Three essays in empirical finance

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Résumé :

Cette thèse se compose de trois chapitres distincts. Dans le premier chapitre, nous examinons si les facteurs explicatifs de la maturité de la dette précédemment identifiés dans la littérature ont des impacts qui varient en fonction du niveau de maturité de la dette en mettant l'accent sur les cas extrêmes. Nous constatons que les effets des déterminants classiques varient sensiblement en fonction de la distribution de la maturité de la dette. Ces effets sont beaucoup plus faibles pour les percentiles les plus bas et les plus élevés. Cela indique que le risque de refinancement est beaucoup plus contraignant à très court terme et beaucoup moins à très long terme. En revanche, le fait d'avoir accès ou non au financement public accentue ce phénomène d'hétérogénéité de l'impact des déterminants en fonction du niveau de maturité de la dette. Ce dernier point peut s'expliquer par le fait que le risque de refinancement est beaucoup plus important pour les entreprises n'ayant pas accès au financement public. En résumé, nos résultats confirment notre intuition concernant les impacts hétérogènes des déterminants de la maturité de la dette en fonction du niveau de maturité de la dette et en particulier dans les cas extrêmes. Dans le deuxième chapitre, nous examinons les choix de la maturité de la dette des entreprises dans une perspective dynamique. Premièrement, nos résultats mettent en évidence des effets moutonniers. Aussi bien en termes de niveaux de la maturité de la dette qu'en termes de modifications de la maturité de la dette, les entreprises reproduisent le comportement des entreprises du même secteur. Ce comportement moutonnier explique beaucoup plus les variations de la maturité des dettes que les caractéristiques propres des entreprises. Après avoir éliminé l'impact des variations de la structure par terme des taux d'intérêt, ce comportement moutonnier en réponse aux modifications de la maturité de la dette des entreprises du même secteur est encore plus conséquent. Deuxièmement, nous constatons une persistance de niveaux de maturité de la dette dans le temps, notamment pour les entreprises ayant des maturités de la dette très faibles. Le troisième chapitre analyse l'impact du « *market timing* » sur la maturité de la dette. Nous affirmons que les grandes entreprises affichant des fondamentaux solides ont tendance à émettre des dettes à long terme plutôt qu'à court terme en cas de surévaluation temporaire des titres de ces entreprises. En particulier, pour ce type d'entreprises, l'effet du timing domine celui du comportement moutonnier pendant les périodes de refinancement important. Pour les petites entreprises dont les fondamentaux sont faibles, l'effet du « *market timing* » est faible, tandis que celui du comportement moutonnier est conséquent.

Mots-clés :
Maturité de la dette, déterminants classiques, cas extrêmes, comportement moutonnier, « *peer effects* », « *market timing* »

Abstract:

This dissertation is made of three distinct chapters. The first chapter investigates whether the effects of the previously identified factors vary along the debt maturity spectrum. Special emphasis is place on the extreme cases. Notably, we find that the effects of the conventional determinants vary substantially across the debt maturity distribution. Effect attenuation is observed at the lower and the higher debt maturity percentiles. The mechanism lies in the binding refinancing risk in the short extremes and the lessened refinancing risk in the long extremes. By contrast, the fact that a firm has access to public credit or not accentuates to a larger degree the heterogeneity in the observed effects of the included factors across the debt maturity distribution. This result can be explained by the argument that the refinancing risk is even more binding for firms without access to public credit. Altogether, our findings confirm our intuition concerning the heterogeneous effects of the conventional factors exerted along the debt maturity spectrum, especially for the extreme cases. In the second chapter, we examine debt maturity choices of firms from a dynamic perspective. Our results draw clear implications for a herding effect. Firms herd towards the levels as well as the changes of industry peers' debt maturities. Remarkably, this herding effect explains a much larger proportion of variation in debt maturity adjustment than firms' own characteristics. After eliminating the impact of changes in the yield curve, changes in peer firms' debt maturity policies drives debt maturity dynamics to a larger extent. Meanwhile, we find that debt maturity is persistent over time and that the persistence is primarily attributed to firms with short debt maturities. The third chapter analyzes the impact of market timing. We document that big firms with strong fundamentals attempt to "time" the issuance of long-term debts subsequent to temporary market mispricing. Particularly, for this type of firms, the effect of market timing dominates over that of herding during the periods firms raise large amounts of debts. For small firms with weak fundamentals, the effect of market timing is insignificant whereas the herding evidence is prominent.

Key words:
Debt maturity; conventional determinants; extreme cases; herding behavior; peer effects; market timing

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General Introduction

A sequence of unanticipated collapse of magnates during the last U.S. sub-prime crisis brings the debt maturity issue to the frontier of capital structure research. In particular, researchers hold that the crisis is characterized by the collapse of the short-term commercial paper market. Firms who finance a great portion of their long-term assets with short-term debts are exposed to great refinancing risk (e.g., Daianu and Lungu (2008), Duchin et al. (2010), He and Xiong (2010b), Gopalan et al. (2010)). Specifically, when debt market deteriorates, creditors raise by big percentages firms' interest rates to compensate for the amplified credit risk. In the worst case, they refuse to roll over the maturing debts and lead firms to early liquidations. Others stress that in periods of credit crunch, short-term borrowing induces more severe debt overhang[1] than long-term borrowing (e.g., Almeida et al. (2009), Almeida et al. (2012), Diamond and He (2014)).

Nevertheless, long-term debt is not a free ride. Outstanding long-term debt is likely to distort firms' incentives to undertake profitable investment projects and incline firms to invest in risky assets (Myers (1977), Barnea et al. (1980)). Besides, conventional wisdom

[1] The term "debt overhang" indicates a situation in which a firm's debt is so large that earnings generated by new investment projects are appropriated by existing creditors. As a consequence, firms probably forgo projects with positive net present values and hence damage the value of the firm (Myers, 1977).

holds that relative to short-term debt, long-term debt bears generally higher nominal interest rate and underwriting cost due to its illiquidity nature.

To summarize, short-term debt helps firms to align the interests of entrenched managers with their shareholders, synchronize investment demand, and allow firms to refinance at more beneficial terms when expecting credit rating upgrades (e.g., Myers (1977), Barnea et al. (1980), Fama (1990), Harris and Haviv (1990), Aivazian et al. (2005) and Diamond (1991)). In comparison, long-term debt is preferable when firms face high refinancing risk (e.g., Diamond (1991), Diamond (1993) and Jun and Jen (2003)).

A recent literature review of Graham and Leary (2011) underlines the non-monotonic effects of the capital structure determinants. They argue that the real question in capital structure research is to figure out the most important forces other than to test the general implications of the trade-off theory for any decision a firm make can be viewed as a trade-off between benefits and costs. Financing attitudes of firms are expected to vary according to the settings in which firms are situated. Besides, loan supply constraints may prevent them to make desired decisions. Consistent with this argument, Diamond and He (2014) contend that the relevance of the debt overhang effect propounded by Myers (1977) vary with economic cycles. In hard times, short-term debt imposes stronger overhang effect than long-term debt does. By all accounts, we have good reasons to believe that the effects of financial frictions, which are presumably related to debt maturity choices, are contingent on characteristics of firms as well as exogenous forces such as credit access and market shocks. Alternative forces (e.g. managerial interests in herding industry peers and timing favorable market conditions), rational or not, may also contribute to shaping firms' debt maturity policies. It is therefore of great interest to provide an in-depth

analysis of debt maturity choices of firms, with multidimensional considerations. As a start, we discuss the theoretical and empirical evidence based on prior literature.

1. Debt maturity choices of firms

1.1. Theoretical evidence

Financial literature has achieved considerable advancement in terms of how firms make choices between debt and equity. However, detailed features of debt financing contracts, including debt maturity structure, are greatly overlooked. In a perfect and complete capital market implied by Modigliani and Merton (1958) and Stiglitz (1974), debt maturity choice is irrelevant to the valuation of firm. Subsequent literature releases the assumption of ideal market and put corporate debt maturity structure at stake by taking into considerations of various financial frictions confronting firms, such as agency conflicts (e.g., Myers (1977), Barnea et al. (1980)), information asymmetry (e.g., Flannery (1986), Kale and Noe (1990)), credit risk (e.g., Diamond (1991, 1993)) and taxation (e.g., Brick and Ravid (1985, 1991), Lewis (1990)), and market conditions (e.g., Baker et al. (2003), Greenwood et al. (2010)).

- Agency Problems

Hinging on the conflict of interest between shareholders and creditors, two types of agency problems associated with the design of debt indenture are brought out, i.e., underinvestment and asset substitution.

Underinvestment, also known as debt overhang describes the instance when a firm renounces valuable investment opportunities. Myers (1977) categorizes the assets of firms into assets in place and growth options. The value of growth options depends on the way that the assets in place are financed. With a long-term debt overhang at the moment

of exercising growth options, firms possibly forgo profitable projects, for otherwise the future benefits of growth options will go to the creditors. A common prescription for this debt overhang problem is to match the maturity of debt to that of asset. The idea is to make sure that debt matures at the time that managers need to take incremental investment decisions. Another solution proposed by Myers (1977) is to finance the assets-in-place with short-term debt maturing before the growth option will be exercised. Diamond and He (2014) develop the model of Myers (1977) to various settings. They derive that the debt overhang effect varies depending largely on economic state, investment horizon, and information release timing.

Equity holders have incentives to increase their wealth at the expense of debt holders by investing in very risky projects, known as the "asset substitution" problem (Jensen and Meckling (1976, 1986)). Creditors will rationally foresee this risk-shifting incentive of firms and require ex ante a higher rate of interest in order to compensate for the potential loss. The extra costs incurred are recognized as the agency cost of "asset substitution". Barnea et al. (1980), Leland and Toft (1996) and Stulz (2000) bring up the idea of alleviating the problem by specifying an appropriate shorter maturity. They contend that by shortening the maturity structure of debt, creditors are provided with an option to monitor regularly the borrowers. To ensure their access to future loans, equity holders are forced to carefully evaluate the risk of their assets and the efficiency of their investment decisions.

Jensen (1986) elucidates the role of short term debt in aligning the interests of executive management with those of shareholders. Specifically, by cutting down frequently the free cash flow, short-term debt helps to supervise the over-investment behaviors of managers. Besides that, in a way that short-term debt increases the possibility of bankruptcy,

managers' incentives for increasing the efficiency of fund utilization are enhanced. Hart and Moore (1994, 1995) find that short-term debt is effective in mitigating managerial discretion behaviors.

- **Information Asymmetry and Credit Risk**

Models of information asymmetry take into account the role of private information in affecting the manner by which firms raise funds. The key to this line of literature lies in the "adverse selection" issue, characterized by the undervaluation of high quality firms and the overvaluation of low quality ones under information asymmetry.

Creditors cannot tell high quality borrowers from the low quality ones due to lack of information. Therefore an industry-average credit risk rating is assigned to both types of firms. Consequently, new debt issues of high-quality low-risk firms are under-estimated, whereas those of low-quality high-risk firms are over-estimated. Before private information is disclosed, high quality firms have no choice but to borrow at the same cost as low quality ones.

Short-term debt is less sensitive to mispricing as it provides lenders with the possibility of frequently updating a firm's credit information (Flannery (1986)). For this reason, high quality firms would prefer to issue short-term debts. In the interest of gaining maximum benefits from market-overvaluation, low quality firms should prefer long-term debts. Nevertheless, as soon as low quality firms realize that long-term debt issuance signals bad image to the market, they will imitate high quality firms of issuing short-term debts. In the long run, all firms choose to issue short-term debts, defined by Flannery (1986) as the "pooling equilibrium".

Further, Flannery (1986) derives that the "pooling equilibrium" merely happens when the signaling is costless. In the presence of high refinancing costs, only high quality firms can afford to signal their states through continuing to borrow short-term debts. This eventuates in the "separating equilibrium" where high quality firms issue short-term debt and low quality firms issue long-term debt. Kale and Noe (1990) extend the model of Flannery (1986) to a sequential games framework. They conclude that the "separating equilibrium" exists even in the absence of transaction costs.

On the basis of Flannery's (1986) model, Diamond (1991) stresses the impact of credit risk originated by rolling over short-term debts at the time when refinancing is expensive or unavailable. In his model, low quality firms are screened out of the long-term debt market as creditors are simply unwilling to offer long-term loans under considerations of high asset substitution risk. On the other hand, most creditworthy firms will reserve their rights in issuing long-term debt but continue to issue short-term debt in order to signal favorable private information. Medium-quality firms take credit risk more seriously. Thus, in equilibrium, only medium-quality firms use long-term debts, while both high- and low-quality ones issue short-term debts.

- **Taxation**

Debt maturity models capturing the implications of debt tax shields began to appear in the middle 1980s' under the background that U.S. Tax code exacted tax of firms' capital gains on the basis of realization, rather than accrual. The tax-based argument holds that interest expense is tax-deductible and debts with diverse term structures differ in the size of tax shield effects.

Brick and Ravid (1985) examine the tax shield effects of debt with various maturities under the assumption of interest rate certainty. They state that the non-flat term structure of interest rates makes taxation relevant for debt maturity decisions of firms. Adjusted for default risk, long-term borrowing is optimal when the term structure of interest rates is upward sloping in the way that long-term debt accelerates tax benefits and in turn, maximizes shareholder wealth. By contrast, if the term-structure of interest rates is downward sloping, short-term debt borrowing is preferable. In their extended model allowing for interest rate uncertainty, Brick and Ravid (1991) show that long-term debt is desired for an extensive range of term structures: upward, flat and even downward. However, Lewis (1990) shows that the optimal debt maturity is irrelevant to the tax consideration if the leverage is simultaneously determined with debt maturity.

A number of researchers relate debt maturity decisions of firms to the tax-timing option. Emery, Lewellen and Mauer (1988) find that long-term debt enhances firm's tax-timing option through repurchasing bonds during the time when interest rates decrease. The idea is to realize a tax-deductible loss, and to trade at a premium in comparison with the issue price. Brick and Palmon (1992) study the role of debt maturity decision in timing tax option within a perpetuity framework in which only one future tax-trading opportunity is available, while Kim et al. (1995) analyze in a multi-period model considering uncertain interest rates. Both of them come to a conclusion that issuing long-term debt implicitly generates a valuable tax timing option when interest rate greatly floats.

- **Market Timing**

Market timing issue has been a question of great theoretical and practical interest since the proposition of equity market timing (e.g., Lucas and McDonald (1990), Loughran and

Ritter (1995), Baker and Wurgler (2000) and Baker and Wurgler (2002)). Generally, it holds that managers who have private information on firms' future earnings are able to exploit stock mispricing by issuing stocks when firms are overvalued and repurchasing shares when the firms are undervalued.

Early studies (e.g., Bosworth (1971), Taggart (1977), Marsh (1982), and Levy (2007)) appeal to the simple relationship between corporate debt maturity structure and market conditions such as inflation, interest rates, term spreads, credit spread, stock market return etc. They find that managers adjust the maturities of their debts for the purpose of seizing the opportunity windows of favorable financing conditions. In contrast with tax models, market models predict the term structure of interest rate in the opposite direction. Specifically, they hold that, rationally or irrationally, firms issue short-term debts "when short-term interest rates are low compared to long-term interest rates" and "when waiting for long-term market interest rates to decline".

The turning point is marked by Baker et al. (2003) who find evidence that firms "time" long-term debt issuance prior to low future excess bond returns, i.e. the relative cost of long-term debt to short-term debt. They show that excess bond returns can be predicted by debt market conditions. More precisely, their analysis includes inflation (both actual and expected), short-term interest rate (real and ex ante), the term spread, the credit spread and the credit term spread. Their empirical results indicate that managerial debt maturity timing attempt accounts for the substantial year-to-year movements in average debt maturities of U.S. firms. Subsequent researchers strongly challenged Baker et al. (2003) in questioning whether managers are successful in timing new debts issuance prior to interest rate movements (Butler et al. (2006) and Barry et al. (2008)). To confront these critics, Greenwood et al. (2010) provide a new angle to explain the debt maturity

market timing story of Baker et al. (2003) in MM's limited arbitrage framework. Their derivation show that firms are actually able to time the bond market thanks to the comparative advantage in absorbing the supply shocks of government debts over the other arbitrageurs, rather than in predicting bond market returns. Precisely, when the government issues more long-term debt, firms respond to issue more short-term debt, namely "the gap-filling behavior".

The debate on whether managers succeed in minimizing the cost of borrowing by timing debt market keeps going on in the American academic community, common consensus has been achieved on the presence of managerial market timing behaviors. Most convincingly, in the survey report of Graham and Harvey (2001), a large proportion of chief financial officers admit to issue short-term debts "when short-term interest rates are low compared to long-term rates (35.94%)" and "when waiting for long-term market interest rates to decline (28.70%)". Note that the survey of European companies yields similar evidence (Bancel and Mittoo (2004)).

1.2. Empirical evidence

Empirical research on debt maturity choices of firms came into vogue in late 1990s, represented by the seminar work of Barclay and Smith (1995), Stohs and Mauer (1996) and Guedes and Opler (1996). The subsequent studies has devoted to explaining the debt maturity variation by a set of firm- and economic-specific factors[2], as predicted by various theoretical models. The most commonly investigated factors include firm size, age, growth options, asset maturity, abnormal earnings, leverage, asset volatility, cash

[2] Demirgüç-Kunt and Maksimovic (1999) and Fan et al. (2012) document the impact of institutional factors on debt maturity decisions of firms. As this dissertation is confined to a sample of U.S firms, we confine our analysis to firm and economic factors.

holdings, credit access, and the term structure of interest rate. Be that as it may, great inconsistencies turn up.

According to the theoretical predictions, firm size is supposed to be positively associated with debt maturity. Small firms are considered by creditors as riskier as they have relatively high business risk and are more likely to suffer temporary losses. For monitoring purpose, creditors will lend them short-term debts. Analogously, small firms are also more susceptible to underinvestment problems due to the high-growth feature. They thus will find short-term debt fund optimal. Empirically, a mixture of positive (e.g., Barclay and Smith (1995) and Stohs and Mauer (1996)), negative (e.g., Scherr and Hulburt (2001)) and non-monotonic (e.g., Guedes and Opler (1996), Barclay et al. (2003), Johnson (2003), Datta et al. (2005), Billet et al. (2007), Brockman et al. (2010), and Custódio et al. (2013)) coefficients are found.

Some studies emphasize the role of firm-bank relationship (Berger and Udell (1995), Blackwell and Winters (1997) and Boot (2000)). Firms with high reputations have close relationships with their creditors and are likely to negotiate more easily the terms of their debt contracts, including maturity structures. Intuitively, older firms with more financing experience with banks will be able to borrow more long-term. But again, there's no consensus in the empirical literature (see Scherr and Hulburt (2001) and Custódio et al. (2013)).

Growth option is frequently tested for the underinvestment hypothesis, which expects an inverse relationship between growth option and debt maturity. Empirically, Barclay and Smith (1995) and Guedes and Opler (1996) find the expected negative sign, but Stohs and Mauer (1996) and Datta et al. (2005) show positive signs. Even confusingly, the vast

majority of the rest finds either equivocal, or statistically insignificant or economically negligible estimates (e.g., Scherr and Hulburt (2001), Johnson (2003), Billet et al. (2007), Brockman et al. (2010), and Gustódio et al. (2012)).

Under severe information asymmetry, there is a risk that high quality firms are underestimated and therefore obliged to borrow at high cost. To signal their future prospects and hereafter borrow at lower interest rates, firms with high abnormal earnings have a tendency to issue short-maturity debts. This hypothesis is empirically validated by Mitchell (1991), Barclay and Smith (1995), Stohs and Mauer (1996), Johnson (2003) and Billet et al. (2007), whereas rejected by Guedes and Opler (1996), Datta et al. (2005), Brockman et al. (2010), Gustódio et al. (2012).

The information asymmetry models of Flannery (1986) and Kale and Noe (1990) suggest a negative impact of credit quality on debt maturity. By contrast, Diamond (1991, 1993) implies a nonlinear relationship. The latter proposition has gained more empirical support (see Barclay and Smith (1995), Stohs and Mauer (1996), Guedes and Opler (1996) and Billet et al. (2007)).

Debt level in capital structure is a key factor that rating agencies look at in their analytical approaches. A high level of debt ratio is commonly treated as a default warning for it subjects a firm to more severe liquidity problems. For hedging purpose, high leveraged firms are expected to use more long-term debts (e.g., Diamond (1991), Morris (1992), Leland and Toft (1996) and Jun and Jen (2003)). Agency models draw a different inference. To mitigate the underinvestment problem, in addition to employing short-term debts, alternative strategies, such as using less debt, including call and sinking fund provisions, and imposing restrictive debt covenants are also held as valid. Therefore, in

cases of joint employing multiple strategies, the relation between debt maturity and leverage is going to be attenuated. Yet, the empirical evidence on leverage is also confusing. In particular, Stohs and Mauer (1996), Scherr and Hulburt (2001), Johnson (2003), Datta et al. (2005), Brockman et al. (2010) and Gustódio et al. (2012) find that leverage is positively related to debt maturity, while Barclay et al. (2003), Johnson (2003), Billet et al. (2007) and Dang (2011) show negative relations. Specifically, the latter provides evidence that agency conflicts are virtually attenuated by using less debt other than by shortening the maturities of debts after treating debt maturity and leverage as simultaneously decided.

Asset volatility is often viewed as a signpost of firms' business risk. Firms with highly volatile assets are subject to high refinancing cost, and are likely to be screened out of the long-term debt market. As it implies, asset volatility is supposed to be negatively associated to debt maturity (e.g., Kane et al. (1985) and DeMarzo and Sannikov (2006)). Indeed, the effects that asset volatility exerts on debt maturity are found, in most cases, negative (e.g., Barclay and Smith (1995), Guedes and Opler (1996), Datta et al. (2005), and Billet et al. (2007)). While Stohs and Mauer (1996), Brockman et al. (2010) and Gustódio et al. (2012) find mixed results.

As a rule of thumb, a firm's investment can be partially financed by external capital and partially by cash reserves. Diamond and He (2014) find that firms establish flexible debt repayment policies by saving cash in good times and paying back the matured short-term debts with cash reserves in bad times. In this regard, firms with large cash holdings are able to employ more short-term debts. The empirical studies concerning the effect of cash on firms' debt maturity choices are relatively new and have yielded inconclusive results. Specifically, the findings of Harford et al. (2014) corroborate the role of cash holdings in

reducing refinancing risk. They show that large cash holdings are related to short debt maturities. Instead, Gustódio et al. (2012) and Brick and Liao (2013) find positive relationships between cash holdings and debt maturities of firms.

Following a hedging strategy against refinancing and underinvestment risk, firms are expected to match the maturities of assets and debts. Evidence for this maturity matching principle is more consistent (e.g., Stohs and Mauer (1996), Scherr and Hulburt (2001) and Brockman et al. (2010)), although some show misleading findings in attenuated and reversed effects (Datta et al. (2005), Billet et al. (2007), and Gustódio et al. (2012)).

Some refer to the supply-side effect. Specifically, they investigate the influence of the credit access (Faulkender and Petersen (2006) and Sufi (2009)). Financial intermediaries (e.g., banks) usually request a premium for additional monitoring and information collection. Ceteris paribus, borrowing from bond market is thus less costly than borrowing from financial intermediaries. As a consequence, firms with access to public credit market will have natural preferences for public debts whose maturities are longer than that of bank loans in general terms. Commercial paper, with a maturity of no more than 9 months, is a cheap fund alternative to bank line of credit. It is commonly issued by firms with great financial flexibilities and excellent credit ratings. Typically, a firm with commercial paper programs is more likely to have a short debt maturity structure.

With respect to the term structure of interest rates, the taxation hypothesis is in contradiction with the market-timing hypothesis. Notably, most, if not all, existent studies favor the market-timing hypothesis (e.g., Barclay and Smith (1995), Guedes and Opler (1996), Baker et al. (2002), Jun and Jen (2003), Datta et al. (2005), and Custódio et al. (2013)). Others report mixed results (e.g., Stohs and Mauer (1996), Billet et al. (2007),

Brockman et al. (2010)). Using aggregate level data, Baker et al. (2002) show clear managerial incentives in timing long-term debt issuance prior to low future excess return. Greenwood et al. (2010) further point out that financially flexible firms are more active in responding to favorable debt market conditions. In particular, these empirical findings are in accord with the survey results of Graham and Harvey (2001) and Bancel and Mittoo (2004).

To conclude, the existing evidence is largely inconclusive. Previous studies of corporate debt maturity decisions contradict each other from both theoretical and empirical perspectives. It also happens that two or more theories lead to opposite predictions for certain factors. So far it is not clear which economic forces firms take seriously when deciding about the maturities of their debts. Besides, it is not sure whether the observed maturities of debts are out of active or passive choices. Table I defines a summary of the main theoretical and empirical findings on conventional debt maturity determinants.

[Insert Table I about here]

2. Extreme debt maturity policies, herding behavior, and market timing

This dissertation is dedicated to examining debt maturity choices of firms. Specifically, we aim to tackle three novel issues: (1) the heterogeneous effects of the conventional determinants along the debt maturity spectrum and in the extreme cases; (2) the driving forces of debt maturity dynamics and the herding behaviors of firms; (3) firm's attempt to time long-term debt issuance when its security is temporarily mispriced.

The first essay, presented in Chapter 1, tests the first issue concerning the heterogeneous effects of conventional debt maturity determinants along the debt maturity spectrum. The

starting point for this essay is the argument of Graham and Leary (2011) who contend that "a given market friction may be a first-order concern for some type of firms, but of little relevance to others". Enlightened by this argument, we reexamine the issue of debt maturity determinants considering their effects in the entire range of the observed debt maturity. Accounting for an exogenous refinancing restriction imposed on the abilities of firms to actively choose the maturities of their debts, a special focus is put on the extreme users (i.e. firms heavily reliant on short-term and those with an overload of long-term debts). We apply the conditional quantile regression technique to address the heterogeneity issue, by characterizing various parts of the debt maturity distribution. To correct biased standard errors due to correlated residuals across firms, we follow Machado et al. (2013) to calculate asymptotically valid standard errors under heteroscedasticity and intra-firm correlation[3]. Notably, our results show that one out of ten U.S. non-financial non-utility firms during the period 1986-2010 adopt extremely short debt maturity policies, with their assets totally financed by short-term debt maturing in one year. It turns out that the extreme debt maturity users are not outliers. Besides, we provide evidence that the effects of conventional determinants vary considerably along the debt maturity spectrum. A wider range of disparities are found on the two tails of the debt maturity distribution. We argue that the underlying mechanism is the increasingly binding refinancing risk in the short debt maturity extremes and the lessened refinancing risk in the long extremes. We next proceed with the same analysis for subgroups of firms with and without public credit access. The resulting estimates indicate even larger disparities in the effects of the included factors, in particular for firms

[3] We are grateful to Professor Eric De Bodt for leading us to take care of the potential bias due to correlated residuals across firms in panel regressions.

with flexible credit access. On the other side, this result suggests even more binding refinancing risk for constrained firms with limited access. Altogether, our findings demonstrate a significant tendency for effect dispersion, which confirms our intuition about the heterogeneous effects of the conventional factors along the debt maturity spectrum, especially in the extreme cases. Besides, by providing new evidence in the behaviors of the extremely short debt maturity firms, our first essay corroborates a prominent strand of literature considering the inefficient short-term borrowing issue (e.g., He and Xiong (2012a), Cheng and Milbradt (2012), and Brunnermeier and Oehmke (2013)), and the intensified refinancing risk resulted from excessive employment of short-maturity debts (e.g., Acharya et al. (2011), He and Xiong (2012b), Harford et al. (2014)). Our evidence also complements a line of capital structure research on the low-leverage puzzle (e.g., Goldstein et al. (2001), George and Hwang (2010), Strebulaev and Yang (2013)).

Given that the observed debt maturity could be due to passive choice and may not reflect firm's real intent, Chapter 2 examines debt maturity decisions of firms from a dynamic perspective and put peer effects at stake. Precisely, we investigate the question of whether debt maturity dynamics is driven by dynamics in conventional factors or more by a herding force toward industry peers. We start by tracing the event-time debt maturity evolution of originally short, medium, long and very long debt maturity portfolios. Notably, our analyses reveal an important convergence in debt maturity which we find is related to firm's attempt to herd industry peers. We next model, in a multi-period regression framework, the over-time variations in debt maturity with the concurrent variations in the conventional factors, along with two measures of herding towards peers' debt maturity (weighted average) level and their debt maturity changes respectively.

Note that the investigated firm is excluded from calculating peer firms' weighted average debt maturity. The regression results indicate that firm's debt maturity herding behavior plays a much greater role in driving debt maturity dynamics relative to the conventional debt maturity factors. The pattern is robust after controlling mechanical mean reversion, accounting for company conglomerates and considering a variety of specifications such as firm fixed effects and interdependencies of corporate policies, that is, endogeneity. Additionally, our portfolio analyses show persistence in debt maturity. Firms with originally short debt maturities continue to shorten the maturities of their aggregate debts. This is even true for a group of firms that have survived our sample period. Note that this evidence is in line with the results obtained in the first essay in terms of the binding feature of short maturity. In an extension, we eliminate the impact of economy-wide shocks by computing a debt maturity indicator adjusted for the yield curve change[4]. The resulting estimates suggest that firms are more likely to herd towards changes in peer firms' debt maturity and only firms in high volatility group herd to the level. Taken together, the second essay deepens our understanding of firms' debt maturity decisions from a dynamic perspective and sheds new light on two particular channels of the financial crisis, i.e. the herding and the short debt maturity persistence. Note that the evidence obtained in this study coincides with several strands of the prior literature, i.e., the significance of the peer effect in influencing firms' financing decisions (Mackay and Phillips (2005), and Leary and Roberts (2014)), the puzzle of debt maturity shortening (Custódio et al. (2013), Harford et al. (2014)), and the persistence and convergence in capital structure (Lemmon et al. (2008) and Chen (2010)).

[4] We sincerely thank Patrick Navatte for guiding us to this novel measure for debt maturity.

Chapter 3 addresses an issue that has been topical in capital structure studies but largely neglected in debt maturity research, that is, the market timing of long-term debt issuance subsequent to temporary market over-evaluation (the only exception is Fama and French (2012)). Note that for the sake of contrast, the herding force is also incorporated in this study. The main hypothesis we test is that firms are likely to time long-term debt issuance when their securities are temporarily overvalued relative to their fundamentals. Fama and French (2012) examine the debt maturity timing pattern by making inferences from the price-to-book ratio. We however note that the information conveyed by the price-to-book ratio can be mixed. High price-to-book can not only reflect high growth option but market overvaluation as well. Note that market timing and agency models predict the price-to-book ratio in exactly opposite directions. To be more specific, when a firm's price-to-book is high, market timing models imply that the firm issue long-term debts in order to exploit market overvaluation, whereas agency models imply that the firm issue short-term debts for the purpose of mitigating underinvestment problems. To account for this source of bias, we disentangle mispricing from growth option by measuring the latter with a firm's past and future external finance weighted average market-to-book following Hovakimian (2006). Moreover, we extend the constrained regression model of Fama and French (2012) for the split of liabilities between short-term and long-term to a system of three regressions for the allocation of liabilities between short-term, long-term financial debts and operating liabilities. To do so, we take into account the difference between financial and operating liabilities and the need of debt retirement/refinancing. Different from Fama and French (2012) who find inconclusive evidence of debt maturity timing, our results display that stock misevaluation plays a significant part in debt maturity decisions of big and financially flexible firms (while not in those of small and constrained firms). Last but not least, our results indicate that, intra-industry debt maturity herding

behavior prevails in a group of firms with small size. For big firms, the timing outperforms the herding during significant debt financing periods. Above all, these findings improve our knowledge about how managerial attempts of timing market misevaluation are related to debt maturity decisions. In addition, this study presents a methodological contribution by separating miscellaneous operating liabilities from financing debts and accounting for debt refinancing needs.

As a whole, our dissertation adds to a growing capital structure literature considering the dynamic nature of firms' financing decisions (e.g., Fischer et al. (1989), Flannery and Rangan (2006), Strebulaev (2007), Byoun (2008), Frank and Goyal (2009), Hovakimian and Li (2011), and Faulkender et al. (2012)) and the significance of maturity risk for constrained firms (Almeida et al. (2009), Duchin et al. (2010), He and Xiong (2010a, 2010b), Gopalan et al. (2010), Diamond and He (2014)).

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Table 1 Summary of the main theoretical and empirical findings on conventional debt maturity determinants

	Theoretical Findings			Empirical Findings			
Determinants	Positive	Negative	Non-monotonic	Positive	Negative	Non-monotonic	Mixed
Size	Agency model/Liquidity Risk Model	N.A.	Information Asymmetry and Liquidity Risk Model	Barclay and Smith (1995), Stohs and Mauer (1996)	Scherr and Hulburt (2001)	Guedes and Opler (1996) , Barclay et al. (2003), Johnson (2003), Datta et al. (2005) , Billet et al.	N.A.
Leverage	Liquidity Risk Model	Agency model	N.A.	Stohs and Mauer (1996), Scherr and Hulburt (2001), Johnson (2003), Datta et al. (2005) , Brockman et al. (2010), Custódio et al. (2013)	Barclay et al. (2003), Johnson (2003), Billet et al. (2007), Billet et al. (2007)	N.A.	N.A.
Credit Quality	N.A.	Information Asymmetry Model	Information Asymmetry and Liquidity Risk Model	N.A.	Mitchell (1991)	Barclay and Smith (1995), Stohs and Mauer (1996),	N.A.
Term Structure	Tax Model	Market Timing Model	N.A.	Johnson (2003)	Barclay and Smith (1995), Guedes and Opler (1996), Datta et al. (2005), Custódio et al. (2013)	N.A.	Stohs and Mauer (1996), Billet et al. (2007), Brockman et al. (2010)

Table 1 *(Continued)*

	Theoretical Findings			Empirical Findings			
Determinants	Positive	Negative	Non-monotonic	Positive	Negative	Non-	Mixed
Asset Maturity	Agency model/Liquidity Risk Model	N.A.	N.A.	Stohs and Mauer (1996), Scherr and Hulburt (2001), Brockman et al. (2010)	N.A.	Guedes and Opler (1996)	Datta et al. (2005), Billet et al. (2007), Custódio et al. (2013)
Growth Option	N.A.	Agency model	N.A.	Stohs and Mauer (1996), Datta et al. (2005)	Barclay and Smith (1995), Guedes and Opler (1996)	N.A.	Scherr and Hulburt (2001), Johnson (2003), Billet et al. (2007), Brockman et al. (2010), Custódio et al. (2013)
Abnormal Earnings	N.A.	Information Asymmetry Model	N.A.	N.A.	Mitchell (1991), Barclay and Smith (1995), Stohs and Mauer (1996), Johnson (2003), Billet et al. (2007)	N.A.	Guedes and Opler (1996), Datta et al. (2005), Brockman et al. (2010), Custódio et al. (2013)
Age	Information Asymmetry Model	N.A.	N.A.	Custódio et al. (2013)	Scherr and Hulburt (2001)	N.A.	N.A.
Asset Volatility	N.A.	Liquidity Risk Model	N.A.	N.A.	Barclay and Smith (1995), Guedes and Opler (1996), Datta et al. (2005), Billet et al. (2007)	N.A.	Stohs and Mauer (1996), Brockman et al. (2010), Custódio et al. (2013)
Cash	N.A.	Liquidity Risk Model	N.A.	Custódio et al. (2013)	Harford et al. (2014)	N.A.	N.A.

Chapter 1

On Debt Maturities of Firms and Refinancing Risk: A Consideration of Heterogeneous Effects and Extreme Cases

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Abstract

This paper investigates the research question of whether the previously identified factors affect debt maturity choices of the short maturity firms in the same way as the long maturity firms. We find great disparities in the effects of conventional factors across the debt maturity distribution, especially for firms present at the lower and the upper percentiles. This pattern can be explained by the refinancing risk channel. Constrained firms who are heavily reliant on short-term debts find refinancing risk so binding that they fail to respond readily to the conventional financial frictions. In an attempt to alleviate refinancing risk, relatively flexible firms with large cash reserves are able to borrow at the short-end of the debt maturity spectrum. Conversely, flexible firms who are greatly reliant on long-term debts have minor refinancing pressure, hence would display more interest in gaining cost advantage from short-term public credit programs. Furthermore, we discern that the disparities between debt maturity and the common debt maturity factors are substantial for firms who have access to public credits. The pattern is accentuated if we consider the upper and lower tails of the debt maturity distribution. Note that this paper provides a novel perspective of examining heterogeneous effects of conventional determinants over the debt maturity range and drawing particular implications in the extreme cases.

Keywords: Debt maturity structure; extreme cases; effect attenuation; conditional quantile regression

JEL Classification: G3

1.1. Introduction

Recent research documents a downward trend in debt maturities of U.S. firms over the last three decades (Custódio et al. (2013)). Notably, we show that one out of ten U.S. non-financial non-utility firms during the period 1986-2010 adopts extremely short debt maturity policies, with their assets totally financed by short-term debt maturing in one year.

The employment of short-term debt is however not costless. Reliance on short-term debt subjects a firm to higher rollover cost when the firm suffers from temporary business downturn or if interest rate increases. In the case of a credit crunch, excessively short debt maturity intensifies refinancing risk, distorts investment incentives, increases information asymmetry premium, and can even lead to early liquidations (see e.g., Almeida et al. (2009), Duchin et al. (2010), Gopalan et al. (2010), He and Xiong (2010b), and Diamond and He (2014)). The meltdown of Bear Stearns and Lehman Brothers are two typical examples.

Excessively long debt maturity can also impose adverse outcomes. In particular, agency theories advocate that long-term debt induce severe debt overhang. For firms with valuable investment opportunities, long-term debt over-hang at the moment of exercising growth options creates incentives for firms to forgo profitable projects, for otherwise the future benefits of growth options go to the creditors (Myers (1977)). Besides, long debt maturity inclines firms to take on risky projects at the cost of creditors. To compensate for the potential loss from this risk-shifting behavior, creditors request ex ante a higher rate of interest, that is, the cost of "asset substitution" (Barnea et al. (1980) and Leland and Toft (1996)).

Then why firms continue to use excessively short-maturity debt even if it exposes them to high refinancing risk? Analogously, why do some firms rely heavily on long-term debt if it leaves them vulnerable to high agency costs? The explanation can be twofold.

On the one hand, debt maturity choice of a firm may be passive rather than active, especially for those employing extreme debt maturity policies. Custódio et al. (2013) own the recent debt maturity shortening to the booming new listings in the 1980s and the 1990s, representing a group of small firms suffering from high information asymmetry. Based on an equilibrium model for the effect of bank runs (that is, the dynamic coordination among multiple creditors concerning the decisions of debt rollovers and liquidations), Brunnermeier and Oehmke (2013) derive that short debt maturity is a result of maturity rat race among multiple creditors. They further come up with a conclusion that the derived short debt maturity is actually inefficient.

On the other hand, to make debt maturity decisions, firms may be concerned only with the most relevant friction(s). A recent literature review of Graham and Leary (2011) underlines the non-monotonic effects of conventional financial structure determinants. "A given market friction may be a first-order concern for some type of firms, but of little relevance to others", as Graham and Leary (2011) contend. Firms that are heavily reliant on short-term debts are likely to have more complications. Especially, it is likely that the refinancing risk outweigh or/and intensify the other debt maturity related risks in short debt maturity extremes. Long debt maturity firms can be considered as the opposite to short debt maturity firms in terms of refinancing risk exposure. Intuitively, they shall show less concern for refinancing risk. Allowing for the low refinancing needs, they shall show stronger incentives of issuing short-term debts to confront agency dilemma or to

borrow cheaper through commercial paper program or when short-term interest rates are low relative to long-term rates.

Above all, it implies that the effects of conventional debt maturity determinates are non-monotonic across the debt maturity spectrum. Distinct risk structures are likely to be embedded in the extreme cases, with the short extreme case more related to refinancing risk and the long extreme case more related to incentive provisions. Existing studies that have estimated the average (mean) effects of debt maturity factors, combining inherently the magnitudes of effects upon various parts of the debt maturity distribution, may miss important causal impacts. As an example, researchers usually model the average effect of growth options as a negative function of debt maturity. If agency problems are more prevalent than refinancing issues, there is a reason to believe that the negative effect of growth option at the lower debt maturity percentiles shall be substantially higher than on average or at median. Yet, it could also be the case that the negative effect of growth option is attenuated in the lower part of the debt maturity distribution if the refinancing cost dominate over the agency cost at the lower percentiles, most probably for constrained firms. Truly, Leland and Toft (1996) infer that firms with more growth opportunities do not necessarily employ short term debt, since in most cases, they have not only greater operating risk but also higher bankruptcy costs.

Taken together, we ask *"do the previously identified factors affect debt maturity choices of the short maturity firms in the same way as the long maturity firms?"* To the best of our knowledge, this is the first attempt ever made to address the heterogeneous effects of debt maturity determinants, especially from the perspective of extreme cases.

To address this question, we adopt the conditional quantile regression, modeling the conditional quantiles of debt maturity with a standard set of previously identified factors that are believed influential to debt maturity decisions. To correct the potential bias due to correlated residuals across firms, we follow Machado et al. (2013) to calculate asymptotically valid standard errors under heteroscedasticity and intra-firm correlation. Confining our attention to the lower and the upper tails of the distribution, we show that the pre-documented factors do influence firms' debt maturity decisions on the whole, whereas the relations depend fundamentally on debt maturity levels and firms at the top and the bottom of the distribution exhibit distinctive patterns.

Particularly, more prominent effect heterogeneities are observed in debt maturity extremes for conventionally investigated determinants, such as firm size, asset maturity, leverage ratio and growth options. For example, we find that firms present at the short and the long end of the maturity spectrum slow down their pace in employing long-term debts when growing in size, lengthening in asset maturity and taking on more debts. The negative effects of growth option and short-term credit access on debt maturity are found on average and at median. However, the magnitude of the effect is higher in the upper side of the conditional debt maturity distribution. This pattern can be explained by the refinancing risk channel. Specifically, refinancing risk in short debt maturity extremes can be so binding that firms may fail to take timely actions in response to relevant frictions. On the other hand, firms who have debts maturing in the far future have low refinancing need and therefore may not treat refinancing risk seriously. Instead, other concerns may take place, for instance, about borrowing cheaper.

Additionally, the effects of certain factors even change signs as the quantile increases. Age plays a positive role at the lower debt maturity quantiles but a negative role at the upper

quantiles. For financially flexible firms, asset volatility is negatively related to debt maturity upon the most parts of the conditional debt maturity distribution while showing positive signs at the lowest quantile, perhaps to prevent early liquidations. Moreover, our evidence corroborates Harford et al. (2014) who maintain that large cash reserves enable firms to utilize short-term debt through its role of reducing refinancing risk. Specifically, significantly negative correlation between cash holdings and debt maturity is observed at the lower conditional percentiles. We further show that the pattern is reversed at the long end of the maturity spectrum. Firms shorten debt maturity to a greater extent if they are older, have access to short-term public debt market and when short-term debt is cheaper relative to long-term debt. These results support well our intuition concerning the vital (secondary) role of refinancing risk in short (long) debt maturity extremes.

A further investigation reveals the role of credit access in moderating the above pattern. Firms with sufficient credit access behave very different from firms with limited credit access, i.e. those who are heavily reliant on bank loans. In particular, the previously found effect disparities are accentuated for firms with public credit access. Firms with high market-to-book and future abnormal earnings have substantially shorter debt maturities in the lower tail than at median and in the other parts of the conditional distribution. This is also true when we consider a group of highly leveraged firms. By sharp contrast, high market-to-book firms who borrow heavily show longer debt maturities in the higher tail. These results suggest that refinancing risk for firms with flexible credit access is not as binding as for those with limited access, even in the short extremes. Cash plays a negative role at the left tail of the distribution in the forgoing analysis. Nevertheless, this evidence reverses when we consider a group of firms with high leverage ratios. In this case, it indicates the dominance of refinancing risk which could not be alleviated by reserving

cash. Note that these results fit well into the line of literature which emphasizes the significance of credit access in influencing firms' financial decisions (see e.g., Faulkender and Petersen (2006), Rauh and Sufi (2010), and Sufi (2007, 2009)).

Overall, our findings are robust after considering the endogeneity between leverage and debt maturity, firm fixed effects, alternative measures for debt maturity and conventional determinants, and remain reliable after including non-US incorporated firms and American Depositary Receipt.

The remainder proceeds as follows. Section 1.2 reviews the related literature. Section 1.3 defines the variables of interest and develops the empirical model. Section 1.4 describes the data. Section 1.5 presents empirical results on the effects of conventional factors across the debt maturity distribution. Section 1.6 empirically addresses the role of credit access in moderating the effects of conventional factors across the debt maturity distribution. Section 1.7 provides robustness checks. Section 1.8 concludes.

1.2. Related literature

1.2.1. Factors influencing debt maturity decisions of firms

On the basis of the different theoretical predictions, researchers have investigated a set of factors presumably influencing corporate debt maturity choices. Generally, the literature predicts positive signs on firm size, age, leverage, asset maturity, long-term public credit access, and negative signs on growth option, future abnormal earnings, asset volatility, short-term public credit access, cash holdings and the term structure of interest rate[5].

[5] Note that we do not exhaust the factors investigated in the existing studies. Instead, we discuss the mainstreams.

Myers (1977) argues that with a long-term debt over-hang at the moment of exercising growth options, firms possibly forgo profitable projects, for otherwise the future benefits of growth options will at least go partly to the creditors. To mitigate this underinvestment problem, firms shall match the maturities of their assets and debts or finance the assets-in-place with debts maturing before the growth options will be exercised. Big firms have relatively low business risk and are less likely to suffer temporary losses. As they are considered by creditors as less risky, they are able to employ more long-term debts. Reputable old firms with close firm-bank ties are less likely to be severely affected by asset substitution. They are thus more capable of obtaining long-term loans.

Under severe information asymmetry, firms with future abnormal earnings would choose to issue short-term debt in the interest of signaling their prospects (see Flannery (1986), Kale and Noe (1990)). On the other hand, overloading of debt burdens brings firms to favor long-term debts for the sake of hedging against liquidity risk (Diamond (1991), Morris (1992), Leland and Toft (1996) and Jun and Jen (2003)). Low asset volatility encourages creditors to lend more and longer (Kane et al. (1985) and DeMarzo and Sannikov (2006)). For a firm with great volatility, a succession of short-term lending helps creditors to evaluate fairly the firm's creditworthiness.

Faulkender and Petersen (2006) and Sufi (2007, 2009) highlight the importance of debt fund availability to financing decisions. They maintain that there is a tendency for firms with access to the public credit market to use more public debts. And due to the fact that the maturities of public debts are generally longer than those of bank loans, debts issued by firms with access to long-term public credit have relatively longer maturities than those without access. Some concern the prevalence of commercial paper, a low-cost debt device alternative to bank line of credit. The low-cost feature makes it particularly

preferable for firms with great financial flexibility and little concerns for refinancing risk. All else equal, firms with commercial paper programs, hence short-term public credit access, would have an inclination towards short-term debts.

Harford et al. (2014) report that refinancing risk induced by debt rollover can be mitigated by holding large cash reserves. Particularly, they find that the marginal value of cash is higher for short debt maturity users. When debt market deteriorates, firms are able to pay down maturing debts with reserved cash without tapping capital markets. In this regard, cash holdings serve as a hedge device against refinancing risk.

Market conditions models establish that for the purpose of seizing opportunity windows of favorable financing conditions, firms issue short-term debts "when short-term interest rates are low compared to long-term interest rates" and "when waiting for long-term market interest rates to decline", rationally or not.

