mauer (1996) find that large and less risky firms with long asset maturity have longer-term debt, as well as that firms with more earning surprises have more short-term debt; lastly they find a non-monotonic relationship between debt rating and maturity, with both very high- and low-rated firms having short-term debt. Barclay, Smith, and Watts (1995)finds that firms with low growth options and large firms both choose more long term debt. Guedes and Opler (1996) focuses on debt maturity as a function of size and credit rating and finds that large firms with investment credit rating have both short-term maturity debt and very long-term debt, while firms with speculative ratings issue debt with mid-term maturity. We note that these inconsistent results might come from the different definitions of debt maturity as well as different types of debt (i.e., bonds vs bank loans).Guedes and Opler (1996) investigates new bond issues and focuses on incremental debt maturity. This approach has the benefit of relying on maturities of debt from a balance sheet that aggregates all debt with maturities of greater than one to five years. Previous empirical studies of debt maturity choice focus on the maturity of all liabilities on a firm's balance sheet (Barclay, Smith, and Watts (1995),Stohs and Mauer (1996); Johnson (2003)). We follow Guedes and Opler (1996) by examining the maturity of incremental debt issues from FISD data; furthermore we complement it with Compustat data in which debt maturity appears within five-year aggregates on a firm's balance sheet. Guedes and Opler (1996) argues that this incremental approach is well-suited to test theories that rely on state variables that fluctuate substantially over time. In addition, this approach helps identify the determinants of financing choices at all points on the maturity spectrum. Recent work by Harford, Klasa, and Maxwell (2014) also utilizes both bank debt and public bonds in order to investigate how debt maturity affects a firm's cash holding decisions. Our empirical investigations help explain these inconsistencies by employing various databases (i.e., FISD, DealScan, and Compustat) as well as investigating different types of debt maturity (i.e., bonds vs bank loans).

The financial crisis of 2007-2009 called attention to the issues of corporate leverage and debt maturity, raising questions as towhy firms, in particular, financial institutions, use so much short-term debt financing, even when this exposes them to significant roll-over risk (Brunnermeier and Oehmke (2013)). He and Xiong (2012) develops a dynamic model in which a deterioration of liquidity in the bond market leads to an increase not only in the liquidity premium of bonds, but also the credit risk. This increases in credit risk is rooted in the firm's roll-over risk. The roll-over risk has a first-order effect on the short-term maturity debt and leads to default at higher fundamental thresholds. In the same line of research, Brunnermeier and Oehmke (2013) characterize the extreme reliance on short-term financing as the maturity rat race. A failure of creditor coordination leads to an extreme reliance on short-term debt financing; financial institutions then become vulnerable to a strong mismatch of maturity. They argue that the maturity rat race is inefficient and creates suboptimal, costly outcomes. A growing empirical literature links the shortening maturity of debt with increased credit and liquidity risk in businesses, the mechanism by which many firms were greatly affected during the 2007-2009 financial crisis. Almeida et al. (2009) points out the importance of debt maturity for corporate financial policy by revealing that firms with larger long-term debt maturing in the middle of a financial crisis decreases their investment rate more than other firms with long-term debt maturing in later years. Their findings show how debt maturity affects the real economy by the cutting of investment by firms with high roll over costs in the middle of the recent financial crisis. Custodio, Ferreira, and Laureano (2013) finds that debt maturities of more than three years greatly decrease from 56 percent in 1976 to 6 percent in 2008. In addition, they discovered that firms with higher information asymmetry and new firms with an IPO issue more short-term debts. Recent empirical papers explore an increasing trend of cash holdings in U.S industrial firms over the last two decades; they show firms managing their liquidity risk by storing cash. Harford, Klasa, and Maxwell (2014) finds that higher cash holdings mitigate the refinancing risks of firms and that short-term debt can be substituted for cash. In the same line as Harford, Klasa, and Maxwell (2014), the shortening of debt maturities explains approximately 32% of the increase in corporate cash reserves over the period studied by Bates, Kahle, and Stulz (2007). We also find a negative relation between debt maturity and cash holdings, which is consistent with Bates, Kahle, and Stulz (2007) and Harford, Klasa, and Maxwell (2014).

Lastly, our work contributes to the literature on underwriting and financial policy. Various studies have examined the determinants of direct issue costs, which consist primarily of underwriter fee. These studies generally find that the direct issue costs are positively related to bond maturity and are negatively related to issue size and credit quality(Gande et al. (1997), Melnik and Plaut (1996)). The positive association between bond maturity and direct issue costs is empirically supported by our analysis; thereby, higher direct issuance costs holds up faster adjustments of capital structure.

2 Dynamic Model of Optimal Capital Structure

2.1 Base Model

We consider a firm which continuously receives a cash flow, ξ. The cash flow is an earning before interest and taxes (EBIT) and under the risk-neutral measure it has the following process

$$d\xi_t = \xi_t \mu dt + \xi_t \sigma dW_t$$

with constant drift, μ and the volatility, σ. Here W denotes a standard Brownian motion. The firm can issue debt and equity and optimize its capital structure by dynamic trade-offs between tax advantage of debt and bankruptcy costs. This set-up follows Leland (1994); Fisher, Heinkel, and Zechner (1989); Kane, Marcus, and McDonald (1984).

At the first date, the firm optimally issues debt with principal P and coupon rate c. We assume debt is issued at par, thus, the initial market value of the debt at date zero. We model a finite maturity of debt in the same way as inEricsson (2000)and Leland (1994). The debt is going to be repaid at par at a fixed fractional rate of λ of the remaining outstanding principal. Hence, if the remaining principal is P_t, at date t, then during the next infinitesimal time period the firm will repay debt back at the rate λP_t at par value.

$$dP_t = -\lambda P_t dt$$

with the initial condition

$$P_0 = P$$

The solution is

$$P_t = Pe^{-\lambda t}$$

Hence, the accumulated dollar amount of principal repaid at date t is

$$\int_0^t -\lambda P_s ds = \int_0^t -\lambda P_s e^{\lambda s} ds = P - Pe^{\lambda t}$$

With this setup the issued debt will have an average maturity of

$$\frac{1}{P_0}\int_0^\infty -\lambda P_s s ds = \frac{1}{\lambda}$$

In order to price debt and equity we need to specify their cash flows. The after-tax cash flow to the debt holders at date t will be

$$(1-\tau_i)ce^{-\lambda t} + \lambda Pe^{-\lambda t} = ((1-\tau_i)\,c + \lambda P)\,e^{-\lambda t}$$

The firm promises a coupon rate c at date zero and as the principal of the remaining outstanding debt is shrinking so is the coupon payments. Hence, at date t the promised coupon payment rate is

$$ce^{-\lambda t}$$

We assume that coupons are taxed at the rate τ_i. Moreover, since debt is issued at par repayment of principal is not taxed. We assume that the firm pays out its entire EBIT to its claim holders. That is, there is no retained earnings in the firm. Hence, the after-tax rate cash flows to the equity holders, at date t, is

$$(1-\tau_e)\,\xi_t - ((1-\tau_e)\,c + \lambda P)\,e^{-\lambda t}$$

Now, we will denote the date t values of debt and equity as

$$D\left(\xi_t, t\right)$$

and

$$E\left(\xi_t, t\right)$$

when the current level of the EBIT is ξ_t.

The value of debt and equity, at a given date t, can be calculated as

$$\begin{aligned} E_{nb}\left(\xi_t, t\right) &= \boldsymbol{E_t}\left[\int_0^{\propto} e^{-r(u-t)}\left(1-\tau_e\right)\xi_u - \left(\left(1-\tau_e\right)c+\lambda P\right)e^{-\lambda u}du\right] \\ &= \frac{\left(1-\tau_e\right)\xi_t}{r-\mu} - \frac{\left(\left(1-\tau_e\right)c+\lambda P\right)e^{-\lambda t}}{r+\lambda} \end{aligned}$$

$$\begin{aligned} D_{nb}\left(\xi_t, t\right) &= \boldsymbol{E_t}\left[\int_0^{\propto} e^{-r(u-t)}\left(\left(1-\tau_i\right)c+\lambda P\right)e^{-\lambda u}du\right] \\ &= \frac{\left(\left(1-\tau_i\right)c+\lambda P\right)e^{-\lambda t}}{r+\lambda} \end{aligned}$$

These results will serve as benchmarks and as inspiration when we include the possibility that the firm may go bankrupt. We derive the fundamental partial differential equation(PDE).

$$\frac{1}{2}\sigma^2\xi_t^2F_{11}\left(\xi_t, t\right)+\mu\xi_tF_1\left(\xi_t, t\right)+F_2\left(\xi_t, t\right)-rF\left(\xi_t, t\right)+a\xi_t+be^{-\lambda t}=0$$

At date zero, we have the following initial conditions,

$$D\left(\xi_0, 0\right)=P$$

$$D\left(\xi_0, 0\right)=A-P\left(1-k\right)$$

The solutions to the debt and equity values are solved as

$$E(\xi_t, t) = e_2 e^{\lambda(x_2-1)t}\xi_t^{x_2} + \frac{(1-\tau_e)\,\xi_t}{r-\mu} - \frac{((1-\tau_e)\,c + \lambda P)\,e^{-\lambda t}}{r+\lambda}$$

$$D(\xi_t, t) = d_2 e^{\lambda(x_2-1)t}\xi_t^{x_2} + \frac{((1-\tau_i)\,c + \lambda P)\,e^{-\lambda t}}{r+\lambda}$$

2.2 Dynamic Model

In the base model the equity holders maintain a fixed constant debt level. This is the debt level that maximizes the firm value at date zero, but it may not be the optimal debt level at the date of issue. In the dynamic version of the model, we allow the equity holders to re-issue debt continuously in time in a dynamically optimal way. The first thing we need to figure out is when it is actually dynamically optimal for the equity holders to re-issue debt. We assume that the firm buys back all the outstanding debt at its market value from the existing debt holders before it issues new debt. So when the firm is going to issue new debt, the new issue will be done when there is no debt in the firm at all. Hence, if the firm re-issue debt at date t, then the Earnings Before Interests and Taxes (EBIT) level is ξ_t then the optimal coupon of the new issue will be $c\xi_t$ and the corresponding value of the debt will be $P\xi_t$.

The fundamental Partial Differential Equation(PDE) based on no arbitrage for the general value function, $\mathcal{F}(X, M)$ in the dynamic case is very similar to the fundamental PDE in the static case. The state variable, X with probability one is strictly below M. Hence, M is a constant with probability one. Hence, when $X < M$, the general value function, $\mathcal{F}(X, M)$, must fulfill the fundamental PDE.

$$\frac{1}{2}\sigma^2 X^2 \mathcal{F}_{11}(X, M) + (\mu+\lambda)\,X\mathcal{F}_1(X, M) + \mathcal{F}_2(X, M) - (r+\lambda)\,\mathcal{F}(X, M) + aX + bM = 0$$

Also, using the homogeneity degree of one property of $\mathcal{F}$, we can simplify $\mathcal{F}$ in the following way,

$$\mathcal{F}(X, M) = X\mathcal{F}(1, Z) = X\mathcal{F}(Z)$$

where

$$Z = \frac{M}{X}$$

The partial derivatives of $\mathcal{F}$ and F are related as follows,

$$\begin{aligned}\mathcal{F}_1(X, M) &= F(Z) - ZF'(Z) \\ \mathcal{F}_{11}(X, M) &= \frac{Z^2}{X}F''(Z)\end{aligned}$$

Hence, when $Z > 1$, $F(Z)$ must satisfy the ODE

$$\frac{1}{2}\sigma^2 Z^2 F''(Z) - (\mu + \lambda) ZF'(Z) + F_2(Z) - (r - \mu) F(Z) + a + bZ = 0$$

The general solution is

$$F(Z) = f_1 Z^{1-x_1} + f_1 Z^{1-x_1} + \frac{a}{r - \mu} - \frac{bZ}{r + \lambda} - \frac{\frac{b}{r+\lambda} - g}{x_1 - 1} Z^{1-x_1}$$

2.3 Numerical Illustration

Miltersen and Torous (2007)plots the value of a firm's newly issued debt and equity as a function of its chosen average maturity, $\frac{1}{\lambda}$ of its debt for three different volatilities. Figure 1 illustrates that a firm with an EBIT volatility of 10% should choose an average of around 1 year, whereas a firm with an EBIT volatility of 25% should choose an average of maturity of around 0.5 year. Finally, a firm with an EBIT volatility of 50% should choose a perpetual debt. The amount of debt issuing increases both as the maturity gets shorter and as the volatility increases. As the volatility of cash flow increases it will become optimal to choose perpetual debt for a given issuing cost k. Miltersen and Torous (2007) compares their static and dynamic models with the classical capital structure model developed by Leland (1994). In Leland's case, the average maturity of debt decreases monotonically as the volatility of cash flow increases from 10% to 25% and 50%.