Empirically, all these propositions have gained some support, however great inconsistency has been detected from one paper to another. Notably, researchers disagree over basis facts. Two of the most influential papers, Barclay and Smith (1995) and Guedes and Opler (1996), provide evidence that U.S. firms attempt to mitigate underinvestment problems by using short-term debts. Nevertheless, Stohs and Mauer (1996) report noisy results after adopting a weighted average measure for debt maturity. Evidence on information signaling is also puzzling. Mitchell (1991) demonstrates that firms with profitable projects issue short term-to-maturity bonds when confronted with severe information asymmetry problems between shareholders and creditors. Yet, Barclay and Smith (1995), Stohs and Mauer (1996) and Guedes and Opler (1996) find either statistically insignificant or economically negligible effects. The evidence of the liquidity

risk model is less contradictory, but still the literature shows slight inconformity. Mitchell (1993) finds that firms with higher bond ratings are more likely to issue debts with short maturities. In contrast, Guedes and Opler (1996) show that firms with investment-grade ratings issue debts with both short and long maturities and that firms with speculative-grade ratings issue medium-term debts. The empirical results on tax models are even conflicting. The coefficients on the term structure of interest rates are reported by Barclay and Smith (1995) and Stohs and Mauer (1996) in the wrong direction (negative). Guedes and Opler (1996) find no effect of taxation on debt maturity decisions of firms. The empirical results on the effect of cash are also inconclusive. Specifically, the evidence in Harford et al. (2014) confirms the negative role of cash holdings in debt maturity, whereas Custódio et al. (2013) and Brick and Liao (2013) find positive relationships between the two.

1.2.2. Extreme debt maturity and refinancing risk

Recent research documents an important debt maturity shortening phenomenon. Custódio et al. (2013) address the question of why U.S. firms are using more short-term debts and attribute the downward trend to the booming of small size firms with high information asymmetry. Sufi (2007) turns to the supply-side effect. He finds that the shortening of debt maturities is due to the growth of the syndicated loan[6] market. The arrangement of a syndicated debt shares the risk across multiple creditors, leading to a shorter maturity. Brunnermeier and Oehmke (2013) argue that a borrower who cannot commit to an aggregate maturity structure has an incentive to shorten the maturity of an

[6] Syndicated debt, by definition, is issued by a syndicate of investors which can include multiple banks or/and financial institutions.

individual creditor's loan for it dilutes the value of the remaining creditors. Therefore, in equilibrium, all the creditors shorten maturity dates of their contacts.

Nonetheless, short-term debt is not a free lunch. A firm who finances a great portion of its assets with short-term debts is confronted with high refinancing risk (e.g., Diamond (1991, 1993), Diamond and Rajan (2001), Diamond and He (2014)). Due to high rollover frequency, the firm is likely to find itself trying to refinancing at an inappropriate time when interest rates are high. If the situation worsens to the extent that the firm is unable to pay off the maturing debts, it might have to sell off its assets at cut-throat prices. In the worse-case scenario, creditors underestimate the fundamental value of the firm and choose to liquidate it early. Indeed, Brunnermeier and Oehmke (2013) argue that the extremely short debt maturity driven by the "maturity rate race" is actually costly and inefficient.

Diamond (1991) is the first to address the refinancing issue considering its effect on debt maturity choices of firms. Expanding Flannery (1986)'s asymmetric information model, he considers the situation that creditors refuse to roll over maturing short-term debts for high-risk firms. Naturally, high-risk firms opt for long-term debt to prevent from refinancing debts in hard times. Yet, for extremely high-risk firms, they are screened out of the long-term debt market due to excessive asset substitution risk. Altogether, he predicts a non-monotonic relation between debt maturity and credit risk. In a dynamic global-games setting, He and Xiong (2012a) model a firm with time-varying fundamental, who finances its long-term assets by rolling over short-term debts with several creditors. The maturity dates of the firms' short-term debt spread out across time. The creditors face a risk that 1) the firm fails to commit to the subsequent debt contract; 2) the future creditors refuse to roll over the maturing debts. In closed form, they derive a unique safety

threshold considering dynamic coordination among creditors. They show that as long as the current fundamental of the firm is above the threshold, each creditor chooses to roll over the maturing debts. Further, He and Xiong (2012b) emphasize the impact of short debt maturity in intensifying rollover risk in credit crunch. They find that the conflict of interest between credit holders and equity holders deepens in crisis periods, forcing firms into early liquidations. To the extent that the losses firms suffer from rolling over maturing debts are absorbed by equity holders and not by debt holders, firms opt for early default.

An alternative literature argues that rolling over large amount of short-term debts at the time when a firm is suffering temporary business downturns or/and facing high interest rates can also distort the firm's investment incentives. Different from classical agency models which predict long-term debt overhang (e.g. Myers (1977)), Diamond and He (2014) contend that short-term debt may impose even stronger overhang than long-term debt does. Particularly, Diamond and He (2014) criticize that treating short-term debt as riskless is the fatal defect in previous research.

Empirically, Almeida et al. (2009) and Duchin et al. (2010) provide evidence that firms with an overload of debts maturing at the onset of the 2007/2008 crisis are more likely to forgo valuable investment opportunities. Hu (2010) finds significantly higher credit spreads for these firms. Acharya et al. (2011) show that high rollover frequency results in diminishing collateral value and debt capacity.

To sum up, the existing literature suggests inherent risk embedded in extreme debt maturity cases, especially on the short end of the spectrum. Using short-term debt mitigates incentive provisions. However, excessive reliance on short-term debt

exacerbates liquidity risk. Long-term debt alleviates refinancing risk, but excessive reliance on long-term debt can result in severe debt overhang.

1.2.3. Heterogeneous Effects of Debt Maturity Determinants

The implication of the extreme debt maturity can be projected onto the contingency of financial frictions. As Graham and Leary (2011) suggest, a specific friction can be a primary concern under certain circumstance but have no importance in other contexts. To put it simply, debt maturity decisions depend on the financial friction(s) firms are most concerned about.

Firms who finance a large portion of their assets with short-term debts should be much more concerned about the liquidity issue. As soon as they are unconstrained, they shall show more interest in matching the maturities of assets and liabilities. In the case that debt is the main source of funds, they would naturally incline toward long-term debt, given the probability of insolvency (Geanakoplos (2010)). When their assets become volatile, they would negotiate with their creditors to obtain long-term debts to hedge against early liquidations. Those with long-term credit access would naturally have a strong tendency for long-term debt. Accounting for the high asset substitution risk caused by short debt maturity, big firms will be valued by creditors to a greater degree as they are less likely to encounter business hazards. Alternatively, creditors would be more ready to offer better terms and conditions (e.g. longer loan maturity) for old firms with close bank relationships. Considering high refinancing risk, the signaling incentive shall play a smaller role at the short end of the debt maturity distribution than in the long end. The inverse relationship between cash holdings and debt maturity shall be more pronounced for firms with high refinancing risk, that is, firms who have a large portion of debts maturing in the near future.

In an analogous manner, firms present at the higher debt maturity quantiles shall care less about refinancing needs but are more likely to come across severe debt overhang. As a consequence, they shall show more concern for agency dilemma. Besides, allowing for the low refinancing frequency and therefore low liquidity risk exposures, they shall have stronger incentives of issuing short-term debts in the interest of borrowing cheaper, e.g. through commercial paper program, lower short-term interest rates relative to long-term interest rates or waiting for the long-term interest rates to decline. Furthermore, with trivial rollover risk, the negative relation between cash holdings and debt maturity is expected to weaken, disappear or even reverse.

It indicates that the direct effects of firm age, size, asset maturity, leverage and long-term public credit access as predicted by classical models shall decrease along the debt maturity spectrum, while the inverse impacts of growth option, asset volatility, future abnormal earnings, term structure, and short-term public credit access shall increase along with the debt maturity level.

Nonetheless, it worth noting that these expected relationships at both tails of the debt maturity distribution would only occur when firms are not constrained and concerned about the relevant frictions as discuss above. In other words, the above pattern is only expected to take place in an active manner. Be that as it may, this just shows the contingent role of financial frictions and thus the heterogeneity in their effects on debt maturity.

On the basis of the above, we generally hypothesize that the relevance of the conventional financial frictions varies with debt maturity levels. Liquidity problems are expected to be more binding in short debt maturities while becoming secondary in long debt maturities.

1.3. Methodology

1.3.1. Variables

1.3.1.1. Debt maturity structure

In the literature, two major approaches are employed to measure the maturity structure of debt: the balance sheet approach and the incremental approach. The balance sheet approach, which is most commonly used, defines maturity structure of a firm's overall debt as either the percentage of liabilities with certain maturities (e.g., Barclay and Smith (1995), Barclay et al. (2003), Johnson (2003), Billet et al. (2007)) or the weighted average maturity (e.g., Stohs and Mauer (1996), Saretto and Tookes (2011), Chen et al. (2012)). The incremental approach measures debt maturity as the term-to-maturity of new debt issues (e.g., Mitchell (1991), Guedes and Opler (1996), Berger et al. (2005)). One of the main advantages of this approach is to provide the possibility of examining the interplays between the maturity structure and the other features of debt contracts, such as call and put provisions, sinking funds, redemption schedules and debt covenants (e.g., Mitchell (1991), Guedes and Opler (1996), Billet et al. (2007) and Barry et al. (2008)). However, one should interpret the resulting findings with caution because one-shot debt issuance does not necessarily reflect a firm's unalloyed financing intent. Focusing on a specific type of debt is obviously inadequate considering that firms usually use a combination of both public and private debts. As a proof, Billett et al. (2007) find that a firm's total debts reported in COMPUSTAT exceeds its aggregate debt issues in Fixed Investment Securities Database (FISD). Similarly, Rauh and Sufi (2010) show that a majority of firms in their sample use bank loans as well as non-bank debts. Besides, concrete term-to-maturity decisions are, in most cases, less relevant for firms in comparison with short- versus long-term debt choices. For instance, once a firm has decided to enter the long-term bond

market, it may be indifferent between issuing a 10-year bond or a 15-year bond. We thereby ground our research on the balance sheet approach. Prior studies on debt maturity determinants define long-term debts as the financial obligations that are to come due in more than one year (e.g., Scherr and Hulburt (2001), Antoniou et al. (2006) and Fan et al. (2012)), three years (e.g., Barclay and Smith (1995), Barclay et al. (2003), Johnson (2003), Datta et al. (2005), and Billet et al. (2007)) or five years (e.g., Ozkan (2000) and Datta et al. (2005)). Measures of this type are, however, suspicious to bias as debts with maturities below and over the definition threshold are treated as homogeneous, which is not the real case. To address this issue, we construct a value weighted debt maturity structure. Precisely, debt maturity is defined as the value weighted average life for a firm's total debts, as calculated in formula (1.1) below.

$$DMAT = \sum_{i=1}^{5} \frac{Debt_i}{Tdebt} \times Duration_i + \frac{(Tdebt - \sum_{i=1}^{5} Debt_i)}{Tdebt} \times Duration_r \quad (1.1)$$

Where DMAT represents the value weighted average debt maturity structure of a firm, $Debt_i$ represents the amount of financial debts payable in year i for i≤5. *Tdebt* refers to the amount of total financial debt, which is calculated as the sum of total long-term debts and debts in current liabilities. Note that we exclude operating and miscellaneous liabilities to measure DMAT.

Duration of a financial asset is defined theoretically as the weighted average length of time until all payment streams generated by the asset are received. It takes into account the elasticity of the bond price to interest rate and identifies the "actual" weighted length of time needed to recover the current cost of the bond (Copeland et al. (2005)). Due to the fact that we work on balance sheet data, we have no sufficient information (e.g., payment schedules) to calculate the real durations of all the debts employed by a firm. But at least

we know that the duration of a debt should always be shorter than the time-to-maturity except for zero-coupon bonds. Reasonably, we follow Jun and Jen (2003) and Chen et al. (2012) to assume that the average durations of a firm's debts payable in year 1,2,3,4,5 (denoted by $Debt_1$, $Debt_2$, $Debt_3$, $Debt_4$, $Debt_5$) are 0.5, 1.5, 2.5, 3.5 and 4.5 years respectively, denoted by $Duration_i$ for i ≤5. For the rest of debts, we assign them an average duration of 10 years, denoted by $Duration_r$. This measurement may be less accurate than the term-to-maturity measure. But it is more efficient in describing the overall maturity profile of a firm's debt usage and is much more precise compared to the regularly used long-term debt proportion measure.

1.3.1.2. Debt maturity factors

We examine a standard set of factors assumably influencing debt maturity choices of firms, including firm size, age, leverage, asset maturity, growth options, future abnormal earnings, asset volatility, credit access, cash holdings and the term structure of interest rate.

Specifically, to remove the effect of over-time growth in stock market, we infer a firm's relative size from Fama and French (2001)'s NYSE percentile. Precisely, we estimate firm size as the percentage of NYSE firms that have the same or smaller market capitalization. Firm's CRSP listing years is used to measure firm age. We calculate book leverage (the ratio of a firm's total debt outstanding to book assets) instead of market leverage, following the argument that market leverage could be spuriously correlated with other explanatory variables, such as growth options (e.g., Rajan and Zingales (1995) and Graham and Harvey (2001), Barclay et al. (2006)). For asset maturity, we follow the formula of Stohs and Mauer (1996) to compute the weighted average maturity of current and long-term assets. To capture the growth options of firms, we resort to two variables:

the market-to-book ratio and the R&D ratio. The former is calculated as book value of total assets minus book value of common equity plus market value of common equity, all divided by book value of total assets. The latter is the fraction of a firm's R&D expenses to total book assets. Further, to measure managerial anticipation of a firm's future prospect, we use the firm's future abnormal earnings. We calculate a firm's idiosyncratic volatility, subtracting the industry-level asset volatility (the medium asset volatility of Fama-French 48 industry). We proxy for firms' public credit access with reference to Standard and Poor's domestic long- and short- term issuer credit ratings. Cash holdings of firms are measured as the ratio of cash and short-term investment to total book assets. The term structure of interest rates is calculated as the yield spread on 10-year U.S. T-bond and 3-month U.S. T-bill. All the variables are defined in Table 1.1.

[Insert Table 1.1 about here]

1.3.2. Empirical specification

The general idea of the paper is to reconsider the debt maturity determinants issue by asking whether the previously identified factors, such as underinvestment and liquidity risk affect debt maturity choices of the long maturity users the same way that the short maturity users are affected. To answer this question, we refer ourselves to the quantile regression technique ((hereafter QR)), developed by Koenker and Bassett (1978).

QR addresses the relationships between a response variable Y and a set of covariates X over the whole range of the conditional distribution function of Y. The ability of offering a much more complete picture of the relationship between X and Y sets it apart from the conventional least squares estimation method which simply plots the group means. Specifically, focusing on the central tendency of a response variable's distribution, OLS

estimates how the covariates X influence the response variable Y on average. In cases that other quantiles of Y are of interest, OLS is incapacitated while QR becomes desired (Koenker and Bassett (1978)). In this regard, QR suits perfectly our research context.

The economic framework of QR is expressed as follows.

Consider a random variable Y with probability distribution function

$$F\ (y) = P(Y \leq y) \tag{1.2}$$

The θ^{th} quantile of Y conditional on the covariates X is defined as

$$Q_\theta(y|x) = \ \inf\{\text{y: F}\ (y|x) \geq \theta\} \tag{1.3}$$

Assuming that the θ^{th} quantile of the conditional distribution of Y is linear in X, then

$$Q_\theta(y|x) = \ \text{x}\beta_\theta \tag{1.4}$$

where β_θ is the parameter to be estimated for the θ^{th} quantile ($0 < \theta < 1$).

Errors for quantile θ, denoted as ε_θ are assumed to have

$$Q_\theta(\varepsilon_\theta|x) = 0 \tag{1.5}$$

Different from OLS estimation that solves the problem of minimizing a sum of squared residuals, QR solve the problem of minimizing the symmetry (median) or asymmetry (other quantiles) weighted sum of absolute errors as stated below

$$\min \sum_{i=1}^{n} \rho_\theta|y_i - x_i\beta_\theta| = \ \min \sum_{i=1}^{n} \rho_\theta|\varepsilon\ | \tag{1.6}$$

$$\text{where } \rho_\theta(\varepsilon) = \begin{cases} \theta\varepsilon & when\ \varepsilon\ \geq 0 \\ (\theta - 1)\varepsilon & when\ \varepsilon < 0 \end{cases} \tag{1.7}$$

The QR estimator does not have an explicit expression form but linear programming such as simplex, interior point and smoothing algorithm can solve the problem quite efficiently (see Koenker and Basset (1978)).

There is a growing literature in empirical finance employing QR methods. Most has been dedicated to address the issue of value at risk (Bassett and Chen (2001)). QR methods are surprisingly underdeveloped in capital structure research, despite the fact that great disparity is found in firms' financial structures. For instance, Strebulaev and Yang (2013) underline a phenomenon concerning the presence of a crowd of zero-leverage firms. In terms of debt maturity, Guedes and Opler (1996) have attempted to address the uneven effects of debt maturity determinants. They classify new debt issuance into several maturity categories and next running multinomial logit regressions. Their results show substantial differences relative a baseline group of issues with short maturities. Although their method helps to explore the extreme cases to a certain degree, truncating the dependent variable into subsets treats firms within categories as homogeneous and throws away useful information. As is clearly put by Heckman (1979) and Koenker and Hallock (2001), this type of analysis which is based upon the unconditional distribution in nature would yield a common bias, known as "the sample selection bias".

In an effort to address the question of whether conventionally investigated debt maturity factors influences debt maturity choices of firms the same way across the debt maturity spectrum, we estimate the conditional debt maturity quantile regression at the θ^{th} quantile as follows,

$$Q_\theta\left(DMAT_{i,t}\middle|X_{i,t-1}\right) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} +$$
$$\beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} +$$

$$\beta_{10\theta} ACCESS\_S_{i,t-1} + \beta_{11\theta} TERM_{i,t-1} + \beta_{12\theta} CASH_{i,t-1} + \beta_{13\theta} CONSTRAINT_{i,t-1} +$$

$$\beta_{14\theta} CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta} CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \dots, n \quad t = 1, \dots, T \tag{1.8}$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1. We include a dummy variable for financially constrained firms and its interactions with asset volatility and cash holdings, allow for different attitudes of financially constrained and unconstrained firms in response to fundamental volatility and cash policies. Specifically, firms are sorted and categorized into three groups using the 30% and the 70% cutoffs of Altman's Zscore. Firms present in the bottom 30% are identified as financially constrained. All the explanatory variables are lagged one period allowing for delays in firms' financing decisions. The only exception are firms' future abnormal earnings, on the grounds that it proxies for managerial anticipation for future prospects rather than past returns.

In light of the properties of datasets (i.i.d./non i.d.d., large/small sample size), standard errors and confidence intervals for the parameter β_θ can be computed using either Koenker or Basset's asymptotic method or bootstrapping method (e.g., Buchindky (1995), Buchindky (1998)). Although instructive, these estimation methods fail to capture the specific features of panel data. The dataset employed in this paper contains observations for the same firm over multiple years. It is therefore possible that the debt maturities of a given firm are correlated across time[7]. In particular, the renowned work of Petersen (2009) brings the attention of empirical finance researchers to the essentiality of properly treating the cross-sectional and the time-series residual dependence related to panel data.

[7] We sincerely thank Eric De Bodt for drawing our attention to estimating robust standard errors considering the fact that the residuals are correlated across firms for panel data.

Given this specificity, a recent research of Machado et al. (2013) estimates asymptotically valid standard errors under heteroscedasticity and intra-cluster correlation. Following their estimation strategy, we calculate clustered standard errors which are robust to intra-firm correlations.

1.4. Data

1.4.1. Sample

Our sample is drawn from CRSP/Compustat Merged Database. Compustat PERMNO-PERMCO-GVKEY link is used to merge CRSP, COMPUSTAT and Rating Data. Market-specific information is acquired from the Federal Reserve Bank of St. Louis database. Similar to other debt maturity studies, we confine our sample to U.S. publicly traded non-financial non-utility firms. Precisely, we exclude firms with primary Standard Industrial Classification codes 6000-6999 (Finance, Insurance and Real Estate) and 4900-4999 (Electric, Gas, and Sanitary Services). To avoid noisy findings due to the existence of non U.S. based firms in the sample, we eliminate firms which are listed on U.S. stock exchanges but incorporate and operate in other countries. In this case, debt maturity decisions of firms can be greatly influenced by the domicile country's institution. Accordingly, American Depositary Receipt (ADR) are eliminated. Our sample period begins in 1986 and ends in 2010.

To concentrate on firms' debt maturity decisions, we discard firm-year observations with zero debt outstanding and observations with incomplete debt maturity information. Further, we remove observations where leverage values are inferior to 0 or superior to 1. Note that quantile regression is robust to extreme points in the response variable rather than in the covariates. We thereby winsorize all the explanatory variables at the 1st and 99th percentiles. The final sample is comprised of 7734 firms with 47161 firm-year

observations. The panel is unbalanced and not all firms are present in all of the observation years.

Table 1.2 checks the over-time distribution of firms by size. To isolate the effect of the general growth of U.S. stock market and to allow for a year-by-year comparison, we measure the fraction of a firm's market capitalization to the total market value of CRSP US total market index[8]. Firm-year observations are pooled and then sorted into size deciles for the whole period 1986-2010. For a specific size decile and a given sub-period (1986-1989, 1990-1994, 1995-1999, 2000-2004 and 2005-2010), we calculate the percentage of firms to the total number of firms present at the corresponding period.

[Insert Table 1.2 about here]

As the table shows, the number of firms has generally increased in the 1990s, and subsequently cut back to nearly the original level in the 2000s. In the periods 1986-1989, 1990-1994 and 1995-1999, 52%, 53% and 56% of firms are smaller than the period median. Yet, by the end of our sample period, only 38% of firms are smaller than the period median. This result confirms the prevalence of small firms in recent decades. As small firms have a natural tendency towards short-term debts, this result corroborates the prior evidence concerning the debt maturity shortening (see Custódio et al. (2013) and Harford et al. (2014)).

1.4.2. Descriptive statistics

Table 1.3 reports the descriptive statistics of debt maturity structure and firm characteristics measured as of the fiscal year end. To compare with previous studies, we

[8] As a robustness check, we measure Fama and French (2001)'s NYSE percentile. This exercise yields similar results.

discuss in the first place the proportions of debts with maturities of more than one through five years for our sample firms.

[Insert Table 1.3 about here]

Similar to previous studies (e.g., Billett et al. (2007), Custódio et al. (2013) and Chen et al. (2012)), the average firm of our sample has 72% of total debts maturing in more than one year, 48% of total debts maturing in more than three years, and 31% of total debts maturing in more than five years. For our weighted average debt maturity measure, the mean value is 4.40 years, which is slightly shorter than 4.76 years in Chen et al. (2012). Notice that Chen et al. (2012) impose additional restrictions on the sample selection (e.g., total debt must represent at least 5% of total asset) and cover a longer period of time (from 1974 to 2010). Our results are therefore not directly comparable with theirs in the sense that we are not investigating the identical group of firms. Further, the standard deviation and inter-quartile range suggest substantial cross-sectional variation in debt maturities of U.S. firms. It's worth noting that the 90th percentile of DMAT is roughly 13 times the 10th percentile, indicating the significant debt maturity disparity between firms.

Summary statistics for key firm features show no divergence against previous literature. The only exception is abnormal earnings. Specifically, the average firm in our sample performs relatively badly, with abnormal earnings of -0.03. Other studies, for instance Johnson (2003) and Billett et al. (2007), report positive abnormal earnings. We probe into this issue and find that this is due to the inclusion of the recent financial crisis. Similar

evidence of negative abnormal earnings is documented in Custódio et al. (2013) whose sample period contains the financial crisis of 2007/2008[9].

Figure 1.1 plots the debt maturity histogram, which reveals overwhelmingly skewed debt maturity distribution for U.S. non-financial non-utility firms. Particularly, extreme values appear on both the left and the right sides of the distribution. In particular, it appears that one out of ten U.S. non-financial non-utility firms during the period 1986-2010 adopt extremely short debt maturity policies, with their assets totally financed by short-term debt maturing in one year.

[Insert Figure 1.1 about here]

Figure 1.2 exhibits the year-over-year debt maturity changes. The shaded areas represent NBER-dated recessions. In accordance with Barclay and Smith (1995) and Brockman et al. (2010), we observe a gradual decline in both the average and the median debt maturity from 1986 to the early 2000s. The average debt maturity is 4.76 years in 1986 then reaches the bottom of 4.00 in 2000. Thereafter, the average debt maturity rises sharply until it meets another trough in 2009. The mean and median values of debt maturity are very similar in earlier years. However, the difference has been widened since 1989, indicating the appearance of short debt maturity users during that period, most probably new listed small firms. The two nadirs of debt maturity coincide with two famous U.S. economic recessions: the Dot-Com crisis and the recent credit crunch following the subprime mortgage crisis. This over time pattern holds for all the percentiles but the shift downward is more pronounced for the lowest percentile and the shift upward is more prominent for the highest percentile, indicating an increasing polarization. Firms at the

[9] In our robustness analysis, we limit our sample period to 2006. Indeed, the average abnormal earning turns to positive.

bottom 10th percentile, throughout the period except for in 1986, issue debts with average maturities of less than one year while firms at the top 10th percentile issue debts with average maturities of more than eight years.

[Insert Figure 1.2 about here]

The examination of extreme cases helps researchers inhibit the over-generalization problem. As suggested above, some firms finance their assets with a great percentage of long-term debts. Others use a high proportion of short-term debts. These extreme cases can be exceptionally informative as they may indicate particular financing strategy formulation. To address this concern, we conduct unconditional decile analysis before turning to quantile regression analyses. Firm-year observations are sorted and equally divided into 10 portfolios based on the weighted average debt maturity of firms. For each debt maturity decile, we report the mean value of each firm-specific variable, as documented in Table 1.4.

[Insert Table 1.4 about here]

Several interesting features unfold. First of all, it shows that firms vary greatly in employing debt with different maturities. Average debt maturity ranges from 0.51 years in the lowest decile to 9.32 years in the highest decile. Secondly, by and large, firms in the longer debt maturity deciles are distinct from those in the shorter debt maturity deciles. In general, the former firms are generally larger, less volatile, flexible in obtaining public credit and slower in growth rate. Besides, they have heavier debt load and invest more in long-term assets. The values of market-to-book, R&D and volatility basically decrease along the spectrum and are slightly reversed in the highest decile. Thirdly, large cash reserves are found in both the highest and the lowest debt maturity deciles. It seems that

firms with extremely short and long debt maturities reserve more cash in comparison with those that lie in between. Although these findings are instructive, they are limited by the fact that they are merely demonstrating unconditional relations. The following section will be confined to examining the conditional relations between debt maturity and the above factors.

1.5. Do conventional factors affect debt maturity choices the same way along the debt maturity spectrum?

Motivated by investigating the heterogeneous effects of conventional factors over the entire range of debt maturity, Figure 1.3 plots the quantile processes for Specification (1.8). For each of the 16 covariates (including an intercept), we plot the quantile regression estimates as a function of quantile ranging from 0.05 to 0.95, shown as the point wise solid curve. The shaded grey band depicts the conventional 90 percent confidence interval. The OLS estimates are plotted for comparison purpose, shown as the long dashed line. The two surrounding dotted lines denote its confidential band.

[Insert Figure 1.3 about here]

Regularities emerge from the OLS results. Specifically, debt maturity is found positively associated with firm size, leverage, asset maturity and long-term public credit access and negatively associated with market-to-book ratio, R&D ratio, future abnormal earnings, short-term public credit access and the term structure of interest rate. By sharp contrast, quantile regression results differ fundamentally from the OLS results in size, significance and even in the sign of the estimated coefficients.

To be precise, the quantile processes show clear effect disparity across the conditional debt maturity distribution. The effect is accentuated if considering the lower and upper

tails of the distribution. The traditional least squares estimation, which inherently combines the sizes of effects along the conditional debt maturity distribution, does a poor job of displaying this range of heterogeneities. For instance, it turns out that highly leveraged large firm with long asset maturity has obvious inclination to borrow at the long end of the debt maturity spectrum although the magnitudes of the estimates are smaller at the tails. Note that the dashed least square confidential intervals pass above the estimates for leverage, size and asset maturity at the lower and upper tails of the distribution, indicating that the least square estimates are captured mainly by the middle parts of the conditional distribution.

Effect enforcement at the long debt maturity end is perceived for certain variables, such as short-term public credit access, future abnormal returns, and term structure of interest rates. Take short-term public access for example. Its quantile process, illustrated in the third panel of the third row, shows how different are the corresponding debt maturities of firms with and without short-term public credit access. Overall, firms with short-term public credit access have shorter debt maturities than their counterparties. But as is clear from the quantile regression results, the disparity is considerably smaller in the left tail of the distribution but much larger in the right tail. It suggests that firms with particularly large long-term debt overhang have strong incentives to cut down long-term debt usage when cheap short-term public credits become accessible.

Researchers, e.g., Shyam-Sunder and Myers (1999), Chen and Zhao (2007), Chang and Dasgupta (2009), have highlighted the mean-reversion process considering the boundary feature of financial structure. Given that the commonly used debt maturity measures, including ours, bear a boundary feature, it is possible that the attenuated effects observed in the tails are driven in part by mechanical mean reversion. Indeed, in the unreported

cross-sectional quantile regressions using the time-series mean of each variable by firm[10], the above attenuation pattern on the right tail (the 90th and the 95th quantiles) is flattened.

We next report OLS and quantile regression results for the 10th, 25th, 50th, 75th and 90th quantiles, as shown in Table 1.5. Clustered standard errors by firm are reported. For each covariate, the estimates in the corresponding quantile process can be interpreted as the impact of a one-unit change of the covariate on debt maturity holding other covariates constant. To avoid drawing mistaken inferences due to the mechanical patterns around the boundaries of debt maturity, we interpret our results based two lower quantiles and two upper quantiles: the 10th and 25th quantiles (for short debt maturity), and the 75th and 90th quantiles (for long debt maturity). Then, to check whether the differences of coefficient estimates between quantiles are statistically important, we report in Panel B, Table 1.5 the interquantile regression results.

[Insert Table 1.5 about here]

As is clearly shown in the above table, heterogeneous effects along the distribution of debt maturity unfold. Holding all the other variables constant, debt maturities of firms with long-term public credit access are 1.846 years longer than those of firms without long-term public credit access at the 50th quantile. At the 10th and 90th quantiles, the disparities are 1.468 and 1.355 years respectively. Similar patterns can be observed for leverage, size and asset maturity. There are negative relations between growth option and debt maturity. The size of the relation is larger at the higher quantiles, especially at the 75th quantile. The expected negative sign for firms' future abnormal returns is found at most

[10] Although instructive, modeling the mean response may suppress important over-time characteristics. We therefore do not

quantiles. But again, the effect appears more remarkable at the upper percentiles. Likewise, high term structure of interest rates is prone to shorten the debt maturities of the upper tail firms more than those of the lower tail firms.

Notably, the estimates for age, asset volatility and cash holdings change directions upon different parts of the conditional debt maturity distribution. Note that the confidence interval of the ordinary least squares estimation suggests weak effect of firm age on average. Yet, the quantile regression results exhibit a distinct pattern. Specifically, the slope parameter of age changes from positive (0.004 at the 10^{th} quantile) to negative (-0.005 at the 90^{th} quantile) over the debt maturity distribution. Previous studies, as discussed earlier, argue that firms with large cash holdings are relatively low in refinancing risk and therefore able to use more debts with short maturities. Our results show consistent evidence in the significantly negative estimates for cash at the lower quantiles for firms with strong fundamentals. At the longer debt maturity quantiles, the estimates for cash are positive. Specifically, a one-unite change of cash holdings decreases debt maturity of unconstrained firms by 0.269 years at the 10th percentile of the conditional distribution but increases debt maturity of these firms by 3.409 years at the 90th percentile. The positive estimates for cash at the higher quantiles are mitigated for firms with weak fundamentals but the coefficients are not statistically significant. Generally speaking, asset volatility is negatively related to debt maturity, with the only exception at the 10^{th} quantile for financially unconstrained firms. Note this result coincides with He and Xiong (2012a) who argue that in the interest of hedging against early liquidations, short debt maturity firms with high asset volatility would negotiate with their creditors to obtain long-term debts as long as the value of their assets do not fall below the fundamental threshold. Moreover, we find that in the short-end of the debt

maturity distribution, higher asset volatility forces constrained firms to employ even shorter debt maturities, while lead unconstrained firms to adopt higher debt maturities. The former firms are most probably screened out of the long-term debt market while the latter firms have a tendency to take active actions to hedge against refinancing risk. Similarly, cash reserves help unconstrained firms to use more short-term debts at the lower debt maturity quantiles, whereas lean constrained firms towards long-term debts. These results imply distinctly different financing patterns between constrained and unconstrained firms.

The interquantile regression results confirm that the conventional debt maturity factors exert significantly different roles for short and long debt maturity users. The impacts of the included factors vary with the debt maturity spectrum in a significant manner. This pattern of polarization is prominently displayed in the two extremes, especially for age, asset maturity and cash. Age is positively related to debt maturity at the lower percentiles while negatively related to debt maturity at the higher percentiles. Note that the difference in the AGE estimates between the 10^{th}/25^{th} and the 50^{th} quantiles is positive (0.004, 0.003) and significantly different from zero. Yet, the difference between the 75^{th}/90^{th} and the 50^{th} quantiles is significantly negative (-0.005/-0.006). The effect of asset volatility reverses from positive at the 10^{th} percentile to negative at the higher percentiles for financially flexible firms. The interquantile regressions further confirm that the differences in the effect of asset volatility are significantly positive between the lower and the higher quantiles in the lower half of the debt maturity distribution but is significantly negative (-1.173) for the 75^{th}-50^{th} interquantile. Cash reserves are only inversely associated with debt maturity at the lower quantiles for financially flexible firms.

The interquantile coefficients show that the negative effect of cash on debt maturity for these firms is truly more salient at the lower quantiles.

Do conventional debt maturity factors have persistent influences over the quantile range? To address this question, we run OLS and Quantile regression at the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantile for annual cross-sections from 1986 to 2010, which generates 25 estimates for each variable and every investigated quantile. Then we investigate how often the estimated coefficients of a covariate are different from zero at the conventional statistical significances (1%, 5% and 10%), in positive or negative signs. The results are displayed in Table 1.6.

[Insert Table 1.6 about here]

Effect attenuation is again observed on the tails of the debt maturity distribution. For instance, even though the estimated coefficients of leverage and asset maturity have consistent signs at the given quantiles, the statistical significance is marginal at the long extremes. In particular, asset maturity is only effective in 12 out of 25 periods, suggesting that low rollover risk embedded in long debt maturities makes matching maturities of assets and liabilities a low priority for firms. The effects of short-term credit access are negative in most of the periods at the higher quantiles. However, at the lower quantiles, the effects are inconclusive. Precisely, in the lower half of the debt maturity distribution, the estimates for ACCESS_S are negative in certain periods but positive in others. It implies that high rollover risk embedded in short debt maturities leans firms to long-term debts even cheap short-term credit access is available. Note that firms with short-term public credit access usually have very flexible credit access, not only to short-term and but to long-term as well. The quantile effects of firm age, future abnormal earnings and asset

volatility show little persistence. This is perhaps due to the time-series nature of the effects of these factors on debt maturity.

Intuitively, this brings us to the question of whether the above evidence is led by the fact that the effects of these factors vary with the business cycle. Shocks in an economy make financial frictions more binding (Almeida et al. (2004), Gomes et al. (2006), Campello and Chen (2010)). During recessions, corporate cash flow drops sharply and public debt market is suppressed. The fundamental threshold of a firm's default probability becomes higher consequently, resulting in higher credit risk and higher cost of information asymmetry (e.g., Korajczyk and Levy (2003), Hackbarth et al. (2006), Levy and Hennessy (2007), and Bhamra et al., (2010)). To investigate whether business cycles moderate the previous findings, we divide firm-year observations into three sets: observations in soft periods, normal periods and hard periods. The classification is made according to the term structure of interest rates, measured as of a firm's fiscal year end. An observation with fiscal-year-end term structure above the 70^{th} percentile is classified as in soft periods and those below the 30^{th} percentile are classified as in hard periods. We then estimate Specification (1.8), separately for hard and soft periods. The term structure of interest rate is excluded from the quantile regressions.

[Insert Table 1.7 about here]

Conforming to the previous findings, we find monotonic relationships between debt maturity and its determinants along the debt maturity spectrum in both hard and soft periods, as reported in Table 1.7. Firms at the lowest and the highest percentiles exhibit distinctive patterns in attenuated, strengthened and reversed parameter estimates (e.g., AGE, VOLAT, and CASH). The results also confirm the conventional wisdom in that

refinancing risk is more binding in hard periods. Firms subjecting to high rollover risk (i.e., those present at the lower percentiles of the debt maturity distribution) place more value to long-term credit access in hard periods relative to soft periods. Soft period results report significantly positive effects for the financial constraint dummy (CONSTRAINT) at the 10^{th} and the 25^{th} quantiles. It turns out that expanded economy inclines firms with high refinancing risk towards borrowing more long-term debts for self-protection purpose. Yet, there is also evidence in support of the flight-to-quality phenomenon in hard period, as reflected in the significantly negative estimates for ACCESS_S. During the periods of financial turmoil, credits are limited and firms who have access to short-term public credits are those with great financial flexibilities. As a result, they are valued to a greater extent by creditors and therefore able to benefit from borrowing cheaper short-term debts. Keefe et al. (2011) find that the market value of cash is lower during economic contractions than in economic expansions. We provide relevant evidence in the strengthened negative coefficients of CASH at the 25^{th} quantile in soft periods relative to in hard periods. It is also important to note that for constrained firms, the negative influences of asset volatility at the lower quantiles are significant in hard periods whereas insignificant in soft periods.

To conclude, the above results indicate prominent effect disparities of the conventional determinants across the conditional debt maturity distribution, in both hard and soft periods. The mechanism can be explained by the argument that risk factors associated with debt rollover are prevalent and strengthened in short debt maturities, but attenuated in long debt maturities. There is one caveat, however. On the grounds that refinancing risk is the most prevalent financial friction and that refinancing risk decreases along the debt maturity spectrum, we would expect the relations between debt maturity

and its conventional determinants to be monotonic along the debt maturity spectrum. Our quantile regression results however reveal non-monotonic effects from lower to upper quantiles. For example, it is expected that size has a positive effect on debt maturity and the positive effect of size decreases along with the debt maturity level. The rationale is that the increasing refinancing risk embedded in the shorter debt maturities lean larger firms to issue more long-term debts, whereas the decreasing refinancing risk embedded in the longer debt maturities alleviate this hedging incentive. As the quantile process shows, the effect of firm size increases monotonically at the lower quantiles of the debt maturity, but then decreases monotonically at the upper quantiles. In an analogous way, the magnitude of the negative impact of market–to-book ratio is anticipated to increase along the debt maturity spectrum. The anticipated pattern is corroborated in general terms. Yet the effect is attenuated in the long debt maturity end. It appears that there is another force which moderates the effects of the conventional determinants across the debt maturity distribution. The literature concerning the passive choices of firms points to the importance of accounting for the supply side effect.

In particular, it is well documented that the relevance of financial frictions is contingent on credit access. Firms borrowing from private creditors are more likely to be strictly monitored and suffer enormously from lending barriers if the credit deteriorates (e.g., Faulkender and Petersen (2006), Sufi (2007, 2009)). In this regard, firms with access to public credits are supposed to behave in a more active way comparing with those exclusively reliant on bank loans. To address this concern, we turn to the next question of whether credit access moderates the effects of the conventional debt maturity factors along the debt maturity spectrum.

1.6. Does credit access moderate the effects of the conventional factors along the debt maturity spectrum?

A small but growing number of literature studies how credit access affect firms' ability and their manner to raise fund. The central argument is that firms may not be able to borrow as much and as long as they want coming down to differential credit access. On the whole, small firms with limited access to debt market face more difficulties in raising funds. By contrast, it is much easier for big firms with public credit access to take on additional long-term debts and borrow at cheaper terms (Faulkender and Petersen (2006)). Firms reliant heavily on short-term debts are obliged to repay maturing loans in high frequencies (e.g., Duchin et al., (2010), Gopalan et al. (2010)). Taken together, firms with limited credit access shall show even greater constraints if present at the short debt maturity spectrum. By contrast, big firms with flexible credit access concern less about refinancing risk. Instead, they may show higher flexibility if present at the higher debt maturity quantiles. Facing the conventional frictions associated with debt maturity choices, the former firms are likely to be too passive to take ready actions whereas the latter may be too flexible to care.

To capture this pattern, we investigate debt maturity decisions of firms with flexible access to credits separately from those of firms with limited access to credits. The classification is made based on Standard & Poor's long- or short-term bond ratings. Reconciling with Whited (1992) and Faulkender and Petersen (2006), firms who have positive debt outstanding and Standard & Poor's long- or short-term bond ratings are perceived to possess access to public credits. The rest is perceived to rely on bank loans. Then we re-estimate, for each group, Specification (1.8), excluding the variables of short-term and long-term public credit access.

[Insert Table 1.8 about here]

Notably, the results displayed in Table 1.8 uncover a clear distinction between the two types of firms. According to the medium regression results, the positive coefficients of size, age, leverage, and asset maturity are larger for firms reliant on bank loans relative to firms with public credit access. This corroborates the financial constraint literature, holding that firms who have limited credit access seek to protect themselves from liquidity and refinancing problems by borrowing long-term. However, at the 10^{th} quantile, most variables play marginal roles for these firms. This confirms our intuition that banks rate firms who have a large portion of debts maturing in the near future as highly risky and monitor them more closely. In this case, firms may find it difficult to choose actively the desired debt maturity levels. That is, the observed debt maturities of these firms are stemming from passive choices. The pattern is reflected in the attenuated effects of the conventional frictions.

Divergent pattern is observed for firms with flexible credit access. Asset maturity plays a greatest role at the 10^{th} debt maturity percentile. The effect gets weaker when moving from the 10^{th} percentiles to the higher percentiles. The greatest attenuation is observed at the 90^{th} quantiles, suggesting the asset-debt maturity mismatching in long debt maturity extremes. Note that the estimates for size and leverage even change signs. On the one hand, there exist positive effects of size and leverage at the lower quantiles, implying strong matching incentives in short debt maturity users with public access. On the other hand, the impacts of size and leverage are negative and significant at the higher quantiles, suggesting eminent mismatching patterns. The negative effects of market-to-book, R&D and abnormal earnings on debt maturity are present at most quantiles of the conditional debt maturity distribution. Yet, the magnitudes of the effects are greater at

the low quantiles. It appears that firms with flexible credit access are likely to deal with incentive provisions more actively. The estimated negative effect of cash reserves at the 10^{th} quantile is economically significant but statistically marginal for these firms.

Above all, evidence for firms with limited credit access is generally consistent with those illustrated in the prior section (see Table 1.5). Nevertheless, firms who have access to public credit market show distinct financing attitudes along the debt maturity spectrum. At a given quantile, some factors are more influential to the former but some are more related to the latter. The term structure of interest rate seemingly only affects debt maturity choices of firms without public credit access and that the negative effect is stronger in the long end. The coefficients of asset volatility (VOLAT) are found negative only for firms without public credit access. Firms with public credit access, the estimated coefficients are positive. Perhaps, the latter issues long-term bonds to bail them out from the refinancing dilemma, while the former fails to get long-term loans even though they may try to negotiate with their creditors.

On the whole, our results suggest that refinancing risk is a secondary concern for firms with access to public debt market. However, some may argue that given the credit availability, these firms probably employ more debts comparing with those with no access to public market. As a result, the above findings are mechanically driven by sample truncation. To provide relevant evidence, we rank and classify our sample firms into two groups using the 70% cutoff points based on the book leverage. Firms in the highest ranked group are considered as highly leveraged. We focus our analysis on a group of firms with high leverage ratios, as we believe that debt maturity choices are much more

pertinent for this type of firms[11]. Further, we divide the highly leveraged firms into two subgroups: firms with public credit access (hereafter HLWSA) and firms without public credit access (hereafter HLWLA). Quantile regressions are then implemented for each group of firms, as shown in Table 1.9. Note that leverage and credit access variables are excluded from the model.

[Insert Table 1.9 about here]

Generally speaking, these results are in line with our prior results in Table 1.8, confirming that HLWLA firms (shown in Panel A) are more sensitive to refinancing problems in comparison with their counter parties with sufficient credit access (shown in Panel B). The mismatching pattern reappears for HLWSA firms, particularly at the higher debt maturity quantiles. At the 75th and 90th quantiles, the estimated coefficients for size are positive in HLWLA firms, but significantly negative in HLWSA firms. Similarly, the impact of asset maturity is greatly weakened at the 90th quantile for HLWSA firms. Age plays a uniformly negative role in HLWSA firms, even at the low quantiles. The market-to-book ratio is found positively associated with debt maturity, at odds with the agency argument. By inference, this might be explained by firms' attempts to "time" long-term debt issuance subsequent to stock overvaluation. Moreover, there is a notably significant impact of abnormal earnings at the 10th debt maturity quantile for both HLWSA and HLWLA firms, with HLWSA firms affected to a larger degree. It reveals that promising future prospects bring highly leveraged firms to employ extremely short debt maturities, regardless of whether they have access to public credit access or not.

[11] We run quantile regression for low leveraged firms present below the 30% leverage cutoff. The results show that except the long-term and short-term public credit access, none of the variables is found economically significant at the 10th debt maturity quantile. To save space, these results are not presented.

Above all, the implication of our empirical findings in this section lies in the supply-side effect. To the extent that a firm relies on bank loans, credit monitoring and control becomes binding. This supply-side constraint makes firm impotent when facing conventional frictions. Conversely, firms who are able to borrow from the public market are less likely subject to frequent monitoring. When present at the lower debt maturity quantiles, they are less constrained by credit availability in a way to treat more readily the conventional frictions. When present at the upper debt maturity quantiles, refinancing need is probably not a priority. Consequently, they would show disinclinations to pursue hedging strategies, as indicated in the reversed effects of asset maturity, leverage, etc.

1.7. Robustness checks

We report in this section several robustness tests considering the impacts of CEO features, the endogeneity between leverage and debt maturity, firm fixed effect, and alternative debt maturity definitions.

1.7.1. CEO features

Recent research highlights that corporate governance structure plays a role in debt maturity decisions. Do managerial incentives drive the extreme debt maturity decisions? To address this question, we re-estimate our quantile regression model (Specification (1.8)) with additional variables of CEO features. Following Strebulaev and Yang (2013), we calculate CEO stock ownership (the fraction of CEO holdings of a firm's stocks to the firm's total shares outstanding), CEO option compensation (the fraction of CEO holdings of a firm's stock options to the firm's total shares outstanding) and CEO cash compensation (the logarithm of the sum of CEO salary and bonus).

[Insert Table 1.10 about here]

The results illustrated in Table 1.10 are generally similar to those reported for firms who have access to public credit. Effect attenuation and reversion are found in the long end of the conditional debt maturity distribution. A logical explanation is the Compustat Execucomp Database covers mainly big firms with flexible credit access (see e.g. Datta et al. (2005)). Besides, it demonstrates that extremely short debt maturity is linked with high stock ownership. This result corroborates the empirical evidence of Datta et al. (2005) in the negative relation between managerial stock ownership and debt maturity. Self-interested managers have preferences for long-term debts to exploit private benefits of control (Benmelech (2006)). Yet, increasing managers' stock ownership aligns the interest of managers in taking value-maximizing decisions when facing agency issue. Brockman et al. (2010) documents that executive compensation influences managerial risk preference. By properly establishing executives' compensation portfolio, their incentives of using short-maturity debt to mitigate agency problems will be strengthened. We, however, find no significant effects of CEO compensations. Note that as we are not studying the sensitivities of CEO's stock compensations to stock prices and volatilities, our results in this regard are not perfectly comparable with theirs. It deserves further investigation. As this topic is beyond the scope of this paper, we leave the question open for future research.

1.7.2. Endogeneity

Debt maturity decisions are endogenously determined with leverage decisions. Do our findings suffer from endogeneity problems? To check robustness, we estimate two-stage instrumental variable quantile regressions for Specification (1.8).