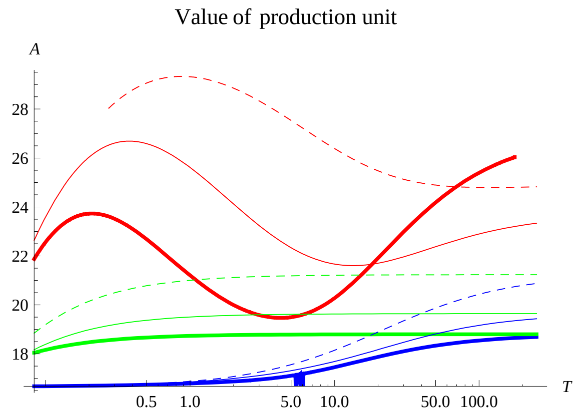


Figure 1: Maturity and Cash Flow Volatility

Note: In this figure, we plot the value of a firm's newly issued debt and equity as a function of its chosen average maturity, $\frac{1}{\lambda}$ of its debt for three different volatilities. The figure illustrates that a firm with an EBIT's volatility of 10% optimally choose an average of around 2-3 years, whereas a firm with an EBIT's volatility of 25% optimally choose an average of maturity of around 1 year. Finally, a firm with an EBIT's volatility of 50% optimally choose perpetual debt. We also compare a model of Miltersen and Torous (2007) with the classical dynamic capital structure model developed by Leland (1994). In Leland's case, the average maturity of debt decreases monotonically as the volatility of cash flow increases from 10% to 25% and 50%.

There are several insights from the numerical analysis of Miltersen and Torous (2007), whose work compares three different examples: red presents the dynamic capital structure of Miltersen and Torous (2007), blue displays the static case of Miltersen and Torous (2007), and lastly green shows Leland (1994). Moreover, three different volatility levels are illustrated: thick $\sigma = 50\%$, thin $\sigma = 25\%$ and dashed $\sigma = 10\%$.

First, the effect of volatility on firm value was considered. The value of the firm decreases as the volatility of cash flow increases for both the static case of Miltersen and Torous (2007) and Leland (1994). Figure 1 plots firm values as the volatility varies from 10 % to 25 %, and 50%; blue presents the static case of Miltersen and Torous (2007), green displays Leland (1994). It can be seen that firm value does not monotonically increase or decrease as the earning process becomes volatile in the dynamic capital structure of Miltersen and Torous (2007), presented by the red line. We find that a firm achieves the greatest value of its asset as the maturity of debt is chosen at an optimal level. If the firm selects the maturity of debt away from the optimal point, it loses asset value as well.

Second, the optimal maturity of debt is a non-monotonic function of volatility in the dynamic capital structure of Miltersen and Torous (2007), while in both the static case of

Miltersen and Torous (2007) and in Leland (1994), the optimal maturity of debt becomes infinite (i.e., console bonds). In the static case(blue) of Miltersen and Torous (2007), the optimal maturity of debt varies little, implying that an infinite maturity of debt is optimal in this analysis. In the dynamic case(red) of Miltersen and Torous (2007), the optimal maturity of debt has a local minimum; when the value of firm is maximized, the optimal maturity of debt has a local minimum at 0.5 years (at $\sigma = 25\%$), and 1 years(at 10%), while a very short maturity cannot have a local minimum. Consequently the infinitely long maturity becomes optimal at $\sigma = 50\%$. Lastly, in case of Leland (1994) the optimal maturity of debt displays a monotonic relationship between volatility and firm value: as the volatility increases, the optimal maturity get shorter, although its variance is not large.

3 Data Overview

3.1 Sample Description

Our final sample comes from various sources. We start with corporate bonds data drawn from from the Fixed Income Security Database(FISD), representing publicly-offered U.S. corporate bond data. We obtain information on bonds, such as, issuing dates, maturity, offering amount, offering yield, coupon frequency, coupon type (fixed, various, or zero) and other relevant features from the FISD. We take firm's accounting information from Compustat North America files, which are available in both annual and quarterly formats. For most companies, an annual history is available back to 1950 and a quarterly history back to 1962, with a monthly market history also available back to 1962. We merge Compustat North America Fundamental Annual and Quarterly for balance sheet information, with the FISD Mergent database for Corporate bond issues. We exclude financial firms, being those with standard industrial classification(SIC) codes from 6000 to 6999. We winsorized the top and bottom 1% of variables to minimize the effect of outliers. We include firms with three years of consecutive observations in our final sample. The main variables are maturity of long-term debt, leverage, and volatility of asset. We proxy debt maturity as amounts weighted time-to-maturity at bond issuance; leverage as the fraction of long-term debt to book value of total debt plus market value of equity; and performance uncertainty as asset volatility.

$$Wgt\,Maturity = \frac{Amount\,Outstanding}{Total\,Amount\,Outstanding} * Remaining\,Maturity \tag{1}$$

$$Leverage = \frac{Long\,Term\,Debt}{Total\,Asset} \tag{2}$$

We define measures of asset volatility, as

$$\sigma_A = \sigma_E \frac{E}{E+X} \tag{3}$$

closely following a measure of asset volatility by Correia, Kang, and Richardson (2014), where E is the market value of the firm's equity and X is the book value of long term debt plus half of the book value of short term debt.

3.2 Summary of Statistics

Comparing the long-term bond issuers and all Compustat firms, Table 1 presents mean and median statistics of key firm characteristics aggregated across all years for bond issuers and the entire Compustat population winsorized at 1% both top and bottom. Bond issuers comprise around 5% of the Compustat population for the same period from 1986 through 2010. We test whether bond issuers are different from the overall Compustat population, in key firm characteristics by using the two-sided t-test. We report *t-statistics* and *p-values* for each variables at the last two columns. This test shows that bond issuers are bigger (measured in log(total asset)); more leveraged in both book leverage and market leverage; more profitable; and have more tangible assets. On the other hand, all Compustat firms have higher market-to-book ratios. Nonetheless, the medians of corresponding variables are similar across the two samples.

In order to see time trends in bond characteristics, we divide the sample into five-year time periods, compute the annual median and standard deviation of each variable, and then calculate the average over the years for each time period. From 1991 to 2000, there are around 15,000 bond issues with 9 years of maturity. On the other hand, in the next decade between 2001 and 2010, the number of bond issues decreases by 22% from the previous decade and the maturity of bonds also decreases to 8 years. Table 2 provides the

Table 1: Summary of Statistics: Bond issuers vs All Compustat Firms

Note: This table presents the summary statistics of variables from both the overall Compustat firms and bond issuing firms. Table 1 compares mean and median statistics of firm's key characteristics aggregated across all years for bond issuers and the overall Compustat population winsorized at 1% both top and bottom. Bond issuers comprise around 5% of the Compustat population for the same period from 1990 through 2010. We test whether bond issuers are different from the overall population, in firm's characteristics by using the two-sided t-test. We report *t-statistics* and *p-values* for each variable at the last two columns.

	Bond Issuers			All Compustat			T-Test	
Variables	# of Obs	Mean	Median	# of Obs	Mean	Median	t statistics	p-value
Book Leverage	11,358	0.3008	0.2096	70,603	0.31	0.37	3.1	0.002
Market Leverage	6,506	0.5387	0.5061	53,540	0.522	0.515	-5.2	0.00
Total Debt	11,358	15,061	5,469	70,603	1,411	161	-76.3	0.00
Size	11,358	9.2721	9.3852	70,603	5.53	5.71	-190	0.00
Profitability	11,022	0.0945	0.0889	67,496	0.004	0.094	-49.2	0.00
Market-to-Book	6,506	1.1606	0.9905	53,540	1.609	0.961	24.8	0.00
Tangibility	10,780	0.3850	0.3394	68,002	0.382	0.335	-0.89	0.37
Cash holding	11,354	0.0680	0.0219	70,592	0.076	0.029	7.20	0.00

summary statistics of the number of bond issuance, the offering amounts and the maturity of bonds for the period from 1991 through 2010. The highest number of bond issuance is 7,962 between 1996 and 2000, with an average offering amounts of USD 130 million and an average maturity of 9 years, while the least number of bond is 5578 between 2006 and 2010 with an average amounts of USD 290 million and an average duration of 8.1 years. The yield-to-maturity and coupon decreases from 7.74(coupon rate 7.78) percent to 6.05 (coupon rate 6.48)percent from 1991 to 2010.

3.3 Summary Statistics of Bond Issuance

For our final sample, we combine Compustat annual/quarterly file, CRSP Return and FISD bond issuance data. We winsorized the top and bottom 1% of variables to minimize the effect of outliers. The combined data set covers the period from 1986 through 2009. Our sample include only straight bonds by excluding callable, convertible and redeemable bonds. We include firms with three years of consecutive observations in our sample. Our final sample of 2345 firm-year observations consists of U.S.incorporated industrial firms (financial firms are excluded) from 1986 to 2009 with non-zero total assets. The main variables are maturity of long-term debt, leverage, and volatility of earnings. We proxy

Table 2: Summary Statistics of Bonds

Note: Table 2 provides the summary statistics of the number bond issuance, the offering amounts and the maturity of bonds of the period from 1991 through 2010 in every five years. On one hand, the highest number of bond issuance is 7,962 between 1996 and 2000, with an average offering amounts of USD 130 million and an average maturity of 9 years On the other hand, the least number of bond is 5,578 between 2006 and 2010, with an average amounts of USD 290 million and an average duration of 8.1 years. The yield-to-maturity and coupon decreases from 7.74 percent to 6.05 percent and the coupon rate 7.78 percent to 6.48 percent from 1991 to 2010.

Variable	1991-1995		1996-2000	
	Median	Std	Median	Std
Time-to-Maturity	9.20	9.03	9.00	9.42
Offering Amt	33.6	152.7	130.9	9,571.5
Gross Spread	6.02	7.12	6.30	15.2
Coupon	7.78	1.44	7.56	2.08
Yield to Maturity	7.74	1.93	7.35	1.96
Total Bond issues	7299		7962	

cont'd

Variable	2001-2005		2006-2010	
	Median	Std	Median	Std
Time-to-Maturity	8.20	7.05	7.60	8.09
Offering Amt	207.7	1,055.5	290.3	1,000.7
Gross Spread	6.60	28.98	6.70	4.72
Coupon	6.39	2.31	6.48	2.62
Yield to Maturity	5.87	2.24	6.05	2.80
Total Bond issues	6899		5578	

Table 3: **Summary Statistics of Bond Issuance**

Note:Table3 presents summary statistics for our final bond issuance sample. Time-to-maturity is the difference between year in maturity and an offering year. Other variables follow the extant literature. Book and Market leverage are the fraction of total long-term debt scaled by book values of asset or market values of asset. Size is defined as Logarithm of Book Value of Total Assets(6). Profitability is measured as Operating Income Before Depreciation(13)/Total Assets(6). Tangibility is measured as Net Property, Plant, and Equipment(8)/Total Assets(6). Market-to-Book Ratio is defined as (Mv Equity+Total Debt+Preferred Stock-Deferred Taxes &Tax Credit(35))/Total Assets(6).Cash Holding is defined as Cash and Short-Term Investments divided by total debt. Volatility is measured in three different ways; Asset, Cash flow, and Stock Return. Gross Spread is the difference between the price that the issuer receives for its securities and the price that investors pay for them. This spread equals the selling concession plus the underwriting and management fees.

Variable	No.Obs	Mean	Median	Std. Dev	Min	Max
Time-to-Maturity	2345	8.52	7.00	6.05	0.38	22.0
Book Leverage	2345	0.44	0.47	0.34	0.00	0.99
Market Leverage	2345	0.47	0.44	0.21	0.11	0.97
Size	2345	8.54	8.66	1.59	4.60	12.3
Cash Holding	2339	0.08	0.03	0.24	0.00	0.68
Profitability	2331	0.12	0.12	0.07	-0.07	0.34
Market-to-Book	2345	1.09	0.90	0.68	0.35	4.21
Tangibility	2341	0.46	0.45	0.25	0.03	0.91
Asset Volatility	2166	0.14	0.12	0.06	0.03	0.37
Stock Return Volatility	2345	0.24	0.20	0.15	0.12	0.83
Cash Flow Volatility	2054	0.02	0.01	0.11	0.00	0.30
Return	2345	0.12	0.09	0.47	-0.82	1.88
Altman Z score	2047	2.43	2.18	1.66	-1.01	8.18
Amount of Bond (M)	2345	236.4	185.0	221.5	10.0	1,400.0
Coupon	2345	8.18	7.95	2.26	0.00	15.4
Gross Spread	1996	7.42	6.83	5.27	0.00	34.7

debt maturity as the remaining time-to-maturity; leverage as the fraction of total long-term debt scaled by book values of asset or market values of asset; and performance uncertainty as asset volatility defined as 3. Table3 presents summary statistics for the final sample. There are several important observations from the table. First, average leverage is substantial, with mean book leverage of 0.44 and market leverage of 0.47. The leverage variables also show notable cross-sectional variation, with the standard deviation of 0.33 and 0.19, respectively. Second, bond duration is fairly long, with time to maturity of bond of 8.52 years. Third, asset volatility is smaller than stock return volatility, but greater than cash volatility.

3.4 Flexibility of Short-term Financing

Voluntary Debt Reduction

Dangl and Zechner (2006) prove theoretically that voluntary debt reduction is more likely to occur with more short-term debt in a firm's capital structure should any bad shocks occur. The flexibility benefits will be available for firms with more short-term debt once short-term financing can be retired in times of trouble, thereby reducing the financial distress. We look at the dynamics of capital structure over time; assessing whether a firm is optimally adjusting its dynamics of maturity and leverage to performance shocks over periods of our years.

All firms are first sorted by year and allocated into five bins on the basis of their stock returns. This procedure keeps a roughly equal number of firms in each quin-tiles, holding calendar year and the number of firms constant. After sorting according to annual stock returns, we divide them into five bins on the basis of debt maturity. In total, we have cross-sections of 25 bins by their performance and debt maturity in each year from 1986 through 2013. We keep firms that survived for four years in our sample, since we focus on how a firm's leverage has changed according to its performance and whether changes in leverage are different according to the debt maturity. On one hand, we select the worst performing group. We assume this group is sensitive to managing its capital structure due to a negative performance shock. On the other hand, we select the best performing group in order to see whether a different maturity group with a positive performance shock behave differently in case of a capital structure adjustment. We choose the combination of the worst performers with the shortest debt maturity in year $t = 0$ and compare them with the worst performers with the longest debt maturity in year $t = 0$ as well. We keep tracking their leverage between a previous year $(t-1)$ and next three years $(t+3)$ with a negative(positive) shock in year $t = 0$, thereby observing a firm's dynamic adjustment in its capital structure.

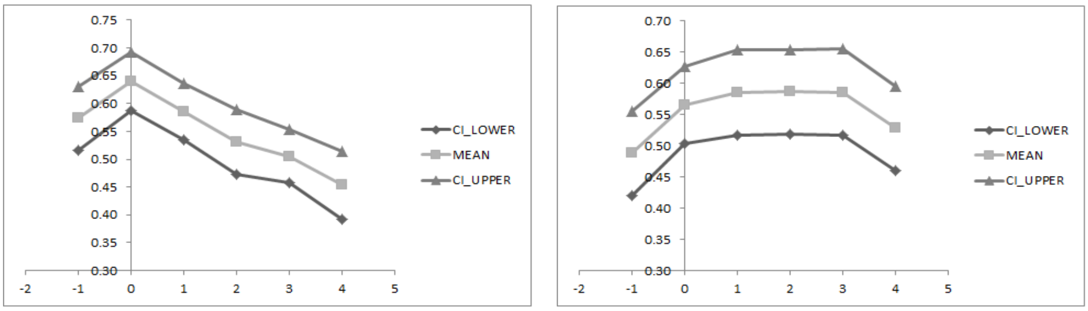
The upper Figure 2 shows how the shortest maturity group adjust after a positive performance shock measured by stock return, while the lower Figure 2 shows the average leverage dynamics of the longest maturity group. The solid line with square represents the mean value of leverage, triangle display the upper bound of leverage and lastly dia-

Figure 2: Leverage Dynamics with the lowest Performance Shock in $t = 0$ over the period 1987- 2010

Note: The figure 2 illustrates the dynamics of leverage from $t-1$ through $t+3$ for the firms with lowest performance group at $t = 0$. The solid line with rectangle represents the average value of market leverage for firms. The line with triangles shows the upper confidence interval for 95 % significance. The line with diamonds gives the lower confidence interval for 95% significance. Figure (a) shows the dynamics of leverage with the shortest maturity while Figure (b) shows the equivalent with the longest maturity.

(a) Leverage Dynamics/Lowest Return + Shortest Maturity

(b) Leverage Dynamics/Lowest Return+Longest Maturity



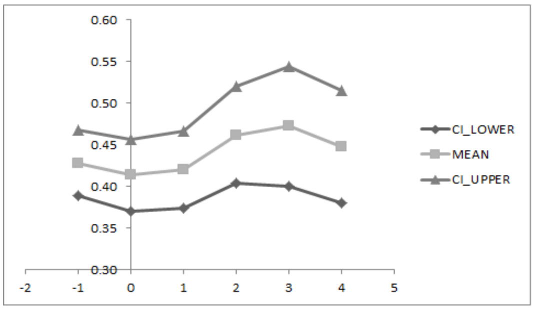
mond show the lower bound of leverage. We expect that voluntary debt reductions are more prominent in the shortest debt maturity group (Dangl and Zechner (2006)) while the longest debt maturity group is slower than its counterparts. The leverage in the lowest performance quin-tile with the shortest maturity has risen from year $t = 0$ to year $t = 1$ after very low equity return in $t = 0$. This follows mechanically from the reduction in the denominator of the leverage calculation (long-term debt + total equity). However, the leverage is readjusted quickly between year $t = 1$ and$t = 2$ but later on it stays at a lower level at the end of observation year $t = 3$ than in its starting year $t = -1$. On the other hand, the lowest performance quin-tile with the longest maturity group has also raised its leverage ratio but it has not delevered between year $t = 1$ until year $t = 3$. Moreover it has not approached its previous level(at the first observation year $t = -1$) at $t = 3$.

If we examine the highest performance group, changes in capital structure differ from the previous analysis; its leverage ratio decreases after the positive performance due to a mechanical increase in the denominator. Later, the shortest maturity group quickly levered itself up higher than in the starting year. In contrast, the longest maturity group de-levers itself mechanically at first, stays constant for while, and then starts to recover its leverage to the same level as before the shock.

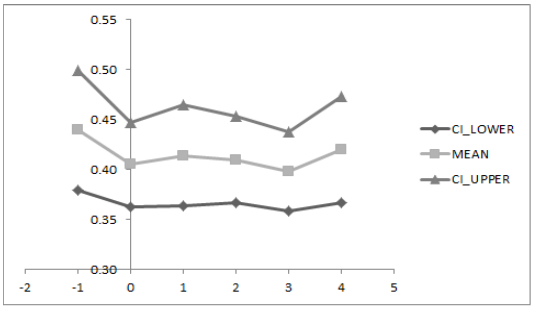
Figure 3: Leverage Dynamics with the highest Performance Shock in $t = 0$ over the period 1987- 2010

Note: The figure 2 illustrates the dynamics of leverage from $t-1$ through $t+3$ for the firms in a group with the most positive shock in $t = 0$. The solid line with rectangles represents the average value of market leverage for firms with positive return shock. The solid line with triangles displays for the upper confidence interval for 95% significance. The line with diamonds show the lower confidence interval for 95% significance. Figure (a) shows the dynamics of leverage of firms with the shortest maturity while Figure (b) shows the equivalent with the longest maturity.

(a) Leverage Dynamics/Highest Return + Short Maturity



(b) Leverage Dynamics/Highest Return+Long Maturity



4 Benchmark Empirical Analysis

4.1 Empirical specification

There are four main purposes of our empirical analysis. The first is to examine the relation between the volatility of assets and the maturity decision of firms. The second goal is to decide whether these maturity decisions impact the leverage as well. Third, we also look at how changes in volatility affect the leverage decision. The dependent variables of interests are debt maturity, leverage and asset volatility. Lastly, we also investigate the relation between maturity, leverage and cost of debt issuance. Debt maturity is defined as amount-weighted average of time to maturity at bond issuance. Leverage is defined as either book leverage or market leverage. Book leverage is defined as total debt (the book value of long-term debt plus debt in current liabilities), divided by the book value of assets. Market leverage is defined as total debt divided by market value of equity plus total debt. We include both of these leverage variables in all of the empirical analysis for robustness. Table 4 provides the definitions of variables in the regression analysis. The independent variables of interest are following: asset volatility is defined as the standard deviation of equity return multiplied by Market value of Equity divided by Market value of Equity plus total long-term debt plus half of short-term debt. Stock return volatility is measured as the standard deviation of return for daily return. Cash flow volatility is the standard deviation of operating income for the last 12 quarters scaled by total assets. Size is the log of total assets. Profitability is operating income scaled by total assets. Tangibility is net property, plant and equipment scaled by total assets. Market to Book ratio is market value of equity plus total debt minus deferred taxes and investment tax credit scaled by total assets.

4.2 Empirical Hypothesis

Based on the theoretical findings in Section 2, we further develop and empirically investigate our testable hypotheses. In a dynamic model, the maturity structure of a firm's corporate debt is determined by the speed of repayment with a sinking fund provision. The higher the firm selects its speed of repayment, the more of its debt mature per unit of time. This gives the firm more flexibility, since it can always issue some more debt. This flexibility comes at a cost, since debt reissuing is costly. We show that there is an optimal choice of maturity structure counter-balancing tax benefits, bankruptcy costs, flexibility benefits and issuing costs. Miltersen and Torous (2007) provide the empirical implication that the higher the volatility of the firm's asset, the shorter the optimal maturity. Other empirical predictions are also followed:firms with shorter maturity will have more debts on their balance sheet, while asset volatility and leverage are negatively associated, provided that the financial policy of the corporate is optimally determined. Lastly, the lower the issuance costs, the shorter maturity of debt issued. In section 6 and 7 below, we investigate whether a different type of debt maturity allows a firm's decision on an optimal capital structure to differ from our benchmark analysis in Section 5.