[Insert Table 1.11 about here]

As an instrumental variable, we incorporate predicted leverage instead of actual leverage to run quantile regressions. Following Johnson (2003), the variables used to predict book leverage are tangibility (the ratio of net property, plant, and equipment to total book assets), profitability (the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to total book assets), firm size (the percentage of NYSE firms that have the same or smaller market capitalization), asset volatility (the standard deviation of monthly stock return during a firm's fiscal year, multiplied by the share of the firm's market value of common equity to the market value of total assets), abnormal earnings (the year-by-year difference in firm's income before extraordinary items adjusted for common stock and equivalent, divided by market capitalization), a dummy variable for net operating loss carry forwards and a dummy variable for investment tax credits.

In short, our findings in terms of the heterogeneous effects of conventional factors across the debt maturity distribution are robust to this specification. The results for firms with public credit access are also consistent. On the one hand, there are effect attenuation of asset maturity and effect reversion of size at the higher debt maturity quantiles. On the other hand, the negative coefficients of cash, market-to-book and R&D ratio are more prominent at the lower quantiles (i.e., the 10th or 25th quantile).

1.7.3. Firm fixed effects

In our main analyses, we calculate standard errors clustered by firm. An alternative specification would be to incorporate firm effects. Fixed effect models for quantile regressions are greatly underdeveloped due to the highly complexity in estimating a substantial number of parameters. A feasible approach, known as the threshold-crossing approach, is to define extreme debt maturities policies by means of specific debt maturity thresholds (e.g., DMAT present at the 10^{th} and 90^{th} percentiles of the debt maturity

distribution) and estimates the effects of conventional inputted factors on these extremes using logistic regression or OLS regression including dummies for extreme debt maturities along with its interaction terms with conventional factors. Relevant evidence is presented in Table 1.12.

[Insert Table 1.12 about here]

Panel A estimates the fixed-effect regressions of debt maturity on previously included variables (see Table 1.5), extreme debt maturity dummies and their interactions. Panel B estimates binomial logistic regressions of extreme debt maturity policies with the same set of previously included variables and firm fixed effects. Extremely short debt maturity policies are defined as DMAT present at the 10^{th} percentile of the distribution. Extremely long debt maturity policies are defined as DMAT present at the 90th percentile of the distribution. When modeling choice of extremely short debt maturities, extremely long debt maturity firms are excluded from the sample and vice versa. To run fixed-effect logistic regressions, firms who have never employed extreme debt maturity policies during the sample period are eliminated. The sample used for logistic regressions is thus whittled to 1751 firms and 12313 firm-year observations for the "short" regression and 1613 firms and 17416 firm-year observations for the "long" regression.

Notably, the fixed-effect least square regression results provide confirmation of the effect heterogeneity along the debt maturity spectrum and the effect attenuation (e.g., size, leverage, asset maturity, market-to-book, long-term public credit access) in the debt maturity extremes. Importantly, the evidence also supports the idea that large cash holdings lead to short debt maturity. The logistic regression results are also ensuring for

the effect of cash holdings. Effects of market-to-book and abnormal earnings are more robust to our findings concerning firms with public credit access.

Yet, it's important to emphasize the implications of the quantile regression approach, which are different from the threshold-crossing approach. Particularly, the latter locks common unconditional thresholds, whereas the former investigates particular conditional quantiles of the distribution. For example, the estimates from the logistic regression model for "SHORT" infer the effects of the inputted variables, e.g., asset volatility, upon the conditional probability $\Pr(DMAT < DMAT^{10^{th}} \mid X)$. That is, X is possibly truncated and the effect estimated may just be at a part of X values. The corresponding quantile regression models the conditional quantile $Q_{10\%}(DMAT|X)$. As the value of $Q_{10\%}(DMAT|X)$ may be below the settled short debt maturity threshold for some X values and above it for others, X is not truncated and the effect estimated is at all X values. In this regard, the effects estimated from quantile regressions and the logistic and OLS regressions are not perfectly comparable. Another significant distinct is that the threshold-crossing approach provide only inferences of SHORT versus NON-SHORT debt maturities and LONG versus NON-LONG debt maturities. The quantile regression approach, however, can provide inferences at different parts of the distribution. The former is sufficient to answer the question of which factors lead to extreme debt maturities choices, while the latter has advantage in offering more complete comparison.

1.7.4. Alternative debt maturity definitions

So far, emphasis has been put on a value-weighted definition of debt maturity. Robustness is provided in Table 1.13 to define debt maturity alternatively. Specifically, we measure debt maturity as the proportion of interest bearing financial obligations with maturities

of more than three years (in Panel A) and the weighted average debt maturity structure using various duration cutoffs (in Panel B and Panel C).

[Insert Table 1.13 about here]

Note that to calculate the weighted average debt maturity structure, we have assumed that the average durations of a firm's debts payable in year 1, 2, 3, 4, 5 and more than 5 years are 0.5, 1.5, 2.5, 3.5, 4.5 and 10 years. Panel B and Panel C reproduce our main analyses by use of alternative schemes in defining the maturity profiles: durations of 0.3 and 0.7 years for debts payable in year 1, durations of 1.3 and 1.7 years for debts payable in year 2, durations of 2.3 and 2.7 years for debts payable in year 3, durations of 3.3 and 3.7 years for debts payable in year 4, durations of 4.3 and 4.7 years for debts payable in year 5, and durations of 7 and 13 years for debts payable beyond year 5. The effects of previously included factors hold in general terms. We also perform our main analysis using the cutoff of five years to define long-term debt and excluding capital lease. The results for these analyses, unreported for brevity, are also valid.

In addition to the above robustness tests, we also checked different measures for the explanatory variables[12], incorporated additional variables (for instance a dummy for mergers and acquisitions), undid the winsorization of the explanatory variables, included non-US incorporated firms and American Depositary Receipt (ADR) and performed separate quantile regression analysis for subgroups of small and large firms[13]. The results

[12] For example, we measured firm size as log (market value of total asset) and log (total sales), and leverage as total financial debt/total equity and total non convertible debt/total assets.

[13] Based on Fama and French (2001)'s NYSE percentile, we rank and classify firms into three size groups using the 30% and the 70% cutoff points. Firms in the highest ranked group (big firms) are considered financially unconstrained, whereas those in the lowest ranked group (small firms) are considered constrained.

of these analyses, unreported for brevity, show general robustness of our findings concerning the distinctive effects of conventional factors in debt maturity extremes.

1.8. Conclusion

There are effect disparities in the conventional debt maturity determinants. By means of the conditional quantile regression approach, we show that the relations between debt maturity and its conventional determinants vary fundamentally across the debt maturity distribution. Notably, this pattern is accentuated when we consider the upper and lower tails of the distribution. A further investigation shows that credit access moderates the above pattern to a larger degree. Specifically, more severe effect disparity unfolds for firms with public credit access.

Our empirical results can be explained by the intensified refinancing risk in the lower tail of the debt maturity distribution and the lessened refinancing risk in the upper tail. In the extremely short debt maturity scenario, rollover risk is so high that creditors are reluctant to improve their debt contracts, for instance, to lengthen the maturity structure (He and Xiong (2012a), Cheng and Milbradt (2012)). In the extremely long debt maturity scenario, rollover risk is likely to be the last priority. Instead, other economic forces may play greater roles. The relevance of financial frictions is therefore contingent on debt maturity levels and credit accessibility of firms.

Other results are also worth noting. According to Bates et al. (2009), the average U.S. industrial firm has doubled their cash-to-assets ratio over the last three decades. Harford et al. (2014) correlate this pattern with the stylized fact of debt maturity shortening. Our analysis provides relevant evidence concerning the negative effect of cash at the lower debt maturity percentiles. Yet, we also show that this is not true for highly leveraged firms.

For firms with sufficient credit access, the negative effects of growth options and future prospects are more salient in short debt maturity end, implying secondary role of refinancing risk in this type of firms. Most probably, firms' incentive to borrow cheaper through short-term public credit programs, e.g., the commercial paper program, prevails in firms with public credit access. Besides, there is a hint that highly leveraged firms with access to public debt market lengthen debt maturities when their stocks are valued high, perhaps out of timing purpose.

As suggested by Brunnermeier and Oehmke (2013), there is a possibility that short debt maturity policies of firms are inefficient due to bank runs. Consistent with this argument, our results in terms of the attenuated effects of common factors in the tails of the conditional debt maturity distribution imply that the observed debt maturity structure does not necessarily reflect the actual desires of firms. Hence, an important direction in which the current research could be extended is to examine the dynamics in debt maturity decisions. Particularly, a number of researchers hold that financing structures of firms, in a dynamic economy, are likely to deviate from the desired levels due to the presence of transaction cost (e.g., Leland (1994, 1998), Fisher et al. (1989), Goldstein et al. (2001), Ju et al. (2003) and Strebulaev (2007)). Note that this could also be true for debt maturities of firms. Research taking into account the dynamic properties of debt maturity decisions could therefore have profound implications for understanding the empirical results of the cross sections.

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Table 1. 1 Variable definitions

Variables	Abbreviation	Expected Sign	Measurement
Size	NYP	+	Relative Size = the percentage of NYSE firms that have the same or smaller market capitalization
Reputation	AGE	+	Listing Age = the number of years and months elapsed since a firm's first CRSP listing date
Leverage	LEV	+	Book Leverage = the ratio of a firm's total debt outstanding to the book value of total assets
Asset Maturity	AMAT	+	Weighted Average Maturity of Assets = (current assets ÷ total book assets) × (current assets ÷ cost of goods sold) + (net property plant and equipment ÷ total book assets) × (net property plant and equipment ÷ depreciation and amortization)
Growth Option	MTB	-	Market-to-Book Ratio = (book value of total assets – book value of common equity + market value of common equity) ÷ book value of total assets
	R&D	-	R&D Ratio = the ratio of a firm's R&D expenses to the book value of total assets
Abnormal Earnings	ABNEARN	-	Future Abnormal Earnings = the difference of the income before extraordinary items adjusted for common stock and equivalent between year t+1 and t divided by market capitalization in calendar year t
Volatility	VOLAT	-	Relative Asset Volatility = asset volatility of a firm - asset volatility of the industry = monthly stock return standard deviation during a firm's fiscal year × (market value of common equity ÷ market value of total assets) – median (asset volatilities of firms in the industry)
Credit Access	ACCESS_L	+	Long-term Public Credit Market Access = a dummy variable which takes a value of one if Standard and Poor's domestic long-term issuer rating is available and 0 otherwise
	ACCESS_S	-	Short-term Public Debt Market Access = a dummy variable which takes a value of one if Standard and Poor's domestic short-term issuer rating is available and 0 otherwise
Cash	CASH	-	Cash holdings = The ratio of a firm's cash and short-term investment to total assets
Term Structure	TERM	-	Yield Spread between Long- and Short-term Debt = the difference of month-end yields on 10-year U.S. treasury bond and 3-month U.S. treasury bill, averaged over a firm's fiscal year period
Financial Constraint	CONSTRAINT	-	Financial Constraint = a dummy variable which takes a value of one if a firm is identified as financially constrained and 0 otherwise. Specifically, firms are sorted and categorized into three groups using the 30% and the 70% cutoff points of Altman's Zscore. Firms present in the bottom 30% are identified as financially constrained. Altman's Zscore = 1.2×T1+1.4×T2+3.3×T3+0.6×T4+1.0×T5, where T1 = working capital/total assets; T2= retained earnings/total assets; T3= EBIT/ total assets; T4= market value of equity/book value of total liabilities; T5= total sales/total assets.

Table 1. 2 Over-time distribution of firms by size

This table presents the over-time distribution of firms by size. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010.

Decile	Percentage of Firms					
	1986-2010	1986 -1989	1990 -1994	1995 -1999	2000 -2004	2005 -2010
Smallest	10	9	10	13	12	6
2	10	10	11	12	10	7
3	10	12	11	11	9	7
4	10	11	11	11	9	8
5	10	11	11	10	9	10
6	10	10	10	10	10	11
7	10	9	9	9	11	12
8	10	9	9	9	11	14
9	10	9	10	8	10	13
Largest	10	11	10	8	9	13
Obs.	47161	8462	10366	10829	8748	8756

Table 1. 3 Descriptive statistics

This table documents descriptive statistics of long-term debt proportion (one through five years), weighted average debt maturity structure (DMAT), firm size (NYP), age (AGE), book leverage (LEV), asset maturity (AMAT), market-to-book ratio (MTB), R&D ratio (R&D), abnormal earnings (ABNEARN), volatility (VOLAT), long-term public credit access (ACCESS_L), short-term public credit access (ACCESS_S), cash holdings (CASH) and term structure of interest rate (TERM). The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The weighted average debt maturity structure is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles.

Variable	Mean	STD	P10	P25	Median	P75	P90
Proportion of debts with maturities of more than							
1 Year	0.72	0.32	0.07	0.58	0.86	0.96	1.00
2 Years	0.59	0.35	0.00	0.30	0.70	0.89	0.98
3 Years	0.48	0.35	0.00	0.12	0.53	0.79	0.95
4 Years	0.39	0.33	0.00	0.03	0.38	0.68	0.88
5 Years	0.31	0.31	0.00	0.00	0.23	0.55	0.79
DMAT	4.40	2.80	0.64	1.95	4.17	6.64	8.43
NYP	55.44	28.14	14.38	32.16	57.74	79.88	92.37
AGE	16.39	16.43	1.67	4.50	11.50	22.58	36.33
LEV	0.27	0.19	0.03	0.12	0.24	0.38	0.52
AMAT	4.58	5.17	1.08	1.76	2.99	5.34	9.57
MTB	1.80	1.46	0.90	1.08	1.38	1.96	3.03
R&D	0.03	0.08	0.00	0.00	0.00	0.03	0.10
ABNEARN	-0.03	0.53	-0.20	-0.04	0.01	0.03	0.13
VOLAT	0.01	0.06	-0.05	-0.03	-0.01	0.02	0.07
ACCESS_L	0.30	0.46	0.00	0.00	0.00	1.00	1.00
ACCESS_S	0.10	0.31	0.00	0.00	0.00	0.00	1.00
CASH	0.13	0.17	0.01	0.02	0.06	0.16	0.34
TERM	1.82	1.04	0.39	1.00	1.70	2.83	3.08

Table 1. 4 Firm characteristics across debt maturity deciles

This table presents firm characteristics across debt maturity deciles. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The weighted average debt maturity structure is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Firm-year observations are sorted and equally categorized into 10 portfolios according to firms' debt maturity structure. The mean values of the included variables are reported for each debt maturity decile.

Variable	Deciles									
	1	2	3	4	5	6	7	8	9	10
Proportion of debts with maturities of more than										
1 Year	0,01	0,45	0,65	0,77	0,81	0,84	0,87	0,90	0,94	0,98
2 Years	<0,01	0,08	0,37	0,61	0,68	0,73	0,77	0,83	0,89	0,96
3 Years	<0,01	0,03	0,16	0,31	0,55	0,61	0,66	0,75	0,84	0,95
4 Years	<0,01	0,02	0,07	0,16	0,30	0,49	0,54	0,66	0,77	0,93
5 Years	<0,01	0,01	0,04	0,08	0,15	0,27	0,42	0,55	0,70	0,91
DMAT	0.51	1.13	1.95	2.77	3.68	4.63	5.63	6.65	7.76	9.32
NYP	37.82	39.42	43.15	49.35	54.52	60.07	65.24	69.32	69.06	66.59
AGE	9.99	11.48	13.42	14.90	16.40	18.38	20.59	22.15	20.37	16.24
LEV	0.13	0.18	0.24	0.27	0.28	0.29	0.30	0.31	0.33	0.32
AMAT	3.60	3.40	3.45	4.04	4.34	4.82	5.01	5.49	6.01	5.65
MTB	2.50	2.12	1.75	1.75	1.67	1.66	1.59	1.57	1.57	1.84
R&D	0.09	0.06	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03
ABNEARN	0.00	-0.02	-0.03	-0.04	-0.04	-0.04	-0.03	-0.03	-0.05	-0.07
VOLAT	0.04	0.02	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.00
ACCESS_L	0.03	0.05	0.09	0.16	0.24	0.33	0.43	0.55	0.59	0.62
ACCESS_S	0.01	0.02	0.04	0.06	0.09	0.14	0.19	0.22	0.19	0.10
CASH	0.23	0.18	0.11	0.10	0.10	0.10	0.09	0.09	0.10	0.15
TERM	1.81	1.80	1.84	1.85	1.82	1.79	1.84	1.82	1.84	1.75

Table 1. 5 OLS & Quantile regression results: the effects of conventional debt maturity determinants across the debt maturity spectrum

This table documents the OLS results (in the first column of Panel A), the 10th, 25th, 50th, 75th, 90th quantile regression results (in the second to the sixth columns of Panel A) and the 50th-10th, 50th-25th, 75th-50th, 90th-50th, 75th-25th and 90th-10th interquantile regression results (in Panel B) for the effects of debt maturity determinants. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model for the quantile regressions is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \quad i = 1,\dots,n; t = 1,\dots,T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are reported for OLS& quantile regressions. Interquantile regressions are computed using the bootstrapping method. ***, ** and * show that the coefficient is significantly correlated at 1%, 5% and 10% level respectively.

	Panel A : OLS & Quantile Regression											
	OLS		10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	1.785	0.072***	0.066	0.048	0.250	0.053***	0.966	0.072***	2.836	0.130***	5.642	0.155***
NYP	0.030	0.001***	0.013	0.001***	0.024	0.001***	0.034	0.001***	0.037	0.002***	0.025	0.002***
AGE	<0.001	0.002	0.004	0.002**	0.003	0.002*	0.001	0.002	-0.004	0.002*	-0.005	0.002**
LEV	2.984	0.124***	2.136	0.109***	2.952	0.113***	3.497	0.157***	3.066	0.199***	1.596	0.185***
AMAT	0.049	0.005***	0.024	0.005***	0.051	0.006***	0.069	0.006***	0.062	0.010***	0.044	0.005***
MTB	-0.193	0.015***	-0.138	0.014***	-0.182	0.015***	-0.202	0.016***	-0.221	0.025***	-0.118	0.042***
R&D	-1.963	0.255***	-0.346	0.135***	-0.850	0.163***	-1.775	0.250***	-3.038	0.398***	-2.621	0.603***
ABNEARN	-0.089	0.019***	-0.051	0.013***	-0.053	0.018***	-0.096	0.027***	-0.100	0.032***	-0.103	0.034***
VOLAT	-0.557	0.360	0.604	0.177***	-0.079	0.223	-0.882	0.319***	-2.054	0.657***	-0.669	0.668
ACCESS_L	1.500	0.061***	1.468	0.085***	1.813	0.078***	1.846	0.081***	1.647	0.089***	1.355	0.078***
ACCESS_S	-0.778	0.086***	-0.107	0.127	-0.428	0.124***	-0.807	0.102***	-1.139	0.117***	-1.224	0.110***
CASH	0.634	0.187***	-0.269	0.113**	-0.390	0.114***	0.057	0.180	2.438	0.316***	3.409	0.284***
TERM	-0.046	0.011***	-0.020	0.008**	-0.031	0.010***	-0.044	0.013***	-0.065	0.019***	-0.078	0.022***
CONSTRAINT	-0.123	0.047***	-0.022	0.038	-0.044	0.045	-0.188	0.052***	-0.188	0.077**	-0.085	0.077
CONSTRAINT×VOLAT	-1.194	0.489**	-0.955	0.298***	-0.815	0.331**	-0.403	0.463	-0.525	0.753	-2.351	0.899***
CONSTRAINT×CASH	0.381	0.227*	0.280	0.117**	0.550	0.150***	0.532	0.253**	-0.242	0.471	-0.251	0.474
R^2	0.3042		0.2843		0.2959		0.3028		0.2943		0.2419	

Table 1.5 *(Continued)*

	Panel B: Interquantile Regression											
	10th-50th		25th-50th		10th-25th		90th-50th		75th-50th		90th-75th	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Intercept	-0.901	0.043***	-0.717	0.043***	-0.184	0.034***	4.676	0.091***	1.870	0.060***	2.806	0.089***
NYP	-0.021	0.001***	-0.011	0.001***	-0.010	0.001***	-0.009	0.001***	0.003	0.001***	-0.012	0.001***
AGE	0.004	0.001***	0.003	0.001**	0.001	0.001	-0.006	0.001***	-0.005	0.001***	-0.001	0.001
LEV	-1.361	0.083***	-0.546	0.060***	-0.816	0.073***	-1.901	0.132***	-0.431	0.096***	-1.470	0.102***
AMAT	-0.045	0.003***	-0.018	0.003***	-0.027	0.002***	-0.025	0.005***	-0.007	0.005	-0.018	0.005***
MTB	0.064	0.012***	0.019	0.007***	0.045	0.008***	0.083	0.027***	-0.019	0.010*	0.103	0.024***
R&D	1.430	0.126***	0.925	0.122***	0.505	0.086***	-0.846	0.416**	-1.263	0.216**	0.417	0.351
ABNEARN	0.044	0.030	0.043	0.027	0.002	0.014	-0.007	0.042	-0.004	0.030	-0.004	0.033
VOLAT	1.486	0.211***	0.803	0.135***	0.683	0.152***	0.213	0.729	-1.173	0.467**	1.385	0.667**
ACCESS_L	-0.378	0.066***	-0.033	0.050	-0.345	0.046***	-0.491	0.061***	-0.199	0.063***	-0.292	0.059***
ACCESS_S	0.699	0.068***	0.379	0.053***	0.320	0.074***	-0.417	0.058***	-0.333	0.044***	-0.085	0.073
CASH	-0.326	0.128**	-0.448	0.087***	0.121	0.052**	3.351	0.166***	2.381	0.146***	0.970	0.230***
TERM	0.024	0.014*	0.013	0.012	0.011	0.009	-0.033	0.020*	-0.020	0.019	-0.013	0.016
CONSTRAINT	0.166	0.028***	0.143	0.038***	0.022	0.025	0.103	0.061*	0.000	0.057	0.103	0.045**
CONSTRAINT×VOLAT	-0.551	0.426	-0.411	0.271	-0.140	0.346	-1.948	0.851**	-0.122	0.609	-1.826	0.730**
CONSTRAINT×CASH	-0.252	0.102**	0.018	0.130	-0.270	0.090***	-0.782	0.350**	-0.773	0.285***	-0.009	0.323

Table 1. 6 The persistence of the effects of conventional debt maturity determinants across the debt maturity spectrum

This table reports the persistence of the effects of debt maturity determinants across the debt maturity distribution. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. For annual cross sections over the period from 1986 to 2010, we calculate how often the estimated coefficients of a covariate specified in the empirical model are found statistically significant at the conventional significance levels (1%, 5% and 10%) in a specific sign (positive or negative). The statistics of OLS regressions are presented in the first column of the table and the statistics of the 10th, 25th, 50th, 75th and 90th quantile regressions are presented in the rest of the columns. The empirical model for the quantile regressions is specified as follows,

$$Q_{\theta}(DMAT_{i,t}|X_{i,t-1}) = \alpha_{\theta} + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \dots, n; t = 1, \dots, T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed.

	OLS		10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	+ %	- %	+ %	- %	+ %	- %	+ %	- %	+ %	- %	+ %	- %
NYP	100		100		100		100		100		100	
AGE	12	16	12	4	20	4	12	16	4	28		28
LEV	100		100		100		100		96		80	
AMAT	100		76		96		96		88		48	
MTB		96		92		100		96		84		40
R&D		64		8		40		64		44	4	28
ABNEARN	4	36	8	32	4	24	4	32	8	28	8	12
VOLAT		12	20		8			20		36	8	20
ACCESS_L	100		100		100		100		100		100	
ACCESS_S		88	16	36	8	60	4	88		92		92
CASH	48			20		24	16	12	68		96	
CONSTRAINT	8	28	16	20	20	20	4	20	4	20	4	16
CONSTRAINT×VOLAT		12	4	20		16		4		8		8
CONSTRAINT×CASH	16	12	24	8	16	4	20		4	16	4	12

Table 1. 7 Economic conditions and the effects of conventional debt maturity determinants across the debt maturity spectrum

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for subperiods of hard and soft economic conditions. The original sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Term structure of interest rate is used to sort and classify firm-year observations into three groups using the 30% and the 70% cutoff points. Observations in the highest ranked group are considered in soft periods, whereas those in the lowest ranked group are considered in hard periods. The empirical model is specified as follows,

$$Q_{\theta}(DMAT_{i,t}|X_{i,t-1}) = \alpha_{\theta} + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \quad i = 1, \dots, n; t = 1, \dots, T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Hard Periods										
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.100	0.054*	0.273	0.062*	0.893	0.097***	2.600	0.185***	5.520	0.224***
NYP	0.011	0.001***	0.021	0.001***	0.032	0.002***	0.035	0.002***	0.022	0.003***
AGE	0.005	0.002**	0.004	0.002**	0.003	0.003	-0.003	0.003	-0.005	0.003
LEV	1.966	0.154***	2.755	0.167***	3.492	0.230***	3.213	0.305***	1.605	0.286***
AMAT	0.021	0.007***	0.049	0.009***	0.071	0.009***	0.077	0.010***	0.058	0.008***
MTB	-0.105	0.019***	-0.158	0.018***	-0.184	0.023***	-0.193	0.034***	-0.101	0.033***
R&D	-0.403	0.185**	-0.984	0.244***	-2.071	0.324***	-3.368	0.446***	-1.479	1.227
ABNEARN	-0.030	0.016*	-0.010	0.018	-0.020	0.024	-0.057	0.063	-0.046	0.047
VOLAT	0.337	0.228	-0.249	0.279	-0.766	0.419*	-1.523	1.337	-0.751	1.608
ACCESS_L	1.620	0.129***	2.033	0.105***	2.070	0.108***	1.768	0.135***	1.516	0.123***
ACCESS_S	-0.337	0.149**	-0.677	0.157***	-1.100	0.143***	-1.353	0.152***	-1.443	0.152***
CASH	-0.251	0.149*	-0.293	0.157*	0.048	0.230	2.814	0.579***	3.780	0.364***
CONSTRAINT	-0.021	0.056	-0.085	0.062	-0.266	0.075***	-0.227	0.121*	-0.093	0.136
CONSTRAINT×VOLAT	-0.917	0.437**	-1.024	0.527*	-0.853	0.605	-0.581	1.558	-2.195	1.766
CONSTRAINT×CASH	0.405	0.193**	0.835	0.245***	1.514	0.359***	0.561	0.737	-0.022	0.791
Soft Periods										
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.066	0.060	0.023	0.073	0.867	0.097***	2.687	0.177***	5.415	0.245***
NYP	0.014	0.001***	0.024	0.001***	0.033	0.002***	0.036	0.002***	0.026	0.003***
AGE	0.004	0.002*	0.005	0.002**	0.001	0.002	-0.004	0.003	-0.005	0.003
LEV	2.130	0.154***	2.867	0.161***	3.115	0.204***	2.806	0.304***	1.573	0.313***
AMAT	0.027	0.007***	0.053	0.008***	0.068	0.008***	0.064	0.011***	0.037	0.008***
MTB	-0.155	0.020***	-0.172	0.026***	-0.184	0.021***	-0.237	0.030***	-0.165	0.050***
R&D	-0.142	0.152	-0.544	0.181***	-1.341	0.261***	-2.291	0.502***	-3.118	0.896***
ABNEARN	-0.059	0.063	-0.073	0.077	-0.166	0.094*	-0.179	0.141	-0.257	0.220
VOLAT	0.445	0.274	0.006	0.361	-1.210	0.446***	-3.853	1.036***	-3.730	1.131***
ACCESS_L	1.327	0.104***	1.682	0.115***	1.889	0.110***	1.778	0.137***	1.418	0.128***
ACCESS_S	0.151	0.168	-0.230	0.181	-0.633	0.109***	-1.073	0.151***	-1.096	0.189***
CASH	-0.134	0.142	-0.467	0.168***	-0.213	0.273	2.246	0.501***	3.475	0.361***
CONSTRAINT	0.126	0.054**	0.148	0.069**	0.005	0.071	-0.096	0.112	-0.050	0.134
CONSTRAINT×VOLAT	-0.663	0.437	-0.827	0.518	0.112	0.626	0.839	1.294	-0.912	1.843
CONSTRAINT×CASH	-0.284	0.189	-0.093	0.222	-0.196	0.300	-1.480	0.711**	-0.859	0.987

Table 1. 8 Credit access and the effects of conventional debt maturity determinants across the debt maturity spectrum

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for the effects of debt maturity determinants for subgroups of firms, that is, firms without public credit access and firms with public credit access. The original sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Standard and Poor's bond ratings (both long-term and short-term) are used to categorize firms into two subgroups. Firms with positive debt outstanding but lack of Standard and Poor's long- or short-term bond ratings are considered to have no access to public credit and the remainder is considered to have access to public credit. The empirical model is specified as follows,

$$Q_\theta(\mathrm{DMAT}_{i,t}|\mathrm{X}_{i,t-1}) = \alpha_\theta + \beta_{1\theta}\mathrm{NYP}_{i,t-1} + \beta_{2\theta}\mathrm{AGE}_{i,t-1} + \beta_{3\theta}\mathrm{LEV}_{i,t-1} + \beta_{4\theta}\mathrm{AMAT}_{i,t-1} + \beta_{5\theta}\mathrm{MTB}_{i,t-1} + \beta_{6\theta}\mathrm{R\&}D_{i,t-1} + \beta_{7\theta}\mathrm{ABNEARN}_{i,t} + \beta_{8\theta}\mathrm{VOLAT}_{i,t-1} + \beta_{9\theta}\mathrm{ACCESS\_L}_{i,t-1} + \beta_{10\theta}\mathrm{ACCESS\_S}_{i,t-1} + \beta_{11\theta}\mathrm{CASH}_{i,t-1} + \beta_{13\theta}\mathrm{CONSTRAINT}_{i,t-1} + \beta_{14\theta}\mathrm{CONSTRAINT} \times \mathrm{VOLAT}_{i,t-1} + \beta_{15\theta}\mathrm{CONSTRAINT} \times \mathrm{CASH}_{i,t-1} + \varepsilon_{i,t} \quad i = 1,\dots,n; t = 1,\dots,T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Firms without Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.200	0.038***	0.248	0.053***	0.634	0.080***	1.964	0.153***	4.578	0.201***
NYP	0.009	0.001***	0.021	0.001***	0.034	0.001***	0.041	0.002***	0.033	0.002***
AGE	0.004	0.002**	0.009	0.002***	0.015	0.003***	0.017	0.004***	0.014	0.005**
LEV	1.881	0.095***	3.058	0.119***	3.935	0.179***	4.014	0.283***	2.589	0.279***
AMAT	0.012	0.004***	0.039	0.007***	0.081	0.009***	0.102	0.011***	0.077	0.008***
MTB	-0.078	0.008***	-0.141	0.012***	-0.182	0.015***	-0.211	0.024***	-0.178	0.054***
R&D	-0.208	0.085**	-0.604	0.118***	-1.220	0.184***	-2.271	0.347***	-1.455	1.271
ABNEARN	-0.031	0.011***	-0.035	0.016**	-0.032	0.025	-0.022	0.049	0.024	0.066
VOLAT	-0.048	0.137	-0.387	0.191**	-0.810	0.314***	-2.045	0.735***	-0.986	1.256
CASH	-0.167	0.077**	-0.330	0.106***	-0.065	0.171	2.043	0.514***	3.730	0.346***
TERM	-0.011	0.007	-0.029	0.010***	-0.049	0.016***	-0.089	0.026***	-0.135	0.035***
CONSTRAINT	-0.133	0.035***	-0.190	0.044***	-0.275	0.060***	-0.308	0.095***	-0.124	0.117
CONSTRAINT×VOLAT	-0.173	0.251	-0.234	0.318	0.109	0.431	-0.548	0.900	-2.886	1.492*
CONSTRAINT×CASH	0.261	0.087***	0.540	0.127***	0.526	0.213**	0.093	0.636	-0.100	0.525
	Firms with Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.198	0.285	2.164	0.301***	6.363	0.314***	9.851	0.217***	10.819	0.149***
NYP	0.032	0.003***	0.030	0.003***	0.000	0.004	-0.021	0.002***	-0.020	0.002***
AGE	0.003	0.003	-0.004	0.002*	-0.008	0.002***	-0.012	0.002***	-0.012	0.002***
LEV	2.848	0.382***	2.353	0.333***	1.006	0.306***	-0.390	0.217*	-0.597	0.176***
AMAT	0.065	0.010***	0.059	0.008***	0.039	0.010***	0.020	0.006***	0.001	0.005
MTB	-0.440	0.048***	-0.481	0.055***	-0.236	0.093**	-0.003	0.058	0.052	0.038
R&D	-5.511	1.133***	-8.318	2.411***	-6.048	2.096***	-2.465	1.118**	-1.911	0.678***
ABNEARN	-0.194	0.024***	-0.153	0.065**	-0.158	0.030***	-0.051	0.037	-0.029	0.025
VOLAT	0.275	1.233	1.276	1.657	4.754	1.671***	4.370	1.378***	3.373	1.068***
CASH	-1.181	0.693*	0.659	0.655	4.114	0.540***	3.871	0.471***	2.852	0.307***
TERM	-0.024	0.027	-0.030	0.028	-0.007	0.025	-0.024	0.021	0.025	0.018
CONSTRAINT	0.097	0.134	0.185	0.126	0.268	0.104***	0.259	0.091***	0.145	0.077*
CONSTRAINT×VOLAT	1.071	2.209	-1.225	2.379	-2.302	1.965	-1.041	1.946	-0.098	1.268
CONSTRAINT×CASH	2.751	0.868***	1.021	1.206	-1.819	0.703***	-1.437	0.541***	-1.096	0.387***

Table 1. 9 Capital structure, credit access and the effects of conventional debt maturity determinants across the debt maturity spectrum

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for the effects of debt maturity determinants for subgroups of firms: highly leveraged firms without public access versus highly leveraged firms with public access. The original sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Book leverage (the ratio of a firm's total debt outstanding to book assets) is used to sort and categorize firms into three groups using the 30% and the 70% cutoff points. Firms in the highest ranked group are considered highly leveraged, whereas those in the lowest ranked group are considered low leveraged. Standard and Poor's bond ratings (both long-term and short-term) are used to categorize firms into two subgroups. Highly leveraged firms without public access are those lack of Standard and Poor's bond ratings and present in the highest leverage group. Highly leveraged firms with public access are those with Standard and Poor's bond ratings and present in the highest leverage group. The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}AMAT_{i,t-1} + \beta_{4\theta}MTB_{i,t-1} + \beta_{5\theta}R\&D_{i,t-1} + \beta_{6\theta}ABNEARN_{i,t} + \beta_{7\theta}VOLAT_{i,t-1} + \beta_{8\theta}ACCESS\_L_{i,t-1} + \beta_{9\theta}ACCESS\_S_{i,t-1} + \beta_{10\theta}TERM_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \quad i = 1, \dots, n \; t = 1, \dots, T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Highly Leveraged Firms without Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.416	0.087***	0.866	0.099***	1.808	0.141***	3.411	0.193***	5.924	0.281***
NYP	0.024	0.001***	0.033	0.002***	0.041	0.002***	0.037	0.003***	0.024	0.003***
AGE	0.007	0.003**	0.005	0.003*	0.001	0.005	-0.001	0.006	-0.007	0.010
AMAT	0.052	0.008***	0.077	0.008***	0.098	0.010***	0.096	0.010***	0.061	0.008***
MTB	-0.146	0.020***	-0.245	0.030***	-0.293	0.050***	-0.195	0.049***	-0.149	0.100
R&D	-0.450	0.278	-0.864	0.460*	-1.612	0.548***	-2.970	0.316***	-1.365	1.014
ABNEARN	-0.078	0.034**	-0.078	0.040**	-0.041	0.044	-0.028	0.054	0.030	0.059
VOLAT	-1.899	0.488***	-2.209	0.679***	-2.082	1.163*	-3.849	1.013***	-1.752	1.435
CASH	0.383	0.417	1.997	0.773***	6.069	0.632***	7.273	0.427***	6.877	0.753***
TERM	0.019	0.022	0.020	0.025	-0.051	0.033	-0.096	0.042**	-0.108	0.058*
CONSTRAINT	-0.003	0.059	0.159	0.077**	0.312	0.099***	0.490	0.129***	0.444	0.169***
CONSTRAINT×VOLAT	-0.434	0.680	-0.155	0.958	-0.882	1.404	0.451	1.376	-1.891	2.028
CONSTRAINT×CASH	-0.342	0.449	-0.983	0.779	-3.371	0.910***	-2.033	0.618***	-2.443	0.864***
	Highly Leveraged Firms with Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	1.960	0.358***	3.624	0.440***	6.508	0.310***	9.238	0.241***	10.241	0.161***
NYP	0.025	0.003***	0.023	0.003***	-0.001	0.004	-0.017	0.003***	-0.018	0.002***
AGE	-0.007	0.004*	-0.014	0.004***	-0.013	0.003***	-0.014	0.003***	-0.012	0.003***
AMAT	0.043	0.013***	0.034	0.011***	0.016	0.008**	0.008	0.009	0.001	0.004
MTB	-0.282	0.133**	-0.341	0.219	0.056	0.074	0.124	0.081	0.171	0.062***
R&D	-12.332	4.020***	-6.826	3.889*	-5.616	4.239	-1.011	1.366	-0.653	0.711
ABNEARN	-0.159	0.040***	-0.112	0.095	-0.139	0.049***	-0.064	0.049	-0.019	0.020
VOLAT	-2.054	2.729	-2.861	3.745	-0.718	2.329	1.404	2.165	0.787	1.926
CASH	2.996	2.246	5.495	0.892***	4.982	0.615***	3.526	0.543***	2.504	0.530***
TERM	-0.039	0.048	-0.078	0.042*	-0.013	0.036	-0.101	0.030***	-0.029	0.026
CONSTRAINT	0.505	0.218**	0.669	0.205***	0.584	0.139***	0.452	0.111***	0.186	0.115
CONSTRAINT×VOLAT	5.177	3.282	4.810	3.918	3.651	2.636	2.164	2.440	1.524	1.944
CONSTRAINT×CASH	-0.380	2.259	-2.944	1.366**	-2.560	0.931***	-1.686	0.590***	-1.029	0.582*

Table 1. 10 Robustness check: CEO features

This table reports the 10th, 25th, 50th, 75th and 90th quantile regression results for the effects of previously investigated debt maturity determinants and CEO features (CEO stock ownership, CEO option compensation and CEO cash compensation). Stock ownership is the fraction of CEO holdings of a firm's stocks to the firm's total shares outstanding. Option compensation is the fraction of CEO holdings of a firm's stock options to the firm's total shares outstanding. Cash compensation is the logarithm of the sum of CEO salary and bonus. The final sample consists of 2012 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_\theta(\mathrm{DMAT}_{i,t}|\mathrm{X}_{i,t-1}) = \alpha_\theta + \beta_{1\theta}\mathrm{NYP}_{i,t-1} + \beta_{2\theta}\mathrm{AGE}_{i,t-1} + \beta_{3\theta}\mathrm{LEV}_{i,t-1} + \beta_{4\theta}\mathrm{AMAT}_{i,t-1} + \beta_{5\theta}\mathrm{MTB}_{i,t-1} + \beta_{6\theta}\mathrm{R\&}D_{i,t-1} + \beta_{7\theta}\mathrm{ABNEARN}_{i,t} + \beta_{8\theta}\mathrm{VOLAT}_{i,t-1} + \beta_{9\theta}\mathrm{ACCESS\_L}_{i,t-1} + \beta_{10\theta}\mathrm{ACCESS\_S}_{i,t-1} + \beta_{11\theta}\mathrm{TERM}_{i,t-1} + \beta_{12\theta}\mathrm{CASH}_{i,t-1} + \beta_{13\theta}\mathrm{CONSTRAINT}_{i,t-1} + \beta_{14\theta}\mathrm{CONSTRAINT} \times \mathrm{VOLAT}_{i,t-1} + \beta_{15\theta}\mathrm{CONSTRAINT} \times \mathrm{CASH}_{i,t-1} + \beta_{12\theta}\mathrm{Stock\ Ownership}_{i,t-1} + \beta_{12\theta}\mathrm{Option\ Compensation}_{i,t-1} + \beta_{12\theta}\mathrm{Cash\ Compensation}_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \dots, n;\ t = 1, \dots, T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.379	0.353	0.600	0.433	2.163	0.510**	5.496	0.553**	8.008	0.576**
NYP	0.019	0.003**	0.023	0.003**	0.026	0.004**	0.009	0.005*	-0.005	0.004
AGE	0.008	0.003**	0.005	0.003*	0.002	0.003	-0.004	0.003	-0.005	0.003*
LEV	3.174	0.294**	3.360	0.292**	2.831	0.361**	1.421	0.389**	0.004	0.312
AMAT	0.084	0.013**	0.089	0.010**	0.063	0.010**	0.034	0.010**	0.007	0.011
MTB	-0.265	0.052**	-0.271	0.045**	-0.293	0.068**	-0.214	0.097**	-0.062	0.040
R&D	-1.638	0.800**	-2.475	0.939**	-3.290	1.107**	-3.089	2.458	-0.267	1.063
ABNEARN	-0.060	0.044	-0.025	0.028	-0.070	0.088	-0.013	0.069	-0.049	0.036
VOLAT	0.795	0.629	0.662	1.007	-0.527	1.316	-0.049	1.337	2.308	1.280*
ACCESS_L	0.857	0.100**	1.435	0.118**	1.849	0.149**	1.672	0.159**	1.187	0.131**
ACCESS_S	0.066	0.124	-0.180	0.150	-0.440	0.126**	-0.580	0.119**	-0.740	0.133**
CASH	-0.635	0.284**	-0.866	0.296**	0.734	0.648	4.611	0.776**	3.668	0.347**
TERM	-0.035	0.021*	-0.061	0.024**	-0.055	0.028**	-0.040	0.032	0.003	0.030
CONSTRAINT	0.203	0.120*	0.225	0.110**	-0.025	0.121	0.165	0.129	0.116	0.137
CONSTRAINT×VOLA	0.962	1.859	0.262	1.293	-0.275	2.225	0.674	1.682	-1.036	3.104
CONSTRAINT×CASH	-0.611	0.630	-0.047	0.488	-0.546	0.783	-1.830	1.549	-0.497	0.664
Stock Ownership	**-**	**0.583****	**-1.012**	**0.739**	**-**	**1.073**	**-**	**1.140**	**0.897**	**1.139**
Option	**-**	**9.090**	**-**	**8.529**	**2.827**	**8.291**	**-**	**10.311**	**-**	**8.257**
Cash Compensation	**0.008**	**0.054**	**-0.037**	**0.065**	**-**	**0.078**	**-**	**0.079**	**0.042**	**0.077**
R^2	0.1698		0.1786		0.1857		0.1382		0.0241	

Table 1. 11 Robustness check: endogeneity

This table documents two-stage instrumental variable quantile regression results at the 10th, 25th, 50th, 75th, 90th quantiles for the effects of debt maturity determinants. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_\theta(\mathrm{DMAT}_{i,t}|\mathrm{X}_{i,t-1}) = \alpha_\theta + \beta_{1\theta}\mathrm{NYP}_{i,t-1} + \beta_{2\theta}\mathrm{AGE}_{i,t-1} + \beta_{3\theta}\mathrm{LEV(Predicted)}_{i,t-1} + \beta_{4\theta}\mathrm{AMAT}_{i,t-1} + \beta_{5\theta}\mathrm{MTB}_{i,t-1} + \beta_{6\theta}\mathrm{R\&}D_{i,t-1} + \beta_{7\theta}\mathrm{ABNEARN}_{i,t} + \beta_{8\theta}\mathrm{VOLAT}_{i,t-1} + \beta_{9\theta}\mathrm{ACCESS\_L}_{i,t-1} + \beta_{10\theta}\mathrm{ACCESS\_S}_{i,t-1} + \beta_{11\theta}\mathrm{TERM}_{i,t-1} + \beta_{12\theta}\mathrm{CASH}_{i,t-1} + \beta_{13\theta}\mathrm{CONSTRAINT}_{i,t-1} + \beta_{14\theta}\mathrm{CONSTRAINT} \times \mathrm{VOLAT}_{i,t-1} + \beta_{15\theta}\mathrm{CONSTRAINT} \times \mathrm{CASH}_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\ldots,n;\ t = 1,\ldots,T$$

Specifically, we use the predicted book leverage instead of the actual book leverage. The variables used to predict book leverage include tangibility (the ratio of net property, plant, and equipment to total book assets), profitability (the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to total book assets), firm size (the percentage of NYSE firms that have the same or smaller market capitalization), asset volatility (the standard deviation of monthly stock return during a firm's fiscal year, multiplied by the share of the firm's market value of common equity to the market value of total assets), abnormal earnings (the year-by-year difference in firm's income before extraordinary items adjusted for common stock and equivalent, divided by market capitalization), a dummy variable for net operating loss carryforwards and a dummy variable for investment tax credits. The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Quantile Regression									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.385	0.124***	-0.189	0.142	0.701	0.167***	2.809	0.254***	5.685	0.347***
NYP	0.015	0.001***	0.025	0.002***	0.035	0.002***	0.034	0.002***	0.021	0.003***
AGE	-0.001	0.003	-0.002	0.003	-0.006	0.003**	-0.010	0.003***	-0.007	0.003**
LEV (Predicted)	3.708	0.447***	4.673	0.522***	5.130	0.503***	4.394	0.740***	1.686	0.927*
AMAT	0.034	0.013***	0.066	0.017***	0.063	0.010***	0.049	0.013***	0.038	0.012***
MTB	-0.171	0.036***	-0.222	0.033***	-0.241	0.044***	-0.262	0.046***	-0.085	0.049*
R&D	-0.612	0.312**	-1.406	0.390***	-2.900	0.602***	-2.642	0.806***	-2.108	1.058**
ABNEARN	-0.030	0.027	-0.018	0.033	-0.134	0.051***	-0.087	0.060	-0.129	0.037***
VOLAT	0.499	0.368	-0.093	0.452	-1.281	0.734*	-0.834	1.143	-0.195	1.271
ACCESS_L	1.599	0.120***	1.955	0.109***	1.949	0.122***	1.825	0.113***	1.501	0.108***
ACCESS_S	0.022	0.168	-0.380	0.144***	-0.857	0.120***	-1.114	0.150***	-1.012	0.137***
CASH	-1.071	0.269***	-0.942	0.259***	0.281	0.472	3.402	0.459***	4.152	0.405***
TERM	-0.021	0.015	-0.033	0.018*	-0.039	0.020*	-0.044	0.027*	-0.012	0.031
CONSTRAINT	0.141	0.064**	0.140	0.080*	0.087	0.083	0.068	0.104	0.061	0.117
CONSTRAINT×VOLAT	-1.655	0.678**	-1.311	0.700*	-2.047	1.053*	-2.578	1.686	-3.172	1.865*
CONSTRAINT×CASH	0.441	0.271	0.451	0.276	0.144	0.568	-1.535	0.734**	-1.266	0.721*
R^2	0.2416		0.2547		0.2636		0.2477		0.1950	

Table 1. 12 Robustness check: firm fixed effects

This table documents the robustness of our findings on extreme debt maturity policies, taking into account firm fixed effects. Extremely short debt maturity policies are defined as DMAT present at the 10th percentile of the distribution. Extremely long debt maturity policies are defined as DMAT present at the 90th percentile of the distribution. Panel A estimates the fixed-effect regressions of debt maturity on conventional debt maturity determinants, extreme debt maturity dummies and their interactions. Panel B estimates binomial logistic regressions of extreme debt maturity policies with conventional debt maturity determinants and firm fixed effects. The sample is composed of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The sample used for fixed-effect logistic regressions is comprised of 1751 firms for the "short" regression and 1613 firms for the "long" regression. The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. ***, ** and * show that the coefficient is significantly correlated at 1%, 5% and 10% level respectively.