- *Hypothesis 1 Firm with more volatile asset dynamics issues debt with shorter maturity.*

- *Hypothesis 2 Firm with shorter maturity debt optimally levers itself up to a higher leverage.*

Table 4: Description of Variables

Variable	Construction
Firm Size	Logarithm of Book Value of Total Assets(6)
Time-To-Maturity	The difference between year in maturity and an offering year
Preferred Stock	Max[Preferred liquidating (10), Preferred Redemption(56), Preferred Carrying (130)]
Book Value of Equity	Total Assets(6)-Total Liabilities(181)-Deferred Taxes &Tax Credit(35)-Preferred Stock
Total Debt	Debt in Current Liabilities(34)+Long-Term Debt(9)
Book Leverage	Total Debt/Total Assets(6)
Market Value of Equity	Stock Price(199)×Common Shares Used to Calculate EPS(54)
Market Leverage	Total Debt/(Total Debt+Market Value of Equity)
Profitability	Operating Income Before Depreciation(13)/Total Assets(6)
Tangibility	Net Property, Plant, and Equipment(8)/Total Assets(6)
Market-to-Book	(Mv Equity+Total Debt+Preferred Stock-Deferred Taxes &Tax Credit(35))/Total Assets(6)
Cash Holding	Cash and Short-Term Investments(1)/Total Debt
Asset Volatility	Std Dev of Equity Return multiplied by Market value of Equity
	divided by Market value of Equity plus total long-term debt plus half of short-term debt
Cash Volatility	Std Dev of Operating Income(13) over Previous 12 Quarters Scaled by Total Assets(6)
Equity Volatility	Std Dev of Equity Return over Previous 12 Quarters

- *Hypothesis 3 Firm with more volatile asset dynamics optimally levers it down.*
- *Hypothesis 4 Firm with low issuance costs issues debt with shorter maturity.*
- *Hypothesis 5 Firm with high private short-term debt fraction in its capital structure is insensitive to adjustment in financial policy.*
- *Hypothesis 6 Firm with high short-term debt fraction in its capital structure behaves in a similar way to adjustments in financial policy but less sensitive.*

5 Bond issuance data

5.1 Base Regression

We motivate our empirical analysis of the relation between the financial policy and volatility of earning. We investigate four empirical hypotheses using the bond issuance sample, where the maturity of debt is estimated with time to maturity in years of a bond. It is difficult to renegotiate terms and conditions of public bond after issuance, due to the dispersion of ownership. This characteristic makes corporate bonds more eligible for examination in our framework; in which the flexibility benefits of the capital structure only comes only from the maturity of debt outstanding. In contrast, private debt can be renegotiated in a frequent manner if creditors(banks) and debtors(corporate firms) agree upon the new covenants. Therefore, we will explore in Section 6 whether the maturity of a private debt (i.e.,bank loan) has a different tendency towards the optimal financial policy and the dynamics of leverage over a period of years.

- *Hypothesis 1: Firm with more volatile earning issues debt with shorter maturity.*
- *Hypothesis 2 Firm with shorter maturity debt optimally levers itself up to a higher leverage.*
- *Hypothesis 3 Firm with more volatile asset dynamics optimally levers it down.*
- *Hypothesis 4 Firm with low issuance costs issues debt with shorter maturity.*

To examine the first main hypothesis, we estimate the following simple regression model.

$$(Maturity)_{i,t} = \alpha_i + y_t + \beta X_{i,t} + \epsilon_{i,t}, \tag{4}$$

$$(Leverage)_{i,t} = \alpha_i + y_t + \beta X_{i,t} + \epsilon_{i,t} \quad (5)$$

where $X_{i,t}$ is a matrix of independent variables, α_i is a firm or industry level fixed effect, and y_t is a year fixed effect. The independent variables of interests among $X_{i,t}$ in a maturity equation are threefold: leverage, asset volatility, and debt issuance costs; while maturity, asset volatility, and debt issuance costs appear in a leverage equation. We measure asset volatility as a deleveraged historical equity volatility, using information from historical stock returns. We take direct issuance costs in our analysis rather than indirect costs which include direct issuance costs and rollover costs. The indirect issuance costs, such as rollover costs, or liquidity risks are not considered in our optimal framework. We proxy gross spread which is the difference between the offered amount and the proceeds to the issuer as a percentage of the issue size as direct issuance costs.

Table 5 reports a pooled ordinary least squares (OLS) regression with or without year and industry fixed effects. The main results of Panel (a) of Table 5 support our core hypothesis that firms are likely to issue debts of shorter maturity when their earnings displays more volatile feature. We also employ year fixed effects as well as industry fixed effects in order to consider variations among industry- and year- specific observations. Panel (a) of Table 5 reports the regression results with year and industry fixed effects. Though different specifications of pooled OLSs are made, our empirical findings support the main hypotheses. First, we confirm the negative association between maturity and volatility of asset dynamics in a pooled OLS equation with a statistical significance of 99 percent while the sign is reversed with fixed effects. Also, the maturity and leverage are negatively associated, as we predicted. In the first equations, time-to-maturity of bond is statistically significant in explaining the leverage ratio; in the second equation, the leverage ratio is negatively related with the independent variable of maturity with a statistical significance of 99 percent. Third, we find that the relation between asset volatility and leverage is inversely related. Lastly, the issuance costs, proxied by gross spread, has a positive association with debt maturity. As the issuance costs get more expensive, firms tend to issue longer-term debt, with transaction costs outweighing the flexibility benefits. This finding is consistent with our theoretical hypothesis as well as with the extant literature on a underwriter compensation and issue costs (Gande et al. (1997); Melnik and Plaut (1996)).

We also look at whether other variables are consistent with the literature. In a maturity equation, size is negatively related with bond maturity. Market-to-Book ratio is positively associated with debt maturity. The debt maturity gets extended as cash holdings increase. As a firm becomes more profitable, its bond maturity gets shorter. As its tangible asset increases, a firm shortens its bond maturity. In a leverage equation, size is negatively related with leverage ratio. The leverage gets longer as cash holdings increase. While a firm becomes more profitable, the leverage gets shorter. As both tangible assets and Market-to-Book ratio increase, a firm also levers itself down.

Differencing approaches such as fixed effects are simple and effective so long as individual fixed effects do not vary across periods and any correlation between treatment and unobserved outcome potential is described by an additional time-invariant co-variate (Schroeder (2009)). We utilize a difference-in-difference method in this section to control unobserved variations among firms. In a maturity equation using differencing methods, our hypotheses are also supported. A firm with higher volatility earnings tends to issue shorter-term bonds, while its statistical and economical significance get weaker than the pooled OLS reported in 5. In a similar way, a firm with shorter-term bonds tends to increase debt financing with a weak statistical significance. Higher issuance costs counter-balance the financial flexibility obtained, leading to the issuance of longer maturity bonds. Among control variables, size, tangibility and cash holding have consistent findings with a pooled OLS from 5. On the other hand, a strong growing opportunity, measured as Market-to-Book ratio, is negatively associated with debt maturity.

In the leverage equation results presented in Table 6, a dependent variable, a leverage, is explained by asset volatility, maturity and issuance costs with a statistical and economical significance. A firm with great asset, high profit, strong growth opportunities, and high tangibility tends to lever itself down while a firm with higher cash holding tries to lever itself up.

Table 5: **Base Regression for Bond Maturity**

Note: The 5 table provides the cross-section of regression results for the following two regression equations. In the upper panel, it reports a maturity equation: $Maturity_{i,t} = \alpha_i + y_t + \beta X_{i,t} + \epsilon_{i,t}$, where $X_{i,t}$ is a matrix of independent variables including main explanatory ones, i.e., leverage, volatility, etc, α_i is a firm or industry level fixed effect and y_t a year fixed effect. In the lower panel, it reports a leverage equation: $Leverage_{i,t} = \alpha_i + \beta X_{i,t} + \epsilon_{i,t}$, where $X_{i,t}$ is a matrix of independent variables including main explanatory ones, i.e., maturity, volatility, etc. Numbers in parenthesis report the *t-statistics*.

Dependent Variable:	**Maturity**	(EX. Crisis)
	(a)OLS	(b)OLS
Asset Volatility	-1.00 (-0.61)	3.47 (1.73)*
Leverage	-2.66(-4.42)***	-1.99 (-2.69)***
Profitability	-3.48 (-1.60)	-4.57 (-2.04)**
Market-to-Book	0.13 (0.57)	0.60 (2.48)**
Tangibility	-0.73 (-1.70)*	1.00 (1.38)
Size	-0.66 (-9.33)***	-0.49 (-6.04)***
Cash holding	3.11 (2.47)**	3.93 (3.13)***
Gross Spread	0.09 (4.30)***	0.07 (3.52)***
Year Fixed	No	Yes
Industry Fixed	No	Yes
R Squared	0.10	0.29
#obs	1504	1504

Dependent Variable:	**Leverage**	(EX. Crisis)
	(a)OLS(~2007)	(b)OLS(~2007)
Asset Volatility	-0.37 (-5.59) ***	-0.62 (-8.83)***
Maturity	-0.003 (-3.56) ***	-0.003 (-2.69)***
Profitability	-0.60 (-7.51) ***	-0.68 (-8.69)***
Market-to-Book	-0.12 (-14.3)***	-0.09 (-11.3)***
Tangibility	-0.12 (-7.38) ***	-0.07 (-2.82)***
Size	-0.04 (-14.2) ***	-0.04 (-13.1) ***
Cash holding	0.32 (6.90)***	0.32 (7.14) ***
Gross Spread	0.001 (1.36)	0.001 (1.89)*
Year Fixed	No	Yes
Industry Fixed	No	Yes
R Squared	0.60	0.64
#obs	1504	1504

Table 6: **Regression for Bond Maturity using Diffence methods**

Note: The 6 table provides the cross-section of regression results for the following two regression equation. In the upper panel, it reports a maturity equation: $\triangle Maturity_{i,t}=\alpha_i+\beta\triangle X_{i,t}+\epsilon_{i,t}$, where $\triangle$ presenting changes or growth rates of $X_{i,t}$, which is a matrix of independent variables, α_i is a firm or industry level fixed effect. In lower panel, it reports a leverage equation: $\triangle Leverage_{i,t}=\alpha_i+\beta\triangle X_{i,t}+\epsilon_{i,t}$, where $\triangle$ presenting changes or growth rates of $X_{i,t}$, which is a matrix of independent variables, α_i is a firm and industry level fixed effect. Numbers in parenthesis report the *t-statistics.* $\triangle$ represents an annual growth or change.

Dependent Variable:	**△ Maturity**	(EX. Crisis)
	(a)OLS	(b)OLS
△Asset Volatility	-0.55 (-0.53)	-1.15(-1.05)
△Leverage	-1.58 (-1.91)*	-1.23 (-1.43)
△Profitability	3.57 (1.79)*	3.40 (1.67)*
△Market-to-Book	-0.58 (-2.55)**	-0.48 (-2.08)**
△Tangibility	0.31 (0.40)	0.62 (0.79)
△Size	-0.67 (-5.42) ***	-0.72 (-5.63)***
△Cash holding	1.34 (1.13)	1.10 (0.93)
△Gross Spread	0.22 (7.68) ***	0.22 (7.64)***
Year Fixed	No	Yes
Industry Fixed	No	Yes
R Squared	0.10	0.17
#obs	1504	1504

Dependent Variable:	**△Leverage**	(EX. Crisis)
	(a)OLS	(b)OLS
△Asset Volatility	-0.10 (-2.76) ***	-0.11 (-3.02) ***
△Maturity	-0.002 (-1.91) **	-0.001(-1.43)
△Profitability	-0.70 (-10.9)***	-0.72 (-11.2) ***
△Market-to-Book	-0.09 (-12.4)***	-0.08 (-11.6)***
△Tangibility	-0.04 (-1.41) ***	-0.03 (-1.26)
△Size	-0.05 (-13.7) ***	-0.05 (-13.6) ***
△Cash holding	0.11 (2.70)***	0.11 (2.87)***
△Gross Spread	0.003 (2.70) ***	0.002 (2.31)**
Year Fixed	No	Yes
Industry Fixed	No	Yes
R Squared	0.60	0.58
#obs	1504	1504

5.2 Joint Determination of Maturity and Leverage

We specify a system of two simultaneous equations that maturity is determined endogenously with leverage. We estimate the maturity and the leverage equation separately, since the choice of maturity and leverage might occur jointly. We follow the empirical methodology by Johnson (2003), Brockman, Martin, and Unlu (2010) and Harford, Klasa, and Maxwell (2014). Hence we estimate the two equations simultaneously by two-stage least squares as well as instrumental regression. Our two-equation system is specified as follows:

$$\begin{aligned} Maturity_{i,t} &= \alpha_0 + \alpha_1 Cash\,Volatility_{i,t} + \alpha_2 Leverage_{i,t} + \alpha_3 Size_{i,t} \\ &\quad + \alpha_4 Profitability + \alpha_5 Tangibility_{i,t} + \alpha_6 M/B_{i,t} + \alpha_7 Cashholding_{i,t} \\ &\quad + \alpha_8 Term_{i,t} + \alpha_9 ZscoreDum_{i,t} + \alpha_{10} IndMat_{i,t} \end{aligned}$$

$$\begin{aligned} Leverage_{i,t} &= \alpha_0 + \alpha_1 Cash\,Volatility_{i,t} + \alpha_2 Leverage_{i,t} + \alpha_3 Size_{i,t} \\ &\quad + \alpha_4 Profitability + \alpha_5 Tangibility_{i,t} + \alpha_6 M/B_{i,t} + \alpha_7 Cashholding_{i,t} \\ &\quad + \alpha_8 TaxCreditDum_{i,t} + \alpha_9 AcquistionDum_{i,t} + \alpha_{10} IndLev_{i,t} \end{aligned}$$

We rely on earlier theoretical studies to guide our selection of instrumental variables in the simultaneous equations. Theoretical capital structure literature finds that expected marginal tax rate($TaxCreditDum$), acquisition dummy($AcquistionDum$) and the industry leverage ($IndLev$) are important determinants of leverage (Barclay, Smith, and Watts (1995); Barclay, Marx, and Smith (2003); Brockman, Martin, and Unlu (2010); Billett, KING, and Mauer (2007)). On the other hand, those variables do not play any important role in determining maturity of debt. We therefore conjecture that these variables are orthogonal to the error terms and having zero coefficients in the maturity regression. Furthermore, term structure($term$), industry maturity($IndMat$), and financial distress($ZscoreDum$) are important determinants of maturity but not leverage. Hence, we treat these variables as orthogonal to the error term and having zero coefficients in the leverage equation.

Table 7: **Two Stage Regression For Bond Maturity**

Table 7 provides two-stage regression results of maturity and leverage on the explanatory variables. The results from debt maturity regression, we find a strong support that the earning uncertainty shortens the maturity of debt. We find a negative coefficient on the asset volatility in the maturity regression. Also, we find a substantial evidence, suggesting that firms with shorter maturity of debt lever up. The coefficient on the leverage has a negative sign with a statistical significance. The result from leverage regression also supports the negative relationship between maturity and leverage; the coefficient on the maturity is negative and statistically significant. Moreover, it supports the negative association between leverage and asset volatility with statistical significance.

Dependent Variable :(a) Leverage (b) Time-to-Maturity		
	(a) First	(b) Second
Leverage(predicted)		-2.44 (-3.56)**
Asset Volatility	-0.34 (-5.63)***	-3.52 (-1.98)**
Profitability	-0.60 (-7.98)***	-3.48 (-1.60)
Market-to-Book	-0.13 (-17.6)***	-0.73 (-1.70)*
Tangibility	-0.10 (-6.95)***	0.13 (0.57)
Size	-0.03 (-13.2)***	-0.66 (-9.33) ***
Cash holding	0.23 (5.41)***	3.11 (2.47) **
Gross spread	0.0002 (0.32)	0.09 (4.30) ***
Tax Credit dummy	0.03 (3.80)***	
Acquisition dummy	0.02 (2.45)**	
Industry Leverage	-0.28 (-16.3)***	
R Squared	0.58	0.10
F-test	172.5	15.87
Nobs	1504	1504

cont'd

Dependent Variable :(c) Maturity (d) Leverage		
	(c) First	(d) Second
Maturity		-0.003 (-3.56)***
Asset Volatility	3.46 (2.36)**	-0.37 (-5.59)***
Profitability	-2.80 (-1.56)	-0.09 (-9.99)***
Market-to-Book	0.49 (2.79) ***	-0.12 (-14.3)***
Tangibility	0.19 (0.57)	-0.12 (-7.38)***
Size	-0.25 (-4.60)***	-0.04 (-14.2)***
Cash holding	1.69 (1.65)	0.32 (6.90)***
Gross Spread	0.05 (2.87)***	0.001 (1.36)
Industry Maturity	0.93 (28.6)***	
Term spread	0.01 (0.09)	
Z-score_dummy	-0.12 (-0.65)	
R Squared	0.41	0.50
Nobs	1504	1504
F-test	86.97	149.91

Table 7 provides two-stage least squares results of regression of maturity and leverage on the explanatory variables. The results from debt maturity regression in the upper panel support our main hypothesis: first, the earnings uncertainty is likely to shorten the maturity of debt; second, a firm with shorter maturity of debt tends to lever up; finally a firm with higher issuance costs tends to issue longer debt maturity. The results from leverage regressions in the lower panel support the negative relationship between maturity, leverage, and asset volatility; the coefficient on the maturity is negative and statistically significant as well as that for asset volatility. We find a firm with shorter debt maturity optimally increases its debt, thereby making full use of the available financial flexibility while a firm with higher volatility asset dynamics optimally tends to lever itself down, thereby reducing its financial distress.

We also look at whether findings on other variables are consistent with the extant literature. In a maturity equation, size is negatively related with bond maturity. Bigger firms tend to issue shorter-term bonds. Guedes and Opler (1996) and Johnson (2003) suggest firm size for credit quality. They hypothesize that higher credit quality firms are likely to issue both short-end and long-end of maturity while firms with lower credit quality choose medium maturity. Johnson (2003) furthermore elaborates that size has a non-monotonic relation with debt maturity; at first, size is inversely related to debt maturity, while the squared size term is positively associated with debt maturity. The literature of debt maturity has been focused on agency problems; Jensen and Meckling (1976) points out that equity holders increase investment risk by asset substitution. Myers (1977); Barnea, Haugen, and Senbet (1980); Stohs and Mauer (1996) among others, suggest that short-term debt mitigates agency costs or underinvestment problems. In empirical tests, our findings support the benefit of short-term debt in reducing agency problems; a growth opportunities, measured as Market-to-Book ratio, is positively associated with debt maturity. A recent paper by Harford, Klasa, and Maxwell (2014) highlights that cash holdings help reduce liquidity risk and thereby complement short-term debt. The debt maturity gets longer as cash holdings increases, which is consistent with our empirical finding. As a firm gets more profitable, the bond maturity gets shorter. As the tangible asset increases, a firm shortens the bond maturity. In a leverage equation, size is negatively related with the leverage ratio. The leverage gets higher as cash holding increases. As a firm becomes more profitable, with higher proportion of tangible asset, and stronger growth opportunities, a firm also levers itself down. Hovakimian, Opler, and Titman (2001) hypothesizes that firms with higher proportions of tangible assets are likely to increase debt financing, because such assets can be used as collateral.

6 Bank Loan Maturity

In this section, we utilize DealScan data to use the maturity of bank loans to provide further evidence on how differently debt maturity and leverage of firm interact with two forms of debt in a firm's capital structure. Thomson-Reuters' LPC DealScan (DealScan), also known as Loan Pricing Corporation Deal Scan, is reliable information on the global commercial loan market. The DealScan database contains a comprehensive historical information on loan pricing and contracts details, terms, and conditions. DealScan data are compiled from SEC filings and public documents (10Ks, 10Qs, 8Ks and registration statements), and loan syndicates as well as other internal sources.

We expect the interaction among maturity, leverage and asset volatility in bank loan differs from that of bonds. A bond faces difficulties of renegotiation due to the dispersion of ownership even though a firm's performance may fluctuate over its maturing periods. In contrast, a bank loan has a higher possibility of renegotiation along the path of performance of its issuer. The bank can closely monitor a firm's performance and rearrange its interest rates, maturity, amount of outstanding and so on over its loan's lifetime. We again test four hypotheses using DealScan data. We take as a proxy debt maturity the loan's time-to-maturity, instead of using the bond's time-to-maturity.

To begin with, Table 8 provides summary statistics of bank loans between 1986 through 2007. The final sample consists of 5196 loan observations. Some observations for other variables are missing. The maturity of bank loans is estimated as 2.56 years (median). The average amount of bank loans is 150 million dollars(median) and 299 million dollars(mean) which indicates the tail distribution of bank loan is positively skewed. AllinDrawn spread describes the amount the borrower pays in basis points over Libor for each dollar drawn down. It adds the spread of the loan with any annual (or facility) fee paid to the bank group. AllInUndrawn spread measures the amount a borrower pays for each dollar avail-

Table 8: **Summary Statistics of Bank Loan**

Note: Table 8 provides summary statistics of bank loans between 1986 through 2014. The final sample consists of 5196 loan observations. Some observations for other variables are missing. The maturity of bank loans is measured as amount weighted maturity and the mean of maturity is 2.56 years. The average amount of bank loans is 150 million dollars(median) and 299 million dollars(mean) which indicates the tail distribution of bank loan is positively skewed. AllinDrawn describes the amount the borrower pays in basis points over Libor for each dollar drawn down. It adds the spread of the loan with any annual (or facility) fee paid to the bank group. AllInUndrawn measures the amount a borrower pays for each dollar available under a commitment. It adds the commitment and annual fee. Commitment Fee measures the amount a borrower pays for each dollar available under a commitment. Assignment Fee is the amount a prospective lender must pay to an existing lender in return for obtaining a portion of the existing lender's commitment to lend to the borrower. Sales At Close is the financial amount by which the company's sales revenue is measured as of the closing date of the agreement

Variables	Nobs	Mean	Std	Min	Max
Loan Maturity	5548	2.56	1.74	0.00	10.0
AllInDrawn	5462	218.83	120.16	4.40	876.66
AllInUnDrawn	4860	36.8	23.2	0.25	283.2
Assignment Fee	4557	3391.1	683.8	0.00	9572.4
Loan Amt/Sales	3662	0.34	0.70	0.00	21.6
Loan Amt(Million)	5548	396.9	817.6	0.21	22,237.4
Sales(Million)	5042	4,334.3	45,776.2	-4,214.9	1,851,180.0

able under a commitment. It adds the commitment and annual fee. Commitment Fee measures the amount a borrower pays for each dollar available under a commitment. Assignment Fee is the amount a prospective lender must pay to an existing lender in return for obtaining a portion of the existing lender's commitment to lend to the borrower. Sales is the financial amount by which the company's revenue is measured.

6.1 Leverage Dynamics

Figure 4 illustrates the dynamic leverage reduction from $t-1$ through $t+3$ with the firms in the group with the lowest shock in $t = 0$. The solid line with rectangles represents the average value of market leverage. The line with triangles represents for the upper confidence interval for 95% significance. The line with diamonds is for the lower confidence interval for 95% significance. Figure (a) of 4 shows the average leverage dynamics due to a negative performance shock measured by stock return for the shortest maturity group while Figure (b) shows the equivalent with the longest maturity group. The average leverage has mechanically risen between $t = -1$ and $t = 0$ since the value of denominator decreases. Firms with the shortest maturity do not actively manage their financial policy over the observation years. In contrast, the leverage keeps rising even after two years from the first negative shock for firms with the longest maturity. The average leverage dynamics for both groups differ from the previous section, in which we define maturity as remaining time-to-maturity for bonds. First, the lowest performer with the shortest bond maturity quickly shakes off its debts by letting debts matured while the lowest performer with the shortest loan maturity will not adjust its leverage as fast as the former. Second, the lowest performer with the longest bond maturity has not actively managed its leverage, while the lowest performer with the longest loan maturity keeps its leverage ratio rising.

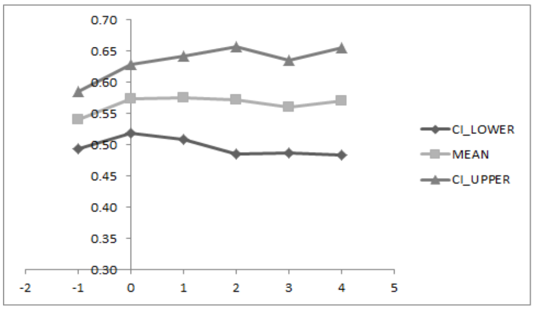
Figure 4 illustrates the average leverage dynamics from $t-1$ through $t+3$ with the firms in the group with highest performance shock in $t=0$. The solid line with rectangles represents the average value of market leverage. The line with triangles shows for the upper confidence interval for 95% significance. The line with diamonds gives the lower confidence interval for 95% significance. Figure (a) of 4 shows the average leverage dynamics due to positive performance shock measured by stock return in the highest performers with the shortest maturity while Figure (b) shows the equivalent with the longest maturity.

Firms with the shortest maturity keep raising their leverage after their leverage had fallen from the positive shock, while the leverage has fallen at first and then not changed much for firms with the longest maturity. In the case of a positive performance shock, all firms behave in a similar trend by increasing their leverage after shock. The upward movement is seen in both bond issuance and private debt maturity.