	Panel A: OLS regressions				Panel B: Logistic regressions			
	SHORT		LONG		SHORT		LONG	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
NYP	0.016	0.001***	0.018	0.001***	-0.019	0.003***	0.005	0.002**
AGE	-0.009	0.002***	-0.014	0.002***	0.020	0.005***	-0.026	0.004***
LEV	1.328	0.090***	1.824	0.077***	-3.954	0.237**	0.400	0.180**
AMAT	0.027	0.003***	0.028	0.003***	-0.021	0.008***	0.021	0.007***
MTB	-0.023	0.011**	-0.089	0.009***	0.087	0.018***	0.060	0.024**
R&D	-0.746	0.278***	-0.595	0.219***	0.599	0.382	-0.009	0.584
ABNEARN	-0.072	0.019***	-0.062	0.016***	0.148	0.046***	-0.095	0.038**
VOLAT	0.536	0.267**	0.063	0.212	0.491	0.434	1.444	0.612**
ACCESS_L	1.175	0.041***	0.909	0.037***	-0.688	0.159***	0.930	0.073***
ACCESS_S	-0.262	0.063***	0.020	0.055	-0.980	0.358***	-0.625	0.121***
CASH	1.127	0.119***	0.215	0.100**	0.611	0.221***	1.395	0.247***
TERM	-0.043	0.009***	-0.028	0.008***	0.049	0.023**	0.025	0.019
CONSTRAINT	-0.049	0.036	-0.071	0.031**	0.337	0.097***	-0.162	0.079**
CONSTRAINT×VOLAT	-0.748	0.404*	-0.371	0.322	-1.417	0.688**	-0.153	0.959
CONSTRAINT×CASH	0.163	0.171	0.252	0.141*	0.019	0.294	0.504	0.320
SHORT/LONG	-0.901	0.133***	6.005	0.130***				
SHORT/LONG×NYP	-0.024	0.002***	-0.021	0.002***				
SHORT/LONG×AGE	-0.018	0.004***	0.001	0.002				
SHORT/LONG×LEV	-2.038	0.255***	-2.171	0.173***				
SHORT/LONG×AMAT	-0.028	0.007***	-0.044	0.005***				
SHORT/LONG×MTB	0.036	0.020*	0.221	0.025***				
SHORT/LONG×R&D	1.131	0.350***	1.100	0.481**				
SHORT/LONG×ABNEARN	0.047	0.054	-0.009	0.048				
SHORT/LONG×VOLAT	-0.512	0.542	-0.807	0.651				
SHORT/LONG×ACCESS_L	-1.771	0.189***	-0.655	0.070***				
SHORT/LONG×ACCESS_S	0.989	0.335***	-0.565	0.102***				
SHORT/LONG×CASH	-1.074	0.232***	1.358	0.224***				
SHORT/LONG×TERM	0.075	0.030**	0.057	0.024**				
SHORT/LONG×CONSTRAINT	-0.081	0.116	0.183	0.079**				
SHORT/LONG×CONSTRAINT×VOLAT	1.474	0.881*	2.782	1.087**				
SHORT/LONG×CONSTRAINT×CASH	0.254	0.364	-0.623	0.347*				
log likelihood					-3815.669		-6213.996	
R^2	0.3933		0.5267					
Nb. of Observations	47161		47161		12313		17416	
Nb. Of Firms	7734		7734		1751		1613	

Table 1. 13 Robustness check: alternative debt maturity definitions

This table shows the 10th, 25th, 50th, 75th, 90th quantile regression results for the effects of debt maturity determinants. In panel A, debt maturity (DMAT) is defined as the proportion of interest bearing financial obligations with maturities of more than three years. In panel B & panel C, debt maturity (DMAT) is calculated as the weighted average debt maturity structure of a firm's total debt based on two different duration schemes. Panel B defines the duration of 0.3 years for debts payable in year 1, 1.3 years for debts payable in year 2, 2.3 years for debts payable in year 3, 3.3 years for debts payable in year 4, 4.3 years for debts payable in year 5, and 7 years for debts payable beyond year 5. Panel C defines the duration of 0.7 years for debts payable in year 1, 1.7 years for debts payable in year 2, 2.7 years for debts payable in year 3, 3.7 years for debts payable in year 4, 4.7 years for debts payable in year 5, and 13 years for debts payable beyond year 5. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \quad i = 1,\dots,n; t = 1,\dots,T$$

Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: Debt maturity (DMAT) is calculated as the proportion of interest bearing financial obligations with maturities of more than three years

	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.012	0.002***	-0.071	0.006***	0.050	0.012***	0.459	0.014***	0.754	0.011***
NYP	0.000	0.000***	0.003	0.000***	0.005	0.000***	0.004	0.000***	0.002	0.000***
AGE	0.000	0.000	0.000	0.000	-0.001	0.000**	-0.001	0.000***	0.000	0.000***
LEV	0.043	0.005***	0.388	0.019***	0.519	0.021***	0.286	0.019***	0.116	0.013***
AMAT	0.000	0.000**	0.006	0.001***	0.008	0.001***	0.005	0.001***	0.002	0.000***
MTB	-0.002	0.000***	-0.020	0.002***	-0.026	0.002***	-0.023	0.003***	-0.006	0.002**
R&D	-0.006	0.003**	-0.078	0.019***	-0.267	0.035***	-0.482	0.056***	-0.184	0.058***
ABNEARN	-0.001	0.001	-0.005	0.002**	-0.013	0.005***	-0.011	0.003***	-0.003	0.002*
VOLAT	0.011	0.007	0.031	0.027	-0.210	0.049***	-0.282	0.063***	-0.108	0.051**
ACCESS_L	0.344	0.014***	0.348	0.013***	0.185	0.010***	0.126	0.007***	0.065	0.005***
ACCESS_S	-0.026	0.018	-0.095	0.012***	-0.145	0.011***	-0.144	0.010***	-0.092	0.008***
CASH	0.000	0.004	-0.012	0.012	-0.025	0.033	0.192	0.029***	0.144	0.017***
TERM	0.000	0.000	-0.004	0.001***	-0.008	0.002***	-0.015	0.002***	-0.010	0.001***
CONSTRAINT	0.000	0.002	-0.003	0.006	-0.033	0.007***	-0.027	0.007***	-0.007	0.005
CONSTRAINT×VOLAT	-0.022	0.011**	-0.102	0.042**	0.014	0.068	-0.050	0.095	-0.073	0.091
CONSTRAINT×CASH	-0.003	0.004	0.037	0.018**	0.104	0.036***	0.068	0.045	0.043	0.022*
R^2	0.1945		0.2739		0.2963		0.2809		0.2479	

Table 1.13 *(Continued)*

Panel B: Debt maturity (DMAT) is calculated as the weighted average debt maturity structure of a firm's total debt based on the duration scheme of 0.3 years for debts payable in year 1, 1.3 years for debts payable in year 2, 2.3 years for debts payable in year 3, 3.3 years for debts payable in year 4, 4.3 years for debts payable in year 5, and 7 years for debts payable beyond year 5

	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.073	0.041*	0.182	0.044***	1.003	0.060***	2.521	0.088***	4.241	0.091***
NYP	0.012	0.001***	0.020	0.001***	0.027	0.001***	0.025	0.001***	0.016	0.001***
AGE	0.002	0.002	0.001	0.001	-0.001	0.001	-0.003	0.002*	-0.003	0.001***
LEV	1.930	0.101***	2.530	0.100***	2.574	0.104***	1.944	0.129***	1.028	0.112***
AMAT	0.022	0.004***	0.041	0.005***	0.048	0.004***	0.040	0.006***	0.028	0.003***
MTB	-0.124	0.012***	-0.156	0.012***	-0.161	0.011***	-0.156	0.013***	-0.075	0.017***
R&D	-0.330	0.115***	-0.835	0.156***	-1.703	0.181***	-2.342	0.267***	-1.633	0.463***
ABNEARN	-0.048	0.012***	-0.058	0.011***	-0.070	0.023***	-0.082	0.020***	-0.060	0.018***
VOLAT	0.541	0.148***	-0.227	0.183	-0.970	0.275***	-1.397	0.411***	-0.500	0.414
ACCESS_L	1.312	0.066***	1.317	0.054***	1.107	0.053***	0.987	0.054***	0.842	0.046***
ACCESS_S	-0.246	0.094***	-0.468	0.075***	-0.624	0.065***	-0.754	0.074***	-0.773	0.064***
CASH	-0.245	0.101**	-0.361	0.099***	0.029	0.156	1.619	0.220***	2.100	0.161***
TERM	-0.015	0.007**	-0.021	0.008***	-0.039	0.010***	-0.054	0.012***	-0.054	0.013***
CONSTRAINT	-0.020	0.035	-0.066	0.037*	-0.166	0.039***	-0.133	0.049***	-0.040	0.048
CONSTRAINT×VOLAT	-0.856	0.250***	-0.609	0.281**	-0.359	0.396	-0.359	0.557	-1.260	0.725*
CONSTRAINT×CASH	0.235	0.103**	0.508	0.127***	0.468	0.185**	-0.095	0.317	-0.259	0.265
R^2	0.2975		0.3113		0.3168		0.3043		0.2527	

Panel C: Debt maturity (DMAT) is calculated as the weighted average debt maturity structure of a firm's total debt based on the duration scheme of 0.7 years for debts payable in year 1, 1.7 years for debts payable in year 2, 2.7 years for debts payable in year 3, 3.7 years for debts payable in year 4, 4.7 years for debts payable in year 5, and 13 years for debts payable beyond year 5

	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.240	0.051***	0.331	0.061***	0.945	0.085***	3.231	0.179***	7.081	0.214***
NYP	0.014	0.001***	0.026	0.001***	0.041	0.001***	0.049	0.002***	0.034	0.003***
AGE	0.005	0.002***	0.005	0.002**	0.002	0.003	-0.006	0.003*	-0.007	0.003**
LEV	2.251	0.117***	3.329	0.138***	4.317	0.195***	4.125	0.276***	2.132	0.258***
AMAT	0.026	0.005***	0.058	0.008***	0.088	0.008***	0.084	0.013***	0.058	0.008***
MTB	-0.148	0.015***	-0.203	0.017***	-0.238	0.019***	-0.285	0.029***	-0.159	0.058***
R&D	-0.355	0.140**	-0.835	0.178***	-1.867	0.295***	-3.606	0.433***	-3.362	1.085***
ABNEARN	-0.052	0.015***	-0.070	0.022***	-0.122	0.038***	-0.155	0.043***	-0.146	0.045***
VOLAT	0.629	0.183***	0.072	0.257	-0.857	0.368**	-2.792	0.933***	-0.967	0.884
ACCESS_L	1.601	0.090***	2.323	0.104***	2.669	0.107***	2.272	0.121***	1.848	0.111***
ACCESS_S	0.056	0.158	-0.340	0.150**	-1.012	0.131***	-1.530	0.157***	-1.626	0.146***
CASH	-0.309	0.125**	-0.385	0.126***	0.080	0.220	3.225	0.473***	4.621	0.378***
TERM	-0.027	0.009***	-0.035	0.012***	-0.037	0.016**	-0.080	0.027***	-0.102	0.031***
CONSTRAINT	-0.023	0.042	-0.038	0.050	-0.189	0.067***	-0.234	0.105**	-0.126	0.108
CONSTRAINT×VOLAT	-1.011	0.321***	-0.934	0.367**	-0.406	0.523	-0.634	1.323	-3.528	1.558**
CONSTRAINT×CASH	0.299	0.132**	0.481	0.163***	0.557	0.271**	-0.445	0.668	-0.308	0.568
R^2	0.2724		0.2834		0.2915		0.2850		0.2352	

Figure 1. 1 Histogram of debt maturity structure

This figure exhibits the debt maturity histogram. The weighted average debt maturity structure is calculated according to the Formula (1.1). The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010.

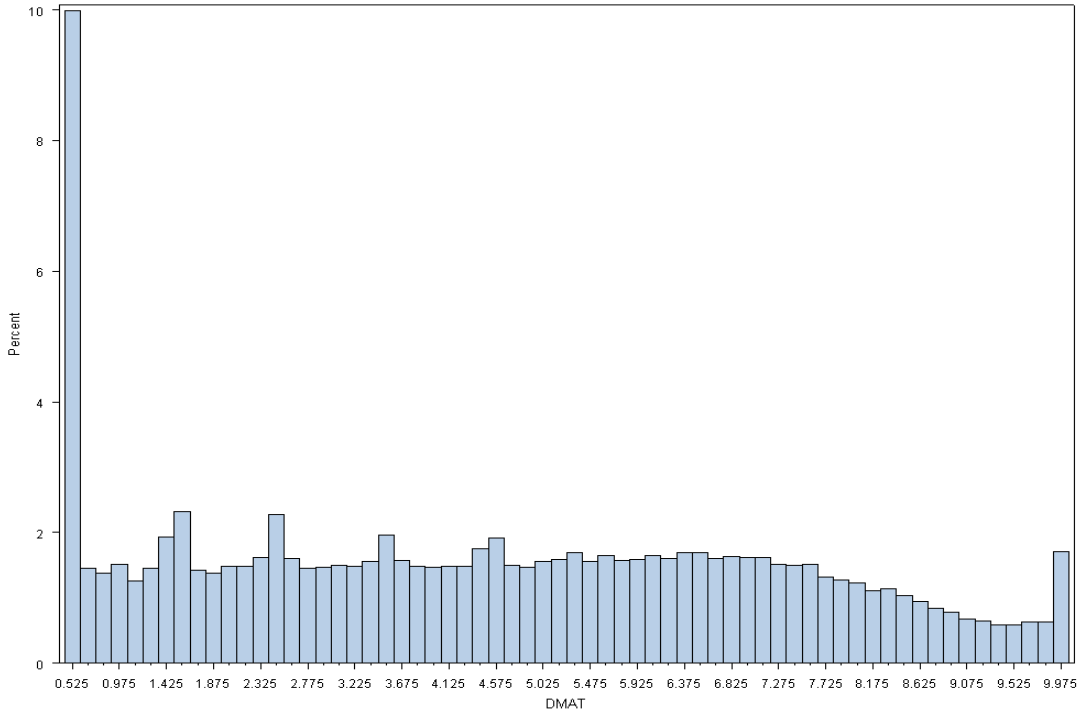
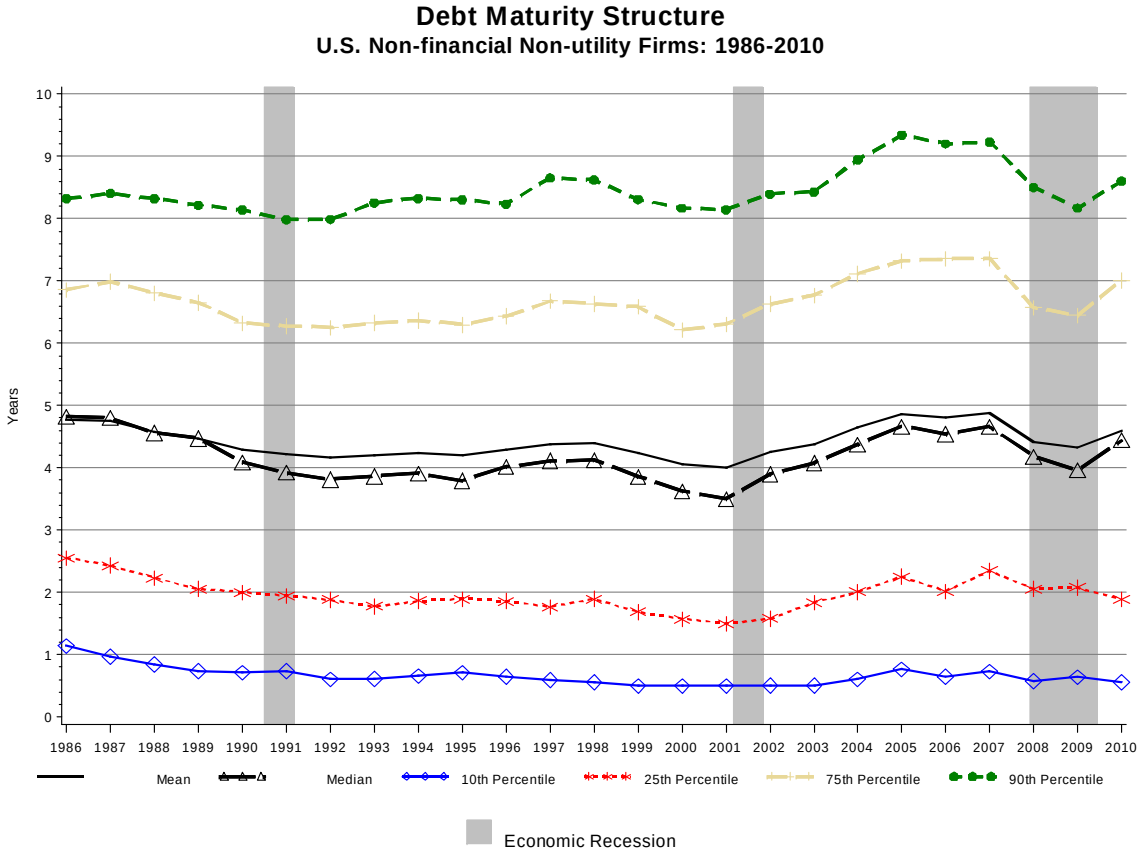


Figure 1. 2 Year-over-year changes in debt maturities of U.S. firms

This figure exhibits the year-over-year distribution of the weighted average debt maturity structure from 1986 to 2010. The weighted average debt maturity structure is calculated according to the Formula (1.1). The over-time cross-sectional mean, median, 10th percentile, 25th percentile, 75th percentile and 90th percentile are displayed separately. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010.



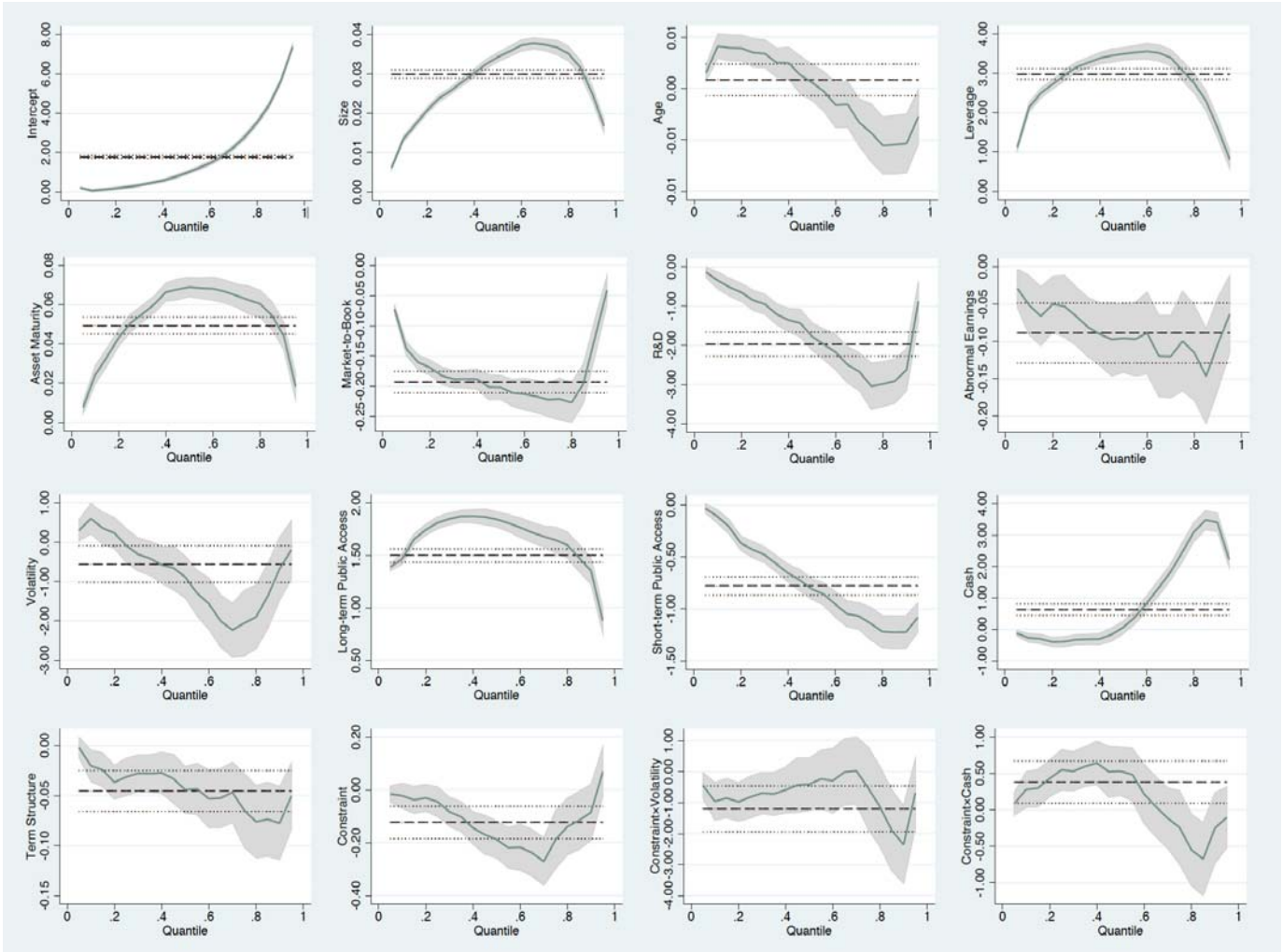
Data Source: Compustat Industrial Annual Database, Federal Reserve Saint Louis Database

Figure 1. 3 Quantile processes

This figure produces a total of 12 quantile processes for the covariates specified in the following empirical model. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_{\theta}\left(DMAT_{i,t}\middle|X_{i,t-1}\right) = \alpha_{\theta} + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&_{\ i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \ldots, n; t = 1, \ldots, T$$

The weighted average debt maturity structure is calculated according to the Formula (1.1). Other variables are defined in Table 1.1 and are winsorized at the 1st and 99th percentiles. For each covariate, we plot the quantile regression estimates as a function of quantile ranging from 0.05 to 0.95, shown as the pointwise solid curve. The shaded grey band depicts the conventional 90 percent confidence interval, estimated using the bootstrapping method. The long dashed line is the OLS estimate and the two dotted lines denote its confidential band.



Chapter 2

Dynamics in Debt Maturities of Firms: Conventional Determinants versus Herding Behaviors?

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Abstract

The current paper examines the driving forces of debt maturity dynamics. This is the first attempt ever made to explain whether debt maturity dynamics is better explained by the variations in conventional debt maturity determinants or by firm's attempt to herd peer firms' debt maturity. By tracking the event time debt maturity evolution and estimating in a multi-period regression framework the significances of these two forces, we find that debt maturity herding dominates over the conventional determinants in driving over-time debt maturity variation. This pattern holds after controlling for mean-reversion (induced by the presence of the extreme debt maturity users), accounting for company conglomerates, and considering a variety of specifications such as firm fixed effects and the interdependencies of corporate policies. When ruling out the impact of changes in the yield curve, we find that the herding in response to changes in industry peers' debt maturity is more effective. In addition, our results indicate important debt maturity persistence especially in short debt maturity firms. After controlling effects of herding and the conventional factors, firms with originally short debt maturities continue to shorten the maturities of their aggregate debts.

Keywords: Debt maturity; dynamics; herding; conventional determinants; extreme cases

JEL Classification: G3

2.1. Introduction

The existing empirical research on debt maturity determinants is characterized as single-period static analyses, in which the observed debt maturity is viewed as the optimum[14]. However, in a dynamic economy, there is a high probability that the observed debt maturity departs from the optimal debt maturity due to the presence of market frictions. For instance, during tight money periods, firms may not be able to borrow as long as they want since access to credit is limited. The existing studies that aim to test the "optimal" logic and constrain themselves to static cross-sectional analyses are apparently unable to capture firms' real intention in making debt maturity decisions. In this context, it would be interesting to reexamine the issue from a dynamic perspective.

Different from previous studies which investigate the speed of adjustment to target (optimal) debt maturities of firms (e.g., Ozkan (2000), Antoniou et al. (2006), Cai et al. (2008) and Terra (2011)), the current paper studies the driving forces of debt maturity dynamics. In particular, we aim to figure out whether debt maturity dynamics are driven by changing conventional determinants or by firm's attempt to approach industry peers' debt maturity. Our empirical results show that the over-time debt maturity adjustment is explained much better by the herding behavior than by changes in previously identified debt maturity determinants. This evidence is robust even after controlling for mechanical reversion, conglomerates, and alternative estimation methods. Furthermore, we show that when the market effects are eliminated, firms herd more to changes in industry peers' debt maturities than levels. A one-year lengthening in peer firms' yield-curve-adjusted

[14] Examples of single-period specifications in debt maturity literature include Mitchell (1991), Barclay and Smith (1995), Guedes and Opler (1996), Stohs and Mauer (1996), Scherr and Hulburt (2001), Barclay, Marx and Smith (2003), Johnson (2003), Datta et al. (2005), Berger et al. (2005)), Billet et al. (2007), Saretto and Tookes (2011), and Fan et al. (2012).

debt maturity leads a firm to lengthen its yield-curve-adjusted debt maturity by 0.51-0.52 years.

Empirical results on debt maturity dynamics are, at best, limited, which have been focusing on estimating the adjustment speed towards target. The most popular method to estimate a target financial structure has been to compute the fitted value from a regression of observed financial structure on determinants of its optimal. Target financial structure is, however, unobservable. The existing tests of debt maturity adjustment to target are, as a consequence, "tests of a joint hypothesis that (1) firms adjust to target and (2) the target proxy approximates the true target relatively well" (Hovakimian and Li (2011)).

Meanwhile, instructive implications can be drawn from a herding effect in terms of debt maturity dynamics. Notably, Leary and Roberts (2014) emphasize the impact of peer firms in shaping capital structure. They suggest that a firm's financial structure is not only a function of the firm's own characteristics. The actions or characteristics of its peer firms could also enter into the firm's financing objective function due to learning motives or similar investment opportunity sets. Nonetheless, in debt maturity research, the role for peer firm behavior is often overlooked, or at most implicitly assumed by adding industry dummies. It lacks an explicit test on the significance of the debt maturity herding behaviors relative to other economic forces, for example, major changes in firm characteristics.

We conduct the current research in three steps. To begin with, we trace the event-time evolution of debt maturity (measured as the weighted average maturity for a firm's total debts) and debt maturity deviation (measured as the difference between a firm's

observed debt maturity and its peer firms' weighted average debt maturity). Our results demonstrate that debt maturities of actual debt maturity portfolios converge through time, whereas firms with initially short debt maturity continue to stay in the short debt maturity group and vice versa. This convergence pattern shows preliminary evidence of debt maturity herding. The rationale lies in the intuition that firms sorted according to the observed debt maturity are classified into the portfolios deviating from industry peers', with the two extreme portfolios misclassified to a greater extent. The herding attempt pushes the average debt maturity towards the equilibrium, resulting in substantial convergence. For the medium and long portfolios, the herding attempt generates two forces that cancel each other out, keeping the average debt maturity of the two moderate portfolios comparatively stable. The longest and the lowest portfolios are pushed by a single force to the center. This intuition is further supported by the evidence in the evolution of debt maturity deviation, characterized by converging curves towards zero.

Next, we examine, in a multivariate analytical framework, the driving forces of debt maturity dynamics. The major forces to estimate are changes in conventional debt maturity determinants and debt maturity herding behavior. Moreover, we decompose the herding behavior into, (1) mimicking debt maturity levels of industry peers; (2) responding to changes in peer firms' debt maturities. In a way that the firm under observation is excluded from calculating industry peers' debt maturity, the debt maturity determinants are made exogenous. Note that adding industry dummies would not have that luxury. As a whole, our results confirm a central and accumulative role of debt maturity herding. Depending on the time frame, 9.2 to 21.9 percent of the variation in overtime debt maturity adjustment is explained by the single force of herding. By sharp contrast, major changes in firm fundamentals explain only 3.7 to 8.8 percent of the

variation. Further evidence shows that although the mechanical reversion (driven by the extreme cases) and the herding effects coexist, the latter shows a good ability of robustness. The estimated coefficients for the herding variables are only slightly weakened after incorporating the extreme debt maturity dummies. Reversely, the estimated coefficients for the extremely short and long debt maturity dummies are mitigated to a larger extent after entering the two herding variables, suggesting non-trivial herding in debt maturity extremes. Furthermore, our analyses show that after controlling the herding effect and the conventional factors, the persistence in debt maturity is primarily attributed to firms with short debt maturities. Firms with originally short debt maturities appear to continue shortening the maturities of their aggregate debts. This evidence also corroborates our portfolio analysis results, especially for survivor firms. A further investigation on debt maturity targeting behavior reveals that the persistence is most likely associated with an unobserved time-invariant component in debt maturity, especially in short debt maturity firms.

Lastly, as an extension, we study debt maturity herding, screening out the market effects. Specifically, we adjust debt maturities of firms for changes in the yield curve and then reevaluate previous findings on debt maturity herding. Remarkably, the herding with respect to the changes in peer firms' debt maturity stands out sharply. A further analysis shows that only firms in the high volatility group herd towards the debt maturity levels of peers. This result suggests that peer firms' actions probably play a more important part in forming a firm's debt maturity policy than their characteristics.

This paper is a first attempt to explain debt maturity dynamics from the herding point of view. In addition, by entering separately the response to levels and changes in peer firms' debt maturities, along with extreme debt maturity dummies, we make a leap in providing

neat estimates for the debt maturity herding effect. Adjusting debt maturity measure to the changes in the yield curve is also novel. In particular, it helps to eliminate the impact of the sloping yield curve changes on the wide economy and eventually net out the herding effect.

The remainder of the paper proceeds as follows. Section 2.2 reviews related literature. Section 2.3 discusses the data, defines the variables and presents descriptive statistics. Section 2.4 provides preliminary investigation into the event-time debt maturity evolution. Section 2.5 analyses empirically whether dynamics in debt maturities of firms is better explained by conventional determinants or by debt maturity herding behaviors. Section 2.6 concludes.

2.2. Related literature

The finance literature has identified a set of factors believed to influence debt maturity decisions. The most-cited are incentive provision of mitigating agency problems[15], liquidity provision of lowering financing cost, tax considerations and rollover risk.

Typically, researchers conclude that debt with short maturity acts as a discipline device for moral hazard and firms that are more prone to agency conflicts find short-term debt optimal (Myers (1977), Datta et al. (2005), and Brockman et al. (2010), among others). An alternative literature favoring the use of short-term debt has focused on the liquidity provision. For example, Taggart (1977) and Marsh (1982) posit that short-term debt has cost advantage over long-term debt for its liquidity feature. Despite the benefits, short-

[15] Examples of the types of agency problems documented in prior research include underinvestment (e.g., Myers (1977)), asset substitution (e.g., Barnea et al. (1980) and Leland and Toft (1996)), interest alignment dilemma between shareholders and managers (e.g., Rajan and Winton (1995) and Stulz (2000)), and adverse selection under opaque information environment (e.g., Flannery (1986)).

term debt is likely to increase rollover risk, especially when maturing debt needs to be rolled over at high yields or when credit market freezes. Notably, recent research has put emphasis upon the overload of short-term debt in leading to financial distress of firms and amplifying credit market freeze during the financial crisis of 2007-2008. Researchers hold that short-term debt has compelled firms to refinance maturing debts at higher interest rates (e.g., Acharya et al. (2011)), to intensify underinvestment problems (e.g., Almeida et al. (2010), and Diamond and He (2014) and to cause inefficient liquidation (e.g., He and Xiong (2012a), and He and Xiong (2012b)). Under this premise, a longer maturity of debt helps to reduce the rollover risk. Brick and Ravid (1985, 1991) show that tax advantages of debts with diverse term structures differ according to the term structure of interest rates. Long-term borrowing is preferable when the term structure of interest rates is upward sloping, and vice versa. Baker et al. (2003) and Greenwood et al. (2010) highlight firms' behaviors of timing favorable financing conditions to issue short- or long-term debt in the interest of borrowing at cheaper terms.

The cross-sectional implications in the above theoretical literature have been explored in prior empirical research such as Barclay and Smith (1995), Guedes and Opler (1996), Stohs and Mauer (1996), Datta et al. (2005), and Brockman et al. (2010), among others. Nevertheless, the time-series implication has not yet been emphasized and directed tested. An intuitive hypothesis in time series from the above literature typically poses that **firms manage debt maturity in response to the changes in the conventional factors** such as incentive considerations and rollover risk. Another hypothesis suggests the existence of optimal debt maturity. In particular, the optimal maturity is supposed to be short enough to prevent managerial risk-shifting (e.g. underinvestment, asset substitution), to capture cost advantage associated with the liquidity issue but long-

enough in the way to minimize loss in refinancing maturing debts. Leland and Toft (1996) were perhaps the first to formally address the optimal debt maturity issue. In a closed-form derivation, they show that longer maturity better exploits tax advantages but impedes incentive compatibility between principal and agents. As a result, firms balance the tax benefits against agency and bankruptcy costs in determining the optimal debt maturity. Ju and Ou-Yang (2006) extend the model of Leland and Toft (1996) by considering the interest rate process. They conclude that the optimal debt maturity in a stochastic interest rate environment is jointly determined with the optimal capital structure. Basically, the optimal capital structure is the result of balancing the tax shields against the bankruptcy costs of debts and the optimal debt maturity is the result of trading off the gains (i.e. the tax benefits) of dynamically adjusting the debt amount, and the losses (i.e. the transaction costs of refinancing debt) of doing so. Cheng and Milbradt (2012) analyze the optimal debt maturity of a firm based on the trade-off between incentive provision (i.e. managerial risk-shifting incentives) and debt run risk by creditors. They find that the optimal debt maturity rests at the interior solution that minimizes rollover risk and managers' incentives to take risk-shifting decisions. He and Xiong (2012b) and Chen et al. (2012) derive the optimal debt maturity by examining the liquidity provision along with the rollover risk. Further, Diamond and He (2014) highlight the debt overhang effect on investment. They infer that the optimal maturity structure exists where long-term debt overhang in good times and short-term debt overhang in bad times are traded off. Most convincingly, in two anonymous surveys of Graham and Harvey (2001) and Bancel and Mittoo (2004)), firms do admit to engage in the activities of rebalancing the mix of debts with short and long maturities.

The optimal maturity structure is unobservable and a proxy has to be used in empirical analysis. The common practice is to fit the target from a regression of observed debt maturity on well-known determinants (e.g., Ozkan (2000), Antoniou et al. (2006), Cai et al. (2008), and Terra (2011)). Despite the efforts, a strong query has been raised concerning the robustness of this approach. For instance, Hovakimian and Li (2011), contend that earlier tests of capital structure dynamics are, in effect, "tests of a joint hypothesis that (1) firms adjust to target capital structure and (2) the target proxy approximates the true target relatively well". In particular, the fitted target proxies are biased in a wide range of empirical specifications and tests using the fitted target cannot distinguish between the validation of the target proxies and the targeting evidence. Hovakimian and Li (2011) show that the bias can be mitigated by taking certain specifications into account. However, identifying the "real" target remains empirically challenging.

An enlightening series of studies underline the industry effect. Welch (2004), Frank and Goyal (2009) and Fama and French (2012) show that industry average acts as a reliable proxy for target financial structure and firms that deviate away from their industry average leverage ratio endeavor to rebalance back to it. Although intuitive, they do not give formal explanations for why industry factors are related to firm financial structure. Especially, Mackay and Phillips (2005) find that industry-related factors are of real relevance rather than industry fixed effects and a firm's financial structure is greatly dependent of its industry peers even in competitive industry environments. A recent paper of Leary and Roberts (2014) emphasizes the peer effect in the determination of corporate financing policies. Importantly, they elaborate that the peer effect arises from a learning motive. Firms are actually unsure of how to decide target financing structure

in contrast to what the theories suggest due to the complications to estimate the relative costs and benefits of financing decisions. As a result, they imitate the financial policies of their peer firms with similar characteristics and comparable business opportunities. The findings of Leary and Roberts (2014) suggest that a firm's financing structure is a function of its own characteristics and the characteristics of its industry peers. We are therefore interested to test whether **peer firms matter for debt maturity choice and firms respond to the debt maturity policies of their peers**.

2.3. Data and variables

2.3.1. Data

Our sample is confined to U.S. publicly traded non-financial non-utility firms, drawn from CRSP/Compustat Merged Database. Accordingly, we exclude firms with primary Standard Industrial Classification codes 6000-6999 (Finance, Insurance and Real Estate) and 4900-4999 (Electric, Gas, and Sanitary Services). To avoid noisy findings due to the existence of non-U.S. based firms, we eliminate firms listed on U.S. stock exchanges but domiciled abroad. In turn, non-US incorporated firms and American Depositary Receipt (ADR) are removed.

Two datasets are employed. The first dataset covers firms for the period 1974–2011, used in Section 4. to investigate the event-time debt maturity evolution. The second dataset intercepts the period 1986-2011 to study the main forces that drive debt maturity dynamics in Section 5. The intuition of focusing on the time window from 1986 in Section 5 is to incorporate the effect of public credit access whose data type in Compustat (Standard and Poor's domestic issuer rating) is not available before 1985. Note that firms' access to public credit is found of great importance in determining corporate debt policies (see e.g., Faulkender and Petersen (2006), and Sufi (2009)). Another purpose is to

eliminate the influence of the famous structural shift in US in the early 1980s (see e.g., Butler et al. (2006), Fama and French (2012)).

Firm-year observations with zero debt outstanding and observations with incomplete debt maturity information are discarded. Additional, we require that a firm has at least 5 consecutive debt maturity observations in order to be included into the sample. Coding errors are corrected by excluding observations where leverage values are inferior to 0 or superior to 1. Firms with debt maturity levels less than 0 are also excluded. Our final sample is comprised of 6458 firms in first dataset and 5828 firms in the second dataset.

2.3.2. Variables

2.3.2.1. Debt maturity structure

Prior studies on debt maturity determinants define long-term debts as the financial obligations that are to come due in more than one year (e.g., Scherr and Hulburt (2001), Antoniou et al. (2006) and Fan et al. (2012)), three years (e.g., Barclay and Smith (1995), Barclay et al. (2003), Johnson (2003), Datta et al. (2005), and Billet et al. (2007)) or five years (e.g., Ozkan (2000) and Datta et al. (2005)). Above all, this measurement has a fatal defect when examining within-firm debt maturity dynamics as it treats debts with maturities below and over the definition threshold as homogeneous. Imagine a situation where a firm shortens debt maturity by replacing debts due in 3 years with debts due in 1 year. The firm has an obvious intention to shorten debt maturity. But in the case that long-term debt is defined as debt maturing in more than three years, calculating the difference of long-term debt share gives rise to a misleading result indicating that no adjustment has been made. To address this concern, we construct a value weighted debt

maturity structure and define debt maturity as the value weighted average life for a firm's total debts, as shown in the formula below.

$$DMAT = \sum_{i=1}^{5} \frac{Debt_i}{Tdebt} \times Duration_i + \frac{(Tdebt - \sum_{i=1}^{5} Debt_i)}{Tdebt} \times Duration_r \quad (2.1)$$

Where DMAT represents the value weighted average debt maturity structure of a firm, $Debt_i$ represents the amount of debts payable in year i for i≤5. *Tdebt* refers to the amount of total debt, calculated as the sum of total long-term debts and debts in current liabilities.

Duration of a financial asset is defined theoretically as the weighted average length of time until all payment streams generated by the asset are received. It takes into account the elasticity of the bond price to interest rate and identifies the "actual" weighted length of time needed to recover the current cost of the bond (Copeland et al. (2005)). Due to the fact that we work on balance sheet data, we have no sufficient information (e.g., payment schedules) to calculate the real durations of all the debts employed by a firm. But at least we know the duration of a debt should always be shorter than the time-to-maturity except for zero-coupon bonds. Reasonably, we follow Jun and Jen (2003) and Chen et al. (2012) to assume that the average durations of a firm's debts payable in year 1, 2, 3, 4, 5 (denoted by $Debt_1$, $Debt_2$, $Debt_3$, $Debt_4$, $Debt_5$) are 0.5, 1.5, 2.5, 3.5 and 4.5 years respectively, denoted by $Duration_i$ for i ≤5. For the rest of debts, we assign them an average duration of 10 years, denoted by $Duration_r$.

Although our measurement is less accurate than the measure of term-to-maturity, it is more efficient in describing the complete maturity picture of a firm's debt usage and is much more precise compared to the conventionally used long-term debt proportion measure. Notably, our weighted average debt maturity measure is able to capture, to a

greater degree, a firm's real intention in adjusting the maturities of debts in comparison with the frequently used long-term debt proportion measure[16].

2.3.2.2. Conventional determinants and industry herding behaviors

The goal of this paper is to figure out the driving forces of debt maturity dynamics. Particularly, we are interested in knowing whether firms are more sensitive to changes in their own characteristics (conventional determinants) in determining debt maturities or they are responding more to changes in its peers' debt maturity policies.

Following the work of Barclay and Smith (1995), Stohs and Mauer (1996), and Custódio et al. (2013), among others, we include a vector of variables as proxies for the conventional debt maturity determinants. They are firm size, asset maturity, leverage ratio, market-to-book, R&D ratio, cash holdings, and public credit access. Two additional variables, cumulative stock return and stock return volatility, are incorporated to allow for stock pricing effect. Firm size (SIZE) is measured as the percentage of NYSE firms that have the same or smaller market capitalization. Following Stohs and Mauer (1996), we calculate asset maturity (AMAT) as the weighted average remaining maturity of fixed and current assets, weighted by their shares in total assets. We calculate book leverage (LEV) as the ratio of a firm's total debt outstanding to the book value of total assets. Market-to-Book (MTB) is the book value of total assets minus the book value of common equity plus the market value of common equity, all divided by book value of total assets. R&D ratio (R&D) is the ratio of a firm's R&D expenses to the book value of total assets. Cash holding (CASH) is the ratio of a firm's cash and short-term investment to total assets. Public credit

[16] In robustness checks, we measure corporate debt maturity structure as the proportion of interest bearing financial obligations with maturities of more than one, three and five years.

access (ACCESS) is a dummy variable, which takes a value of one if Standard and Poor's domestic long-term issuer rating is available and 0 otherwise. Firm's stock return (RETURN) is the cumulative log return (monthly) on the stock over the previous year(s). Stock return volatility (VOLAT) is the standard deviation of the monthly stock return over the previous year(s). Specifically, the previous literature predict that **debt maturity variation is positively related to firm size, asset maturity, leverage ratio, public credit access and stock return, and negatively related to Market-to-Book, R&D, cash holding and stock return volatility.**

Enlightened by Leary and Roberts (2014), we measure a firm's industry peers' weighted average debt maturity (denoted as $DMAT^T$), with each firm weighted by its total liabilities. Industry is defined based on Fama French 48 industry classification. For firm i in industry j with N firms, its industry peers' weighted average debt maturity at time t is specified as

$$DMAT_{i,j,t}^{T} = \sum_{k=1}^{N-1} \frac{Labilities_{k,j,t} \times DMAT_{k,j,t}}{\sum_{k=1}^{N-1} Liabilities_{k,j,t}} \quad (2.2)$$

Note that the considered firm is excluded from the calculation to mitigate endogeneity. The difference of debt maturities between the firm and its peers represents debt maturity deviation, denoted as DMATD. Over-time change in peer firms' debt maturity is denoted as $\Delta DMAT^T$. If industry peers really matter for firm's debt maturity choice, **we should observe negative signs on DMATD and positive signs on $\Delta DMAT^T$ in explaining the over-time debt maturity variation**.

2.3.2.3. Descriptive statistics

This section provides descriptive statistics for our sample firms in the second dataset. Specifically, we compute the mean, median and standard deviation for the variations in

debt maturity (DMAT), firm size (SIZE), asset maturity (AMAT), leverage ratio (LEV), market-to-book (MTB), R&D ratio (R&D), cash holding (CASH), public credit access (ACCESS), target debt maturity ($DMAT^T$); accumulations in stock return (RETURN), stock return volatility (VOLAT); and prior levels of debt maturity deviation (DMATD). Various timelines are employed, including the 1-year, 3-years and 5-year schemes. To reduce the influence of extremes, we winsorize the annual samples at the 1st and 99th percentiles on the left and right tails of SIZE, AMAT, LEV, MTB, and R&D. All the variables are defined in Table 2.1. The descriptive statistics are shown in Table 2.2.

[Insert Table 2.1 about here]

[Insert Table 2.2 about here]

Several features for debt maturity are worth noting. First, the standard deviation of the variations in debt maturity (1.83, 2.58 and 2.87 in the 1-year, 3-years and 5-year schemes respectively) suggests important cross-sectional variation in debt maturity adjustment. Second, debt maturity fluctuates substantially over time within firms. In unreported analysis, we calculate the within firm debt maturity range (the shortest debt maturity of a firm minus the longest debt maturity of the firm, during our sample period). We find that for the typical firm, the range between the firm's longest and shortest debt maturity in time series is well over four years. Third, in accordance with the recent evidence of a downward trend in debt maturity of U.S. firms (e.g., Custódio et al. (2013), and Harford et al. (2014)), our results show negative average debt maturity variations. Nonetheless, the weighted average debt maturity of peer firms shows signs of lengthening. Precisely, the average firm decreases its debt maturity by 0.03 years in one year, 0.06 years in three years and 0.10 years in five years, while its industry peers' debt maturity increases by

0.03, 0.07, and 0.09 accordingly. Meanwhile, there is evidence that the typical U.S. firm takes on excessive short-term debt comparing with its industry peers. For the average firm, although its industry peers' debt maturity increases, the debt maturity gap between the average firm and its peers is generally inferior to zero. Fourth, despite the negative values of DMATD along the timeline, the gap narrows down with time, in favor of the debt maturity herding behavior. The mean (median) value of DMATD is -1.01 (-1.67) years measured as of 1 year ago, -0.89 (-1.47) years measured as of 3 year ago, and -0.78 (-1.27) years measured as of 5 year ago.

Summary statistics for changes and accumulations in key firm features show increasing stock return and volatility, shortening asset maturity, decreasing market-to-book, declining holdings of cash assets, and increasing access to long-term public credit. The signs of the mean and median changes in firm size are different. It points to the prevalence of small firms and the great weight of large firms during our 1986-2011 sample period.

2.4. Debt maturity evolution

2.4.1. Actual debt maturity evolution

In order to better understand the underlying patterns, we precede our major analyses with a broader investigation of debt maturity evolution, which offers a useful starting point for identifying the driving forces of debt maturity dynamics.

To eliminate the measurement error induced by individual level random fluctuation and to assimilate the effects of economical and institutional shocks, we refer ourselves to the portfolio analytical framework in a way similar to Lemmon et al. (2008)[17]. The procedure

[17] Lemmon et al. (2008) study the event time leverage evolution. We differ from them in examining the event time debt maturity evolution.

is as follows. Each year, we sort firms by their debt maturities and then split them into four portfolios with equal observations, i.e. the debt maturity quartiles. Firms in the highest quartile comprise the "very long" debt maturity portfolio, and those in the lowest quartile comprise the "short" portfolio. The remaining firms comprise the "medium" and "long" debt maturity quartiles. For a portfolio constructed in a given year, we calculate the average debt maturity for firms present in the portfolio for the subsequent 20 years. The composition of the portfolio remains constant unless a firm spontaneously perishes and exits the portfolio. For each calendar year from 1974 through 2011, we repeat the above sorting and averaging procedure. To homogenize debt maturity difference originated from various firm characteristics and to absorb macro shocks, we track debt maturity evolution in event time, considering the portfolio formation as the specific event under investigation. Specifically, we define portfolio formation year as event time 0 and s years subsequent (prior) to the portfolio formation year as event time s (-s), where s ranges from 1 to 20. For each portfolio, 38 sets of event-time averages (from 1974 to 2011) are generated for s=0. For event time s=1, 37 sets of event-time averages (from 1975 to 2011) are generated, and so on. We next calculate the average debt maturity for a portfolio across event time, that is, the average of the average. Lastly, we plot the mean of the event time averages for each portfolio, shown as the solid lines in Figure 2.1. The surrounding dotted lines depict the conventional 95% confidence intervals, calculated as the two-standard errors of the event-time averages. Results for all firms and survivors are separately presented in Panel A and Panel B. Survivors are defined as firms who have at least 20 debt maturity observations. A backward test is implemented to draw further inferences. For that, we plot the average debt maturity 10 years prior and 10 years subsequent to the portfolio construction year, as demonstrated in Panel C (for all firms) and Panel D (for survivors).

[Insert Figure 2.1 about here]

A prominent pattern of convergence unfolds: although the dispersion of debt maturity between portfolios remains after 20 years, it becomes much less evident, implying the existence of a "decaying transitory component" in debt maturity. For all firms (in Panel A), the difference of the average debt maturity between the "very long" and the "short" portfolios narrows down from 7.19 years at time 0 to 2.53 years at time 20. For survivors (in Panel B), the difference narrows down from 6.98 years to 2.50 years. Figures in Panel C and Panel D demonstrate that the dispersion is greatest around the portfolio formation year, while the convergence is observed at both ends. The speed of convergence is much higher for the years close to the portfolio formation year.

Chen (2010) contends that firms with short lives are more likely to have extreme financial structures, which leads to mechanical convergence. Indeed, the convergence is relieved when firms of this type exit the portfolios, as illustrated in Panel B and Panel D for the survivors. To address the potential mechanical convergence due to the presence of short-lived firms, we next withdraw the short-lived firms from the portfolios and examine the event-time distribution (in percentage) of strict survivor firms throughout debt maturity portfolios subsequent to portfolio formation. Precisely, we require that firms present in the initial portfolio survive 20 years following portfolio creation.

Conditional on the initial portfolio, we report the percentage of firms present in a subsequent debt maturity portfolio (short, medium, high and very high). Firms are sorted by actual debt maturity each year and divided into four equal groups. For each portfolio that is constructed in a given year, we calculate the percentage of firms who are present in a specific portfolio for the subsequent 20 years. For each year from 1974 to 1991, we

repeat the above procedure, generating 18 sets of event-time percentages for each initial portfolio. The mean of the percentages is computed across event time, as shown in Table 2.3 and plotted in Figure 2.2.

[Insert Table 2.3 about here]

[Insert Figure 2.2 about here]

As can be clearly seen, there is still a strong tendency for debt maturity to converge. Firms in a specific debt maturity portfolio subsequently transfer to other portfolios, especially to its neighboring portfolios. Within a year, 13.03% of firms in the initially "short" portfolio move to the "medium" portfolio. 23.37% of firms in the initially "very long" debt maturity portfolio migrate to the "long" group. 20 years later, only 48.72% (38.41%) of firms in the initially "short" ("very long") portfolios continue to employ debts with "short" ("very long") maturities. Meanwhile, it demonstrates that despite the convergence, debt maturities of long debt maturity firms remain long and debt maturities of short debt maturity firms remain short. Firms that continue to stay in the same portfolio account for a larger proportion in comparison with those immigrating to other portfolios, especially for those in initially "short" (48.72%) and "very long" portfolios (38.41%).

Above all, our preliminary evidence concerning the evolution of debt maturity indicates the presence of a transitory component in debt maturity as well as a permanent one. This finding corroborates the capital structure literature in terms of the existence of a target financial structure. For example, Lemmon et al. (2008) document eminent features of convergence and persistence for leverage evolution. They associate the pattern with the firms' attempts to rebalance leverage ratios. Further, Chen (2010) shows that the

convergence comes down to the misclassification by leverage ratios different from the target levels. He argues that as the observed leverage is not necessarily equal to the target leverage, there are good chances that firms sorted according to the actual leverages are classified into the wrong portfolios. The highest and the lowest leverage portfolios are misclassified to a greater extent due to the fact that they are pushed by a single force to the center. For the medium and high leverage portfolios, the targeting pattern generates two forces that cancel each other out, keeping the average leverage comparatively stable.

2.4.2. The evolution of debt maturity deviation

Our research goes beyond traditional tests of debt maturity theories to examine whether debt maturity decisions of individual firms are related to its own features and the implicitly target debt maturity. We also investigate the impact of peer. To investigate whether firm's attempt to approach peer firms' debt maturity has an impact on debt maturity choices, we trace the event-time average of the debt maturity industry deviation. Consider a firm suffering from short-run business downturn and having its debt maturity temporarily deviating far from its peers. If the herding holds, the firm would readily close the gap as far as it might yet be possible in the following periods. The greater the gap, the greater is the convergence feature.

We apply the portfolio construction procedure ibid. Yet, instead of plotting the debt maturity evolution, we plot, in Figure 2.3, the evolution of debt maturity industry deviation, measured as the residual between the observed value of debt maturity and the weighted average debt maturity of industry peers. The solid curves represent the portfolio's average debt maturity deviation and the long-dashed curves surrounded represent the 95% confidence interval.

[Insert Figure 2.3 about here]

In support of the herding argument, the curves of the average debt maturity deviation move gradually towards zero as time progresses. The cross-sectional dispersion becomes rapidly indistinguishable between the "Very Long" and "Long" portfolios. In addition, corroborating the idea of Chen (2010) that financial structure at portfolio formation time is extreme for an individual firm, we find that the dispersion of debt maturity deviation is always greatest at event 0, with positive deviation found for the "Very Long" portfolio and negative deviation for the "Short" portfolio. Moreover, there's a hint of permanence in the negative deviation for the "Short" portfolio. It suggests that debt maturities of short debt maturity users continue to be shorter relative to their industry peers, despite their effort of herding the peers.

Above all, this evidence shows a potentially important role of industry peers to real debt maturity decisions of firms. Table 2.4 estimates to which extent firms adjust their debt maturities according to different levels of debt maturity deviation from peer firms. Specifically, the sample is divided up into four equal groups according to the deviation from peer firms' weighted average debt maturity. For each quartile, the mean and median (in (parentheses)) debt maturity variations are reported. Wilcoxon signed-rank test and student's t test are performed to test the significance of firms' debt maturity variations in each deviation quartile. The 1-year, 3-years and 5-year time windows are considered.

[Insert Table 2.4 about here]

The results are threefold. Firstly, consistent to our previous observations concerning the excessive usage of short-term debts, debt maturity deviation is found negative in three out of four deviation quartiles. Secondly, it appears that debt maturity responds

negatively to the deviation, in favor of the herding hypothesis. The further the deviation, the greater is the pace of adjustment. The mean value of the one-year debt maturity changes is 0.47 years for the lowest deviation quartile and -0.86 years for the highest quartile. Both are significantly different from zero. Thirdly, the effect accumulates with time. Over a period of five years, average variations in debt maturity for the lowest deviation quartile accumulate to 1.13 years. For the highest deviation quartile, debt maturity variations decrease progressively to -2.11 years.

Lemmon et al. (2008) acknowledge that ranking and classifying firms according to their actual financing structure "may simply be capturing cross-sectional variation in underlying factors associated with cross-sectional variation". This implies that firms in the "Short" debt maturity portfolio may just represent firms with similar characteristics predicting short debt maturities (e.g. small size, short asset maturity). The same is true of the "Very Long" debt maturity portfolio. To address this concern, we extend our investigation to include conventional debt maturity determinants in the following section.

2.5. Debt maturity dynamics: conventional determinants versus herding behavior?

2.5.1. Conventional determinants

Table 2.5 reports the correlation coefficients between debt maturity changes and the concurrent changes in conventional debt maturity determinants. On the whole, debt maturity lengthens with firm size, asset maturity, debt ratios, public credit access, cumulative stock return, and shortens with market-to-book ratio, and R&D expenses. Stock return volatility is negatively correlated with debt maturity changes but only in the one-year variation. It may suggest that stock volatility affects debt maturity decisions of firms merely in the short run.

[Insert Table 2.5 about here]

We then document the impacts of the above factors in a multivariate regression framework. Specifically, we regress debt maturity changes on contemporaneous changes in conventional debt maturity determinants. The empirical specification to estimate is,

$$\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \varepsilon_{i,t} \qquad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.3}$$

DMAT is the weighted average debt maturity, calculated according to Formula (2.1). The other variables are defined in Table 2.1. s denotes the observation period for s = 1 , 3, 5 years. The coefficients and standard errors are estimated using the procedure of Fama-Macbeth (1973) based on the time-series of the annual cross-sectional regression coefficients. Autocorrelation-robust standard errors are reported using Newey-West adjustment.

[Insert Table 2.6 about here]

Our estimates on debt maturity determinants, presented in Table 2.6, are consistent with prior research in general terms (e.g., Barclay and Smith (1995), Stohs and Mauer (1996), etc.). Moreover, our results show that the conventional debt maturity determinants actually play minor roles in explaining time-series debt maturity variations. And, although the explanatory power of these firm-specific factors appears to increase with the time span, the effect is not yet noticeable. Particularly, merely 3.7/7.3/8.8 percent of the variation in ΔDMAT is explained by these classical determinants in the one-/three-/five-year timelines respectively.

The preliminary evidence in debt maturity evolution shows that firm's initial debt maturity tends to converge towards peer firms' debt maturity. Can debt maturity herding be the main force that drives debt maturity dynamics? We next expand our analysis to include this factor.

2.5.2. Conventional determinants versus herding behavior

Consider a partial adjustment process in which the presence of transaction cost inhibits firms to adjust their financial structures to the desired levels. A stylized specification is the partial adjustment model[18], as specified below.

$$Y_{i,t} - Y_{i,t-1} = \alpha + \lambda\left(Y_{i,t}^{T} - Y_{i,t-1}\right) + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.4}$$

where $Y_{i,t}^{T}$ denotes the target financial structure for firm i at time t and λ denotes the speed of adjustment towards the target. In a frictionless world, λ is supposed to be 1, meaning that the firm fully adjusts its debt maturity to the target in each period. However, in the real world, the firm may be reluctant to do so as the adjustment may cost too much. In normal cases, λ would be less than 1. The closer λ is to 1, the lower the transaction cost, and the faster the speed of adjustment.

To allow for transaction cost and therefore permit incomplete adjustment of a firm's debt maturity towards its industry peers' debt maturity, we begin by considering a partial

[18] A growing empirical literature investigates the dynamics in firms' financing structures and the role of optimal capital structure using partial adjustment models, e.g., Jalilvand and Harris (1984), Fisher et al., (1989), Shyam-Sunder and Myers (1999), Hovakimian et al. (2001), Fama and French (2002), Leary and Roberts (2005), Flannery and Rangan (2006), Kayhan and Titman (2007), Strebulaev (2007), and Hovakimian et al. (2011).

adjustment model in which firm strives to close the debt maturity gap with its industry peers within each time period.

$$DMAT_{i,t} - DMAT_{i,t-s} = \alpha + \lambda\left(DMAT_{i,t}^{T} - DMAT_{i,t-s}\right) + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.5}$$

Herding behaviors can be decomposed into actions of mimicking debt maturity levels of industry peers and responding to changes in peer firms' debt maturities. To ease interpretations, we rearrange the equation (2.5) as

$$DMAT_{i,t} - DMAT_{i,t-s} = \alpha - \lambda\left\{\left(DMAT_{i,t-s} - DMAT_{i,t-s}^{T}\right) - \left(DMAT_{i,t}^{T} - DMAT_{i,t-s}^{T}\right)\right\} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.6}$$

λ measures the general speed of adjustment to peer firms' weighted average debt maturity level at time t. To account for possibly divergent reactions to levels and changes in debt maturities of industry peers, we reformulate the equation (2.6) as

$$DMAT_{i,t} - DMAT_{i,t-s} = \alpha + \lambda_1\left(DMAT_{i,t-s} - DMAT_{i,t-s}^{T}\right) + \lambda_2\left(DMAT_{i,t}^{T} - DMAT_{i,t-s}^{T}\right) + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.7}$$

Using abbreviations yields

$$\Delta DMAT_{i,t,t-s} = \alpha + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT_{i,t,t-s}^{T} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.8}$$

DMATD denotes debt maturity deviation, which is the difference between the observed and the industry peers' weighted average debt maturity ($\mathrm{DMATD_{i,t-s}} = \mathrm{DMAT_{i,t-s}} - \mathrm{DMAT_{i,t-s}^{T}}$). $\Delta\mathrm{DMAT_{i,t,t-s}^{T}}$ represents changes in peer firms' debt maturity levels between time t-s and time t. **The adjustment speed parameter $\boldsymbol{\lambda_1}$ is expected to be negative and its absolute value is expected to be less than 1, allowing that firms may not be**

able or willing to realize the adjustment instantly. The adjustment speed parameter λ_2 is expected to be positive and inferior to 1.

Note that the partial adjustment model was originally designed to model a firm's targeting behavior. λ_1 and λ_2 are expected to be identical in absolute values if $DMAT^T$ perfectly measures the target. Modeling the herding behavior is, however, different in this sense, as there is a good chance that other idiosyncratic risk factors also play parts in forming target debt maturity as well as systematic risk factors such as economic shocks and institutional transitions. Most likely, the absolute values of λ_1 and λ_2 are different. This gives us yet another reason to separately estimates λ_1 and λ_2, and further include changes in major firm characteristics, which yields

$$\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^T_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.9}$$

Panel A of Table 2.7 reports the regression results of the specifications (2.8) and (2.9), along with a simplified specification (2.10) which only keeps one variable, i.e., the debt maturity deviation.

$$\Delta DMAT_{i,t,t-s} = \alpha + \lambda_1 DMATD_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.10}$$

Panel B of Table 2.7 reports the sensitivity analysis for the magnitude effect, i.e., the variability of real debt maturity changes in response to one standard deviation increase in the right-hand side variables.

[Insert Table 2.7 about here]

Probably the most interesting finding in this table is that a large percentage of the variation in debt maturity changes is explained by the single variable of prior debt maturity deviation ($DMATD_{t-s}$). The coefficient of determination for specification (2.10) ranges from 0.090 in the one-year time span to 0.212 in the five-year time span. Moreover, in support of our hypothesis concerning debt maturity industry herding, we find significantly negative coefficients for $DMATD_{t-s}$ with its absolute value inferior to 1. A one standard deviation increases in the target deviation variable results in a curtailment of debt maturity by 0.55 years for one-year debt maturity variation, 1.06 years in three-year variation and 1.32 years in five-year variation. The expected sign is also found for $\Delta DMAT^{T}$. The estimated coefficient is positive and significant in statistical terms. The inclusion of the conventional determinants (specifications (2.9)) increases the explained variation only marginally by 3.6, 7 and 7.9 percent in the one-, three- and five-year time spans respectively. Furthermore, there is evidence that incorporating DMATD and $\Delta DMAT^{T}$ raise few multicollinearity problems, as adding the coefficients of determination of the specifications (2.3) and (2.8) leads to a similar value to the coefficient of determination of the specification (2.9).

Another feature is worth noting. The economic significance of most right-hand side variables increases with the observation interval, some doubled and others tripled. This may be due to the fact that the effects of these variables persist in time and temporary fluctuations in these variables play smaller parts in firms' debt maturity decisions comparing with long-lasting fluctuations. Two exceptions are $\Delta MTB_{i,t,t-s}$ and $RETURN_{i,t,t-s}$. A one standard deviation increase in cumulative stock return ($RETURN_{i,t,t-s}$) lengthens debt maturity by 0.13 years in one year but by only 0.06 years in five years. Similarly, a one standard deviation increase in $\Delta MTB_{i,t,t-s}$ shortens debt

maturity by 0.12 and 0.13 years in one and three years but by only 0.06 years in five years. A short explanation is that the effects of these two variables reverse in time, probably due to the market timing practice. Since this is beyond the scope of this paper, we leave it for future research. The explanatory power increases negligibly when including $\Delta DMAT^T$. A one standard deviation increase in peer firms' debt maturity changes is associated with the lengthening of debt maturity for 0.07/0.20/0.27 years in the one-/three-/five-year time frames. Perhaps the reason is that industry peer firms' debt maturity evolves slowly.

Above all, our empirical findings suggest a non-trivial role of industry herding in driving debt maturity dynamics, in both short and long run. If we compare the R-squares for the specification (2.3) in Table 2.6 and the R-squares for the specifications (2.8) and (2.10) in Table 2.7, we can conclude that the impact of debt maturity herding is two to three times larger than the impact of conventional debt maturity determinants.

2.5.3. The role of extreme cases

Recent papers address the mechanical reversion issue. In their seminal papers, Shyam-Sunder and Myers (1999), Chen and Zhao (2007) and Chang and Dasgupta (2009) contend that evidence in capital structure dynamics are susceptible to mechanical reversion in which the average leverage has a natural tendency to bound off the extremes due to the fact that leverage ratio is bounded between 0 and 1. This observation is fundamental as debt maturity measured with the balance-sheet approach shares the same feature of boundary, regardless of the definition and measurement. In other words, one cannot distinguish purely mechanical reversion from intentional herding without controlling the influence of the extreme cases which have natural tendencies to revert to

the mean[19]. On the other hand, studying the dynamic pattern of previously extreme debt maturity users helps to answer the question of whether short (long) debt maturity users continue to employ debts with short (long) maturities after ruling out the herding behavior, as indicated by the permanence feature found in debt maturity evolution.

The common practice to address the mechanical mean reversion in the literature is to eliminate the extreme cases or to incorporate corresponding dummies for the extreme cases. Although instructive, the former may induce selection bias and the latter may induce collinearity. We adopt the two devils for robustness. Specifically, we refer extreme cases to firms present at the 10th and 90th percentiles in the annual debt maturity distribution. We next implement three empirical specifications. The first specification excludes the extreme cases and re-estimates Specification (2.9). The second specification (Equation (2.11)) includes extreme debt maturity dummies while excludes debt maturity deviation (DMATD) and changes in peer firms' debt maturity ($\Delta DMAT^T$). The purpose is to examine how and to which extent debt maturities of previously extreme debt maturity users evolve in time without taking into account the herding behaviors of firms. The last specification (Equation (2.12)) considers both extreme dummies and herding variables, allowing for the possibility that extreme debt maturity users are possibly to herd industry peer firms' debt maturity to a larger extent[20].

[19] Extreme debt maturity cases are potentially overlapped with the off-the-optimum observations. To the extent that the off-the-optimum observations are prevalent in the extremes, factors of optimal debt maturity structure may rapidly lose their explanation power. Related implications can be drawn from the previous chapter which finds attenuated effects of conventional determinants in the tails of the debt maturity distribution.

[20] In the unreported analysis, we check frequency distribution across the debt maturity structure and the debt maturity target deviation quartiles. The analysis is conducted for all and survivor firms separately. The results confirm in a statistical term the overlap between the extreme debt maturity cases and the off-the-optimum observations.

$$\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \qquad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.11}$$

$$\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \qquad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.12}$$

Here SHORT is a dummy variable for extremely short debt maturity users, which takes a value of 1 if debt maturity of a firm is at the 10th debt maturity percentile. LONG is a dummy variable for extremely long debt maturity users, i.e. firms present at the 90th debt maturity percentile. Results are reported in Table 2.8.

[Insert Table 2.8 about here]

In line with the mechanical reversion proposition, excluding the extreme debt maturity users from the sample and incorporating the extreme debt maturity dummies weakens the magnitude of the estimated coefficients for DMATD from -0.19 to -0.16 in the one-year variation, from -0.37 to -0.32 in the three-year variation, and from -0.47 to -0.41/-0.40 in the five-year variation. Similarly, the estimates for $\Delta DMAT^{T}$ are attenuated from 0.09 to 0.08, from 0.23 to 0.20, from 0.26 to 0.25/0.23 in the one-/three-/five-year timelines. Yet, note that the coefficient attenuation is marginal. Additionally, regression results for the Specification (2.11) which removes the debt maturity herding behaviors, demonstrate that firms whose debt maturities are exceedingly long in a prior year incline themselves towards short-term debts, while firms with exceedingly short prior debt maturities would incline themselves towards long-term debts. Debt maturity adjustment for the remaining

firms shows no clear patterns in s=3 and s=5. This pattern shows preliminary evidence for a mean reversion process. Nonetheless, regression results for the Specification (2.12) further reveal mitigated mean reversion after considering herding behaviors. Precisely, the estimates for the extreme debt maturity dummies are mitigated and even reversed after including the two proxies for debt maturity herding. In the one-year time frame, the magnitude of the estimates for LONG decreases from -1.40 (Specification (2.11)) to -0.52 (Specification (2.12)), dropped by nearly a third. Controlling the herding behavior even changes the signs of the estimates for the short debt maturity dummy. It seems that clearing off the herding effect, short debt maturity extremes continue to rely exclusively on short-maturity debts. For instance, the estimate for SHORT is -0.30 in the five-year time frame and is significant different from zero. Above all, our results suggest the robustness of our debt maturity herding evidence to a natural mean-reversion process.

It is possible that the effects of the negative and positive deviation differ in magnitude. To address this concern, we revise the specification as follows.

$$DMAT_{i,t} - DMAT_{i,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^T_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \lambda_3 NEG_{i,t-s} + \lambda_4 NEG_{i,t-s} \times DMATD_{i,t-s} + \lambda_5 NEG_{i,t-s} \times \Delta DMAT^T_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \qquad (2.13)$$

where NEG is the dummy variable for negative debt maturity deviation. NEG × DMATD is the interaction item between the negative deviation dummy and debt maturity deviation. The parameters of interest are λ_4 and λ_5, which measure the difference of effects between the positive and the negative deviation. For brevity, we only report the estimates for λ_1, λ_2 , λ_3 , λ_4 and λ_5(see Table 2.9).

[Insert Table 2.9 about here]

Notably, the estimates for λ_4 are always positive (0.07, 0.17, 0.24 in s=1, 3, 5 respectively) and statistically significant, indicating the greater impact of the positive deviation relative to the negative deviation. Specifically, a one-unit increase in the positive deviation curtails debt maturity by 0.18, 0.37 and 0.50 in one, three and five years. In contrast, a one-unit decrease in the negative deviation prolongs debt maturity by only 0.12, 0.23 and 0.30 in the corresponding time frames. The estimates for λ_5 are significantly negative. Taken together, firms with debt maturities located in the lower part of the industry debt maturity distribution herd less than those with debt maturities located in the higher part of the distribution. Firms with negative debt maturity deviations are more likely to report short debt maturities. Our unreported analysis examines whether herding behaviors of extreme debt maturity firms embodies comparable characteristics. Indeed, the resulting estimates uncover that firms that are reliant exclusively on short-maturity debts exhibit much less herding behaviors.

2.5.4. Robustness checks

On the whole, the above findings indicate active debt maturity herding within industries. To analyze the robustness of our results, this section uses alternative estimation method, considers the impact of industry conglomerates, and tests an alternative hypothesis to debt maturity herding, that is, debt maturity targeting. Besides, our unreported robustness tests turn to different debt maturity definitions[21] and alternative duration

[21] Alternatively, we define debt maturity as the proportion of interest bearing financial obligations with maturities of more than one, three and five years as in Barclay and Smith (1995), Johnson (2003) and Antoniou et al. (2006).

cutoffs to construct the weighted average debt maturity measure[22]. By and large, these analyses show no violation of our main findings.

2.5.4.1. Alternative estimation method

Petersen (2009) compares commonly used estimation approaches in finance panel data sets and highlights the importance of properly treating the cross-sectional and the time-series residual dependence. He shows that the Fama-MacBeth estimator is biased downward when a firm fixed effect is present, and that the Newey-West adjustment for time-series autocorrelation does not helps to produce unbiased estimates. Whereas the Fama-MacBeth standard errors are unbiased if only a time effect, i.e. the time-series dependence, is of concern. This paper models variations in debt maturities instead of levels. Thus, there is good reason to believe that firm fixed effects in debt maturity levels are differenced out and that the Fama-MacBeth estimator, which is designed to address a time effect, is valid.

All the same, one may argue that 1) a firm fixed effect may exist in the differences; 2) there is omitted time-varying variables inducing residual correlation across time for a firm, 3) firms' financial policies, such as leverage and debt maturity, are interdependent. To confront these considerations, we re-estimate the specifications (2.9) and (2.12) for a one-year variation, adopting alternative estimators. Results are illustrated in Table 2.10. Specifically, we adopt the firm-year fixed effects estimator (in the **FE** column), firm-year two-way cluster-robust covariance matrix estimator (in the **Cluster** column), and the

[22] We assume that the average durations of a firm's debts payable in year 1, 2, 3, 4, 5, 5+ are 0.3, 1.3, 2.3, 3.3, 4.3, 10 years in the first place, 0.7, 1.7, 2.7, 3.7, 4.7, 10 years in the second place and 0.5, 1.5, 2.5, 3.5, 4.5, 20 years in the last place.

Arellano-Bond (1991) generalized method of moments (GMM) estimator (in the **SYS-GMM** column) in which we treat $DMATD_{i,t-1}$, $\Delta LEV_{i,t,t-1}$ and $\Delta CASH_{i,t,t-1}$ as endogenous.

[Insert Table 2.10 about here]

The results in this table are reassuring and the estimated coefficients of debt maturity deviation (DMATD) and changes in industry peers' debt maturity ($\Delta DMAT^T$) are all significant and in expected signs. Remind that the Newey-West adjusted Fama-MacBeth estimator yields estimates of -0.19 (specification (2.9)) and -0.16 (specification (2.12)) for DMATD, and 0.09 (specification (2.9)) and 0.08 (specification (2.12)) for $\Delta DMAT^T$. The Cluster and the SYS-GMM estimators generate very similar results with respect to the two herding variables. In the specification where extreme debt maturity dummies are controlled, the former estimates -0.15 for DMATD and 0.10 for $\Delta DMAT^T$, and the latter yields, correspondingly, estimates of -0.15 and 0.08. Especially, the results of the SYS-GMM estimator provides robustness of our debt maturity herding evidence with respect to the potential endogeneity between leverage, debt maturity and cash holding policies.

The fixed effect estimator, by contrast, yields substantially higher coefficients, -0.42 for DMATD and 0.23 for $\Delta DMAT^T$ without extreme dummies, and -0.40 for DMATD and 0.21 for $\Delta DMAT^T$ with extreme dummies. It seems that the FE estimator has overestimated the effect of DMATD and $\Delta DMAT^T$. The main cause is perhaps the collinearity between firm's fixed effect and the two herding variables. Moreover, it's worthwhile to note that adding firm and year fixed effects do not help to increase the explanatory power of the model. In other words, firm fixed effects seem unlikely to prevail in our dataset.

Estimates for firm-specific factors are similar to our previous findings. The exceptions are, when the endogeneity problem is eliminated (in SYS-GMM estimator), the positive

association between debt maturity and leverage variations is screened out, while the negative association between debt maturity and cash holdings become apparent. The latter confirms the argument of Harford et al. (2014) in that firms mitigate refinancing risk resulted from short-term debts by accumulating cash reserves. Stock return volatility is negatively related to over-time debt maturity variations. But the sizes of its estimates vary greatly across different estimators. In particular, the estimated coefficients of VOLAT with the SYS-GMM and the FE estimation methods are two and four time smaller than those with the Cluster and the adjusted Fama-MacBeth estimation methods. There is a hint that debt maturity herding is dependent of firm level volatility. We address this issue in Section 2.5.5.

2.5.4.2. Conglomerates

A firm can operate with more than one industry segments. This section examines the robustness of the debt maturity herding to conglomerates[23].

Researchers (e.g., Levy and Sarnat (1970), Lewellen (1971), Melicher and Rush (1974), and Duchin (2010)) conclude that conglomerates help to increase debt capacity and decrease the cost of capital because of imperfectly correlated cash flows, known as the coinsurance effect. Hann et al. (2013) empirically examines the relation between organizational form and the cost of capital. Their estimates imply that diversified firms do have cost advantage over undiversified firms on average. In an analogous way, Melnik and Pollatschek (1973) find that conglomerate mergers help the merged firm to refinance the debt of the acquired firm at a lower cost and thus enable the merged firm to enjoy a direct

[23] "A conglomerate is taken to be a firm that invests in several firms operating in seemingly unrelated industries or product lines", according to the definition of Melnik and Pollatschek (1973).

capital gain. La Rocca (2011) studies the impact of product diversification on debt maturity choices of firms and she finds that unrelated diversification leads to long debt maturities and related diversification lead to short debt maturities.

Given all that, we test the following specification, taking into account the impact of conglomerates. Note that our proxy for peer firms' debt maturity is on an industry classification basis. Or more accurately, it is measured based on the primary Fama French industry of a firm. We include two interaction terms ($\mathrm{CONGLOMERATE_{i,t-s}} \times \mathrm{DMATD_{i,t-s}}$ and $\mathrm{CONGLOMERATE_{i,t-s}} \times \Delta\mathrm{DMAT^{T}_{i,t,t-s}}$) to check whether estimates for debt maturity herding are sensitive to the definition on the primary industry.

$$DMAT_{i,t} - DMAT_{i,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \lambda_3 CONGLOMERATE_{i,t-s} + \lambda_4 CONGLOMERATE_{i,t-s} \times DMATD_{i,t-s} + \lambda_5 CONGLOMERATE_{i,t-s} \times \Delta DMAT^{T}_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.14}$$

CONGLOMERATE is denoted respectively by number of industry segments, changes in industry concentration and the occurrence of merger and acquisition in Panel A, B and C of Table 2.11. Industry concentration is calculated according to the Herfindahl index formula, that is, the sum of the squares of the shares of a firm's business segments defined according to Fama French industry classification codes (48 industries). For brevity's sake, estimates are only reported for λ_1, λ_2, λ_3, λ_4 and λ_5.

[Insert Table 2.11 about here]

Generally, Table 2.11 shows robust estimates for λ_1 and λ_2 and suggests that conglomerates are related to debt maturity lengthening. Specifically, firms who are engaged in various industry segments, increase industry diversifications (opposite to industry concentration) and experience mergers and acquisitions lengthen significantly their debt maturities (see estimates for λ_3). Furthermore, estimates for the interaction terms are insignificant in panel B and only significant in s=1 and s=3 for λ_4 in Panel A. It indicates that for firms with more than one industry segments, estimates are only slightly attenuated for DMATD. The results provide evidence that using the primary industry to define herding variables is robust. Table 2.11, Panel C studies a special form of conglomerate, i.e. merger and acquisition and shows that firms who have undertaken mergers and acquisitions herd more than their counter parties. The results here might also be led by firms conducting within-industry mergers and acquisitions, i.e. mechanical herding. Anyhow, the results of DMATD and $\Delta DMAT^T$ continue to support our herding hypothesis, even after excluding the influence of mergers and acquisitions.

Our unreported analyses show further robustness on these findings to various industry classifications: Fama French 10 industry codes, 2-digit SIC codes and 3-digit SIC codes.

2.5.4.3. Targeting

The preceding results demonstrate that after taking into account the herding behavior of approaching peer firms' debt maturity, extremely long debt maturity users have a tendency to bounce off the upper boundary, in line with the mechanical reversion argument. However, extremely short debt maturity users continue to use more short-term debts. One may argue that this opposite pattern found in the adjustment of the two extreme debt maturity users would be caused by overlooking firm-level idiosyncratic

demand for short debt maturity. Truly, when alternative estimation methods are adopted, estimates for the short debt maturity dummy become mixed (see Table 2.10). This is especial true when including firm fixed effects and accounting for endogeneity between the extreme dummies and DMATD which is calculated from the lagged debt maturity.

As a robustness check, we perform a test by rerunning the debt maturity partial adjustment model with target proxies such as the fitted value from regressions and a firm's past debt maturity average.

The optimal debt maturity literature implies that firms endeavor to rebalance their debt maturities when the gains of adjustment exceed the costs. Conversely, if the gains are not sufficient to offset the costs, firms rebalance debt maturity incompletely. Empirical research to test this hypothesis is scarce. Some first attempts are Ozkan (2000), Antoniou et al. (2006), Cai et al. (2008) and Terra (2011), which find evidence that firms in a variety of countries pursue target (optimal) debt maturities.

The most common way to generate financial structure target is to compute the fitted value in prior studies (e.g. Flannery and Rangan (2006)). The fitted value is either implicitly imposed by running the integrated partial adjustment model or explicitly predicted by an optimal financial structure regression model. An alternative specification is the past average debt maturity of a firm as suggested by Chen (2010). This specification works well in capturing firm-level idiosyncratic volatility, but is less reliable in short time series. Chen (2010) himself, admits that average past leverage performs poorly as a proxy for the target leverage in the first several years.

We examine the fitted targets (by OLS & quantile regressions, Appendix provides a detailed description of the estimation method for the fitted targets.) and the past average debt maturity by reference to Chen (2010).

The fitted targets are functions of debt maturity determinants, and firm's past debt maturities contain a firm-fixed effect which is supposed to be correlated with debt maturity and therefore with its determinants. As a consequence, modeling the fitted target changes and the conventional determinants in the same regression framework is likely to induce severe multicollinearity problem. For this reason, we discard changes in conventional debt maturity determinants and estimate the following specification.

$$DMAT_{i,t} - DMAT_{i,t-s} = \alpha + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.15}$$

Regression results are shown in Table 2.12. The columns of **OLS**, **QR**, **Past Mean** present results for $DMAT^{T}$ proxied by OLS regression fitted, quantile regression fitted and past debt maturity average values respectively.

[Insert Table 2.12 about here]

Qualitatively, the results suggest a greater targeting effect in comparison with the herding effect. The influence of $DMATD_{i,t-s}$ (target deviation) is smallest when debt maturity target is proxied by peer firms' debt maturity and largest when past average debt maturity is used as a proxy. The results are reasonable as these specifications in which debt maturity target is measured are supposed to capture historical volatility of a firm to a larger degree, especially for the past average debt maturity measure. Analogously, the past mean specification also reports the most prominent effect of target changes, except in the one-

year timeline perhaps due to slow evolvement of debt maturity. Next comes the specification in which target is fitted by the quantile regression. A possible explanation is that the quantile regression technique describes more completely the relationships between debt maturity and its determinants, and therefore fits the target better than the OLS regression.

The only divergence rests with the estimates for the short debt maturity dummy, which actually confirms our conjecture in terms of the inertia in short debt maturity. Note that by definition, both past debt maturity average and the quantile regression methods capture a fixed component in the observed debt maturity, through firms' past information for the former and by modeling the conditional quantiles of debt maturity for the latter. Although less severe, the OLS regression also captures the fixed component by including industry fixed effects for the firm under investigation is not excluded. To the extent that these target proxies capture the inertia in short debt maturity, estimates for the short debt maturity dummy will become insignificant or even turn positive. Truly, estimates for SHORT are positive in the "QR" and "Past Mean" columns.

Despite all, this paper focuses on examining the herding behavior rather than the targeting effect. Probing into the implication of this fixed component is beyond the scope of this study. We therefore leave the question open for future research.

2.5.5. To control the impact of changes in the yield curve

So far, our analyses have smoothed out market-wide shocks by running annual cross-sectional regressions and adopting the Fama-Macbeth procedure. Previous research suggests an important role of the yield curve in determining corporate debt maturity structure. An upward sloping yield curve predicts short debt maturity and vice versa.

Nevertheless, economic variables are known to perform poorly in panel data and often explain a low percentage of variation in the dependent variables. To help disentangle the market effects from the firm effects, we re-calculate debt maturities of firms adjusted for changes in the yield curve, formulated as[24]

$$DMATR_{i,t} = \frac{DMAT_{i,t}}{R_{l,t} - R_{s,t}} \tag{2.16}$$

$DMAT_{i,t}$ is the actual weighted average debt maturity for firm i at time t, calculated according to the Formula (2.1). $R_{l,t}$ and $R_{s,t}$ denotes the prevailing long-term and short-term interest rates, proxied by the 10-year U.S. treasury bond yield and the 3-month U.S. treasury bill yield respectively.

In an analogous way, we then estimate the following specification,

$$\Delta DMATR_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATRD_{i,t-s} + \lambda_2 \Delta DMATR^{T}_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \qquad i = 1, \dots, n \;\; t = 1, \dots, T \tag{2.17}$$

Correspondingly, debt maturity deviation (DMATRD) and changes in peer firms' debt maturity ($\Delta DMATR^{T}$) are also adjusted by yield curve changes.

[Insert Table 2.13 about here]

The results in Table 2.13 reveal that interest rate conditions do affect debt maturity herding patterns. Ruling out interest rate shocks, the herding with respect to changes in

[24] We sincerely thank Patrick Navatte for guiding us to consider this market-effect-adjusted debt maturity measure.

industry peers' debt maturities becomes more eminent. All else being equal, if industry peers' yield-curve-adjusted debt maturity lengthens by one year, the firm responds to lengthen its yield-curve-adjusted debt maturity by 0.51-0.52 years. This result arises perhaps because firms are responding in a similar way to shocks of their peers.

Meanwhile, the results show that the herding with respect to previous industry peers' debt maturity levels is no longer robust. Motivated by Leary and Roberts (2014), we suspect that this force may be conditional on firm's risk exposure. To test this possibility, we next implement separate analysis for risk groups. The herding behavior is regarded as industry-specific and risk-specific as well. That is, here peers' debt maturity is calculated using portfolios formed on industry classification (Fama French 48 industry codes) and risk exposure. We measure risk exposure using firm's stock volatility and define risk exposure groups based on the terciles of this measure.

[Insert Table 2.14 about here]

Table 2.14 reports separate regression results of the Specifications (2.12) and (2.17) for low volatility firms whose s-year stock return volatility in fiscal year t are in the lowest tercile, medium volatility firms whose s-year stock return volatility in fiscal year t are in the middle tercile, and high volatility firms whose s-year stock return volatility in fiscal year t are in the highest tercile (s=1, 3, 5). Peer firms are formed according to the Fama French 48 industry classification codes in Specification (2.12). In Specification (2.17), peer firms are formed according to the Fama French 48 industry classification codes together with volatility groups. By doing so, we hypothesize debt maturity herding within industry and risk groups. For the sake of brevity, results are only reported for DMATRD and $\Delta DMATR^{T}$.

Generally speaking, our results show that firms herd more in high volatility groups. Notably, the estimates for DMATRD become significant in the high volatility group. The effects of $\Delta DMAT^T$ also increase with stock return volatility. This finding corroborates Leary and Roberts (2014) in that the herding of a firm's financing policy towards its peers can be attributed to certain common factors in peers, e.g. production technologies, or similar risk exposure. Identifying the herding channels is, however, beyond the scope of this paper.

2.6. Conclusion

This paper examines firm's debt maturity herding behavior and analyzes whether the herding has a greater effect on the over-time variations in debt maturities than the conventional determinants. Our findings are fourfold. First, we find important convergence and persistence in debt maturity evolution. Particularly, we show that the convergence is driven by a transitory component that is probably associated with firms' attempts to approach peer firms' debt maturity. Note that our measure for peer firms' debt maturity excludes the firm under investigation to avoid the multicollinearity and endogeneity problem. Second, our regression results demonstrate that the herding behavior explains a large amount of variation in debt maturity changes and the effect persists through time. It is worthwhile to note that the explanatory power of the herding behavior is nearly three times higher than that of the conventional determinants. Third, short-term debt maturity is persistent over time. Removing the effect of debt maturity herding, we find that short debt maturity firms continue to adopt more short-term debts. This evidence is also consistent with our portfolio analysis results, especially for a group of survivor firms. Fourth, we find that, eliminating the market effects (more precisely, the impact of changes in the yield curve), the herding behavior towards changes in industry

peers' debt maturity becomes more eminent. A one-year lengthening in peer firms' weighted average debt maturity (yield-curve-adjusted) leads a firm to lengthen its debt maturity (yield-curve-adjusted) by 0.51-0.52 years.

Above all, our findings complement previous research work on dynamic debt maturity (e.g. Ozkan (2000), Antoniou et al. (2006), Cai et al. (2008) and Terra (2011)) by exploiting the implications of debt maturity evolution and explicitly studying the significance of debt maturity herding relative to the conventional determinants. Further, our evidence corroborates Leary and Roberts (2014) in the relevance of the peer firms' financing policies and He and Xiong (2012b), Brunnermeier and Oehmke (2013) concerning the inefficiently short-term equilibrium financing.

The current study also sheds some light on future studies concerning different moments of debt refinancing. One interesting direction is to examine whether managerial attempt to "time" the market plays a role in debt maturity decisions of firms and how this force interacts with the herding behavior. We address this question in the next essay.

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Appendix

Estimation of the Fitted Debt Maturity Target

To capture the unobservable firm fixed effects, avoid the look-ahead bias and provide the out of sample prediction, Hovakimian and Li (2011) propose to predict the target financial structure using firms' historical panel information. Following this intuition, we estimate the regression parameters based on firms' complete historical panel information. Specifically, we regress observed debt maturity on a selection of factors whose effects are previously found prominent and persistent in deciding the maturity structure of corporate debts. They are firm size, leverage, asset maturity, market-to-book, R&D ratio and a set of industry dummies constructed according to Fama-French 48 industry classification. Allowing for delays in firms' financing decisions, all the explanatory variables (defined in Table 2.1) are lagged one period. The model is specified as follows[25],

$$DMAT_{i,t} = \alpha_\theta + \beta_{1\theta} Size_{i,t-1} + \beta_{2\theta} Leverage_{i,t-1} + \beta_{3\theta} Asset\ Maturity_{i,t-1} +$$
$$\beta_{4\theta}\ Market - to - Book_{i,t-1} + \beta_{5\theta} R\&D_{i,t-1} + \gamma_\theta Industry_i + \varepsilon_{i,t} \quad i = 1, \dots, n \ \ t = 1, \dots, T$$

The debt maturity target for firm i in year t is computed by applying the coefficient estimates to firm i's characteristics measured as of year t-1.

We next employ quantile regressions to estimate the parameters, accounting for the non-monotonic effects of debt maturity determinants, enlightened by Graham and Leary

[25] Due to the lack of data before 1985 for Standard and Poor's domestic issuer rating which is used to define firms' public credit access, long- and short-term public credit accesses are not incorporated into the model. Our unreported robustness analyses fit debt maturity target with additional predictive variables of firm age, abnormal earnings, asset volatility and cash holdings. The results are robust in general terms.

(2011). Precisely, we regress the conditional quantiles of debt maturity on traditional debt maturity determinants. Below is our estimation model

$$Q_\theta\left(DMAT_{i,t}\middle|X_{i,t-1}\right) = \alpha_\theta + \beta_{1\theta}Size_{i,t-1} + \beta_{2\theta}Leverage_{i,t-1} + \beta_{3\theta}Asset\ Maturity_{i,t-1} + \beta_{4\theta}Market - to - Book_{i,t-1} + \beta_{5\theta}R\&D_{i,t-1} + \gamma_{i\theta}Industry_i + \varepsilon_{i,t} \quad i = 1, \dots, n \ \ t = 1, \dots, T$$

The 25th, 50th, and 75th quantiles of debt maturity (DMAT) for firm i observed in year t is regressed on firm-specific characteristics observed in year t-1. The target debt maturity for the firm i in year t is computed by applying the coefficient estimates corresponding to the debt maturity quantile as of year t-1. That is, the 25th quantile regression results apply to $DMAT_{t-1}$ inferior to the 0.25 percentile, the 50th quantile regression results apply to $DMAT_{t-1}$ superior to the 0.25 percentile and inferior to the 0.75 percentile, and the 75th quantile regression results apply to $DMAT_{t-1}$ superior to the 0.75 percentile.

Table 2. 1 Variable definitions

Variables	Abbreviation	Measurement
Size	SIZE	Relative Size = the percentage of NYSE firms that have the same or smaller market capitalization.
Asset Maturity	AMAT	Weighted Average Maturity of Assets = (current assets ÷ total book assets) × (current assets ÷ cost of goods sold) + (net property plant & equipment ÷ total book assets) × (net property plant & equipment ÷ depreciation & amortization).
Leverage	LEV	Book Leverage = the ratio of a firm's total debt outstanding to the book value of total assets.
Market-to-Book	MTB	Market-to-Book Ratio = (book value of total assets – book value of common equity + market value of common equity) ÷ book value of total assets.
R&D	R&D	R&D Ratio = the ratio of a firm's R&D expenses to the book value of total assets.
R&D Dummy	R&D Dummy	R&D Dummy = a dummy variable which takes a value of one if a firm report positive R&D expense and zero otherwise.
Cash	CASH	Cash holdings = the ratio of a firm's cash and short-term investment to total assets
Industry Dummies	INDUSTRY	Industry Dummies = a set of industry dummy variables based on Fama-French 48 industry classification.
Public Credit Access Dummy	ACCESS	Public Credit Access Dummy = a dummy variable which takes a value of one if Standard and Poor's domestic long-term issuer rating is available and zero otherwise.
Cumulative Stock Return	RETURN	Cumulative stock Return = the cumulative log return on the stock over the previous year(s).
Stock Return Volatility	VOLAT	Stock Return Volatility = the monthly stock return standard deviation over the previous year(s).
Industry Debt Maturity	$DMAT^{T}$	Industry Debt Maturity = the weighted average debt maturity of peer firms in the same industry, with each firm weighted by its total liabilities. Industry is defined according to Fama French 48 industry classification.
Debt Maturity Deviation	DMATD	Debt Maturity Deviation = the difference between a firm's debt maturity and the industry debt maturity.
Short Debt Maturity Dummy	SHORT	Short Debt Maturity Dummy = a dummy variable which takes a value of one if debt maturity of a firm is present at the 10^{th} debt maturity percentile, and zero otherwise.
Long Debt Maturity Dummy	LONG	Long Debt Maturity Dummy = a dummy variable which takes a value of one if debt maturity of a firm is present at the 90^{th} debt maturity percentile, and zero otherwise.

Table 2. 2 Descriptive statistics

This table documents mean, median and standard deviation (Std Dev) for the variables of interest in variations (debt maturity (DMAT), firm size (SIZE), asset maturity (AMAT), book leverage (LEV), market-to-book ratio (MTB), R&D ratio (R&D), public credit access (ACCESS), cash holding (CASH) and industry debt maturity($DMAT^T$)), accumulations (cumulative stock return (RETURN), stock return volatility (VOLAT)), and at prior levels (debt maturity deviation (DMATD)). The weighted average debt maturity structure is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011.

	Variation								
	One-Year			Three-Year			Five-Year		
Variables	mean	median	Std Dev	mean	median	Std Dev	mean	median	Std Dev
DMAT	-0.03	0.00	1.83	-0.06	0.00	2.58	-0.10	0.00	2.87
SIZE	0.10	-0.05	7.74	0.24	-0.10	12.20	0.71	-0.09	14.75
AMAT	-0.09	-0.06	3.48	-0.21	-0.13	4.37	-0.30	-0.19	4.68
LEV	0.00	0.00	0.27	0.01	0.00	0.33	0.01	0.00	0.36
MTB	-0.05	-0.01	1.48	-0.12	-0.03	1.85	-0.18	-0.04	1.94
R&D	0.00	0.00	0.06	0.00	0.00	0.08	0.00	0.00	0.08
CASH	-0.00	-0.00	0.11	-0.01	-0.00	0.15	-0.10	-0.00	0.16
ACCESS	0.01	0.00	0.14	0.02	0.00	0.24	0.03	0.00	0.29
$DMAT^T$	0.03	-0.00	0.73	0.07	0.06	1.01	0.09	0.05	1.13
	Accumulation								
	One-Year			Three-Year			Five-Year		
Variables	mean	median	Std Dev	mean	median	Std Dev	mean	median	Std Dev
RETURN	0.18	0.04	0.93	0.49	0.10	1.97	0.84	0.17	3.20
VOLAT	0.15	0.13	0.11	0.16	0.14	0.10	0.16	0.14	0.09
	Prior Level								
	One-Year			Three-Year			Five-Year		
Variables	mean	median	Std Dev	mean	median	Std Dev	mean	median	Std Dev
DMATD	-1.01	-1.67	3.04	-0.89	-1.47	3.03	-0.78	-1.27	3.01

Table 2. 3 The distribution of survivor firms throughout debt maturity portfolios in event time

This table exhibits the event-time distribution (in percentage) of survivor firms throughout four debt maturity portfolios for initially short, medium, long and very long debt maturity firms. The numbers presented in the table represent the percentage of firms present in a specific debt maturity portfolio. By survivor firms, we mean firms who have complete debt maturity information for the entire 20-year period. The portfolios are constructed based on firms' weighted average debt maturity, calculated according to Formula (2.1). Event time 0 denotes the portfolio formation year and event time s denotes the s^{th} year subsequent to the portfolio formation year. The portfolio formation procedure is described as follows. Each year, we sort firms by the calculated weighted average debt maturity and split them into four equal groups. Then for each constructed group, we calculate the percentage of firms present in a specific group for the subsequent 20 years. For each year from 1974 to 1991, we repeat the above procedure, generating 18 sets of event-time percentages for each initial portfolio. Lastly, we calculate the mean of the percentages across event time. The sample consists of 1083 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1974-2011.