Figure 4: Leverage Dynamics with the lowest Performance Shock in t=0 over the period 1987- 2007

Note: The figure 4 illustrates the dynamics of leverage reduction from $t-1$ through$t+3$ for the firms in the group with the lowest performance shock in $t=0$. The solid line with rectangles represents the average value of market leverage for firms in the lowest performance group. The line with triangles gives the upper confidence interval for 95% significance. The line with diamonds provides the lower confidence interval for 95% significance. Figure (a) shows the average leverage dynamics in the lowest performers with the shortest maturity group while Figure (b) shows the equivalent with longest maturity group.

(a) Leverage Dynamics/Lowest Return + Shortest Maturity



(b) Leverage Dynamics/Lowest Return+Longest Maturity

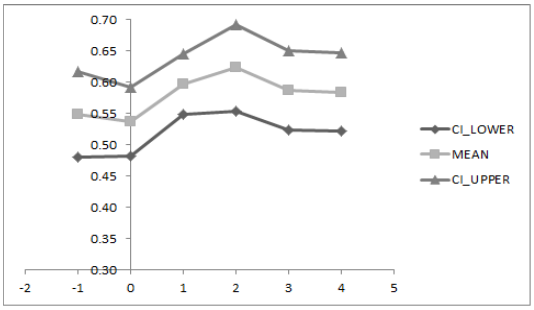
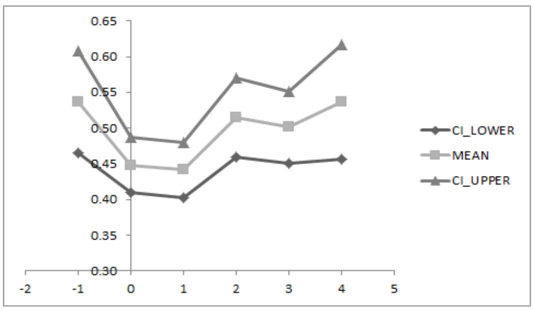


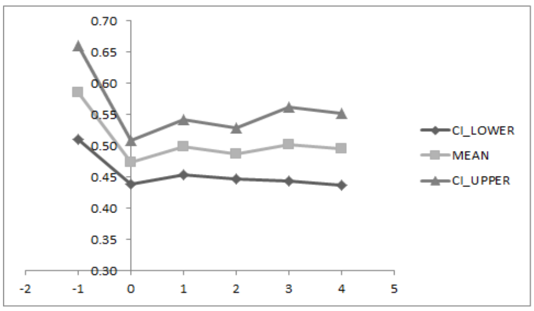
Figure 5: Leverage Dynamics with the highest Performance Shock in t=0 over the period 1987- 2007

Note: The figure 4 illustrates the dynamic leverage dynamics from $t-1$ through $t+3$ for the firms in the group with highest performance shocks in $t=0$. The solid line with rectangles represents the average value of market leverage for firms in highest performance group. The line with triangles gives the upper confidence interval for 95% significance. The line with diamonds provides the lower confidence interval for 95% significance. Figure (a) shows the average leverage dynamics with the shortest maturity while Figure (b) shows the equivalent with the longest maturity.

(a) Leverage Dynamics /Highest Return + Shortest Maturity



(b) Leverage Dynamics/Highest Return+Longest Maturity



6.2 Base Regression

We test the four hypotheses following Section 5 and look at whether maturity of loan acts differently towards the optimal financial policy from the bond issuance data. We only include data before the financial crisis from 1986 to 2007. The financial crisis between 2007-2009 created distrust in credit market supply as well as on the credit demand side, with financial policy endogenously affected by external factors. We define maturity as loan amount weighted time-to-maturity and proxy issuance costs as AllInUndrawn spread.

- *Hypothesis 1: Firm with more volatile earning issues debt with shorter maturity.*
- *Hypothesis 2 Firm with shorter maturity debt optimally levers itself up to a higher leverage.*
- *Hypothesis 3 Firm with more volatile asset dynamics optimally levers itself down.*
- *Hypothesis 5 Firm with high bank debt fraction in its capital structure is less sensitive to adjustments in financial policy.*

Table 9: Base Regression of Bank Loan Sample

Table 9 provides OLS regression results. Column (a) and (c) present pooled OLS regression results without any fixed effects, Column (b) and (d)OLS with Year & Industry Fixed. We utilize an industry fixed effect using a two-digit SIC code. Our sample include between 1986 and 2007 before the 2007-2009 financial crisis. In upper panel, it reports a maturity equation: $Maturity_{i,t}=\alpha_i+y_t+\beta X_{i,t}+\epsilon_{i,t}$, where $X_{i,t}$ is a matrix of independent variables including main explanatory ones, i.e., leverage, volatility, etc, α_i is a firm or industry level fixed effect and y_t a year fixed effect. In lower panel, it reports a leverage equation: $Leverage_{i,t}=\alpha_i+\beta X_{i,t}+\epsilon_{i,t}$, where $X_{i,t}$ is a matrix of independent variables including main explanatory ones, i.e., maturity, volatility, etc. Numbers in parenthesis report the *t-statistics.*

Dependent Variable : Loan Maturity		
	(a)OLS	(b)OLS
Asset Volatility	1.10 (3.59) ***	0.19 (0.50)
Leverage	0.55 (3.40) ***	-0.05 (-0.24)
Profitability	0.50 (1.49)	0.71 (1.86)*
Market-to-Book	0.17 (4.00)*	0.03 (0.58)
Tangibility	-0.37 (-3.20) ***	-0.09 (-0.50)
Size	0.06 (2.70)***	0.10 (4.01) ***
Cash Holding	0.01 (0.11)	0.05 (0.69)
Loan amount/sales	0.08 (1.30)	0.09 (1.28)
AllInUndrawn	0.003 (2.33)**	0.005 (3.01) ***
Year Fixed	No	Yes
Industry Fixed	No	Yes
R squared	0.02	0.22
Obs	2942	2255

cont'd

Dependent Variable : Leverage		
	(c)OLS	(d)OLS
Asset Volatility	-0.49 (-14.3)***	-0.69 (-17.5)***
Loan Maturity	0.01 (3.40)***	-0.001 (-0.24)
Profitability	-0.11 (-2.76)	-0.18 (-4.25)***
Market-to-Book	-0.10 (-21.9)***	-0.07 (-14.2)***
Tangibility	0.00 (-0.10)	0.02 (1.17)
Size	-0.03 (-12.8)***	-0.03 (-12.3) ***
Cash Holding	0.01 (1.67)*	0.00 (-0.14)
Loan amount/Sales	0.03 (4.92)***	0.01 (1.63)
AllInUndrawn	0.001 (6.50)***	0.001 (6.99)***
Year Fixed	No	Yes
Industry Fixed	No	Yes
R squared	0.35	0.52
Obs	2932	2255

Table 9 provides OLS regression results. Column (*a*) and (c) present the OLS regression results without any fixed effects, while Column (*b*) and (d) give OLS results with year and industry fixed effects. We utilize industry fixed effects as a two-digit SIC code. The main dependent variable is loan maturity in a maturity equation and market leverage in a leverage equation respectively. The main focus in explanatory variables includes asset volatility, leverage ratio and AllInUndrawn spread. Other control variables are firm's profitability, tangibility, Market-to-Book ratio, size, loan amount scaled by sales, and cash holdings. We find that the relation between financial policy and asset volatility contradicts our finding from FISD data; the higher the asset volatility, the longer the maturity of loan. The higher fraction of debt to total assets a firm has, the longer the maturity of loan it issues. The relation between asset volatility and leverage is consistent with our finding from FISD data; the higher the asset volatility, the lower the leverage. These opposing findings support our theoretical propositions. The trade-off between transaction costs and the flexibility feature of debt contracts. First, bank debt has in general much shorter maturity compared with public bonds. More importantly, prior works observe that bank loan are frequently renegotiated or restructured. This frequent feature of renegotiation implies cheaper issuance costs of new loans. Thereby, it seems that bank loan's achieves the flexibility benefits through renegotiation or restructuring during the bad times.

6.3 Two-Stage Regression

Firms' capital structure and the maturity of their debt are likely determined jointly. In order to examine the effect of leverage on debt maturity, we use simultaneous equations in which debt maturity and leverage are as endogenously determined. We estimate a two-stage least squares (2SLS) system of equations in which the standard errors of the coefficients are adjusted for the clustering of observations at the firm level. We first separately estimate two OLS regressions for debt maturity and leverage, and then simultaneously estimate the two structural equations by including the predicted values from the first-stage regressions as explanatory variables. The 2SLS methodology accounts for any correlation between the residuals of leverage and the debt maturity models that is caused by unobserved influences on debt maturity and leverage. In this section, we analyze the joint determination of debt maturity and leverage using DealScan data, defining debt maturity as time-to-maturity of loan.

Table 10 provides regression results for the two-stage regression with instrumental variables. Following Harford, Klasa, and Maxwell (2014), we used industry maturity, term spread and acquisition dummy as instruments in the maturity equation and Altman's Z Score dummy, tax credit dummy and industry average leverage as instrument variables in the leverage equation. The upper panel reports the results when loan maturity is used as the dependent variable, while leverage is included as an independent variable. The lower panel reports the results when leverage is used as the dependent variable, while loan maturity is included as an independent variable.

Table 10 reports the two stage regression of sample from the DealScan data. The main dependent variables are first loan maturity and market leverage. Dependent variables are asset volatility, size, profitability, tangibility, Market-to-Book ratio, cash holdings. We employ the same instrumental variables used in Section 5. We find that the two-stage regression results are consistent with findings from a base regression (see Table 9). Firms with longer loan maturity lever up while firms with high uncertainty on asset dynamics also finance with longer loan maturity. Next, we find that a firm with high volatility of asset dynamics reduces its leverage, thereby managing its financial distress.

We analyze the financial policy in a dynamic capital structure using DealScan data in this section and compare the results with the FISD data in section 5. We find that an endogenous decision between maturity and capital structure in DealScan data differs from that in FISD data, in which debt maturity is defined as time-to-remaining maturity of bonds. The financial policy from DealScan data has the longer maturity leading to the higher leverage. Moreover, the higher asset volatility leads to the longer maturity and the lower leverage ratio. On the other hand, firms with high asset volatility has shorter maturity of public bonds. Firms with short-term debt optimally engage more debt, thereby leading to the higher leverage ratio. Lastly, firms with high asset volatility move to the lower leverage, thereby keeping their probability of default adjusted, which is consistent with FISD data analysis. Both private debt and public debt act towards managing its capital structure in reducing a firm's financial distress as asset volatility becomes more volatile, thereby supporting trade-off between tax benefits and financial

Table 10: Two Stage Regression for Bank Loan Sample

Table 10 provides regression results for two-stage regression with instrumental variables. Following Brockman, Martin, and Unlu (2010) and Harford, Klasa, and Maxwell (2014), we use industry maturity, term spread and acquisition dummy as instruments in the maturity equation and Altman's Z Score dummy, tax credit dummy and industry leverage as instruments in the leverage equation. The upper panel reports the results when loan maturity is used as a dependent variable while leverage, asset volatility and AllInUndrawn are independent variables of interests. The lower panel reports the results of the leverage equation while loan maturity, asset volatility, and AllInUndrawn are independent variables of interests.

Dependent : Loan Maturity		
	(a) First	(b) Second
Leverage(Predicted value)		0.55(3.40)***
Asset Volatility	-0.45(-14.1)***	1.10 (3.59) ***
Profitability	-0.11 (-3.06)***	0.50 (1.49)
Market-to-Book	-0.10 (-23.7)***	0.17 (4.00)***
Tangibility	0.02 (1.44)	-0.37 (-3.20)***
Size	-0.03 (-13.1)***	0.06 (2.70)***
Cash Holding	0.01 (1.35)	0.01 (0.11)
Loan amount/Sales	0.03 (4.56)***	0.08 (1.30)
AllInUndrawn	0.001 (5.77)***	0.003 (2.33)**
Industry Leverage	-0.28 (-20.1)***	
Tax Credit Dummy	0.02 (2.43)**	
Acquisition Dummy	-0.02 (-4.01)***	
R Squared	0.43	0.02
Nobs	2942	2942

cont'd

Dependent Variable : Leverage		
	(a) First	(b) Second
Loan Maturity(Predicted value)		0.05 (1.96)**
Asset Volatility	0.21 (0.76)	-0.49 (-12.9)***
Profitability	0.96 (2.93)***	-0.10 (-2.22) **
Market-to-Book	0.02 (0.46)	-0.08 (-17.4)***
Tangibility	-0.07 (-0.58)	0.01 (0.94)
Size	0.05 (2.47) **	-0.03 (-10.9)***
Cash Holding	-0.02 (-0.38)	0.01 (1.48)
Loan amount/Sales	0.05 (0.91)	0.02 (2.81)
AllInUndrawn	0.003(2.18)**	0.001 (6.14)***
Industry maturity	0.97 (32.1)***	
Term Spread	0.00 (-0.13)	
Z-Score Dummy	-0.04 (-0.65)	
R Squared	0.37	0.37
Nobs	2255	2255

distress. In contrast, the frequent renegotiation of loan contracts makes its behavior differ from the financial policy analysis with FISD data. Firms with high bank loan can adjust their optimal leverage without counter-balancing the effects of the flexibility benefits of maturity and the transaction costs of new issuance. A firm's flexibility benefits with bank loans can be available by means of renegotiation with credits during the period of bad performance.

7 Compustat Debt Maturity

We have analyzed public debt and private debt respectively in the previous sections. Now, we will explore the maturity proxies from firm's balance sheets data. In prior works using Compustata data, debt maturity is often measured as a fraction of a firm's long-term debt maturing in less than or equal to 2 years, 3 years, 4 years and 5 years (Barclay, Smith, and Watts (1995); Johnson (2003), Billett, KING, and Mauer (2007)). Harford, Klasa, and Maxwell (2014) uses similar measures but excludes debt due within a year because a debt matured less than a year is used to finance a firm's short-term liquidity needs. Billett, KING, and Mauer (2007) draws on the maturity measure from Compustat data instead of FISD data though they make use of bond covenants information from FISD data. They reason that Compustat's debt amount exceeds its aggregate debt issues in FISD. We first utilize the maturity measure using bond's remaining time-to-maturity from FISD data in Section 5, in addition we employ Compustat data for robustness.

7.1 Summary Statistics

Table11 presents summary statistics for 25,182 firm-year observations over 1986 to 2007. We define a debt maturity as a fraction of total long-term debt due in next three years(DD2+DD3) excluding DD1, scaled by total long-term debt(DLTT) following Harford, Klasa, and Maxwell (2014). We also use similar measures such as DD1/DLTT (the fraction of long-term debt due in next year) and DD5/DLTT(the fraction of long-term debt due in the next 5 years excluding DD1) for robustness. We interpret a higher DD3/DLTT as the shorter maturity of debt. All other variables are defined in Table 4.

Table 11: Summary Statistics for DD3/DLTT Sample

Note:Table11 presents summary statistics for debt due in next three years(DD2+DD3) excluding DD1, scaled by total long-term debt(DLTT). We also report similar measures such as DD1/DLTT (the fraction of long-term debt due in next year) and DD5/DLTT(the fraction of long-term debt due in next 5 years excluding DD1). We interpret the higher DD3/DLTT the shorter the maturity of long-term debt. Others follow the definitions from Table 4.

Variable	No.Obs	Mean	Median	Std. Dev	Min	Max
DD1/DLTT	25182	0.29	0.05	1.30	0.00	8.58
DD3/DLTT	21775	0.27	0.18	0.28	0.00	1.00
DD5/DLTT	21294	0.51	0.47	0.32	0.00	1.06
Book Lev	27823	0.42	0.45	0.34	0.00	0.98
Market Lev	27823	0.54	0.52	0.21	0.10	0.98
Size	27823	6.54	6.66	2.00	0.00	0.91
Cash Holding	27720	0.16	0.04	0.28	0.00	3.85
Profitability	26236	0.09	0.10	0.10	-0.41	0.36
Market-to-Book	27823	1.05	0.88	0.63	0.19	4.72
Tangibility	26254	0.37	0.33	0.28	0.00	0.91
Asset Volatility	19690	0.19	0.15	0.12	0.00	0.82
Stock Ret Volatility	27809	0.34	0.27	0.21	0.12	0.83
Cash Flow Volatility	21035	0.04	0.01	0.13	0.00	1.10
Z-score	20820	1.98	1.91	1.71	-5.42	7.91

7.2 Leverage Dynamics

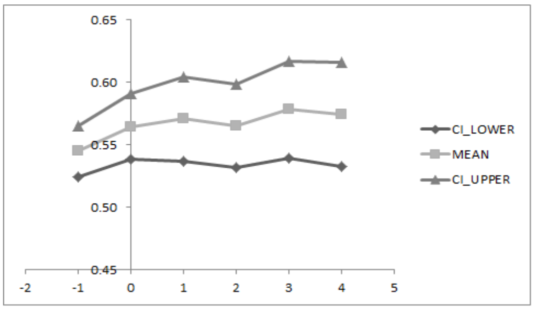
W have analyzed leverage dynamics as to whether the flexibility of short-term debt benefits a firm's more rapid readjustment when it has the greatest negative performance shock. We repeat this analysis using Compustat data. Using the same methods applied earlier, firms are first sorted by quin-tiles of performance in each year and sorted by quin-tiles of maturity from shortest to longest over 1986 to 2007.

Figure 6 illustrates the dynamic leverage reduction from $t-1$ through $t+3$ for the firms in a group with lowest shock in $t=0$. The solid line with rectangles represents the average value of market leverage for firms. The line with triangles show the upper confidence interval for 95 % significance. The line with diamonds gives the lower confidence interval for 95 % significance. (a) of Figure 6 shows the average leverage reduction due to performance shock measured by stock return in the lowest performers with the shortest maturity while (b) of Figure 6 shows the equivalent with the longest maturity. With a negative performance at $t=0$, the leverage ratio mechanically rises in both the shortest maturity and the longest maturity group. On one hand, firms with the shortest maturity lever themselves down between $t=1$ and $t=2$ while the leverage in the longest

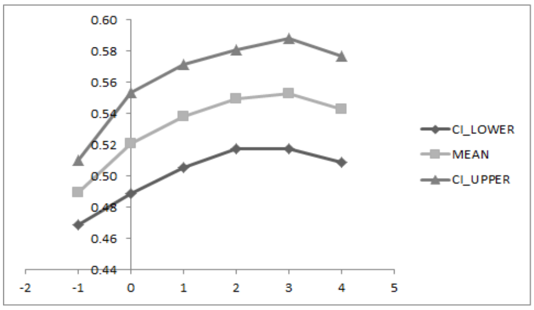
Figure 6: Leverage Dynamics with the lowest Performance Shock in $t = 0$ over the period 1987- 2006

Note: The figure 6 illustrates the dynamic leverage reduction from $t-1$ through $t+3$ for the firms in the lowest performers in $t = 0$. The solid line with rectangles represents the average value of market leverage for firms. The line with triangles provides the upper confidence interval for 95% significance. The line with diamonds gives the lower confidence interval for 95% significance. Figure (a) shows the average leverage reduction due to performance shock measured by stock return in the lowest performers with the highest fraction of short maturity debt to total long-term debt while Figure (b) shows the equivalent with the lowest fraction of short maturity debt to total long-term debt .

(a) Leverage Dynamics/ Lowest Return + Shortest Maturity



(b) Leverage Dynamics/Lowest Return+Longest Maturity



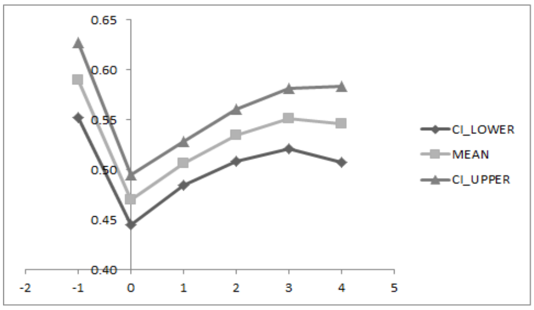
maturity group keeps rising until $t = 2$. Firms with higher proportion of shorter maturity that matured in less than 3 years let some debts mature and do not finance themselves with long-term debt in order to manage the financial distress. On the other hand, firms with lower proportion of shorter maturity in their total debt level cannot shake off some debts even with higher bankruptcy probability and will not reduce their leverage, thereby increasing their risk of financial distress.

Figure 6 illustrates the dynamic leverage dynamics from $t-1$ through $t+3$ for the firms in a group with highest shock in $t = 0$. The solid line with rectangles represents the average values of market leverage for firms in highest performance group. The line with triangles shows the upper confidence interval for 95 % significance. The line with diamonds gives the lower confidence interval for 95 % significance. Figure (a) shows the average leverage dynamics due to positive performance shocks measured by stock return in the highest performers with the highest fraction of short maturity while Figure (b) shows the equivalent with the lowest fraction of short maturity. With the positive performance at $t = 0$, the leverage ratio mechanically falls down in both the highest fraction of short maturity and the lowest fraction of short maturity group between $t = -1$ and $t = 0$. Firms in both the highest fraction of short maturity and the lowest fraction of short maturity groups lever themselves up and this tendency continues over the observation years.

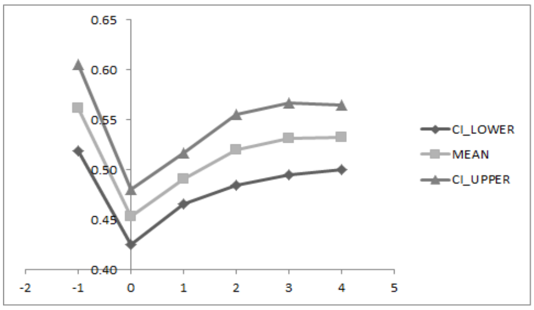
Figure 7: Leverage Dynamics with Positive Performance Shock in t=0 over the period 1987- 2006

Note: The figure 6 illustrates the dynamic leverage dynamics from $t-1$ through $t+3$ for firms belonging to the highest performance group in $t=0$. The solid line with rectangles represents the average value of market leverage for firms. The line with trianglsevprovides the upper confidence interval for 95% significance. The line with diamonds gives the lower confidence interval for 95% significance. Figure (a) shows the average leverage dynamics in the highest performers with the highest fraction of short maturity debt to total long-term debt while Figure (b) shows the equivalent with the lowest fraction of short maturity debt to total long-term debt.

(a) Leverage Dynamics/Highest Return + Shortest Maturity



(b) Leverage Dynamics/Highest Return+Longest Maturity



7.3 Base Regression for DD3/DLTT

In our maturity equation, we use debt maturity defined as DD3/DLTT as the main dependent variable. Our independent variables of interests are the leverage ratio and asset volatility. Unfortunately, it is difficult to proxy a variable measuring cost of issuance from Compustat data. In the leverage equation, we use the leverage ratio as a dependent variable when we consider the maturity and asset volatility as explaining the leverage ratio. We repeat the tests of the following three hypotheses using Compustat data and investigate whether the different data and debt maturity are sensitive to managing the financial policies.

- *Hypothesis 1 Firm with more volatile asset dynamics tends to issue debt with shorter maturity.*
- *Hypothesis 2 Firm with shorter maturity debt optimally tends to lever itself up to a higher leverage.*
- *Hypothesis 3 Firm with more volatile asset dynamics tends to lever it down.*

Fixed effects models identify causal effects when there are constant, unobserved individual characteristics that, because they are related to both outcomes and explanary variables would cause correlated variablesto be ommitted if ignored. To correct this issue, we estimate a panel regression in Table 12 in which the maturity of debt (leverage) is regressed on the determinants of debt maturity (leverage) as well as on the control variables. The control variables are drawn from the literature, following Barclay, Smith, and Watts (1995),Johnson (2003),Brockman, Martin, and Unlu (2010) and Harford, Klasa, and Maxwell (2014). We include year, industry and firm fixed effects in our regression equations to control for other unobserved year, industry and firm fixed effects. The results for the maturity equation in the first panel in Table 12 show that the regression coefficients on leverage and asset volatility are statistically different from zero and have the expected signs. On the contrary, the coefficient on asset volatility of year, industry and firm fixed effects equations has an opposite sign. This indicates that, controlling for potential changes in year, industry and firm characteristics over time, asset volatility does not affect in a persistent manner in the explanation of the debt maturity. The lower panel in Table 12 reports the results when leverage is used as a dependent variable while the debt maturity is included as an independent variable. We find that the signs of coefficients on the leverage model are very persistent and statistically significant in both a pooled OLS regression and other estimations including year, industry and firm fixed effects.