		Event Time																			
Innitially	Subsequently	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Short	Short	79.85	72.76	68.22	64.03	61.39	59.14	58.30	56.90	55.52	54.86	53.65	52.57	50.79	50.58	50.27	49.46	50.55	49.24	48.75	48.72
	Medium	13.03	14.65	16.72	18.56	19.28	20.06	19.76	20.48	21.33	22.40	23.38	24.30	24.61	24.58	25.57	26.36	25.59	26.81	26.07	25.00
	Long	4.27	7.06	8.02	9.03	10.09	10.71	11.12	11.15	12.00	12.07	12.57	12.26	14.31	14.21	12.88	12.76	11.89	11.67	11.99	12.73
	Very Long	3.41	6.39	7.91	8.37	9.15	9.86	11.40	11.51	11.38	10.73	10.71	10.13	10.83	11.11	10.75	11.09	12.69	12.37	12.84	12.94
Medium	Short	16.62	20.92	22.37	22.86	22.56	22.32	22.46	22.01	22.47	21.30	22.76	22.56	24.20	22.91	23.65	23.73	23.32	24.16	24.30	23.64
	Medium	57.11	44.86	38.89	36.87	35.49	34.25	32.01	32.63	32.20	32.30	30.69	30.54	28.74	29.39	30.21	29.80	30.57	30.31	29.84	30.27
	Long	17.71	22.50	24.73	24.95	25.79	25.01	27.01	25.55	26.13	25.45	24.83	24.42	24.77	25.66	24.85	25.25	25.10	24.32	24.98	25.80
	Very Long	8.56	11.72	14.01	15.32	16.15	18.41	18.51	19.82	19.20	20.96	21.73	22.48	22.28	22.04	21.29	21.22	21.01	21.20	20.89	20.30
Long	Short	3.07	4.63	7.47	8.58	10.51	12.47	12.29	12.32	12.96	13.55	13.43	13.63	14.04	14.40	14.12	14.19	13.98	14.61	15.23	16.51
	Medium	25.03	30.27	30.60	28.55	28.51	26.95	28.97	27.92	26.13	26.14	25.55	25.05	25.76	24.97	22.96	24.13	24.52	25.03	24.92	25.40
	Long	55.07	43.87	37.81	36.92	33.82	34.68	31.95	31.97	32.32	31.54	32.66	31.99	30.49	29.93	32.81	31.65	32.35	31.77	32.24	31.58
	Very Long	17.86	21.76	25.39	26.05	27.76	25.97	27.41	27.13	28.67	28.42	28.71	28.93	30.28	30.61	30.08	29.93	29.42	28.63	27.59	27.52
Very Long	Short	2.10	2.67	3.88	5.86	6.07	6.71	7.08	8.73	8.63	10.16	10.28	11.53	11.81	11.72	11.45	12.42	11.62	11.73	11.36	11.14
	Medium	5.18	10.35	14.23	16.32	16.79	18.66	19.24	19.18	20.27	19.67	20.73	19.77	21.14	21.30	21.41	19.45	19.51	17.74	19.49	19.35
	Long	23.37	26.88	29.94	29.41	30.78	29.91	30.52	31.88	29.78	31.35	30.34	31.67	30.94	30.58	29.91	30.64	31.04	32.75	31.29	30.35
	Very Long	70.43	60.83	53.22	50.11	46.53	45.39	42.85	41.24	40.94	39.76	38.96	37.57	36.81	36.54	37.07	37.31	37.38	37.56	38.07	38.41

Table 2. 4 Debt maturity variations categorized by debt maturity deviation

This table displays the mean and median (in (parentheses)) of previous debt maturity deviation and debt maturity variations for quartiles constructed based on previous debt maturity deviation. Number of observations is in [brackets]. The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). Debt maturity deviation is the difference between a firm's debt maturity and its industry peer firms' weighted average debt maturity. Debt maturity variation is the difference of a firm's debt maturity between two periods. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. Student's t-test (for the mean variations) and Wilcoxon signed-rank test (for the median variations) are reported to test whether variations in debt maturity are different from zero at conventional significance levels. ***, ** and * show that variation in debt maturity is significantly different from zero at 1%, 5% and 10% level respectively.

Deviation Quartile	Previous Debt Maturity Deviation			Debt Maturity Variation		
	1-Year	3-Year	5-Year	1-Year	3-Year	5-Year
Lowest Quartile	-4.43	-4.36	-4.28	0.47***	0.88***	1.13***
	(-4.26)	(-4.19)	(-4.12)	(0.00)***	(0.00)***	(0.00)***
	[17047]	[14348]	[11715]	[16217]	[13295]	[10684]
Quartile 2	-2.62	-2.54	-2.46	0.33***	0.65***	0.79***
	(-2.66)	(-2.58)	(-2.50)	(0.00)	(0.00)***	(0.00)***
	[17048]	[14349]	[11715]	[16275]	[13288]	[10651]
Quartile 3	-0.28	-0.17	-0.04	-0.04***	-0.06***	-0.12***
	(-0.31)	(-0.20)	(-0.07)	(-0.32)***	(-0.32)***	(-0.34)***
	[17048]	[14349]	[11715]	[16479]	[13517]	[10862]
Highest Quartile	3.29	3.36	3.42	-0.86***	-1.71***	-2.11***
	(3.02)	(3.08)	(3.15)	(-0.37)***	(-1.26)***	(-1.76)***
	[17047]	[14348]	[11715]	[16433]	[13426]	[10808]

Table 2. 5 Pearson correlations

This table reports Pearson correlation coefficients between debt maturity variations and variations in conventional debt maturity determinants. The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that two variables are significantly correlated at 1%, 5% and 10% levels respectively.

	$\Delta DMAT_{t,t-s}$		
Variables	s=1	s=3	s=5
$\Delta SIZE_{t,t-s}$	0.03***	0.04***	0.05***
$\Delta AMAT_{t,t-s}$	0.03***	0.04***	0.04***
$\Delta LEV_{t,t-s}$	0.08***	0.12***	0.15***
$\Delta MTB_{t,t-s}$	-0.03***	-0.04***	-0.05***
$\Delta R\&D_{t,t-s}$	-0.01***	-0.02***	-0.02***
$\Delta CASH_{t,t-s}$	-0.01***	-0.04***	-0.05***
$\Delta ACCESS_{t,t-s}$	0.09***	0.17***	0.19***
$RETURN_{t,t-s}$	0.02***	0.04***	0.02***
$VOLAT_{t,t-s}$	-0.01***	-0.01*	0.00

Table 2. 6 The driving forces of debt maturity dynamics: conventional debt maturity determinants

This table presents the regression results for the following empirical specification:

Specification $(\mathbf{2.3})$: $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	$\Delta DMAT_{t,t-s}$		
Variable	s=1	s=3	s=5
Intercept	-0.02	-0.16*	-0.22*
	(0.03)	(0.09)	(0.12)
$\Delta SIZE_{t,t-s}$	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)
$\Delta AMAT_{t,t-s}$	0.01***	0.02***	0.02***
	(0.00)	(0.01)	(0.00)
$\Delta LEV_{t,t-s}$	2.42***	2.89***	3.07***
	(0.20)	(0.23)	(0.23)
$\Delta MTB_{t,t-s}$	-0.09***	-0.12***	-0.10***
	(0.01)	(0.02)	(0.01)
$\Delta R\&D_{t,t-s}$	-0.02	-0.28**	-0.46**
	(0.13)	(0.08)	(0.17)
$\Delta CASH_{t,t-s}$	0.11	-0.05	-0.15
	(0.18)	0.22	(0.23)
$\Delta ACCESS_{t,t-s}$	1.03***	1.52***	1.54***
	(0.09)	(0.07)	(0.07)
$RETURN_{t,t-s}$	0.14***	0.09***	0.03**
	(0.02)	(0.02)	(0.01)
$VOLAT_{t,t-s}$	-0.30**	0.01	0.20
	(0.15)	(0.36)	(0.50)
Adj. R^2	0.037	0.073	0.088
Obs.	61887	50441	40462

Table 2. 7 The driving forces of debt maturity dynamics: conventional debt maturity determinants versus herding behavior

This table presents the regression results (in Panel A) and the sensitivity analysis (in Panel B) on how conventional debt maturity determinants and firm's attempt to herd peer firms' debt maturity affect firms' over-time debt maturity variations. The specifications to estimate are as follows.

Specification (2. 10): $\Delta DMAT_{i,t,t-s} = \alpha + \lambda_1 DMATD_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

Specification (2. 8): $\Delta DMAT_{i,t,t-s} = \alpha + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

Specification (2. 9): $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Panel A: Regression results								
	$\Delta DMAT_{t,t-s}$								
	s=1			s=3			s=5		
Variable	(10)	(8)	(9)	(10)	(8)	(9)	(10)	(8)	(9)
Intercept	-0.22***	-0.22***	-0.06**	-0.39***	-0.42***	-0.09	-0.47***	-0.52***	-0.01
	(0.04)	(0.04)	(0.03)	(0.08)	(0.08)	(0.07)	(0.09)	(0.09)	(0.08)
$DMATD_{t-s}$	-0.18***	-0.18***	-0.19***	-0.35***	-0.36***	-0.37***	-0.44***	-0.46***	-0.47***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta DMAT^{T}_{t,t-s}$		0.09***	0.09***		0.20***	0.23***		0.24***	0.26***
		(0.01)	(0.01)		(0.03)	(0.02)		(0.03)	(0.02)
$\Delta SIZE_{t,t-s}$			0.01***			0.01***			0.01***
			(0.00)			(0.00)			(0.00)
$\Delta AMAT_{t,t-s}$			0.01***			0.01***			0.01***
			(0.00)			(0.00)			(0.00)
$\Delta LEV_{t,t-s}$			2.30***			2.53***			2.52***
			(0.19)			(0.19)			(0.17)
$\Delta MTB_{t,t-s}$			-0.08***			-0.07***			-0.03**
			(0.01)			(0.01)			(0.02)
$\Delta R\&D_{t,t-s}$			-0.19			-0.45***			-0.71***
			(0.12)			(0.13)			(0.19)
$\Delta CASH_{t,t-s}$			0.21			0.25			0.22
			(0.17)			(0.17)			(0.18)
$\Delta ACCESS_{t,t-s}$			1.02***			1.40***			1.37***
			(0.10)			(0.11)			(0.13)
$RETURN_{t,t-s}$			0.14***			0.07***			0.02*
			(0.02)			(0.02)			(0.01)
$VOLAT_{t,t-s}$			-1.37***			-2.72***			-3.70***
			(0.18)			(0.38)			(0.44)
Adj. R^2	0.090	0.092	0.128	0.171	0.177	0.247	0.212	0.219	0.298
Obs.	65524	65518	61848	57420	57410	50397	48938	48928	40413

Table 2.7 *(continued)*

One standard deviation change in	*Panel B: Magnitude effect*								
	$\Delta DMAT_{t,t-s}$								
	s=1			s=3			s=5		
	(10)	(8)	(9)	(10)	(8)	(9)	(10)	(8)	(9)
$DMATD_{t-s}$	-0.55	-0.55	-0.58	-1.06	-1.09	-1.12	-1.32	-1.38	-1.41
$\Delta DMAT^{T}_{t,t-s}$		0.07	0.07		0.20	0.23		0.27	0.29
$\Delta SIZE_{t,t-s}$			0.08			0.12			0.15
$\Delta AMAT_{t,t-s}$			0.03			0.04			0.05
$\Delta LEV_{t,t-s}$			0.62			0.83			0.91
$\Delta MTB_{t,t-s}$			-0.12			-0.13			-0.06
$\Delta R\&D_{t,t-s}$			-0.01			-0.04			-0.06
$\Delta CASH_{t.t-s}$			0.02			0.04			0.04
$\Delta ACCESS_{t,t-s}$			0.14			0.34			0.40
$RETURN_{t.t-s}$			0.13			0.14			0.06
$VOLAT_{t.t-s}$			-0.15			-0.27			-0.33

Table 2. 8 Debt maturity dynamics: herding behavior and extreme cases

This table examines the role of extreme cases in affecting firms' debt maturity dynamics. Extreme cases are defined as firms who are present at the 10th and 90th percentile in the annual debt maturity distribution. The specifications to estimate are follows.

Specification (2. 9): $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

Specification (2. 11): $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

Specification (2. 12): $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

Specification (2.9) excludes extreme debt maturity users. Specification (2.11) and (2.12) include all firms. The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	$\Delta DMAT_{t,t-s}$								
	s=1			s=3			s=5		
Variable	(9)	(11)	(12)	(9)	(11)	(12)	(9)	(11)	(12)
Intercept	0.04	0.14***	0.03	0.08	0.19	0.08	0.22**	0.24	0.18*
	(0.03)	(0.05)	(0.03)	(0.07)	(0.12)	(0.07)	(0.09)	(0.16)	(0.09)
$DMATD_{t-s}$	-0.16***		-0.16***	-0.32***		-0.32***	-0.41***		-0.40***
	(0.01)		(0.00)	(0.01)		(0.01)	(0.01)		(0.01)
$\Delta DMAT^{T}_{t,t-s}$	0.08***		0.08***	0.20***		0.20***	0.25***		0.23***
	(0.02)		(0.01)	(0.01)		(0.02)	(0.01)		(0.02)
$\Delta SIZE_{t,t-s}$	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\Delta AMAT_{t,t-s}$	0.02***	0.01***	0.01***	0.02***	0.02***	0.01***	0.02***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\Delta LEV_{t,t-s}$	2.19***	2.39***	2.34***	2.32***	2.73***	2.60***	2.30***	2.82***	2.61***
	(0.27)	(0.22)	(0.20)	(0.20)	(0.24)	(0.20)	(0.16)	(0.23)	(0.19)
$\Delta MTB_{t,t-s}$	-0.08***	-0.09***	-0.08***	-0.09***	-0.10***	-0.08***	-0.05**	-0.08***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)
$\Delta R\&D_{t,t-s}$	-0.19	-0.09	-0.17	-0.42*	-0.38***	-045***	-0.58***	-0.58***	-0.65***
	(0.17)	(0.12)	(0.12)	(0.22)	(0.10)	(0.13)	(0.17)	(0.17)	(0.18)
$\Delta CASH_{t,t-s}$	0.42	0.13	0.17	0.31	0.04	0.13	0.32	0.00	0.08
	(0.26)	(0.17)	(0.17)	(0.21)	(0.22)	(0.17)	(0.24)	(0.23)	(0.17)
$\Delta ACCESS_{t,t-s}$	1.02***	1.03***	1.01***	1.47***	1.44***	1.37***	1.42***	1.41***	1.32***
	(0.11)	(0.09)	(0.10)	(0.12)	(0.07)	(0.10)	(0.14)	(0.09)	(0.12)
$RETURN_{t,t-s}$	0.15***	0.13***	0.14***	0.08***	0.08***	0.08***	0.01	0.03**	0.02**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
$VOLAT_{t,t-s}$	-1.32***	-0.65***	-1.31***	-2.53***	-0.90**	-2.59***	-3.77***	-1.08**	-3.49***
	(0.12)	(0.14)	(0.16)	(0.31)	(0.35)	(0.35)	(0.33)	(0.43)	(0.40)
$SHORT_{t-s}$		0.24***	-0.09***		0.62***	-0.15		0.83***	-0.30***
		(0.07)	(0.03)		(0.10)	(0.11)		(0.13)	(0.09)
$LONG_{t-s}$		-1.40***	-0.52***		-2.76***	-1.05***		-3.31***	-1.18***
		(0.13)	(0.10)		(0.24)	(0.19)		(0.22)	(0.16)
Adj. R^2	0.092	0.097	0.134	0.170	0.189	0.259	0.206	0.224	0.310
Obs.	49770	61887	61848	40204	50434	50397	31884	40448	40413

Table 2. 9 Herding effect : positive deviation versus negative deviation

This table examines the robustness of the previous results on firms' debt maturity industry herding behaviors, allowing different impacts of negative and positive industry deviation. The specification to estimate is as follows.
Specification $(\mathbf{2.13})$: $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^T_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \lambda_3 NEG_{i,t-s} + \lambda_4 NEG_{i,t-s} \times DMATD_{i,t-s} + \lambda_5 NEG_{i,t-s} \times \Delta DMAT^T_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). For brevity, estimates are only reported for λ_1, λ_2, λ_3, λ_4 and λ_5. The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). NEG is a dummy variable which takes a value of one if debt maturity deviation of a firm is negative. NEG × DMATD is the interaction item between the negative debt maturity deviation dummy and debt maturity deviation. NEG × $\Delta DMAT^T$ is the interaction item between the negative debt maturity deviation dummy and changes in peer firms' debt maturity. All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Parameter	s=1	s=3	s=5
λ_1	-0.19***	-0.39***	-0.52***
	(0.02)	(0.03)	(0.04)
λ_2	0.12***	0.29***	0.31***
	0.02	(0.03)	(0.02)
λ_3	0.13***	0.29***	0.21**
	(0.04)	(0.05)	(0.06)
λ_4	0.07**	0.17***	0.24***
	(0.03)	(0.05)	(0.06)
λ_5	-0.07**	-0.15***	-0.15***
	(0.03)	(0.03)	(0.02)

Table 2. 10 Robustness check: alternative estimation methods

This table examines the robustness of the regression results by applying the alternative estimation methods (the firm-year fixed effects estimator (FE), firm-year two-way cluster-robust covariance matrix estimator (Cluster), and the Arellano-Bond (1991) generalized method of moments (GMM) estimator (SYS-GMM)) for the following models:

Model 1: $\Delta DMAT_{i,t,t-1} = f(\Delta SIZE_{i,t,t-1}, \Delta AMAT_{i,t,t-1}, \Delta LEV_{i,t,t-1}, \Delta MTB_{i,t,t-1}, \Delta R\&D_{i,t,t-1}, \Delta CASH_{i,t,t-1}, \Delta ACCESS_{i,t,t-1}, RETURN_{i,t,t-1}, VOLAT_{i,t,t-1}, DMATD_{i,t-1}, \Delta DMAT^{T}_{i,t,t-1})$

Model 2: $\Delta DMAT_{i,t,t-1} = f(\Delta SIZE_{i,t,t-1}, \Delta AMAT_{i,t,t-1}, \Delta LEV_{i,t,t-1}, \Delta MTB_{i,t,t-1}, \Delta R\&D_{i,t,t-1}, \Delta CASH_{i,t,t-1}, \Delta ACCESS_{i,t,t-1}, RETURN_{i,t,t-1}, VOLAT_{i,t,t-1}, DMATD_{i,t-1}, \Delta DMAT^{T}_{i,t,t-1}, SHORT_{i,t-1}, LONG_{i,t-1})$

The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	$\Delta DMAT_{t,t-1}$					
	Model 1			Model 2		
Variable	FE	Cluster	SYS-GMM	FE	Cluster	SYS-GMM
Intercept		-0.07***			0.02	
		(0.02)			(0.02)	
$DMATD_{t-1}$	-0.42***	-0.18***	-0.20***	-0.40***	-0.15***	-0.15***
	(0.00)	(0.01)	(0.05)	(0.00)	(0.01)	(0.05)
$\Delta DMAT^{T}_{t,t-1}$	0.23**	0.11***	0.10***	0.21***	0.10***	0.08***
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.03)
$\Delta SIZE_{t,t-1}$	<0.01***	<0.01***	<0.01**	<0.01***	<0.01***	<0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\Delta AMAT_{t,t-1}$	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\Delta LEV_{t,t-1}$	2.04***	2.24**	0.93	2.05***	2.27***	0.39
	(0.06)	(0.19)	(1.20)	(0.06)	(0.19)	(0.87)
$\Delta MTB_{t,t-1}$	-0.05***	-0.05***	-0.05***	-0.05***	-0.06***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta R\&D_{t,t-1}$	-0.31***	-0.34*	-0.68***	-0.31***	-0.33**	-0.63***
	(0.12)	(0.17)	(0.22)	(0.12)	(0.17)	(0.21)
$\Delta CASH_{t,t-1}$	0.13*	0.17	-1.80***	0.12*	0.13	-1.77***
	(0.07)	(0.13)	(0.59)	(0.07)	(0.13)	(0.56)
$\Delta ACCESS_{t,t-1}$	0.82***	1.09***	0.86***	0.82***	1.08***	0.87***
	(0.05)	(0.12)	(0.11)	(0.05)	(0.12)	(0.10)
$RETURN_{t,t-1}$	0.07***	0.10***	0.09***	0.07***	0.10***	0.08***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
$VOLAT_{t,t-1}$	-0.33***	-1.18***	-0.67***	-0.34***	-1.13***	-0.67***
	(0.09)	(0.12)	(0.17)	(0.09)	(0.11)	(0.15)
$SHORT_{t-1}$				0.01	-0.06*	0.32
				(0.03)	(0.03)	(0.32)
$LONG_{t-1}$				-0.28***	-0.54***	-1.01**
				(0.03)	(0.06)	(0.58)
AR(1) z statistic			-15.16***			-15.63***
AR(2) z statistic			1.29			0.91
Sargen chi2			87.50			147.21
Adj. R^2	0.112	0.124		0.115	0.130	
Obs.	61368	61368	61129	61368	61368	61129

Table 2. 11 Robustness check: conglomerates

This table examines the robustness of the previous results on firms' debt maturity industry herding behaviors to conglomerates. The specification to estimate is as follows.

Specification (2. 14): $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^T_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \lambda_3 CONGLOMERATE_{i,t-s} + \lambda_4 CONGLOMERATE_{i,t-s} \times DMATD_{i,t-s} + \lambda_5 CONGLOMERATE_{i,t-s} \times \Delta DMAT^T_{i,t,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). For brevity, estimates are only reported for λ_1, λ_2, λ_3, λ_4 and λ_5. The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). CONGLOMERATE is number of industry segments (in Panel A), changes in industry concentration (in Panel B, measured by changes in a revenue-based industrial Herfindahl index), and a dummy variable for a merger or an acquisition occurred in a prior period t-s (in Panel C). CONGLOMERATE × DMATD is the interaction item between the CONGLOMERATE proxy and debt maturity deviation. CONGLOMERATE × $\Delta DMAT^T$ is the interaction item between the CONGLOMERATE proxy and changes in peer firms' debt maturity. All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: CONGLOMERATE denoted by number of industry segments

Parameter	s=1	s=3	s=5
λ_1	-0.18***	-0.34***	-0.43***
	(0.01)	(0.01)	(0.01)
λ_2	0.08***	0.22***	0.26***
	(0.02)	(0.02)	(0.02)
λ_3	0.10***	0.19***	0.18***
	(0.01)	(0.02)	(0.02)
λ_4	0.01***	0.01**	0.01
	(0.00)	(0.00)	(0.01)
λ_5	0.00	-0.02	-0.02
	(0.01)	(0.01)	(0.02)

Panel B: CONGLOMERATE denoted by changes in industry concentration

Parameter	s=1	s=3	s=5
λ_1	-0.15***	-0.49**	-0.34***
	(0.01)	(0.17)	(0.05)
λ_2	0.04	0.23***	0.24***
	(0.03)	(0.03)	(0.04)
λ_3	-0.34***	-0.45**	-0.33
	(0.09)	(0.18)	(0.45)
λ_4	0.05	0.07	-0.03
	(0.05)	(0.08)	(0.05)
λ_5	-0.27	0.02	-0.13
	(0.24)	(0.08)	(0.07)

Panel C: CONGLOMERATE denoted by merger and acquisition

Parameter	s=1	s=3	s=5
λ_1	-0.15***	-0.30***	-0.38***
	(0.00)	(0.01)	(0.01)
λ_2	0.07***	0.18***	0.19***
	(0.01)	(0.02)	(0.02)
λ_3	0.16***	0.23***	0.31***
	(0.03)	(0.03)	(0.03)
λ_4	-0.10***	-0.07***	-0.05***
	(0.01)	(0.01)	(0.01)
λ_5	0.05**	0.08**	0.09**
	(0.02)	(0.03)	(0.02)

Table 2. 12 Robustness check: debt maturity targeting

This table tests firm's attempt to approach target debt maturity with various target proxies. The specification to estimate is specified as follows.

Specification (**2. 15**): $\Delta DMAT_{i,t,t-s} = \alpha + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^{T}_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

In the "OLS" column, debt maturity target is estimated as the fitted value from the OLS regression. In the column "QR", debt maturity target is estimated as the fitted value from the 25th, 50th and 75th quantile regressions. In the "Past Mean" column, debt maturity target is estimated as the time-series average of a firm's past debt maturities. The procedure to obtain the fitted targets is described in Appendix. The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	$\Delta DMAT_{t,t-s}$								
	s=1			s=3			s=5		
Variable	OLS	QR	Past Mean	OLS	QR	Past Mean	OLS	QR	Past Mean
Intercept	-0.10***	-0.08*	-0.01	-0.18**	-0.13	-0.09	-0.19**	-0.16	-0.11*
	(0.03)	(0.04)	(0.03)	(0.06)	(0.08)	(0.05)	(0.07)	0.10	(0.06)
$DMATD_{t-s}$	-0.26***	-0.30***	-0.21***	-0.53***	-0.52***	-0.89***	-0.66***	-0.61***	-1.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
$\Delta DMAT^{T}_{t,t-s}$	0.19***	0.98***	-0.01	0.61***	1.03***	1.92***	0.73***	1.03***	1.82***
	(0.01)	(0.03)	(0.06)	(0.03)	(0.02)	(0.05)	(0.03)	(0.02)	(0.05)
$SHORT_{t-s}$	-0.00	0.21***	0.20***	-0.07	0.08	0.48***	-0.21	0.17*	0.53***
	(0.01)	(0.06)	(0.06)	(0.09)	(0.10)	(0.05)	(0.14)	(0.09)	(0.12)
$LONG_{t-s}$	-0.15***	-0.27***	-0.65***	-0.29**	-0.59***	-0.90***	-0.32***	-0.70***	-0.90***
	(0.05)	(0.05)	(0.06)	(0.11)	(0.13)	(0.11)	(0.09)	(0.14)	(0.08)
Adj. R^2	0.127	0.416	0.106	0.275	0.557	0.358	0.341	0.605	0.444
Obs.	59535	59517	61525	51216	51201	52941	42481	42466	43830

Table 2. 13 To control the impact of changes in the yield curve

This table examines the robustness of the previous results on firms' debt maturity industry herding behaviors to changes in yield curve. Specifically, we adjust our debt maturity measure for each firm and each year by the difference of yields between 10-year U.S. Treasury bond and 3-month U.S. Treasury bill. The adjusted debt maturity is denoted as DMATR. The specification to estimate is as follows.

Specification $(\mathbf{2.17})$: $\Delta DMATR_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATRD_{i,t-s} + \lambda_2 \Delta DMATR^T_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \qquad i = 1, \dots, n \;\; t = 1, \dots, T$

The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	$\Delta DMATR_{t,t-s}$		
Variable	s=1	s=3	s=5
Intercept	0.97*	2.80**	2.86*
	(0.51)	(1.33)	(1.49)
$DMATD_{t-1}$	0.10	0.46	-0.19
	(0.27)	(0.62)	(0.21)
$\Delta DMAT^T_{t,t-1}$	0.51***	0.51***	0.52***
	(0.05)	(0.09)	(0.07)
$\Delta SIZE_{t,t-1}$	0.01	0.03	0.01
	(0.01)	(0.02)	(0.00)
$\Delta AMAT_{t,t-1}$	-0.00	-0.00	0.01
	(0.01)	(0.02)	(0.01)
$\Delta LEV_{t,t-1}$	3.55**	4.07**	3.90**
	(1.64)	(1.56)	(1.72)
$\Delta MTB_{t,t-1}$	-0.07	-0.03	-0.10*
	(0.04)	(0.02)	(0.06)
$\Delta R\&D_{t,t-1}$	-0.97*	-1.13*	0.00
	(0.57)	(0.55)	(0.94)
$\Delta CASH_{t,t-1}$	0.01	0.09	-0.11
	(0.33)	(0.24)	(0.16)
$\Delta ACCESS_{t,t-1}$	1.54**	2.16**	1.91***
	(0.59)	(0.80)	(0.63)
$RETURN_{t,t-1}$	0.44	0.04	0.05*
	(0.32)	(0.07)	(0.03)
$VOLAT_{t,t-1}$	-5.61*	-8.26*	-10.20*
	(2.79)	(4.48)	(5.73)
$SHORT_{t-1}$	-1.02*	1.09	-1.59
	(0.57)	(1.86)	(1.18)
$LONG_{t-1}$	-0.39	-0.79	-0.84
	(1.88)	(0.99)	(1.87)
Adj. R^2	0.420	0.455	0.499
Obs.	60960	49608	40018

Table 2. 14 Herding and risk exposure

This table examines the robustness of the previous results on firms' debt maturity industry herding behaviors to firms' risk exposure. The specification to estimate is as follows. Specification (2.12) models the variations in debt maturity ($\Delta DMAT$). Specification (2.17) models the variations in adjusted debt maturity.

Specification $(\mathbf{2.12})$: $\Delta DMAT_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATD_{i,t-s} + \lambda_2 \Delta DMAT^T_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

Specification $(\mathbf{2.17})$: $\Delta DMATR_{i,t,t-s} = \alpha + \beta_1 \Delta SIZE_{i,t,t-s} + \beta_2 \Delta AMAT_{i,t,t-s} + \beta_3 \Delta LEV_{i,t,t-s} + \beta_4 \Delta MTB_{i,t,t-s} + \beta_5 \Delta R\&D_{i,t,t-s} + \beta_6 \Delta CASH_{i,t,t-s} + \beta_7 \Delta ACCESS_{i,t,t-s} + \beta_8 RETURN_{i,t,t-s} + \beta_9 VOLAT_{i,t,t-s} + \lambda_1 DMATRD_{i,t-s} + \lambda_2 \Delta DMATR^T_{i,t,t-s} + \gamma_1 SHORT_{i,t-s} + \gamma_2 LONG_{i,t-s} + \varepsilon_{i,t} \quad i = 1, \dots, n \;\; t = 1, \dots, T$

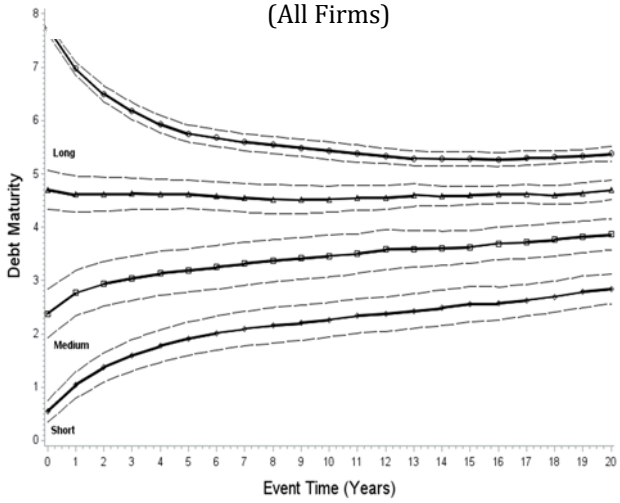
The coefficients are estimated by running Fama-Macbeth regressions. Newey-West adjusted standard errors are reported in (parentheses). The weighted average debt maturity structure (DMAT) is calculated according to Formula (2.1). The adjusted debt maturity (DMATR) is the weighted average debt maturity divided by the difference of yields between 10-year U.S. Treasury bond and 3-month U.S. Treasury bill. All the other variables are defined in Table 2.1. SIZE, AMAT, LEV, MTB, R&D and CASH are winsorized at the 1st and 99th percentiles. Analysis is performed based on the 1-year, 3-year and 5-year timelines. Debt maturity deviation is measured as of 1 year, 3 years and 5 years prior to the observation year t. The sample consists of 5828 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2011. Results are separately presented for low volatility firms whose s-year stock return volatility in fiscal year t are in the lowest tercile, medium volatility firms whose s-year stock return volatility in fiscal year t are in the middle tercile, and high volatility firms whose s-year stock return volatility in fiscal year t are in the highest tercile (s=1, 3, 5). For brevity, results are only reported for $DMATD_{t\text{-}s}$, $\Delta DMAT^T_{t,t\text{-}s}$, $DMATRD_{t\text{-}s}$ and $\Delta DMATR^T_{t,t\text{-}s}$. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Panel A: $\Delta DMAT_{i,t}$								
	s=1			s=3			s=5		
industry	Low	Medium	High	Low	Medium	High	Low	Medium	High
$DMATD_{t-1}$	-0.14***	-0.16***	-0.19***	-0.28***	-0.31***	-0.37***	-0.37***	-0.40***	-0.43***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
$\Delta DMAT^T_{t,t-1}$	0.06***	0.07***	0.09***	0.14***	0.17***	0.20***	0.17***	0.23***	0.26***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
	Panel B: $\Delta DMATR_{i,t}$								
	s=1			s=3			s=5		
Industry	Low	Medium	High	Low	Medium	High	Low	Medium	High
$DMATRD_{t-1}$	0.10	-0.06	-0.19*	0.38	0.05	-0.36**	-0.17	-0.20	-0.49**
	(0.26)	(0.17)	(0.10)	(0.62)	(0.32)	(0.14)	(0.21)	(0.21)	(0.19)
$\Delta DMATR^T_{t,t-}$	0.37***	0.35***	0.35***	0.47***	0.45***	0.48***	0.48***	0.53***	0.50***
	(0.07)	(0.07)	(0.08)	(0.11)	(0.11)	(0.11)	(0.08)	(0.10)	(0.09)

Figure 2. 1 Average debt maturity of actual debt maturity portfolios in event time

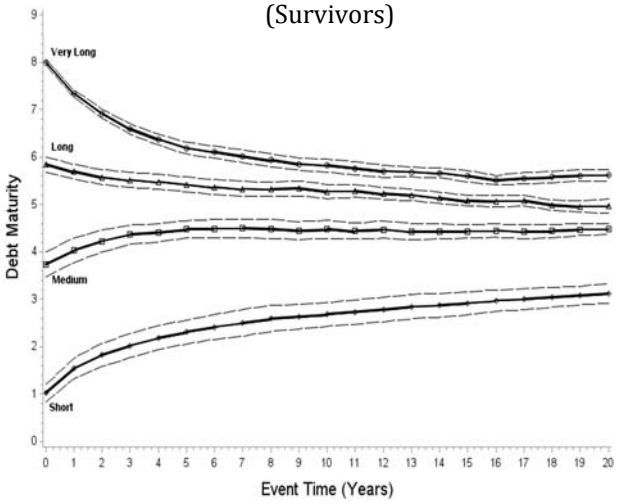
This figure exhibits average debt maturity in event time for four portfolios constructed based on firms' weighted average debt maturity calculated according to Formula (2.1). Event time 0 denotes the portfolio formation year. Event time s denotes the s^{th} year subsequent to the portfolio formation year and event time -s denotes the s^{th} year prior to the portfolio formation year. The solid curves represent the portfolio's average debt maturity and the long-dashed curves surrounded represent the 95% confidence interval. Debt maturity evolution is displayed for all firms in Panel A and for survivors in Panel B. Survivors are defined as firms who have more than 20 debt maturity observations. The portfolio formation procedure is described as below. Each year, we sort firms by debt maturity levels and split them into four equal groups. Then for each group constructed in a given year, we calculate the average debt maturity for firms present in exactly the same group for the subsequent 20 years. The portfolio composition remains relatively unchanged unless a firm spontaneously perishes and exits the portfolio. For each year from 1974 to 2010, we repeat the above sorting and averaging procedure, which generates 37 sets of event-time averages for each group/portfolio. Lastly, we calculate the mean of the event-time averages and the two-standard error interval of the average debt maturity across event time. The sample consists of 6458 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1974-2011.

Panel A: Forward-looking
(All Firms)



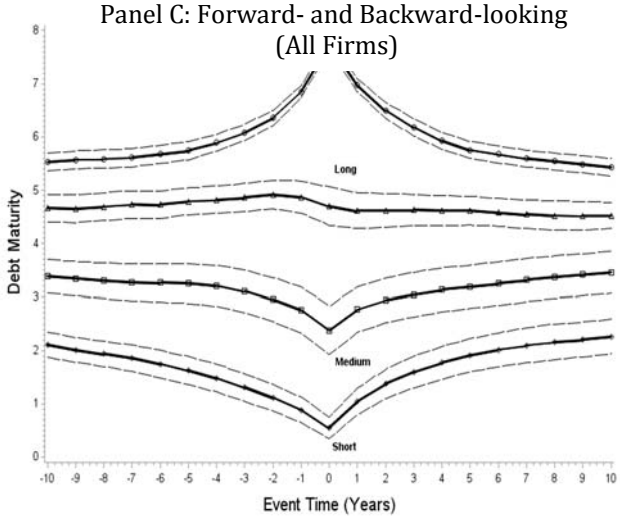
Data Source: Compustat Industrial Annual Database

Panel B: Forward-looking
(Survivors)



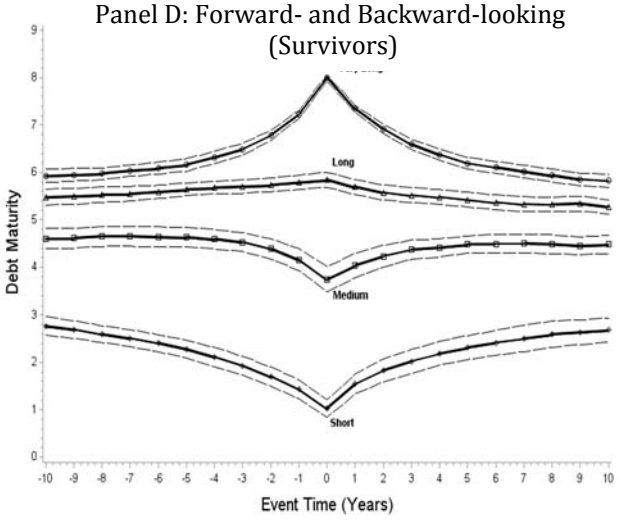
Data Source: Compustat Industrial Annual Database

Panel C: Forward- and Backward-looking
(All Firms)



Data Source: Compustat Industrial Annual Database

Panel D: Forward- and Backward-looking
(Survivors)

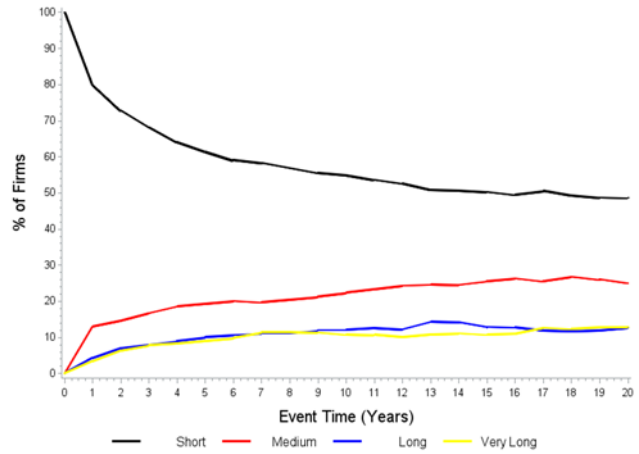


Data Source: Compustat Industrial Annual Database

Figure 2. 2 The distribution of survivor firms throughout debt maturity portfolios in event time

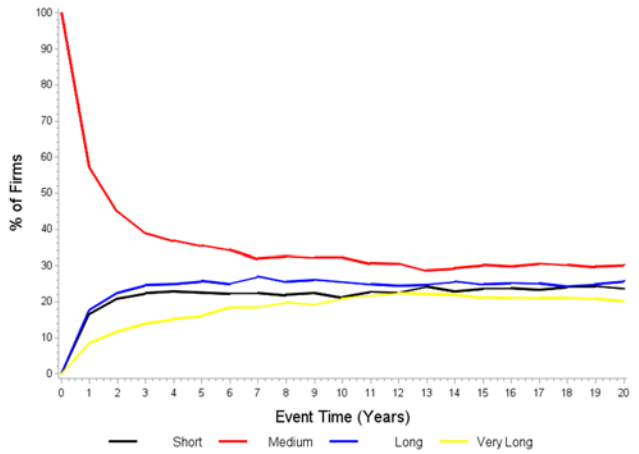
This table exhibits the event-time distribution (in percentage) of survivor firms throughout four debt maturity portfolios for initially short (Panel A), medium (Panel B), long (Panel C) and very long (Panel D) debt maturity firms. By survivor firms, we mean firms who have complete debt maturity information for the entire 20-year period. The portfolios are constructed based on firms' weighted average debt maturity, calculated according to Formula (2.1). Event time 0 denotes the portfolio formation year and event time s denotes the s^{th} year subsequent to the portfolio formation year. The curves represent the percentage of firms present in a specific debt maturity portfolio. The portfolio formation procedure is described as follows. Each year, we sort firms by the calculated weighted average debt maturity and split them into four equal groups. Then for each constructed group, we calculate the percentage of firms present in a specific group for the subsequent 20 years. For each year from 1974 to 1991, we repeat the above procedure, generating 18 sets of event-time percentages for each initial portfolio. Lastly, we calculate the mean of the percentages across event time. The sample consists of 1083 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1974-2011.

Panel A: Initially Short Debt Maturity Portfolio



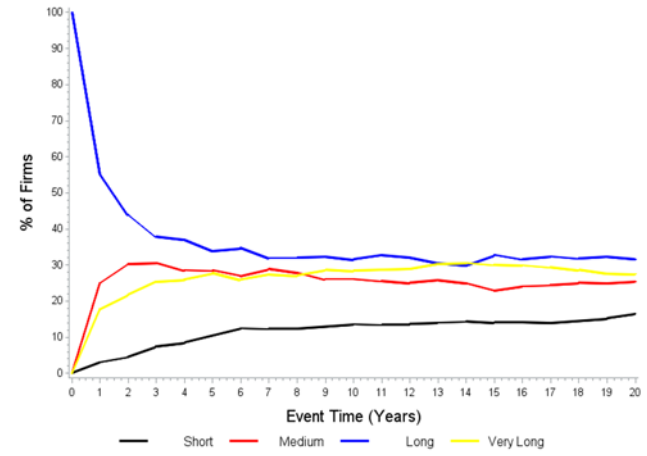
Data Source: Compustat Industrial Annual Database

Panel B: Initially Medium Debt Maturity



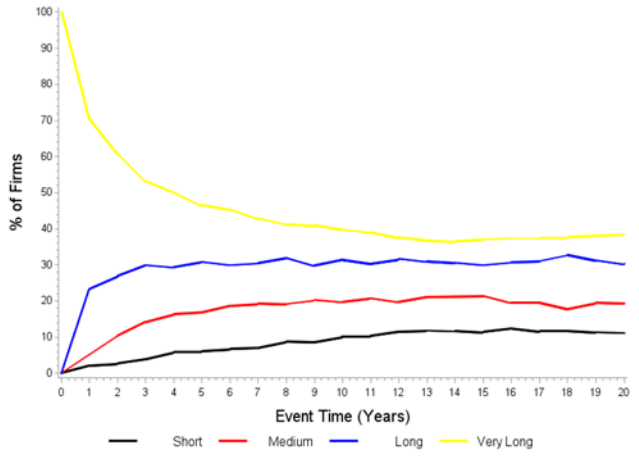
Data Source: Compustat Industrial Annual Database

Panel C: Initially Long Debt Maturity Portfolio



Data Source: Compustat Industrial Annual Database

Panel D: Initially Very Long Debt Maturity Portfolio

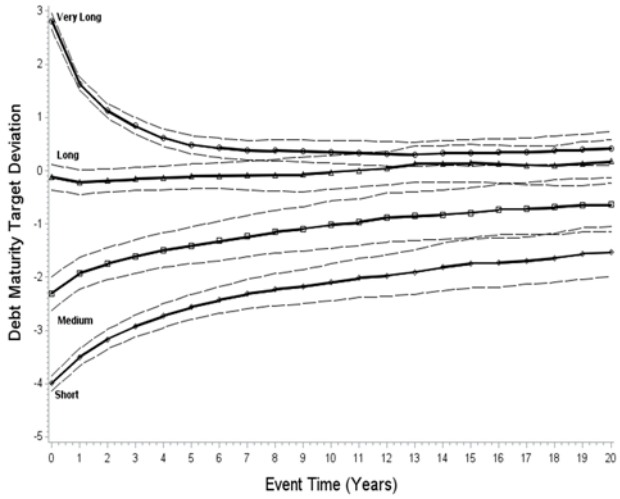


Data Source: Compustat Industrial Annual Database

Figure 2. 3 Average debt maturity deviation of actual debt maturity portfolios in event time

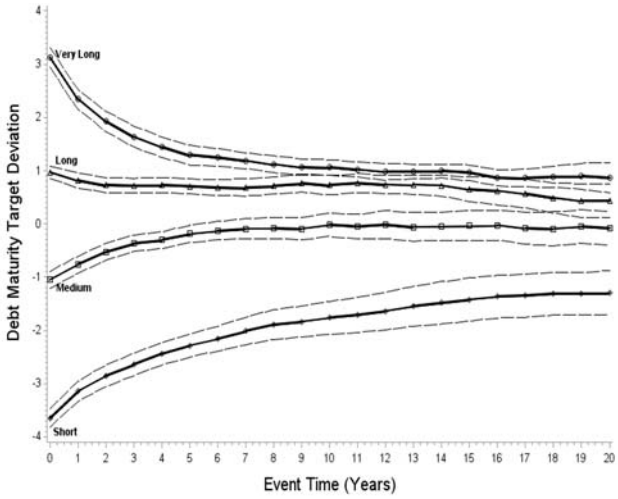
This figure exhibits average debt maturity deviation in event time for four portfolios constructed based on firms' weighted average debt maturity, calculated according to Formula (2.1). Debt maturity deviation is defined as the difference between a firm's observed debt maturity and its industry peers' weighted average debt maturity, with each firm weighted by its total liabilities. Event time 0 denotes the portfolio formation year. Event time s denotes the s^{th} year subsequent to the portfolio formation year and event time -s denotes the s^{th} year prior to the portfolio formation year. The solid curves represent the portfolio's average debt maturity deviation and the long-dashed curves surrounded represent the 95% confidence interval. The evolution pattern is displayed for all firms (Panel A) and survivors (Panel B). Survivors are defined as firms who have more than 20 debt maturity observations. The portfolio formation procedure is described as below. Each year, we sort firms by debt maturity levels and split them into four equal groups. Then for each group constructed in a given year, we calculate the average debt maturity for firms present in exactly the same group for the subsequent 20 years. The portfolio composition remains relatively unchanged unless a firm spontaneously perishes and exits the portfolio. For each year from 1974 to 2010, we repeat the above sorting and averaging procedure, which generates 37 sets of event-time averages for each group/portfolio. Lastly, we calculate the mean of the event-time averages and the two-standard error interval of the average debt maturity across event time. The sample consists of 6458 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1974-2011.

Panel A: Peer Firms' Weighted Average Debt Maturity as Target Proxy (All Firms)



Data Source: Compustat Industrial Annual Database

Panel B: Peer Firms' Weighted Average Debt Maturity as Target Proxy (Survivors)



Data Source: Compustat Industrial Annual Database

Chapter 3

Do Market and Creditworthiness Timings Drive Debt Maturity Decisions of Firms?

Acknowledgements

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Abstract

This paper contributes to the debt maturity literature by addressing the question of whether timing temporary mispricing in stock and creditworthiness influences debt maturity decisions of firms. Separating operating liabilities from financing liabilities, taking into account natural retirement of debts and disentangling in the commonly used market timing proxy (price-to-book) the mispricing and future growth option components, we find that for big firms with strong fundamentals and sufficient credit access, the timing of equity and credit mispricing plays a central role in short-term versus long-term debt choices. Furthermore, our empirical results demonstrate that the timing effect outperforms the effect of intra-industry herding at debt refinancing periods, i.e. when a significant debt issuance or retirement has occurred. Another contribution of this paper is to propose a more concise measure for net long-/short-term debt issuance.