7.4 Two Stage Regression for DD3/DLTT

Table 13 provides regression results for the two-stage regression with instrumental variables. Following Harford, Klasa, and Maxwell (2014), we used term spread, Z Score dummy and industry maturity as instruments in the maturity equation; tax credit dummy, acquisition dummy and industry average leverage as instruments in the leverage equation. The upper panel shows that the coefficients on leverage and volatility are statistically significant and consistent with respect to the base regression results. The fraction of debt matured in within 3 years excluding less than a year increases along with a firm's leverage and asset volatility. The coefficients on leverage and asset volatility are all statistically significant.

Table 12: Base Regression with Debt due in next three years

Note: The 12 table provides the cross-section of regression results for the following two regression equation. In the upper panel, it reports the maturity equation: $Maturity_{i,t} = \alpha_i + y_t + \beta X_{i,t} + \epsilon_{i,t}$, where $X_{i,t}$ is a matrix of independent variables, α_i is an industry level fixed effect and y_t a year fixed effect. In the lower panel, it reports the leverage equation: $Leverage_{i,t} = \alpha_i + y_t + \beta X_{i,t} + \epsilon_{i,t}$, where $X_{i,t}$ is a matrix of independent variables, α_i is an industry level fixed effect and y_t a year fixed effect. Column (a) and (d) report pooled OLS results without any fixed effects; Column(b) and (e) show OLS results with year and industry fixed effect; and lastly Column (c) and (f) provide OLS results with firm, year and industry fixed effect.

Dependent Variable: **DD3/DLTT**

	(a)OLS	(b)OLS	(c)OLS
Leverage	0.12 (8.55) ***	0.03 (2.02)**	0.04 (2.27)**
Asset volatility	0.30 (12.7)***	0.21 (8.15) ***	-0.06 (-1.97) ***
Stock Return	0.00 (0.01)	-0.01 (-2.32)**	0.004 (1.18)
Profitability	0.02 (0.80)	-0.07 (-2.46)**	0.004 (0.11)
Market-to-Book	0.02 (4.42)***	0.02 (3.76)***	0.02 (3.08)***
Tangibility	-0.16 (-18.8) ***	-0.08 (-6.30) ***	-0.05(-2.11)**
Size	-0.03 (-25.6) ***	-0.04 (-25.7) ***	-0.06 (-13.6) ***
Cash holding	-0.02 (-4.65) ***	-0.04 (-6.55) ***	-0.04 (-4.87) ***
Year Fixed	No	Yes	Yes
Industry Fixed	No	Yes	Yes
Firm Fixed	No	No	Yes
R squared	0.15	0.22	0.58
#obs	20300	20300	20300

cont'd

Dependent Variable: Leverage

	(d)OLS	(e)OLS	(f)OLS
DD3/DLTT	0.04 (8.55)***	0.01 (2.02) **	0.003 (0.67)
Asset volatility	-0.40 (-30.6)***	-0.49 (-36.8) ***	-0.38 (-27.4) ***
Stock Return	-0.06 (-24.7) ***	-0.05 (-21.3)***	-0.05 (-23.6)***
Profitability	-0.22 (-14.2) ***	-0.31 (-21.4) ***	-0.36 (-21.2) ***
Market-to-Book	-0.14 (-69.3) **	-0.14 (-67.2)***	-0.13 (-48.4)***
Tangibility	-0.07 (-14.6)***	-0.01 (-1.20)	0.05 (4.07)***
Size	-0.02 (-31.9) ***	-0.06 (-27.5) ***	-0.02 (-10.2)***
Cash holding	0.06 (20.7) ***	0.04 (14.1) ***	-0.01 (-2.02)**
Year Fixed	No	Yes	Yes
Industry Fixed	No	Yes	Yes
Firm Fixed	No	No	Yes
R squared	0.45	0.60	0.85
#obs	20300	20300	20300

Table 13: Two Stage Regression in DD3/DLTT Sample

Table 13 provides two-stage regression results of maturity and leverage on the explanatory variables. On one hand, we find a strong support that the earnings uncertainty increase the fraction of shortly matured debt to total long-term debt. There is a negative coefficient on the asset volatility in the maturity regression. In addition, the coefficients on the leverage and the fraction of debt due in next three years to long term debt have positive signs with a statistical significance. Firms with the higher fraction of shortly matured debt to total long-term debt hire more leverage. The result from leverage regression supports the negative relationship between leverage and asset volatility; the coefficient on the volatility is negative and statistically significant.

Dependent : Fraction of Long-Term Debt in due three years to Total Long-Term Debt		
	(a) First	(b) Second
Leverage(Predicted)		0.12 (8.55) ***
Asset Volatility	-0.41 (-32.2) ***	0.30 (12.7)***
Profitability	-0.20 (-13.6) ***	0.02 (0.80)
Market-to-Book	-0.15 (-74.5) ***	0.02 (4.42)***
Tangibility	-0.06 (-13.0)	-0.16 (-18.8)***
Size	-0.03 (-37.5) ***	-0.03 (-25.6)***
Cash holding	0.06 (19.6) ***	-0.02 (-4.65) ***
Tax Credit Dummy	0.03 (9.09) ***	
Acquisition Dummy	-0.01 (-3.02) ***	
Industry Leverage	-0.30(-31.9) ***	
R Squared	0.48	0.15
Nobs	14527	14527
F-test	1184.7	471.39
p>F	0.000	0.000

cont'd

Dependent Variable : Leverage		
	(c) First	(d) Second
Maturity(Predicted)		0.04 (9.12)***
Asset Volatility	0.17 (7.68)***	-0.41 (-30.5)***
Return	-0.01 (-1.35)	-0.06 (-24.2)***
Profitability	-0.05 (-2.06)**	-0.22 (-14.5)***
Market-to-Book	0.01 (2.55)***	-0.14 (-67.1) ***
Tangibility	-0.04 (-4.65) ***	-0.07 (-14.4)***
Size	-0.03 (-21.9) ***	-0.02 (-30.0)***
Cash holding	-0.05(-9.70)***	0.06 (20.0) ***
Industry Maturity	0.84 (48.2)***	
Term spread	0.001 (0.56)	
Z Score Dummy	-0.02 (-5.01) ***	
R Squared	0.27	0.44
Nobs	13908	13908
F-test	662.91	1613.26
p>F	0.000	0.000

The leverage equation results in the the lower panel shows that higher short-term debt fractions in total long-term debt results in a higher leverage ratio. On the other hand, the significantly negative coefficient on asset volatility implies that as a firm's asset dynamics becomes more volatile, a firm levers itself down in order to reduce the probability of financial distress.

With the same definition of debt maturity and leverage specifications and in the simultaneous equations, Johnson (2003) elaborates how short-term debt affects on the leverage decision. On one hand, short-term debt attenuates underinvestment problem by reducing agency costs and makes a firm engage more debt. On the other hand, a firm with a higher proportion of short-term debt reduces debt outstanding to relieve liquidity risks. Hence, the net effects of short-term debt on the leverage depend on the counter-balancing forces of attenuation effects and liquidity risks. We find that a positive association between debt maturity and growth opportunities, measured by the market-to-book ratio, is consistent with Johnson (2003). Second, our empirical finding is contrasting with Johnson (2003). Our finding suggests that the net effects of the proportion of short-term debt to total debt is positive on the explanation on the leverage: the flexibility benefits plus the attenuation of underinvestment problems against the liquidity risks trade off and the net effect of short-term debt on leverage is positive. The higher proportion of short-term to total debt increases the leverage. Childs, Mauer, and Ott (2005) also find that a firm chooses short-term debt in order to take financial flexibility: short-term debt reduces the agency costs of under- and over-investment. Nevertheless, they argue that the effect of short-term debt on leverage may not be positively related, since a firm's debt level also depends on the type of growth option.

Firm size is negatively related to our maturity and leverage regression(13). Larger firms have lower fraction of shorter-term debt to total debt as well as lower leverage ratio. Barclay, Marx, and Smith (2003); Johnson (2003) and MacKay (2003) among others find that larger firms tend to issue long-term debt with less debt in capital structure, which is consistent with our findings. MacKay (2003) suggests that smaller firms tend to rely on short-term bank debt less severe agency problems occur, and smaller firms tend to have higher leverage: the latter is consistent with our empirical finding while the former is not. Our finding is consistent with that of Childs, Mauer, and Ott (2005); a proxy of firm size as default risk, which is inversely related.

We draw attention on the role of asset volatility on the financial policy; maturity and leverage. On one hand, flexibility benefits become more valuable to a firm with highly volatile assets, hence a firm with high volatility of asset tends to issue shorter-term debt. On the other hand, a firm with high volatility of assets may has high bankruptcy probabilities as well; asset volatility is inversely related to the leverage. Stohs and Mauer (1996); MacKay (2003); Johnson (2003) also find the negative relation between maturity and volatility. In contrast, Diamond (1992); Guedes and Opler (1996); Childs, Mauer, and Ott (2005)predict that the relation is non-linear; firms with low volatility tend to issue both short-end and long-end of maturity and firms with high volatility tend to issue debt with a middle-term maturity.

8 Conclusions

A growing strands of literature explores the joint determination of debt maturity and leverage in a dynamic capital structure model(Dangl and Zechner (2006); Miltersen and Torous (2007); Ju and Ou-yang (2005)). Miltersen and Torous (2007) argue that there are interactions among two different counter-balances: first, the trade-off between the financial distress and tax shields, and second, the trade-off between flexibility benefits and transaction costs. These theoretical works provides several empirical implications: first, the uncertainties in the earning process shorten the maturity of debts. Second, a firm with short-term debt engages more debts. Third, the higher uncertainty of earning, the lower the leverage ratio has in managing the higher bankruptcy probability. Finally, the uncertainty of earnings, measured against the flexibility benefits, weighs out the transaction costs.

We investigate our empirical hypotheses with four different approaches. We first exploit variations in the maturity structure of bond issuers; public debt faces difficulties of restructuring and renegotiation. The only flexibility comes from its maturity, which makes FISD bond issuance data fit in our analysis. Next, we allow for the potential endogeneity of the existence of a debt policy decision of the amount and the maturity by using two-stage least square regressions. Following the empirical literature on the joint determination of leverage and debt maturity (Barclay, Marx, and Smith (2003); Brockman, Martin, and Unlu (2010); Johnson (2003); Harford, Klasa, and Maxwell (2014)), we use instrumental variables to resolve the problem of omitted variable bias and the classic errors-in-variables problem. Third, we focus on private debt and investigate whether different types of debt structure behave differently in order to utilize the flexibility benefits of short-term financing. Finally, we further extend our analysis to the maturity of bank loans and long-term bonds together using Compustat data. We examine whether a fraction of total long-term debt due in next three years leads to different effects on financial policy. We find a strong evidence to support our theoretical propositions in the empirical estimation. We find a negative and statistically significant coefficient for the volatility of asset explaining the debt maturity of both FISD and Compustat data. The volatility of the earnings leads to shorter maturity of bonds and total long-term debt maturing within three years. In contrast, firms with high short-term private debt are less sensitive to adjusting their financial policy since bank loan are likely to be renegotiated upon the negative performance shocks.

This study extends the literature in several areas, including dynamic capital structure, the joint determination of leverage and debt maturity, and the flexibility benefits from short-term debt. Our results add to the literature of joint determination of leverage and maturity. Our empirical findings call attention on the role of short-term debt in managing financial policy over the several financing cycles. Our study also highlights the flexibility benefits of short-term financing during volatile earning periods. More importantly, we provide new explanations as to why financial firms with higher volatile earnings greatly levered up, relying moreover on short-term financing, thereby exposing it to rollover costs. Our empirical work is based on a dynamic capital structure model in which its base parameters follow a continuous process. This approach has some limitations due to the jump or regime-switching feature of market frictions. To the extend that the financial crisis of 2007-2009 is driven by the forces of extreme increase of roll-over costs, our future theme of research calls for more attention to the frictions of the regime-switching when assessing optimal financial policy.

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