Keywords: Mispricing, Debt Maturity, Market Timing, Growth Options, Creditworthiness

JEL Classification: G3

3.1. Introduction

Traditional corporate finance theories typically explain debt maturity decisions of firms within a tradeoff framework, in which firms decide their debt maturity by balancing benefits against costs of using debts with short and long maturities (e.g., Diamond (1991,1993), Jun and Jen (2003), Ju and Ou-Yang (2006), He and Milbradt (2012)). Notwithstanding the efforts of carrying time-series implications in debt maturity rebalancing, this literature fails to explain the instances when firms' debt maturities voluntarily deviate from the target. The market timing models provide one possible explanation. Researchers have documented that firms have short-term incentives to time the issue of debts with various maturity structures around the "window" of opportunity, e.g. the favorable market conditions, the improvement of credit ratings and more fundamentally, the temporary mispricing (Myers and Majluf (1984), Flannery (1986), Baker and Wurgler (2002), and Greenwood et al. (2010)). Faulkender et al. (2012) document that market timing opportunities might impede a firm's incentives to close a leverage gap if corporate bond yields were temporarily low. Despite all, empirical studies in this regard are surprisingly underdeveloped, especially from the timing point of view.

To fill the gap, this paper investigates the effect of stock and debt valuations on debt maturity decisions of firms. Specifically, we address the question of whether timing temporary mispricing of firms' stocks and creditworthiness drives debt maturity decisions of firms.

Separating operating liabilities from financing liabilities, taking into account natural retirement of debts and further disentangling in the commonly used market timing proxy (price-to-book) the mispricing and future growth option components, we find that equity and credit mispricing timing plays an important part in firms' debt maturity decisions,

especially among big firms. Subsequent to stock overvaluation, big firms favor long-term debts other than short-term debts or operating liabilities. Moreover, we show that firms are not likely to issue financing debt when expecting credit quality to raise, neither short-term nor long-term. As a complement, they issue miscellaneous operating liabilities. Note that miscellaneous operating liabilities bear a transitory feature. This finding is consistent with the literature that firms try to issue information insensitive securities when expecting their credit conditions to improve. Prior to credit quality decrease, they issue long-term debt. Further, it turns out that although the herding pattern dominates over the timing pattern in general terms, the latter outperforms the former at debt refinancing points (i.e., when the amount of debt issued for financial purpose exceeds 5% of a firm's book assets) for big firms. This finding holds robust under various cutoffs (3% and 7%) in defining debt issuance spikes (unreported for brevity).

A close precedent to our research is the seminar work of Fama and French (2012)[26]. They employed a constrained regression framework to explain the split of incremental debt financing between short-term and long-term. We follow their logic of imposing cash flow constraint and further revise their approach from the following aspects. Firstly, we separate liabilities between operating and financing. Instead of running a pair of regressions for the allocation of financing between short-term and long-term liabilities, we run a system of three regressions for the allocation of debt between short-term, long-term and operating liabilities. Secondly, we measure net debt changes, accounting for the natural retirement of maturing debts. In order to provide a more complete picture of the

[26] Fama and French (2012) investigate corporate choices of debt versus equity, long-term versus short-term debt and share issues versus retained earnings.

impacts across the maturity spectrum, various maturity cutoffs are adopted to construct the variables of net short-/long-term debt change.

Despite all, the most distinguishing difference between our research and the existing literature, for example Fama and French (2012), among others, is that we seek to capture the misevaluation effect. As a matter of fact, Fama and French (2012) do not find clear evidence that market timing plays a role in debt maturity decisions of firms. The impact of the stock valuation variable P/B_{t-1} in Fama and French (2012) is either insignificant or has the wrong sign during the recent period of 1983–2009. Similarly, our replication of Fama and French (2012) finds similar results against debt maturity market timing. This is, at least in part, due to the fact that P/B_{t-1} has dual implications for firms on the debt maturity issue. A high P/B_{t-1} can reflect a firm's growth options as well as the misevaluation beyond the firm's intrinsic value. Positive growth options are supposed to have a negative impact on debt maturity according to the prediction of the agency model. By contrast, overvaluations due to pricing errors are supposed to have a positive impact according to the prediction of the market timing model. In fact, once firms' growth options are separated, we find evidence that big firms "time" the maturity of their borrowings in case of misevaluation.

This paper adds to the literature on how temporary mispricing affects a firm's debt maturity decision. Our empirical finding corroborates previous research which appeals to market conditions to explain the over-time variations in aggregate debt maturity (e.g., Baker et al. (2003), Greenwood et al. (2010)). For example, our results are in accordance with Greenwood et al. (2010) who conclude that financially strong firms exhibit more aggressive debt maturity timing behavior. Moreover, we bring novel evidence that although there is non-trivial intra-industry herding behavior in the short-term versus

long term debt choice, in times when firms' stocks and creditworthiness are over evaluated relative to their fundamental values, firms take more initiatives to exploit temporary mispricing.

The remainder of the paper is organized as follows. Section 3.2 reviews related literature. Section 3.3 describes the data and presents summary statistics. Section 3.4 reports the empirical findings. Section 3.5 concludes.

3.2. Related literature

3.2.1. Market misevaluation, timing and debt maturity

In a recent review of the empirical corporate finance literature, Baker (2009) argues that "corporate finance outcomes are the intersection of demand and supply". Firms may be mispriced relative to their intrinsic values, due to the fact that the supply of capital is not perfectly competitive and elastic in reality. The theoretical underpinning of the market timing model lies in the behavioral story about the "value premium". Value firms with a high price to book ratio are likely to be wrongly overvalued by investors and growth firms with a low price to book ratio are likely to be wrongly undervalued (see Lakonishok et al. (1994), Shleifer and Vishny (1997), Barberis and Thaler (2003) and among others). Firms who have private information on their future cash flows are able to exploit stock mispricing by issuing shares when they are overvalued and repurchasing shares when they are undervalued[27].

[27] Among others, Lucas and McDonald (1990), Loughran and Ritter (1995), Baker and Wurgler (2000) and Baker and Wurgler (2002) empirically examine the relation between stock valuation and capital structure choices of firms. They show that firms tend to issue new issues when their stocks are valued high. Especially, Baker and Wurgler (2002), Korajczyk and Levy (2003) and Huang and Ritter (2009) conclude that managerial market timing activities affect firms' capital structure in a permanent way.

Some contend that there is a spillover effect of stock valuation on debt pricing (e.g., Myers and Majluf (1984), Baker and Wurgler (2002), and Fama and French (2012)). At a time when the stock of a firm is priced high relative to its fundamental value, the debt of the firm is also likely to be overvalued, with long-maturity debt more overvalued than short-maturity debt. Therefore conditional upon debt issuance, long-term debt should be preferable to short-term debt during periods of stock overvaluation (e.g. Baker and Wurgler (2002), Myers and Majluf (1984)). Others explicitly document firms' intentions of exploiting temporary debt mispricing. Flannery (1986) argues that firms who believe that their credits are under-rated and hold private information about future prospects issue transitional short-maturity debts so that their creditors are able to update regularly their credit information and thereby give more favorable terms.

Empirical research on equity timing patterns has been expanding, following the renowned paper of Baker and Wurgler (2002). By contrast, debt timing patterns on account of the market valuation mechanism is greatly overlooked. The few existing papers are represented by the research on whether debt maturity timing create value for shareholders. Among the first, Baker, Greenwood and Wurgler (2003) show that timing long-term debt issuance prior to low future excess return accounts for a substantial amount of over-time variation in average debt maturities of firms. The subsequent studies raise a query on whether firms are successful in timing debt issuance. A representative counterclaim is Butler et al. (2006) who argue that the presence of structural shift[28] leads to spurious in-sample correlation between long-term debt issuance and excess bond returns. They contest that firms are, in fact, responding to past bond market performance

[28] Specifically, Butler et al. (2006) identify a regime change over the 1981-1982 period when American government adopted monetary and fiscal policy to deal with high inflation After controlling this regime change, their empirical evidence is no longer in support of the successful market timing proposition of Baker et al. (2003).

rather than predicting the future bond market return, described in a related literature, e.g. Schultz (2003) and Barry et al. (2008), as "pseudo market timing". Butler et al. (2006) also question the comparative forecasting advantage of corporate issuers relative to other sophisticated market participants, such as large banks, insurance companies, and pension funds. They contend that firms are not likely to have superior information to predict future interest rates comparing with other market players. Confronting these critics, Greenwood et al. (2010) propose a new debt maturity timing proposition based on the limited arbitrage logic following the MM theorem (1958). They derive that firms are actually able to time the bond market thanks to their comparative advantage over other arbitrageurs in absorbing the supply shocks of government long- or short-term maturity debts, rather than in predicting bond market returns. The main prediction of their model is the "gap-filling behaviors" of firms such that when the government issues more long-term debt, firms will respond to issue more short-term debt, with financially flexible firms exhibiting even stronger patterns. The debate keeps going on and research on whether firms are successful in exploiting temporary debt mispricing by raising debt funds "at the lowest risk-adjusted cost" (Baker et al. (2003)) remains inconclusive.

An alternative line of literature, to which the current paper belongs, examines whether and how market timing considerations play a part in long-term and short-term debt allocation decisions. Survey evidence of Graham and Harvey (2001) indicates that managers issue short-term debt "when short-term interest rates are low compared to long-term rates", and "when waiting for long-term market interest rates to decline". More convincingly, Bancel and Mittoo (2004) find similar evidence for European managers. Taggart (1977) and Marsh (1982) show that debt issuance decisions are related to general market conditions. Barry et al. (2008) refer themselves to publicly issued

corporate bonds and control various characteristics of the bond issues, such as proceeds, maturity, credit rating, call and put provisions, floating or fixed rate. Their empirical results turn out that firms do not issue more long-term debts prior to increases in interest rates. By contrast, they issue long-term debts when the current interest rates are low relative to the historical levels. Although instructive, their research neglected the heterogeneity in firms timing abilities and overlooked the fact that one-shot debt issuance does not necessarily reflect a firm's real financing intention. Using aggregated balance-sheet data, Fama and French (2012) investigate the effect of market timing on the short-term versus long-term debt choice. Yet, debt maturity timing evidence in Fama and French (2012) is inconclusive. For the two separate periods (1963-1982 and 1983-2009) and the three size groups (microcap, smallcap and bigcap firms), only microcap firms report timing behaviors exclusively for the sub-period 1963-1982.

3.2.2. Endogeneity and constrained regression model

Endogeneity induced by simultaneity, omitted variables and measurement error is a major concern in empirical corporate finance. A number of econometric techniques have been proposed by researchers to address endogeneity. The conventional remedy is the instrumental variable approach, among which the most widely used one in the recent literature is the Differenced or System Generalized Method of Moments (GMM) technique (see Arellano and Bond (1991) and Blundell and Bond (1997)). However, in the case that the variable of interest is persistent in time series, inferences drawn from the first-differenced GMM can be misleading due to weak instrument of the lagged levels for subsequent first-differences (see Bond et al. (2001) and Stock et al. (2002) for a detailed discussion). The System GMM, which includes additional moment conditions, is shown to

perform better than the first-differenced GMM in persistent time series (Blundell et al. (2000)).

The use of System GMM is highly recommended to address the dynamic data structure with lagged levels of dependent variables on the right-hand side of an equation. We, however, are more interested in addressing the simultaneity issue. It is well documented in the literature that exogenous variables can have both direct and indirect impacts on the endogenous variables and that investment opportunity sets play indirect role in debt maturity choices through its role in leverage choices (e.g., Barclay et al. (2003)). Nevertheless, not only are leverage and debt maturity decisions simultaneous made, but also investment, financing and dividend payout decisions. Studies that analyze these economic forces in isolation are consequently unable to address the real effect of relevant economic forces, for instance market valuations on debt maturity decisions of firms. In particular, if pecking order forces do affect financing decisions of firms, variation in short- and long-term debt partition in response to cash flows may obscure the influences of other relevant forces (Fama and French (2012)).

Fama and French (2012) propose a novel methodology to involve investment, financing, leverage and debt maturity choices in a unified regression framework. Precisely, by imposing cash flow constraint where total debt financing (the sum of short- and long-term liabilities) must equal total asset investment plus dividend distribution minus financing from stock issues and internal earnings, they run a pair of regressions to explain the split of incremental financing between short- and long-term liabilities. The cash flow constraint in Fama and French (2012) is specified as

$$dSTD_t + dLTD_t = dA_t + D_t - Y_t - dS_t \quad (3.1)$$

where $dSTD_t$ and $dLTD_t$ denote issuance of short- and long-term debts respectively, with the former estimated as the changes in balance-sheet current liabilities and the latter as the residual changes of total liabilities minus current liabilities. dA_t, D_t, Y_t and dS_t represent investment in assets, dividends paid, earnings, and shares issued respectively, all measured in fiscal year t. Then based on the cash flow constraint (1), Fama and French (2012) run a pair of two complementary regressions on the split of financing between short- and long-term liabilities, as follows.

$$\begin{cases} dSTD_t = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} + b_{10} STS_{t-1} + e_t \\ dLTD_t = -a + (1-b_1) dA_t - (1+b_2) NegY_t - (1+b_3) PosY_t - (1+b_4) dS_t + (1-b_5) D_t - b_6 NoD_t - b_7 MC_t - b_8 NegB_{t-1} - b_9 P/B_{t-1} - b_{10} STS_{t-1} - e_t \end{cases} \quad (3.2)$$

Negative earnings ($NegY_t$) are separated from positive earnings ($PosY_t$), allowing for the possibility that the allocation of liabilities between short-term and long-term varies with the sign of income shocks. Earnings are measured as income before extraordinary items available for common stockholders, plus extraordinary items ad discontinued operations, during fiscal year t. The slopes for dA_t, D_t, $PosY_t$, $PosY_t$ and dS_t in the two regressions estimate how and to which extent variations in investment, dividend payment, earnings and stock issuance lead firms to split debt financing between short-term and long-term. Myers and Majluf (1984)'s pecking order story says that the information asymmetry problem induces firms to prefer short-term debts as information asymmetry is more severe for long-term debts.

In addition to the variables specified in the cash flow constraint, Fama and French (2012) incorporate additional variables to test related hypotheses and to check robustness.

Particularly, they refer to the lagged price-to-book ratio (denoted as P/B_{t-1}, the division between the market capitalization at the end of December of calendar year t-1 and book equity at the end of fiscal year t-1) to address the timing effect on debt maturity choices of firms. Debts of firms with high P/B_{t-1} are likely to be over-valued, with long-term debts more over-valued than short-term debts. All else being equal, high P/B_{t-1} firms will prefer long-term debt to short-term debt according to the market timing proposition. Empirically, **P/B_{t-1} is expected to show negative signs in the $dSTD_t$ regression and positive signs in the $dLTD_t$ regression.**

Lagged short-term debt surplus (denoted as STS_{t-1}, the difference between actual and industry short-term debt ratio [29], measured at the end of the fiscal year t-1) is incorporated to test debt maturity targeting behavior. In line with the tradeoff model, typical firms operate with debt maturity target and actively narrow down the target deviation. That is, excessive short-term debt usage above the target shall lean a firm towards issuing long-term debt, while excessive long-term debt shall incline the firm towards issuing short-term debt. Note that Fama and French (2012) employ a firm's industry weighted average debt maturity to proxy for the target. In this sense, the estimates for STS_{t-1} capture more of a herding behavior. Similarly, **STS_{t-1} is supposed to show negative signs in the $dSTD_t$ regression and positive signs in the $dLTD_t$ regression.**

Other control variables include firm size (MC_t, the log value of market capitalization in June of calendar year t), no dividend payment dummy (NoD_t, a dummy variable for firms that do not pay dividends during fiscal year t), and negative book equity dummy ($NegB_{t-1}$,

[29] The industry short-term debt ratio is calculated as the industry weighted average short-term debt ratio based on Fama French 10 industry classification, with each firm weighted by its total liabilities.

a dummy variable for firms with negative book equity value at the end of fiscal year t-1). They are included to allow for debt maturity preference or constraints among firms with different sizes, dividend policies (payers versus non-payers), and firms reporting severe losses. All the variables in Regressions (3.2) are defined in Table 3.1.

[Insert Table 3.1 about here]

The system of regressions (3.2) is built on the cash flow constraint (3.1). Imposing the cash flow constraint implies that the sums of the coefficients of dA_t and D_t in the two regressions must add up to 1, and the slopes on Y_t, and dS_t must add up to -1. For the extra variables, the coefficients must add up to 0. This constraint holds for each firm each year. To put it simply, each year, the intercepts and the residuals in the $dSTD_t$ and $dSTD_t$ regressions must add up to zero, the slopes for dA_t and D_t must add up to one, the slopes for $PosY_t$, $PosY_t$ and dS_t must sum to minus one, and the slopes for the remaining variables (NoD_t, MC_t, $NegB_{t-1}$, P/B_{t-1} and STS_{t-1}) must sum to zero[30].

3.3. Data

Our sample is drawn from CRSP/Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009. Three datasets are employed for our analysis. The first dataset follows Fama and French (2012) as closely as possible, except that we do not supplement the missing book equity with the data from Moody's manuals due to data access restrictions. The second dataset excludes observations with missing Compustat items of total long-term debt, debt in current liabilities and debts due in the first, second, third, fourth and fifth year of the balance sheet. The third dataset only includes firms with

[30] Please note that due to round-off errors, the sum of the estimated coefficients in the complementary regressions may not perfectly comply with the requirements of the cash flow constraint. For instance, in Panel A, Table 3.5, the average regression slopes for $dZ\text{-}Score_{t+1}$ in the $dLTD'^1_t$ regressions sum up to 0.01 instead of 0.

S&P's domestic long-term issuer rating. Fama and French's (2012) sample dates back to 1963 and they demarcate the periods of 1963-1982 and 1983-2009 for separate analysis. The current research focuses on the 1983-2009 period for two reasons. Firstly, note that the market timing effect is found insignificant by Fama and French (2012) for this period, our research is therefore based on this very period for comparison purpose. Secondly, Compustat items of debts due in one, two, third, fourth and fifth year are not available before 1973.

For the first and second datasets, results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. Replicating Fama and French (2012) yields an average annual sample of 2086 micro firms, 837 small firms and 1005 big firms. The sample size is quite similar to Fama and French (2012), although is not identical[31]. The sample employed in our main tests, i.e. the second dataset, is smaller than the replicated sample, i.e. the first dataset, due to missing Compustat items to construct the net issuance of short- and long-maturity debts. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms. The third dataset is a subset of the second dataset, used to examine the effect of credit migration. For this dataset, results are separately presented for speculative-grade firms whose S&P's domestic long-term issuer ratings averaged over the fiscal year t-1 are inferior to "BBB-" and investment-grade firms whose S&P's domestic long-term issuer

[31] Fama and French (2012) use 2380 micro, 767 small and 702 big caps for their regressions of short-term versus long-term debts.

ratings averaged over the fiscal year t-1 are superior to "BB+". The average annual sample represents 385 speculative-grade firms and 237 investment-grade firms.

Table 3.2 reports separate summary statistics (means and standard deviations) for the three datasets. Analogous to Fama and French (2012), we discard observations with common equity superior to total assets at the beginning of fiscal year. Moreover, we trim $PosY_t$, D_t, P/B_{t-1} at the 99.5% of the annual distribution, and dA_t, dS_t and $NegY_t$ at the 0.5% of the annual distribution.

[Insert Table 3.2 about here]

The replicated sample (the first dataset, panel A) closely resembles the sample in Fama and French (2012). It turns out that firms present in our main tests (the second dataset, Panel B) are generally more mature and lower in growth rates in comparison with the firms in the replicated sample (the first dataset, panel A). The average firm in Panel B employs relatively less external funds (neither common equity nor liabilities), has slightly lower past price-to-book ratio, and are more profitable (except for big caps) comparing with the average firm in Panel A. This finding is plausible as the reporting practice says that large and mature firms are more likely to announce "sophisticated" accounting items in their financial statements. Results in panel C suggest that firms with public credit access are lower in P/B_{t-1} and STS_{t-1} than those reliant on private debts. Investment-grade firms issue less stock and more debt (especially short-term) than speculative-grade firms. For example, a typical investment-grade firm issue short–term debt equivalent to 1.38% of total assets and retire common equity equivalent to 0.40% of total assets, whereas a typical speculative-grade firm issue short–term debt and common equity equivalent to 0.93% and 2.64% of total assets respectively. Very likely, this is due to the prevalence of

commercial paper programs (a special vehicle for raising short-term fund) in high-rated firms.

3.4. Empirical results

3.4.1. Replication of Fama and French (2012)

For comparison purpose, we first replicate Fama and French's (2012) regression on the split of financing between short-term and long-term liabilities before proceeding to our main tests. The replication is conducted on the first two datasets as discussed in the previous section. The first dataset matches the sample of Fama and French (2012) as close as possible and the second dataset excludes firms with missing debt maturity information. Remind that the second dataset is employed for our main tests, replicating Fama and French (2012) on the two datasets allows us to check sampling differences.

Table 3.3 reports the Fama-Macbeth regression results for the system of regressions (3.2) in the spirit of Fama and French (2012). Specifically, we run cross-sectional regression for each year t during the period 1983-2009. The reported parameter estimates are the averages of the annual regression coefficients and the t statistics are the student's t values for the average coefficients. R^2 is the average value of the annual coefficients of determination.

[Insert Table 3.3 about here]

The replication with analogous sample formation procedure comes up with very similar results to Fama and French (2012) concerning the lagged price-to-book ratio. As expected, the average P/B_{t-1} slopes are positive in our $dLTD_t$ regressions for micro and small caps (0.06 and 0.05), whereas the estimates are statistically insignificant. For big caps, the sign for the P/B_{t-1} slope is in the wrong direction as in Fama and French (2012). For example,

the average P/B_{t-1} slopes in the $dLTD_t$ regressions for 1983-2009 are -0.09 in Fama and French (2012) and -0.07 for our replicated sample.

Analogous to Fama and French (2012), the argument that a firm's short-term debt ratio tend to revert to its industry average level gets strong support, especially in smaller firms. The regression slopes for STS_{t-1} for micro and small caps are 10.62 and 2.24 for 1983-2009 in Fama and French's (2012) long-term debt regression, and 11.32 and 2.92 in our long-term debt regression for the same period, all more than 2.0 standard errors from zero.

At odds with the pecking order model while in line with Fama and French (2012)'s evidence, the regression slopes for the cash flow variables (dA_t, D_t, $PosY_t$, $PosY_t$ and dS_t) imply that debt financing in response to variation in investment, dividends, earnings and stock issued is primarily long-term (with few exceptions for micro caps), given total debt issued. Specifically, short-term liability issues, on average, absorb between 17% and 42% of the marginal variation in dA_t, D_t, $PosY_t$, $PosY_t$ and dS_t for small and big caps, with the rest (83% to 58%) absorbed by long-term liability issues. For micro caps, short-term liability meets 41% to 61% of the marginal variation in the above cash flow variables.

Results on extra variables are also similar. Both documents that in the $dLTD_t$ regression, firm size plays a positive role in micro caps, a negative role in big caps and no role in small caps. Only a minor distinction is documented on the estimates of $NegB_{t-1}$ and NoD_t among big firms. Precisely, Fama and French (2012) show that big non-dividend payers use more short-term debt, while our results are not statistical significant. We find that big firms reporting negative book equity have an inclination for short-term liabilities, while Fama and French (2012) find no compelling evidence.

Running Fama and French's (2012) complementary regressions on the second dataset leads to resembling results. The coefficient estimates for P/B_{t-1} are insignificant, neither in micro and small firms nor in big firms. Although the estimates for P/B_{t-1} for big caps are still positive (0.05) in the $dSTD_t$ regressions and negative (-0.05) in the $dLTD_t$ regressions, the slopes are just 0.93 and -0.93 standard errors from zero. The average STS_{t-1} slopes are marginally reduced in magnitude but hold significant statistically. The reported average slopes for cash flow variables confirm our previous findings that bigger firms naturally use long-term debt to absorb cash flow shocks. The only exception is the negative book equity dummy whose estimates become indistinguishable from zero, perhaps because most firms reporting negative book equity are excluded from the second dataset due to lack of debt maturity information.

To sum up, replicating Fama and French (2012) provides no evidence that firms take advantage of favorable equity market conditions to allocate more debt fund to long-term.

Indeed, Fama and French (2012) interpret the timing evidence more broadly without separating financial debts from operating debts, and distinguishing between fair evaluation and misevaluation effect. We recognize the necessary of accounting for these relevant issues for potential enhancement.

3.4.2. Distinguishing debts arising in financing activities from liabilities arising in operating activities

Fama and French (2012) partition the total liabilities for a firm into short- and long-term liabilities. However, the balance sheet liabilities also include miscellaneous items such as "account payable", "deferred long term liability charges" and "other liabilities" such as deferred credits, customer deposits, employee wages, estimated tax liabilities and inter-company borrowings etc. These liabilities are money owned to customers, suppliers,

employees and firms' divisions or subsidiaries, incurred in normal business operations and transactions. Present on the current or long-term liability accounts, most of them are non-interest bearing and have a transitory feature in nature. When market is cold or when the value of a firm is under-valued, the market timing model suggests that the firm issues transitional debts to wait for the market to recover so that the firm value will be fairly valued later on. For firms who have funding needs but are high in rollover risk, they may try to employ more miscellaneous liabilities, for instance inter-company borrowings, rather than short-term debts. In this case, treating long-term operating and financing liabilities as homogeneous is likely to underestimate the market timing effect. Moreover, Fama and French (2012) use changes in current liabilities to measure short-term debt issuance and residual changes in total liabilities to measure long-term debt issuance. We, however, suspect that this simplicity is unable to capture the net financial debt issuance, in view of the accounting practice that the balance sheet current liabilities item also contains the current portion of long-term debt which is supposed to be paid off in the next fiscal year. Suppose a firm (1) has a larger proportion of long-term debt due in the current year and a smaller load of debt due in the second year; (2) implements no early retirement; (3) keeps short-term debt usage constant. Since debt maturing in two years changes its accounting identity automatically to the current portion of long-term debt in the next year, Fama and French's (2012) debt issuance measure generates negative changes in short-term debt instead of zero, that is, the real issuance amount. From this point of view, measurement error is likely to be another source of bias in estimating market timing effect.

Given all that, we next examine whether distinguishing between financing and operating liabilities and taking into account the natural retirement of debts modifies the estimates for P/B_{t-1}.

To do so, we revise the constrained regression framework of Fama and French (2012). Specifically, we decompose changes in liabilities into net changes in short-term debt, net changes in long-term debt and net changes in miscellaneous operating liabilities. Accordingly, instead of running a pair of regressions for the allocation of financing between short- and long-term liabilities, we run a system of three regressions for the split of financing between short-, long-term debt and operating liabilities. Accounting for the refinancing of maturing debts, we remove the current proportion of long-term debt to the right side of the cash flow constraint.

The revised cash flow constraint is formulated as below,

$$dSTD'^{x}_t + dLTD'^{x}_t + dMiscL'_t = dA_t + D_t - Y_t - dS_t + DD1_{t-1} \quad (3.3)$$

where $dSTD'^{x}_t$ and $dLTD'^{x}_t$ denote the net issuance of short-term and long-term debts respectively, and $dMiscL'_t$ denotes the issuance of miscellaneous operating liabilities, measured as changes in liabilities excluding short/current long term debt (Compustat item of DLC) and long-term debt (Compustat item of DLTT). To provide a more complete picture of the market timing impacts across the maturity spectrum, we measure debt issuance with respect to various maturity cutoffs, represented by the superscript ^{x}. $DD1_{t-1}$ is the current portion of long-term debt, measured as of the fiscal year t-1.

The cash flow constraint imposes that the external debt funds ($dSTD'^{x}_t + dLTD'^{x}_t + dMiscL'_t$) are equivalent to the demand of asset investment (dA_t), dividend distribution (D_t) and

debt refinancing ($DD1_{t-1}$) minus the supply of internal funds (Y_t) and new shares issued (dS_t).

To calculate $dSTD'^{x}_{t}$ and $dLTD'^{x}_{t}$, we assume that in the year t+1, the current portion of long-term debt in year t is completely refinanced and debts with maturities of n years (n=2, 3, 4, 5) changes its accounting identity to debts with maturities of n-1 years. To put it differently, long-term debt due in the 1st year is paid off in the upcoming year and debt due in the 2nd year turns to debt due in 1 year on the firm's balance sheet, and so on. The accounting identity for the net issuance of debt with various maturities can be written as,

$$dSTD'_t = dDLC_t - dDD1_t \quad (3.4)$$

$$dDD1'_t = DD1_t - DD2_{t-1} \quad (3.5)$$

$$dDD2'_t = DD2_t - DD3_{t-1} \quad (3.6)$$

$$dDD3'_t = DD3_t - DD4_{t-1} \quad (3.7)$$

$$dDD4'_t = DD4_t - DD5_{t-1} \quad (3.8)$$

$$dDD5+'_t = DD5_t + DD6+_t - DD6+_{t-1} \quad (3.9)$$

$dSTD'_t$ represents the net changes in short-term debt during the fiscal year t (the current portion of long-term debt is excluded). $dDD1'_t$, $dDD2'_t$, $dDD3'_t$, $dDD4'_t$ and $dDD5+'_t$ represents the net changes in long-term debts with maturities of one, two, three, four and beyond five years. DLC is Compustat data item for financial debt in current liabilities. DD1, DD2, DD3, DD4, DD5 are Compustat data items for long-term debts payable in one, two, three, four and five years. DD6+ is long-term financial debt maturing in more than 6 years. It is constructed as the result of DLTT (Compustat data item for long-term debt maturing beyond one year) minus the sum of DD2, DD3, DD4 and DD5.

Net issuance of debts with maturities of inferior or superior to x (x=1, 2, 3, 4) years can be easily constructed by adding up related items. For instance, for the one-year maturity cutoff (x=1, where short-term debt is defined as debt with a maturity of one year or less and long-term debt is defined as debts that are to come due in more than one year), net change in short-term debt ($dSTD'^{1}_{t}$) equals $dSTD'_{t}$ (equation (3.4)), and net change in long-term debt ($dLTD'^{1}_{t}$) is the sum of $dDD1'_{t}$ (equation (3.5)), $dDD2'_{t}$ (equation (3.6)), $dDD3'_{t}$ (equation (3.7)), $dDD4'_{t}$ (equation (3.8)) and $dDD5+'$ (equation (3.9)). Analogously, for the three-year cutoff (x=3, where short-term debt is defined as debt with a maturity of three years or less and long-term debt is defined as debts that are to come due in more than three years), net change in short-term debt ($dSTD'^{3}_{t}$) is $dSTD'_{t}$ (equation (3.4)) plus $dDD1'_{t}$ (equation (3.5)), $dDD2'_{t}$ (equation (3.6)), and $dDD3'_{t}$ (equation (3.7)). Net change in long-term debt ($dLTD'^{3}_{t}$) is the sum of $dDD4'_{t}$ (equation (3.8)) and $dDD5+'_{t}$ (equation (3.9)).

Based on our second data set, Figure 3.1 plots the issuance of short- and long-term debt and the lagged price-to-book ratio over our sample period on a yearly basis. Debt issuance is measured in two different manners: Fama and French's (2012) short- and long-term liability annual change and our net debt issuance measure as discussed above. One-year debt maturity cutoff is employed. On the left axis, the black dashed lines are average changes in short- and long-term liabilities (Fama and French's (2012) measure). The red dashed lines are average net issuance in short- and long-term debts (our net issuance measure). The solid blue line, plotted on the right axis is the year-by-year average price-to-book ratio (P/B). Panel A plots for the overall sample. In panel B, same variables are presented for micro, small and big caps separately.

[Insert Figure 3.1 about here]

Interesting patterns unfold. Firstly, it reveals that when P/B_{t-1} is high, the issuance of long-term debt is usually accompanied by the issuance of short-term debt. This can be explained by the fact that in time of expansion, firms tend to employ more external funds to finance their increased investment and they would issue both long-term and short - term. Likewise, low P/B_{t-1} leads to declines in not only long-term debt but short-term debt as well. Although the evidence is economy-wide, it does suggest that studies isolating these two inter-related decisions, that is, addressing the absolute long-term or short-term debt issuance, are peculiarly prone to bias. By contrast, by centering in relative prevalence rather than absolute changes, the complementary regression framework is more capable of addressing such issue. Secondly, in comparison with Fama and French's (2012) short- and long-term liability share, our net debt issuance measure yields slightly smaller values for short-term debt but considerably large values for long-term debt[32]. The average short- and long-term liability issuances, measured in Fama and French's (2012) way, are similar in magnitude most of the time, sometimes overlap. Yet our net financial debt issuance measure says that firms issue more long-term in general terms. Ceteris paribus, this pattern seems fit the common practice better.

To capture the pattern further, we run a system of three complementary regressions (as illustrated in Specification (3.10)) to explain the split of financing between short-maturity financing debt (the first regression), long-maturity financing debt (the second regression), and miscellaneous operating liabilities (the third regression).

[32] In unreported analyses, we find that long-term debt issued by the typical micro firm is equivalent to 0.48% of the total assets using Fama and French (2012)'s measurement and is equivalent to 3.54% of the total assets using our net issuance measurement, more than quadruple. For small and big caps, the difference is less overwhelming but remains remarkable.

$$
\begin{cases}
dSTD'^{x}_{t} = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} + \\
b_{10} STS'^{x}_{t-1} + b_{11} DD1_{t-1} + e_t \\
dLTD'^{x}_{t} = c + d_1 dA_t + d_2 NegY_t + d_3 PosY_t + d_4 dS_t + d_5 D_t + d_6 NoD_t + d_7 MC_t + d_8 NegB_{t-1} + d_9 P/B_{t-1} + \\
d_{10} STS'^{x}_{t-1} + d_{11} DD1_{t-1} + \xi_t \\
dMiscL'_t = -(a+c) + (1-b_1 - d_1) dA_t - (1+b_2 + d_2) NegY_t - (1+b_3 + d_3) PosY_t - (1+b_4 + d_4) dS_t + (1-b_5 - d_5) D_t \\
-(b_6 + d_6) NoD_t - (b_7 + d_7) MC_t - (b_8 + d_8) NegB_{t-1} - (b_9 + d_9) P/B_{t-1} - (b_{10} + d_{10}) STS'^{x}_{t-1} + (1-b_{11} - d_{11}) \\
DD1_{t-1} - (e_t + \xi_t)
\end{cases}
\tag{3.10}
$$

The revised cash flow constraint (3.3) is imposed. The regression results are presented in Table 3.4. For brevity, we only present the results based on the one-year (Panel A) and the three-year (Panel B) maturity cutoffs, according to which we calculate the net debt issuance (short- and long-term), and the lagged short-term debt surplus (see Appendix for a detailed description)[33].

[Insert Table 3.4 about here]

The regression results suggest that for micro firms, short-term and miscellaneous operating debt financing dominates over long-term debt financing in response to variation in investment, dividends, earnings, stock issued and refinancing of maturing debts, in contrast with small and big firms. According to the results based on the one-year maturity cutoff (Panel A, Table 3.4), the marginal variations in dA_t, D_t, $PosY_t$, $PosY_t$, dS_t and $DD1_{t-1}$ absorbed by $dSTD'^{x}_{t}$ and $dMiscL'_t$ ranges from 59% to 85% for micro caps. For small and big caps, the cash flow shocks are mainly met by long-term debt, ranging from 45%

[33] Results based on the two-year and four-year debt maturity cutoffs are available upon request.

to 67% for small caps and 38% to 71% for large caps. Results on the three-year maturity cutoff show similar patterns.

Comparing with the previously replicated regression results of Fama and French (2012), the coefficient estimates for the lagged price-to-book ratio are strengthened for big stocks. Although statistically insignificant, the average slopes for P/B_{t-1} become positive (0.08) in our net long-term debt regression for big stocks. Note that the average slopes for P/B_{t-1} in Fama and French's (2012) long-term liability regression are negative (-0.05). Stronger timing evidence turns up when net debt issuance is calculated using the three-year maturity cutoff. In particular, big caps with high P/B_{t-1} values show inclinations towards long-maturity debt. The positive average slope (0.11) for P/B_{t-1} is more than 2 standard errors from zero. In economic terms, one standard deviation increase in P/B_{t-1} above the mean leads a bigcap firm to increase long-term debt issuance equal to 0.42 % of the total assets (0.11 times the standard deviation of $P/B_{t-1,}$ 3.79). Results for micro caps are however at odds with the market timing hypothesis. The average P/B_{t-1} slopes are reported negative in the $dLTD'^{3}_{t}$ regression and positive in the $dSTD'^{3}_{t}$ regression. It seems that micro firms with high stock valuation tend to shift towards short-term debt other than long-term debt.

Distinguishing financial liabilities from operating ones show some evidence for market timing in big caps, different from the evidence from the replication of Fama and French (2012) (shown in Table 3.3). Although results from the one-year maturity cutoff show insignificant sign for $P/B_{t-1,}$ results from the three-year maturity cutoff do show evidence of debt maturity market timing. Indeed, conventional practice defines long-/short-term debt using the three-year debt maturity cutoff, e.g. Barclay and Smith (1995), Barclay et al. (2003) and Johnson (2003). Implications drawn from the one-year maturity cutoff can

be misleading. We, however, hesitate to draw quick conclusions as the implication conveyed by the price-to-book ratio is at best mixed. It's worthwhile to note that the price-to-book ratio could not only proxy for stock market misevaluation but rational evaluation as well, that is, growth options of firms. Hovakimian (2006) has highlighted this issue and seriously questioned the evidence of Baker and Wurgler (2002) concerning the permanent relationship between equity market timing and capital structure choices. He shows that as both managerial market timing and agency consideration predict a positive sign for the price-to-book ratio on capital structure, the observed effect of market timing in Baker and Wurgler (2002) is over-estimated by absorbing the positive effect of growth options. In terms of the debt maturity decisions, the agency model infers that high growth firms are among those who are more likely to come across underinvestment problems and shall have strong preference for short-term debts as a result (e.g. Myers (1977), Barlay and Smith (1995), Johnson (2003)). Since the predictions of the market timing and agency models on the price-to-book are exclusive, it's possible that the previous estimates for the timing effect are contaminated by the conflicting effect of agency considerations. In an analogous manner, since the market timing and agency models make opposite predictions for the lagged price-to-book ratio, the observed effect of market timing in Fama and French (2012) and our precedent analyses is likely to be under-estimated. This shall be especially true for micro firms who are more likely to encounter agency-type of problems. And it could explain, at least partially, why the estimated coefficient for P/B_{t-1} in micro firms is negative and significant in the $dLTD'^{3}_{t}$ regression.

3.4.3. Distinguishing misevaluation from growth options

Separating misevaluation from growth opportunities is a key issue to figure out the real effect of debt maturity market timing. In this section, we therefore probe into the impact of stock misevaluation on debt maturity choices, net of the impact of growth opportunities.

To do this, we refer to Baker and Wurgler's (2002) external finance weighted-average market-to-book measure (hereafter EFWAMB). This variable is initially developed to measure a firm's past equity market timing motivation. It is established as

$$\text{EFWAMB}_t = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} e_r + d_r} \times (\text{MTB})_s \tag{3.11}$$

where e and d denote net equity and net debt issued, respectively. MTB denotes the market–to-book ratio, calculated as the book value of total assets minus the book value of common equity plus the market value of common equity, all divided by the book value of total assets.

Further researchers (e.g., Hovakimian (2006), Kayhan and Titman (2007)), however, point out that this variable may convey misleading meanings. In particular, according to Hovakimian (2006), EFWAMB proxies better for firm's growth option. He argues that if market corrects the valuation errors more quickly than changes in growth options, the historical weighted average market-to-book ratio (EFWAMB) "could be a less noisy measure of growth opportunities than the current market-to-book". Based on the premise that growth options of firms change relatively slowly, Hovakimian (2006) then proposes an alternative measure for long-term growth options of firms, that is, the future external finance weighted average market-to-book ratio (FEFWAMB), defined as

$$\text{FEFWAMB}_t = \sum_{s=t+1}^{t+n} \frac{e_s + d_s}{\sum_{r=t+1}^{t+n} e_r + d_r} \times (\text{MTB})_s \tag{3.12}$$

In a way to capture temporary fluctuations in market valuations, the current price-to-book ratio should be able to complement EFWAMB and FEFWAMB to capture the misevaluation component. To test this hypothesis, we re-estimate our baseline model by incorporating additional variables of EFWAMB and FEFWAMB, whose signs are supposed to be positive in the short-term debt issuance regression and negative in the long-term debt issuance regression, in conformity with the agency model.

$$\begin{cases} dSTD'^{x}_{t}=a+b_1dA_t+b_2NegY_t+b_3PosY_t+b_4dS_t+b_5D_t+b_6NoD_t+b_7MC_t+b_8NegB_{t-1}+b_9P/B_{t-1} \\ + b_{10}STS'^{x}_{t-1}+b_{11}DD1_{t-1}+\beta GrowthOption_t+e_t \\ dLTD'^{x}_{t}=c+d_1dA_t+d_2NegY_t+d_3PosY_t+d_4dS_t+d_5D_t+d_6NoD_t+d_7MC_t+d_8NegB_{t-1}+d_9P/B_{t-1} \\ + d_{10}STS'^{x}_{t-1}+d_{11}DD1_{t-1}+\lambda GrowthOption_t+\xi_t \\ dMiscL'_t=-(a+c)+(1-b_1-d_1)dA_t-(1+b_2+d_2)NegY_t-(1+b_3+d_3)PosY_t-(1+b_4+d_4)dS_t \\ +(1-b_5-d_5)D_t-(b_6+d_6)NoD_t-(b_7+d_7)MC_t-(b_8+d_8)NegB_{t-1}-(b_9+d_9)P/B_{t-1}-(b_{10}+d_{10})STS'^{x}_{t-1} \\ +(1-b_{11}-d_{11})DD1_{t-1}-(\beta+\lambda)GrowthOption_t-(e_t+\xi_t) \end{cases} \quad (3.13)$$

Here "Growth Option" represents the component of rational stock valuation, proxied by EFWAMB, FEFWAMB or both. P/B_{t-1} reflects the component of irrational stock valuation after growth option proxies are entered. Our results are presented in Table 3.5. Model 1 estimates the model with "Growth Option" proxied by EFWAMB. Model 2 estimates the model with "Growth Option" proxied by FEFWAMB. Model 3 estimates the model with Growth Options proxied by both $EFWAMB_t$, and $FEFWAMB_t$. For the sake of brevity, only slopes for P/B_{t-1}, $EFWAMB_t$, and $FEFWAMB_t$ are reported.

[Insert Table 3.5 about here]

More enhanced timing effect shows up. Remind that the precedent section reports insignificant estimates for P/B_{t-1} for big caps (0.08 with 1.53 standard errors from zero).

Notably, after ruling out the rational stock valuation, the estimates for the lagged price-to-book ratio (P/B_{t-1}) become significant for big caps even in the one-year maturity cutoff (0.10 in Model 1, 0.12 in Model 2 and 0.14 in Model 3). Indeed, for big caps, the average annual coefficients on P/B_{t-1} in the $dLTD^{'}x_t$ regression are all in the predicted positive sign and distinguishable from zero according to conventional statistical levels. Moreover, it shows that not only do big caps engage in debt maturity market timing but small caps as well. The average P/B_{t-1} slopes for small stocks are positive and significant in the long-term debt regression in Model 1 (0.08) and Model 3 (0.11) when the one-year debt maturity cutoff is employed. In the three-year debt maturity cutoff, estimates for P/B_{t-1} for small stocks are strengthened to 0.12 in Model 1, 0.05 in Model 2 and 0.13 in Model 3 and are all statistically significant. Additionally, the previously obscured coefficient estimates for P/B_{t-1} in the micro caps almost run out. Although the average P/B_{t-1} slopes for micro caps are found negative in the regressions of $dLTD^{'}x_t$ when the three-year maturity cutoff is adopted, none of them are more than 2 standard errors from zero. Depending on the maturity cutoff and the empirical specification, the incremental allocation toward long-term debts induced by one standard deviation increase in P/B_{t-1} averages from 0.18% to 0.46% of total assets for small firms and from 0.38% to 0.72% of total assets for large firms.

These results confirm the intuition in that EFWAMB and FEFWAMB capture growth options of firms to a larger extent and the inclusion of these variables helps to provide sharper estimates for the mispricing timing effect. Moreover, in accord with the underinvestment hypothesis, the effect of EFWAMB is found positive in the short-term debt issuance regressions and the pattern is more prominent for small and big caps when debt maturity is defined by use of the three-year maturity cutoff.

Since EFWAMB and FEFWAMB are constructed based on historical and future P/B, the multicollinearity issue merits consideration. To check this potential problem, Panel C of Table 3.5 presents the average variance inflation factor (VIF) for P/B_{t-1}, $EFWAMB_t$ and $FEFWAMB_t$ from the annual regressions. None of them are greater than 2, suggesting minor multicollinearity between P/B_{t-1}, $EFWAMB_t$ and $FEFWAMB_t$, at least in our regression settings.

By all accounts, it turns out that replicating Fama and French (2012) leads to misleading estimates for market timing for big caps (see section 4.1.). Separating financial debts from operating liabilities purifies the effect of timing to a certain degree but not completely (see section 4.2.). Further decontaminating the effect of growth opportunities clears out the timing effect led by market evaluation errors (see section 4.3.). We therefore have reasons to believe that market timing considerations play a role in long-term versus short-term debt choices of firms.

3.4.4. Equity misevaluation versus credit misevaluation

If a firm is going to report stronger credit quality in the next period, there is more chance that the firm is under-evaluated in the current period, all else being equal. This leads us to another issue: credit misevaluation. A strand of related literature examines the "adverse selection" problem, characterized by the undervaluation of high quality firms and the overvaluation of low quality ones under information asymmetry. Without private information, creditors cannot tell high quality firms from low quality ones. As a consequence, an industry-average credit risk rating is assigned to both types of firms and new debt issues of high quality, low-risk borrowers are likely to be under-estimated, and vice versa. Before favorable private information is disclosed to the market, high quality firms have no choice but to borrow at the same cost as low quality firms. Flannery (1986)

establishes that short-term debt is less sensitive to mispricing as it provides lenders with the possibility of updating firm's credit risk information constantly. For this reason, a firm with private information about its prospects will temporarily issue short-maturity debt (Flannery (1986) and Diamond (1991, 1993)).

To draw further implications for credit misevaluation, we incorporate an extra variable of subsequent change in Altman's Z-Score[34] (denoted as dZ-Score$_{t+1}$), specified as

$$\begin{cases} dSTD'^{x}_{t} = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} \\ \quad + b_{10} STS'^{x}_{t-1} + b_{11} DD1_{t-1} + \beta_1 EFWAMB_t + \beta_2 FEFWAMB_t + \beta_3 dZ\text{-}Score_{t+1} + e_t \\ dLTD'^{x}_{t} = c + d_1 dA_t + d_2 NegY_t + d_3 PosY_t + d_4 dS_t + d_5 D_t + d_6 NoD_t + d_7 MC_t + d_8 NegB_{t-1} + d_9 P/B_{t-1} \\ \quad + d_{10} STS'^{x}_{t-1} + d_{11} DD1_{t-1} + \lambda_1 EFWAMB_t + \lambda_2 FEFWAMB_t + \lambda_3 dZ\text{-}Score_{t+1} + \xi_t \\ dMiscL_t = -(a+c) + (1-b_1 - d_1) dA_t - (1+b_2 + d_2) NegY_t - (1+b_3 + d_3) PosY_t - (1+b_4 + d_4) dS_t + (1-b_5 - d_5) D_t \\ \quad - (b_6 + d_6) NoD_t - (b_7 + d_7) MC_t - (b_8 + d_8) NegB_{t-1} - (b_9 + d_9) P/B_{t-1} - (b_{10} + d_{10}) STS'^{x}_{t-1} \\ \quad + (1-b_{11} - d_{11}) DD1_{t-1} - (\beta_1 + \lambda_1) EFWAMB_t - (\beta_2 + \lambda_2) FEFWAMB_t - (\beta_3 + \lambda_3) dZ\text{-}Score_{t+1} - (e_t + \xi_t) \end{cases} \quad (3.14)$$

According to the literature, we expect a positive sign on dZ-Score$_{t+1}$ for short-term debt issuance and a negative sign for long-term debt issuance. The regression results are presented in Panel A, Table 3.6. Only estimates for P/B$_{t-1}$, EFWAMB$_t$, FEFWAMB$_t$ and dZ-Score$_{t+1}$ are reported for brevity's sake.

[Insert Table 3.6 about here]

[34] Altman's Z-Score is a renowned formula to predict a firm's credit quality. Altman's Z-Score = 1,2×T1+1,4×T2+3,3×T3+0,6×T4+1.0×T5, where T1 = Working Capital / Total Assets; T2= Retained Earning/ Total Assets; T3= EBIT / Total Assets; T4= Market Value of Equity / Book Value of Total Liabilities; T5= Total Sales / Total Assets.

The expected negative sign on dZ-Score$_{t+1}$ for long-term debt issuance is found. And the magnitude of the estimates is more prominent for big stocks (-0.08 in the one-year maturity cutoff and -0.06 in the three-year maturity cutoff). It indicates that firms who expect credit quality to increase are not likely to issue long-term financial debts. Conversely, firms are likely to issue more long-term debts when expecting credit quality to decrease in the future. The effect is more prominent in the one-year maturity cutoff. On average, a standard deviation decline in dZ-Score$_{t+1}$ shifts debt fund allocation towards long-term by 0.78% of total assets for small firms and 0.52% of total assets for large firms. Surprisingly, at odds with the prediction of the literature, firms with high dZ-Score$_{t+1}$ wouldn't issue short-term financial debts. Notably, none of the regression slopes for dZ-Score$_{t+1}$ are statistically significant, neither in the one-year nor in the three-year maturity cutoff. By contrast, estimates for dZ-Score$_{t+1}$ are found positive and statistically significant in the operating debt regression for small and big caps, indicating that firms with high dZ-Score$_{t+1}$ tend to issue miscellaneous operating liabilities. Indeed, both short-term financial debt and miscellaneous operating liability bear transitory features. To an extent, the latter acts more like short-term debt in serving temporary use. We address this conjecture in robustness checks.

It's also worthwhile to note that the P/B$_{t-1}$ estimates are even more strengthened after incorporating dZ-Score$_{t+1}$. The average P/B$_{t-1}$ slopes are 0.14 (one-year maturity cutoff)/0.19 (three-year maturity cutoff) without controlling for dZ-Score$_{t+1}$ (see Table 3.5) and increase to 0.15 (one-year maturity cutoff)/0.20 (three-year maturity cutoff) after controlling for dZ-Score$_{t+1}$ (see Table 3.6).

One may argue that it is more direct to examine the role of credit ratings: evaluations of the credit worthiness of debtors by credit rating agencies. Credit rating adjustment may

imply credit risk shift in a firm's business environment. For example, a firm who is going to report technology innovation is likely to receive a credit rating upgrade subsequently. It could also suggest that the current rating assigned by credit rating agencies is under-estimated.

To test whether firms issue transitory debts to wait for credit upgrade and issue long-term debts when expecting credit downgrade, we replace dZ-Score$_{t+1}$ in Specification (3.14) with dRating$_{t+1}$ (subsequent changes in Standard and Poor's domestic long-term issuer rating between the fiscal year t+1 and t) and re-run the regressions. Results are documented in Panel B, Table 3.6 and are separately presented for speculative-grade and investment-grade firms whose S&P's domestic long-term issuer ratings averaged over fiscal year t-1 are inferior to "BBB-" and superior to "BB+" respectively. Note that only a small portion of firms in Compustat reports credit rating information and they are generally larger in size. The average annual sample therefore only represents 385 speculative-grade firms and 237 investment-grade firms.

The results confirm once again that firms, both speculative- and investment-grade, issue transitory operating debts when expecting credit ratings to upgrade. The pattern is more remarkable in speculative-grade firms, for which the average dRating$_{t+1}$ slopes in the dMiscL$_t$ regressions estimate 0.95 and 0.96 in the one-year and the three-year maturity cutoffs respectively. Consistent with the credit misevaluation argument, investment-grade firms would rarely issue long-term debt when expecting their credit ratings to be upgraded. However, the pattern is only significant when net short-/long-term debt issuances are measured based on the one-year debt maturity cutoff. The average dRating$_{t+1}$ slopes for speculative-grade firms in the dSTD$'^{x}_{t}$ regressions are -0.75 and -0.82 in the one-year and the three-year maturity cutoff, suggesting that speculative-grade

firms are not likely to issue short-term debt prior to credit rating upgrades, perhaps due to rollover risk considerations. Moreover, we find strong evidence in support of the equity mispricing timing effect for investment-grade firms. The average slopes for P/B_{t-1} are ranging from 0.18 to 0.20 in the net long-term debt regressions and are more than 3.5 standard errors from zero. For speculative-grade firms, the pattern is only significant in the three-year debt maturity cutoff (average estimates are 0.16 and 2.16 standard errors from zero). We do not find the expected positive signs on EFWAMB in the short-term debt regressions for neither investment-grade nor speculative-grade firms. Perhaps the reason is that firms with public credit access are closely watched by the market and therefore have less under-investment problems. We leave further investigation for future research.

3.4.5. Debt financing points

Given that the relevance of economic forces could vary with firms' financing cycles, several papers (e.g. Hovakimian et al. (2001), Hovakimian et al. (2004), Hovakimian (2004), Leary and Roberts (2005), Hovakimian (2006), and Strebulaev (2007)) highlight the importance of accounting for various financing points. For example, Hovakimian (2004, 2006) shows that corporate financing behaviors and the effects of traditional leverage determinants vary greatly between passive firms; i.e., firms that do not issue or repurchase securities, and active firms; i.e., firms that make significant changes to their capital structure through e.g., equity issue, equity repurchase, debt issue and debt reduction.

There is reason to believe that market mispricing timing plays an even greater role in significant debt financing points. Following Hovakimian et al. (2001) and among others, we define significant debt refinancing point as the year when the value of total debt issued for financial purpose ($dSTD^{'x}{}_t$ plus $dLTD^{'x}{}_t$) represents at least 5% of a firm's book assets

and non-refinancing points otherwise. Then we re-estimate Specification (3.14) for subsamples of firms at significant debt refinancing points and those at non-refinancing points. The purpose is to test whether the coefficients for P/B_{t-1}, $dZscore_{t+1}$ and $STS'x_{t-1}$ differ between these two periods.

Our results (presented in Table 3.7) imply that for large firms, timing equity misevaluation plays a much larger part in determining long-term debt issuance at significant refinancing points than at non-refinancing points. In the one-year maturity cutoff, the average slopes for P/B_{t-1} in the $dLTD'_t$ regression for bigcaps are statistically significant at significant refinancing periods (0.19, 2.85 standard errors from zero) but indistinguishable from zero at non-refinancing periods. The test of difference says that compared with the same type of firms at non-refinancing times, the estimates for equity mispricing timing at significant refinancing points are much higher. One standard deviation increase in P/B_{t-1} leads a big firm to shift towards long-term debt by 0.69% (one-year debt maturity cutoff)/0.99% (three-year debt maturity cutoff) of assets at refinancing points but only by 0.08% (one-year debt maturity cutoff)/0.43% (three-year debt maturity cutoff) of assets at non-refinancing points.

[Insert Table 3.7 about here]

Similarly, firm's attempt to time credit misevaluation also appears more eminent at large refinancing moments, especially for micro and big caps. The average difference of long-term debt issuance between refinancing and non-refinancing periods in response to a one standard deviation decrease in firms' future credit quality represents 4.41% of a micro firm's assets and 1.09% of a big firm's assets in the one-year maturity cutoff. This divergent pattern in the three-year maturity cutoff is less clear-cut in statistical terms.

In addition to the lagged price-to-book ratio and the subsequent change in Altman's Z-Score, the other variable in which we show special interest is the lagged short-term debt surplus (STS'^{x}_{t-1}). Prior research conjectures that a typical firm uses the industry debt maturity level as a baseline to set its own debt maturity policy. In case of deviation, it would actively adjust its debt maturity for the purpose of getting closer to the industry level (e.g. Fama and French (2012)). The incentive of exploiting market mispricing prompts firms to switch between short and long-term debt, implying the secondary role of herding (e.g. Graham and Harvey (2001), Baker and Wurgler (2002)). As it is not clear which one of the two economic forces is more responsible for the short-term versus long-term debt issuance choice, it would be interesting to consider different financing moments and investigate the relevance of the timing and the herding effects.

In line with the debt maturity herding argument, estimates for STS'^{x}_{t-1} are in positive signs in long-term debt regressions and negative in short-term debt regressions. Fama and French (2012) show that debt maturity herding behavior is more prevalent in micro and small caps. Our analyses demonstrate that although there is evidence in support of the herding behavior in general terms, the pattern varies according to the refinancing cycles. Different from micro and small caps, the significance of STS'^{1}_{t-1}'s estimates for big caps at refinancing times becomes less important in both statistical and economic terms. For example, in the one-year maturity cutoff, the average slopes on STS'^{1}_{t-1} in the $dLTD'^{1}_{t}$ regressions are 7.97 (with 10.99 standard error from zero) during non-refinancing periods while reduced by nearly half to 4.14 (with 1.89 standard error from zero) during refinancing periods. By sharp contrast, the impact of equity misevaluation timing is more important for big caps at large refinancing times. The average PTB_{t-1} slopes in Panel A are

0.01, 0.05, 0.02 (for micro, small, big caps respectively) at non-refinancing periods and 0.15, 0.15, 0.19 (for micro, small, big caps respectively) at refinancing periods.

The test of difference shows that for big caps, the estimates for P/B_{t-1} and STS'^{1}_{t-1} at the significant refinancing periods differ fundamentally from the estimates at the non-refinancing periods. Basically, the herding effect lessens during the significant refinancing points for big stocks and the misevaluation timing effect enhances instead. In sum, it indicates that at significant refinancing moments, big firms place more emphasis on timing market mispricing while micro firms are sensitive to herding industry peers' debt maturity.

3.4.6. Robustness checks

In this section, we consider several robustness checks[35].

First, miscellaneous operating liabilities may not be the free rider. They are probably just the consequence of responding to varying transaction needs, e.g., growing sales, or simply the result of complying with industry practice. Table 3.8 reports the estimates for P/B_{t-1}, STS'^{x}_{t-1}, $dZ\text{-}Score_{t+1}$ and $dSale_t$ (sales growth) from estimating Specification (3.14), controlling annual sales growth and industry fixed effects.

[Insert Table 3.8 about here]

Truly, $dSale_t$ yields negative signs in the $dSTD'^{x}_{t}$ and the $dLTD'^{x}_{t}$ regressions and positive signs in the regression of $dMiscL_t$, consistent with the idea that operating liability issuance is closely associated with firms' production and sales. Yet comparing the estimates for P/B_{t-1} and $dZ\text{-}Score_{t+1}$ to those in the Panel A of Table 3.6 suggests that considering the

[35] We sincerely thank Patrick Navatte to guide us through these related issues.

impact of a firm's operating activity and its business environment does not alter the impact of equity and credit mispricing timings on long-term versus short-term versus operating debt choices. In particular, evidence that larger firms issue transitory miscellaneous operating debts prior to credit quality enhancement remains robust.

This leads us to consider whether operating liabilities act more like short-term debt with respect to the timing behaviors. We next re-estimate net short-term debt issuance by classifying $dMiscL_t$ into $dSTD'^{x}_t$ and run a system of two complementary regressions for adjusted short-term debt issuance ($dSTD'_{xt}$ plus $dMiscL_t$) and long-term debt issuance ($dLTD'^{x}_t$). Same explanatory variables as in Specification (3.14) are adopted. This specification presents fairly robust findings in terms of credit and equity misevaluation timing. The estimates for P/B_{t-1} and $dZ\text{-}Score_{t+1}$ in the $dLTD'^{x}_t$ regression closely resemble those in the Panel A of Table 3.6. The $dSTD'^{x}_t$ regression yields negative signs for P/B_{t-1} and positive signs for $dZ\text{-}Score_{t+1}$, which validates the timing effects and the transitory role of operating liabilities.

[Insert Table 3.9 about here]

The timing pattern seems dependent of market conditions. Figure 3.2 plots the year-by-year estimates for P/B_{t-1} in the $dLTD'^{x}_t$ regression for Specification (3.14). The black lines, plotted on the left axis (the short dashed line for micro caps, the long dashed line for small caps and the solid line for big caps), are yearly estimates for P/B_{t-1}. The red solid line, plotted on the right axis, is the yield curve, i.e., the term structure of interest rate.

[Insert Figure 3.2 about here]

Overall, this robustness check demonstrates that the equity timing pattern moves from trough to peak in the opposite direction to the yield curve. Economists believe that the yield curve is a good indicator for the health of the economy. An upward sloping yield curve implies a loose economy, whereas a downward sloping curve implies a tight economy. An inverted yield curve is usually followed by an economic recession. The revealed pattern appears that equity timing activities are more popular in expansions than in contractions. Studying how economic states influence firms' debt maturity timing activities deserves further justification. We leave the question open for future research.

So far, our discussion has been focused on firms with various scales and we find that large scale firms exhibit distinct behaviors in terms of debt maturity market misevaluation timing and industry herding. A strand of literature has highlighted the role of financial constraints in affecting firms' ability and their manner to raise fund. Financially constrained small firms who have limited credit access shall face more difficulties in raising funds (e.g. Faulkender and Petersen (2006)). Therefore, it would be interesting to know whether the previously found results are mainly driven by financial constraints of firms.

We refer to two types of constraints, i.e. financial constraint and credit access constraint. Specifically, we rerun Specification (3.14) and present separate results in Panel A, Table 3.10 for financially constrained, unconstrained and flexible firms[36], and in Panel B for firms without public credit access and firms with public credit access[37].

[36] Financially constrained firms are those with Altman's Z-score below the 30th percentile in a given year. Financially unconstrained firms are those with Altman's Z-score between the 30th and the 70th percentile. Financially flexible firms are those with Altman's Z-score above the 70th percentile.

[37] A firm is defined as constrained to public credit if no credit rating is assigned by Standard & Poor's in a given year. A firm is defined as unconstrained to public credit if Standard & Poor's has assigned it (a) credit rating(s) in a given year.

[Insert Table 3.10 about here]

Our results indicate that financially unconstrained firms with adequate market access exploit temporary market mispricing to a larger extent, similar to previous findings for big firms. In comparison, financially constrained firms with limited credit access do not seem to engage in market mispricing timing activities, neither credit-type nor equity-type. Big firms who have access to public credits are more likely to issue long-term financial debts when their securities are over-evaluated. Yet, timing evidence drawn from the financial constraint classification using Altman's Z-score is relatively weaker. For financially flexible firms, the estimates for P/B_{t-1} in the $dLTD'x_t$ regression are less than 2 standard errors from zero but are still positive as expected. Overall, the revealed pattern suggests that firms are heterogeneous in timing market misevaluation and that firm size and credit access play an essential role in driving timing behaviors.

Other robustness analyses, unreported for brevity, incorporate industry peers' weighted average P/B_{t-1} as a proxy for the evaluation of the industry's growth options, remove $dMiscL_t$ to the right hand of the cash flow constraints and next run pairs of regression, employ alternative cutoffs to define debt maturity (two-year and four-year) and alternative cutting points to describe debt refinancing points (3% and 7% of total book or market assets), control extreme short-term debt users, undo variable trimming, and use various regression specifications. On the whole, these robustness tests show no violations of our main findings. Firms tend to shift towards long-term debts when the market wrongly overvalues their stocks or (and) creditworthiness.

3.5. Conclusion

Firm's financing, investment and dividend payment decisions are simultaneously determined, as well as leverage and debt maturity decisions. Most previous studies that evaluate corporate financing decisions in isolation fail to capture the real intentions of firms, for instance, in timing favorable market conditions. On this ground, Fama and French (2012) propose a system of two complementary regressions to investigate the split of financing between short-term and long-term liabilities, imposing cash flow constraint. Although instructive, their research does not distinguish financial debts from miscellaneous operating debts. Neither do they take into account the natural retirement of maturing debts. Moreover, they have devoted themselves to the commonly used market timing proxy, i.e. the price-to-book ratio, to interpret the impact of market conditions in determining capital structure choices of firms. However, it's worthwhile to note that the price-to-book ratio measures not only the mispricing component of stock evaluation but the rational component of growth options as well. Ignoring this would lead to obscured effect as market timing and agency models suggest opposite predictions on the price-to-book ratio in terms of corporate debt maturity decisions. Indeed, Fama and French (2012) themselves acknowledge that "the relation between security issues and P/B does not in itself allow us to distinguish among market conditions models", i.e., market timing models reliant on irrational pricing and rational managers and others reliant on rational pricing and irrational managers.

Aimed at addressing the empirical question of whether timing temporary mispricing drives debt maturity decisions of firms, this paper makes several adjustments to Fama and French's (2012) specification. First, we propose to run a system of three complementary regressions for the split of "net" financing between short-, long-term

debts, and miscellaneous operating liabilities, taking into account the naturally occurring debt retirement. Second, we make distinctions between growth options and misevaluation by introducing simultaneously firms' historical, current, and future stock valuations. Third, we expand the model to explicitly account for the effect of credit misevaluation.

Notably, adoption of the above refinements leads to sharper estimates for the market mispricing timing effect. Specifically, replicating Fama and French (2012) yields no evidence that firms take advantage of favorable equity market conditions to allocate more debt fund to long-term. The timing pattern begins to emerge after we discriminate between debts arising in financing activities and liabilities arising in operations. Distinguishing growth options from misevaluations yields even more enhanced effect of market mispricing timing. It seems that large firms tend to issue debts at the long end of the maturity spectrum when their stocks are temporarily priced high due to valuation errors. Additionally, there is evidence that firms issue long-term debts when expecting creditworthiness downgrade and issue miscellaneous operating liabilities when expecting creditworthiness upgrade, perhaps for temporary use. Allowing for distinct financing behaviors of firms between refinancing and non-refinancing points, we find that although active herding towards the industry debt maturity level is widespread, the market timing incentive tends to dominate over the herding motive during significant debt refinancing periods for big firms.

As a whole, our empirical results are consistent with the market timing hypothesis of debt maturity choices: when securities of firms are valuated high, firms who choose to issue debts wish to issue more over-valuated debt devices, that is, long-term debts. However, the pattern varies among firms of small and big sizes and firms with limited and adequate

credit access. Big firms with sufficient credit access participate more in debt maturity timing activities and they exploit temporary market mispricing to a larger extent during periods of raising large debt funds.

Timing decisions have to been made by managers. An interesting topic is to study how corporate governance features affect the timing pattern of big firms. A growing literature examines how the design of executive compensation influences managers' risk preference. For instance, Knopf et al. (2002), Coles et al. (2006) and Brockman et al. (2010) conclude that managers' appetites for risk are closely associated with their compensation packages' sensitivity to stock prices and stock return volatilities. It implies a potential link between the design of managers' compensation packages and the market timing behaviors. We leave this topic open for future research.

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Table 3. 1 Variable definitions

Variables	Abbreviati	Measurement
Change in Assets	dA_t	Change in total assets during fiscal year t.
Shares Issued	dS_t	Change in common equity plus dividends minus earnings, during fiscal year t.
Change in Short- term Debt	$dSTD_t$	Change in current liabilities during fiscal year t.
	$dSTD'^{x}{}_t$	Net short-term debt issuance, during fiscal year t. The superscript ^{x} denotes the maturity cutoff.
Change in Long-term Debt	$dLTD_t$	Change in total liabilities minus change in current liabilities, during fiscal year t. Change in total liabilities is change in asset less change in common equity.
	$dLTD'^{x}{}_t$	Net long-term debt issuance, during fiscal year t. The superscript ^{x} denotes the maturity cutoff.
Miscellaneous Liabilities	$dMiscL_t$	Change in total liabilities minus change in total debts, during fiscal year t. Total debt is debt in current liabilities plus debt in total long-term liabilities.
Long-term Debt Payable	$DD1_{t-1}$	Long-term debt due in one year at the end of fiscal year t-1, i.e. at the beginning of fiscal year t.
Dividends	D_t	Dividend per share at ex-date at the end of fiscal year t, multiplied by common shares outstanding at the end of calendar year t.
Earnings	Y_t	Income before extraordinary items available for common stockholders, plus extraordinary items and discontinued operations, during fiscal year t.
Positive Earnings	$NegY_t$	Earnings during fiscal year t if Y_t is negative.
Negative Earnings	$PosY_t$	Earnings during fiscal year t if Y_t is positive.
No Dividends	NoD_t	A dummy variable which takes a value of one if a firm does not pay dividends during fiscal year t and 0 otherwise.
Market Capitalization	MC_t	The log of the common shares outstanding multiplied by CRSP closing price in June of calendar t.
Negative Book Equity	$NegB_{t-1}$	A dummy variable which takes a value of one if a firm's book equity is negative for the fiscal year ending in calendar year t-1 and 0 otherwise.
Lagged Price-to-Book ratio	P/B_{t-1}	Common shares outstanding multiplied by CRSP closing price at the end of calendar year t-1, divided by book equity at the end of fiscal year t-1. Book equity is total stockholders' equity plus deferred taxes and investment tax credit if available, minus postretirement benefits asset if available, minus preferred stock at carrying value if available, or preferred stock redemption value, or preferred stock liquidating value.
Past External Finance Weighted Average Market –to-Book	$EFWAMB_t$	Baker and Wurgler (2002)'s external finance weighted average market–to-book ratio. $\mathrm{EFWAMB_t} = \sum_{s=0}^{t-1} \frac{e_s+d_s}{\sum_{r=0}^{t-1} e_r+d_r} \times (\mathrm{MTB})_s$, where e and d denotes net equity and net debt issued respectively, MTB denotes the market-to-book ratio. MTB = (Book Value of Total Assets – Book Value of Common Equity + Market Value of Common Equity) ÷ Book Value of Total Assets.
Future External Finance Weighted Average Market –to-Book	$FEFWAMB_t$	Hovakimian (2006)'s future external finance weighted average market–to-book ratio. $\mathrm{FEFWAMB_t} = \sum_{s=t+1}^{t+n} \frac{e_s+d_s}{\sum_{r=t+1}^{t+n} e_r+d_r} \times (\mathrm{MTB})_s$, where e and d denotes net equity and net debt issued respectively, MTB denotes the market–to-book ratio. MTB = (Book Value of Total Assets – Book Value of Common Equity + Market Value of Common Equity) ÷ Book Value of Total Assets.

Table 3.1 (*Continued*)

Variables	Abbreviation	Measurement
Subsequent Change in Altman's Z-score	$dZ\text{-}Score_{t+1}$	Change in Altman's Z-Score of a firm between fiscal year t and t+1. Z-Score = 1.2×T1+1.4×T2+3.3×T3+0.6×T4+1.0×T5, where T1 = Working Capital / Total Assets; T2= Retained Earning/ Total Assets; T3= EBIT / Total Assets; T4= Market Value of Equity / Book Value of Total Liabilities; T5= Total Sales / Total Assets.
Subsequent Change in Credit Rating	$dRating_{t+1}$	Change in Standard and Poor's domestic long-term issuer rating between year t and year t+1. We assign numerical values to Standard and Poor's monthly domestic long-term issuer ratings. AAA equals 21, AA+ equals 20, AA equals 19, AA- equals 18, A+ equals 17, A equals 16, A- equals 15, BBB+ equals 14, BBB equals 13, BBB- equals 12, BB+ equals 11, BB equals 10, BB- equals 9, B+ equals 8, B equals 7, B- equals 6, CCC+ equals 5, CCC equals 4, CCC- equals 3, CC equals 2, SD (selectively default) equals 1, and D (default) equals 0. Monthly credit rating values are then averaged over a firm's fiscal year period to construct yearly ratings.
Term Structure of Interest Rates	$Term^{1(3)}_{t+1}$	10-year U.S. treasury bond yield minus 1(3)-year U.S. treasury bill yield, measured at the end of fiscal year t+1.
	$Term^{1(3)}_{t-1}$	10-year U.S. treasury bond yield minus 1(3)-year U.S. treasury bill yield, measured at the end of fiscal year t-1.
Lagged Short-term Debt Surplus	STS_{t-1}	The difference between the short-term debt ratio of a firm and its industry short-term debt ratio in fiscal year t-1. Short-term debt ratio (STD) is current liabilities divided by total liabilities. Peer firms' short-term debt ratio is the weighted average short-term debt ratio by Fama and French 10 Industry, with each firm weighted by its total liabilities.
	STS'^{x}_{t-1}	The difference between the short-term debt ratio of a firm and its peer firms' short-term debt ratio in fiscal year t-1. Short-term debt is defined using various maturity cutoffs. ^{x} denotes the maturity cutoff. In the one-year maturity cutoff, short-term debt is short/current long-term debt minus current portion of long-term debt. In the three-year maturity cutoff, short-term debt is short/current long-term debt plus debt due in two years plus debt due in three years. Short-term debt ratio (STD'^{x}) is short-term debt (as defined in the above manner) divided by total liabilities. Peer firms' short-term debt ratio is the weighted average short-term debt ratio by Fama and French 10 Industry, with each firm weighted by its total liabilities.

* dA_t , dS_t ,$dSTD_t$, $dSTD'^{x}_t$, $dLTD_t$, $dLTD'^{x}_t$, $dMiscL_t$, $DD1_{t-1,}$ D_t, Y_t , $NegY_t$ and $PosY_t$,are scale by total assets at the end of fiscal year t and multiplied by 100. $PosY_t$, D_t, P/B_{t-1} are trimmed at the 99.5% of the distribution, and dA_t, dS_t and $NegY_t$ are trimmed at the 0.5% of the distribution.

Table 3. 2 Descriptive statistics

This table presents summary statistics (Mean and Standard Deviation (Std Dev)) for the split of financing between short-term and long-term liabilities (see Fama-French (2012)), change in assets, positive earnings, negative earnings, shares issued, dividends, no dividends dummy, market capitalization, negative book equity dummy, lagged price-to-book ratio, and lagged short-term debt surplus with respect to industry's weighted average short-term debt ratio. All the variables are defined in Table 3.1. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. Same statistics are reported for three datasets: (1) firms with complete information on the regression variables specified in Fama-French (2012) (in Panel A); (2) firms with complete information on the regression variables specified in Fama-French (2012) and Compustat items of total long-term debt, debt in current liabilities and debts due in the first, second, third, fourth and fifth year(in Panel B); (3) firms with complete information on the regression variables specified in Fama-French (2012) and Compustat items of total long-term debt, debt in current liabilities and debts due in the first, second, third, fourth and fifth year, and S&P's domestic long-term issuer rating(in Panel C). For the first and the second datasets, results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents: 2086 micro firms, 837 small firms and 1005 big firms for the dataset (1); 1664 micro firms, 683 small firms and 798 big firms for the dataset (2); 385 speculative-grade firms and 237 investment-grade firms for the dataset (3).

Panel A: Summary statistics for the dataset (1)													
		Firms	$dSTD_t$	$dLTD_t$	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS_{t-1}
Micro	Mean	2086	1.31	0.60	-1.40	-15.06	3.23	8.89	0.36	0.85	3.29	0.04	2.54	0.19
	Std Dev		18.67	18.02	35.13	31.57	5.04	25.09	1.46	0.36	1.26	0.19	4.02	0.27
Small	Mean	837	2.30	2.34	9.59	-5.03	5.11	5.79	0.92	0.61	5.71	0.02	2.90	0.12
	Std Dev		9.78	13.12	23.80	16.66	5.39	17.53	2.11	0.49	0.70	0.14	3.62	0.26
Big	Mean	1005	2.14	2.79	9.93	-1.57	6.47	1.90	1.79	0.31	7.84	0.01	3.22	0.08
	Std Dev		7.15	10.44	19.53	10.75	5.48	11.94	2.41	0.46	1.30	0.12	3.99	0.22
Panel B: Summary statistics for the dataset (2)														
		Firms	$dSTD_t$	$dLTD_t$	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS_{t-1}
Micro	Mean	1664	1.28	0.48	-1.16	-14.00	3.34	8.12	0.39	0.83	3.31	0.03	2.47	0.20
	Std Dev		17.39	16.40	34.01	30.42	5.06	23.84	1.48	0.37	1.26	0.17	3.90	0.27
Small	Mean	683	2.22	2.29	9.62	-4.45	5.23	5.28	0.95	0.59	5.71	0.02	2.85	0.13
	Std Dev		8.85	12.21	22.58	15.34	5.38	16.64	2.15	0.49	0.70	0.13	3.52	0.26
Big	Mean	798	2.04	2.67	9.69	-1.43	6.41	1.75	1.75	0.30	7.80	0.01	3.08	0.08
	Std Dev		6.98	10.18	18.88	10.45	5.39	11.68	2.29	0.46	1.29	0.11	3.79	0.22
Panel C: Summary statistics for the dataset (3)														
		Firms	$dSTD_t$	$dLTD_t$	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS_{t-1}
Speculative	Mean	385	0.93	2.42	5.02	-3.66	3.17	2.64	0.49	0.70	6.36	0.07	2.27	-0.08
	Std Dev		10.54	15.39	23.66	12.24	4.16	9.60	1.87	0.46	1.48	0.25	3.33	0.18
Investment	Mean	237	1.38	2.65	6.54	-0.51	5.55	-0.40	2.13	0.10	8.23	0.00	2.41	0.05
	Std Dev		6.48	8.21	13.64	3.26	4.28	6.09	1.88	0.30	1.52	0.05	2.35	0.17

Table 3. 3 Timing and debt maturity decisions of firms: the replication of Fama-French (2012)

This table presents the Fama-Macbeth regression results for the split of financing between short-term and long-term liabilities, replicating Fama-French (2012). Accordingly, a system of two equations is estimated as follows,

$$\begin{cases} dSTD_t = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} + b_{10} STS_{t-1} + e_t \\ dLTD_t = -a + (1-b_1) dA_t - (1+b_2) NegY_t - (1+b_3) PosY_t - (1+b_4) dS_t + (1-b_5) D_t - b_6 NoD_t - b_7 MC_t - b_8 NegB_{t-1} - b_9 P/B_{t-1} - b_{10} STS_{t-1} - e_t \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. Regressions are estimated for two datasets: (1) firms with complete information on the regression variables specified in Fama-French (2012) (in Panel A); (2) firms with complete information on the regression variables specified in Fama-French (2012) and Compustat items of total long-term debt, debt in current liabilities and debts due in the first, second, third, fourth and fifth year (in Panel B). Results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents: 2086 micro firms, 837 small firms and 1005 big firms for the dataset (1); 1664 micro firms, 683 small firms and 798 big firms for the dataset (2). ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: Regression results for the dataset (1)

			Intercept	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS_{t-1}	R^2
$dSTD_t$	Micro	Coef	2.41***	0.53***	-0.55***	-0.41***	-0.50***	0.61***	0.75***	-0.35***	-3.30**	-0.06	-11.32***	0.46
		t-Stat	6.27	34.24	-23.30	-18.85	-23.89	20.42	7.88	-4.42	-2.73	-1.70	-12.77	
	Small	Coef	0.66	0.36***	-0.42***	-0.18***	-0.32***	0.18***	-0.03	-0.10	-0.56	-0.05	-2.92***	0.37
		t-Stat	1.05	24.84	-10.54	-8.09	-16.85	5.39	-0.16	-0.86	-0.58	-1.20	-5.30	
	Big	Coef	-1.07***	0.32***	-0.33***	-0.18***	-0.27***	0.17***	0.15	0.10***	1.53**	0.07**	-0.94	0.39
		t-Stat	-5.70	39.23	-10.53	-13.76	-22.20	8.59	1.55	3.75	2.10	2.23	-1.43	
$dLTD_t$	Micro	Coef	-2.41***	0.47***	-0.45***	-0.59***	-0.50***	0.39***	-0.75***	0.35***	3.30**	0.06	11.32***	0.43
		t-Stat	-6.27	30.39	-19.04	-27.04	-23.79	13.01	-7.88	4.42	2.73	1.70	12.77	
	Small	Coef	-0.66	0.64***	-0.58***	-0.82***	-0.68***	0.82***	0.03	0.10	0.56	0.05	2.92***	0.65
		t-Stat	-1.05	44.31	-14.72	-37.43	-35.13	25.13	0.16	0.86	0.58	1.20	5.30	
	Big	Coef	1.07***	0.68***	-0.67***	-0.82***	-0.73***	0.83***	-0.15	-0.10***	-1.53**	-0.07**	0.94	0.72
		t-Stat	5.70	82.84	-21.88	-61.11	-60.50	40.86	-1.55	-3.75	-2.10	-2.23	1.43	

Table 3.3 (*Continued*)

Panel B: Regression results for the dataset (2)

			Intercept	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS_{t-1}	R^2
$dSTD_t$	Micro	Coef	2.16***	0.54***	-0.57***	-0.44***	-0.52***	0.65***	0.71***	-0.35***	-1.69	-0.03	-9.69***	0.48
		t-Stat	5.39	29.20	-21.96	-19.34	-20.74	17.50	7.33	-3.97	-1.29	-0.82	-12.12	
	Small	Coef	0.67	0.35***	-0.41***	-0.17***	-0.32***	0.17***	-0.20	-0.09	-0.90	-0.04	-2.03***	0.39
		t-Stat	0.82	26.93	-11.19	-9.17	-19.02	5.13	-1.20	-0.64	-0.60	-1.36	-4.05	
	Big	Coef	-1.03***	0.32***	-0.35***	-0.18***	-0.27***	0.15***	0.07	0.11***	1.47*	0.05	-0.82	0.39
		t-Stat	-4.72	34.84	-5.83	-11.51	-17.84	6.56	0.63	3.12	1.86	0.93	-1.40	
$dLTD_t$	Micro	Coef	-2.16***	0.46***	-0.43***	-0.56***	-0.48***	0.35***	-0.71***	0.35***	1.69	0.03	9.69***	0.43
		t-Stat	-5.39	24.40	-16.79	-24.77	-18.90	9.62	-7.33	3.97	1.29	0.82	12.12	
	Small	Coef	-0.67	0.65***	-0.59***	-0.83***	-0.68***	0.83***	0.20	0.09	0.90	0.04	2.03***	0.67
		t-Stat	-0.82	49.46	-15.80	-43.36	-41.34	25.25	1.20	0.64	0.60	1.36	4.05	
	Big	Coef	1.03***	0.68***	-0.65***	-0.82***	-0.73***	0.85***	-0.07	-0.11***	-1.47*	-0.05	0.82	0.72
		t-Stat	4.72	73.05	-10.61	-52.47	-48.74	36.12	-0.63	-3.12	-1.86	-0.93	1.40	

Table 3. 4 Timing and debt maturity decisions of firms: distinguishing debts arising in financing activities from liabilities arising in operating activities

This table presents the Fama-Macbeth regression results for the split of financing between short-term financial debt, long-term financial debt and miscellaneous operating liabilities. Accordingly, a system of three equations is estimated as follows,

$$\begin{cases} dSTD'^{x}_t=a+b_1dA_t+b_2NegY_t+b_3PosY_t+b_4dS_t+b_5D_t+b_6NoD_t+b_7MC_t+b_8NegB_{t-1}+b_9P/B_{t-1}+ b_{10}STS'^{x}_{t-1}+b_{11}DD1_{t-1}+e_t \\ dLTD'^{x}_t=c+d_1dA_t+d_2NegY_t+d_3PosY_t+d_4dS_t+d_5D_t+d_6NoD_t+d_7MC_t+d_8NegB_{t-1}+d_9P/B_{t-1}+ d_{10}STS'^{x}_{t-1}+d_{11}DD1_{t-1}+\xi_t \\ dMiscL_t =-(a+c)+(1-b_1- d_1)dA_t-(1+b_2+ d_2)NegY_t-(1+b_3 +d_3)PosY_t-(1+b_4+d_4)dS_t+(1-b_5-d_5)D_t-(b_6+ d_6)NoD_t-(b_7+ d_7)MC_t-(b_8+ d_8)NegB_{t-1}-(b_9+ d_9)P/B_{t-1}- (b_{10}+ d_{10})STS'^{x}_{t-1} \\ +(1-b_{11}-d_{11}) DD1_{t-1}-(e_t+\xi_t) \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. Results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: One-Year Debt Maturity Cutoff

			Intercept	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS'^{1}_{t-1}	$DD1_{t-1}$	R^2
	Micro	Coef	-1.06**	0.22***	-0.25***	-0.28***	-0.23***	0.40***	0.09	-0.29***	-4.21	0.02	-12.69***	0.43***	0.21
		t-Stat	-2.26	11.33	-11.64	-9.44	-11.07	6.53	0.49	-5.19	-1.23	0.39	-10.50	16.25	
$dSTD'^{1}_t$	Small	Coef	-2.18***	0.12***	-0.19***	-0.11***	-0.14***	0.19***	0.01	0.14	-1.88	-0.02	-7.92***	0.20***	0.15
		t-Stat	-2.98	9.38	-5.62	-7.32	-10.51	4.00	0.04	1.07	-1.14	-0.87	-10.62	7.01	
	Big	Coef	-2.58***	0.12***	-0.17***	-0.12***	-0.13***	0.20***	-0.13	0.17***	-1.38	-0.03	-8.28***	0.23***	0.16
		t-Stat	-11.30	16.75	-3.37	-6.03	-12.55	4.69	-1.27	5.37	-1.12	-0.79	-5.88	6.12	
	Micro	Coef	3.15***	0.29***	-0.23***	-0.41***	-0.27***	0.15***	-0.32*	-0.04	4.88	0.01	6.11***	0.32***	0.21
		t-Stat	7.91	17.87	-14.02	-12.49	-15.80	2.80	-2.04	-0.70	1.41	0.30	6.67	10.78	
$dLTD'^{1}_t$	Small	Coef	2.11***	0.50***	-0.45***	-0.67***	-0.52***	0.59***	0.11	-0.12	4.30**	0.01	6.92***	0.65***	0.50
		t-Stat	3.88	27.74	-14.03	-20.56	-25.84	18.20	0.54	-1.25	2.45	0.40	11.83	22.64	
	Big	Coef	3.34***	0.51***	-0.38***	-0.71***	-0.57***	0.64***	0.22	-0.28***	2.52	0.08	7.37***	0.61***	0.55
		t-Stat	8.03	44.41	-5.89	-30.80	-29.77	26.07	1.63	-4.42	1.20	1.53	7.64	14.74	
	Micro	Coef	-2.10***	0.49***	-0.52***	-0.31***	-0.50***	0.45***	0.23***	0.33***	-0.67	-0.03	6.58***	0.24***	0.55
		t-Stat	-9.96	21.01	-32.63	-7.13	-24.16	12.64	3.28	6.12	-1.05	-1.15	13.49	17.33	
$dMiscL_t$	Small	Coef	0.07	0.38***	-0.36***	-0.22***	-0.34***	0.22***	-0.12	-0.02	-2.42***	0.01	1.00**	0.15***	0.50
		t-Stat	0.09	16.42	-13.47	-5.74	-13.41	5.21	-1.04	-0.17	-3.10	0.29	2.71	5.22	
	Big	Coef	-0.75*	0.37***	-0.45***	-0.17***	-0.30***	0.16***	-0.10	0.10**	-1.14	-0.06	0.91	0.16***	0.54
		t-Stat	-2.02	28.53	-9.99	-4.96	-13.93	4.13	-0.63	2.67	-0.82	-1.30	1.20	8.97	

Table 3.4 (*Continued*)

Panel B: Three-Year Debt Maturity Cutoff

			Intercept	dA_t	$NegY_t$	$PosY_t$	dS_t	D_t	NoD_t	MC_t	$NegB_{t-1}$	P/B_{t-1}	STS'^3_{t-1}	$DD1_{t-1}$	R^2
	Micro	Coef	2.82***	0.34***	-0.33***	-0.50***	-0.34***	0.35***	0.37	-0.86***	-2.44	0.16**	-15.72***	0.77***	0.39
		t-Stat	4.33	17.54	-19.97	-9.02	-16.30	5.81	1.56	-8.24	-1.56	2.32	-6.05	27.90	
$dSTD'^3_t$	Small	Coef	0.87	0.24***	-0.29***	-0.23***	-0.24***	0.34***	0.00	-0.50**	-4.22**	-0.05**	-10.92***	0.64***	0.26
		t-Stat	0.85	14.62	-8.67	-10.10	-12.11	7.37	-0.02	-2.68	-2.72	-2.06	-10.62	12.82	
	Big	Coef	-3.70***	0.23***	-0.25***	-0.22***	-0.24***	0.32***	-0.38***	0.23***	-4.76***	-0.05	-9.82***	0.61***	0.27
		t-Stat	-8.91	19.82	-5.47	-11.41	-16.19	6.71	-3.71	6.22	-4.67	-1.69	-9.79	11.12	
	Micro	Coef	-0.50	0.17***	-0.15***	-0.19***	-0.16***	0.16***	-0.64**	0.56***	2.80	-0.14*	11.11***	0.05	0.20
		t-Stat	-0.95	12.63	-9.75	-8.30	-10.95	3.04	-2.56	5.08	1.64	-1.75	4.07	1.47	
$dLTD'^3_t$	Small	Coef	-0.88	0.38***	-0.34***	-0.56***	-0.42***	0.44***	0.11	0.51***	6.61***	0.04*	9.93***	0.23***	0.39
		t-Stat	-1.29	17.69	-10.84	-15.06	-16.46	11.18	0.60	4.11	4.70	1.72	10.67	5.58	
	Big	Coef	4.52***	0.40***	-0.30***	-0.61***	-0.47***	0.51***	0.50***	-0.33***	5.92***	0.11**	10.04***	0.22***	0.45
		t-Stat	19.17	28.95	-5.05	-24.10	-19.19	17.12	3.49	-9.08	3.64	2.51	11.74	3.90	
	Micro	Coef	-2.32***	0.49***	-0.51***	-0.31***	-0.50***	0.49***	0.27***	0.31***	-0.36	-0.01	4.61***	0.18***	0.55
		t-Stat	-12.00	20.57	-31.85	-6.94	-23.80	13.84	3.83	5.99	-0.57	-0.52	12.28	13.29	
$dMiscL_t$	Small	Coef	0.01	0.38***	-0.36***	-0.22***	-0.34***	0.22***	-0.11	-0.02	-2.39***	0.01	0.99***	0.13***	0.50
		t-Stat	0.01	16.35	-13.48	-5.74	-13.43	5.24	-0.92	-0.12	-3.12	0.39	3.17	4.67	
	Big	Coef	-0.82**	0.37***	-0.45***	-0.17***	-0.30***	0.16***	-0.11	0.11***	-1.16	-0.06	-0.22***	0.17***	0.54
		t-Stat	-2.22	28.62	-9.97	-4.96	-13.89	4.42	-0.73	2.88	-0.84	-1.33	-0.57	7.63	

Table 3. 5 Timing and debt maturity decisions of firms: distinguishing misevaluation from growth options

This table presents the effect of equity misevaluation on debt maturity decisions of firms, distinguishing misevaluation from growth options. Fama-Macbeth regression results are presented for the split of financing between short-term financial debt, long-term financial debt and miscellaneous operating liabilities. In order to distinguish equity misevaluation from growth options, proxies for firms' growth options ($EFWAMB_t$ in Model 1, $FEFWAMB_t$ in Model 2, $EFWAMB_t$ together with $FEFWAMB_t$ in Model 3) are incorporated. A system of three equations is estimated as follows,

$$\begin{cases} dSTD'^{x}_t = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} + b_{10} STS'^{x}_{t-1} + b_{11} DD1_{t-1} + \beta\ Growth\ Options + e_t \\ dLTD'^{x}_t = c + d_1 dA_t + d_2 NegY_t + d_3 PosY_t + d_4 dS_t + d_5 D_t + d_6 NoD_t + d_7 MC_t + d_8 NegB_{t-1} + d_9 P/B_{t-1} + d_{10} STS'^{x}_{t-1} + d_{11} DD1_{t-1} + \lambda\ Growth\ Options + \xi_t \\ dMiscL_t = -(a+c) + (1-b_1-d_1) dA_t - (1+b_2+d_2) NegY_t - (1+b_3+d_3) PosY_t - (1+b_4+d_4) dS_t + (1-b_5-d_5) D_t - (b_6+d_6) NoD_t - (b_7+d_7) MC_t - (b_8+d_8) NegB_{t-1} - (b_9+d_9) P/B_{t-1} - (b_{10}+d_{10}) STS'^{x}_{t-1} \\ +(1-b_{11}-d_{11})\ DD1_{t-1} - (\beta+\lambda) Growth\ Options - (e_t+\xi_t) \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. For brevity, results are only reported for P/B_{t-1}, $EFWAMB_t$ and $FEFWAMB_t$. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. Results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: One-Year Debt Maturity Cutoff

			Model 1			Model 2			Model 3			
			P/B_{t-1}	$EFWAMB_t$	R^2	P/B_{t-1}	$FEFWAMB_t$	R^2	P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	R^2
$dSTD'^{1}_t$	Micro	Coef	-0.05	0.08	0.21	-0.02	0.05	0.21	-0.07	0.08*	0.05	0.20
		t-Stat	-0.65	1.41		-0.49	0.86		-0.90	1.97	0.65	
	Small	Coef	0.00	0.05	0.16	-0.02	-0.02	0.16	-0.02	0.09**	-0.02	0.16
		t-Stat	0.01	1.12		-0.60	-0.62		-0.44	2.38	-0.50	
	Big	Coef	-0.04	0.09*	0.16	-0.04	0.01	0.16	-0.06	0.12**	-0.01	0.16
		t-Stat	-1.08	1.88		-0.98	0.93		-1.55	2.15	-0.36	
$dLTD'^{1}_t$	Micro	Coef	0.12	-0.09	0.21	0.03	-0.16**	0.23	0.14	-0.10**	-0.16*	0.24
		t-Stat	1.36	-1.68		0.54	-2.54		1.60	-2.51	-1.86	
	Small	Coef	0.08**	-0.07	0.51	0.03	-0.02	0.52	0.11***	-0.09	0.00	0.52
		t-Stat	2.30	-1.01		1.06	-0.65		3.27	-1.28	-0.06	
	Big	Coef	0.10**	-0.05	0.55	0.12*	-0.08**	0.57	0.14**	-0.07	-0.05	0.56
		t-Stat	2.22	-1.23		1.91	-2.38		2.60	-1.50	-1.46	
$dMiscL_t$	Micro	Coef	-0.07	0.01	0.55	0.00	0.11***	0.57	-0.07	0.02	0.11***	0.57
		t-Stat	-1.29	0.63		-0.06	5.39		-1.22	1.23	4.45	
	Small	Coef	-0.08**	0.02	0.49	-0.02	0.04	0.50	-0.09*	-0.01	0.02	0.50
		t-Stat	-2.23	0.41		-0.46	0.98		-1.92	-0.15	0.54	
	Big	Coef	-0.06*	-0.04	0.55	-0.08*	0.07**	0.55	-0.08**	-0.06	0.06*	0.56
		t-Stat	-1.89	-0.77		-1.81	2.11		-2.13	-1.17	1.95	

Table 3.5 (*Continued*)

Panel B: Three-Year Debt Maturity Cutoff

			Model 1			Model 2			Model 3			
			P/B_{t-1}	$EFWAMB_t$	R^2	P/B_{t-1}	$FEFWAMB_t$	R^2	P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	R^2
$dSTD'^3_t$	Micro	Coef	0.27	-0.16	0.40	0.14	-0.07	0.39	0.27	-0.14	-0.16*	0.40
		t-Stat	1.62	-1.24		1.62	-1.47		1.43	-1.02	-1.81	
	Small	Coef	-0.04	0.09**	0.28	-0.04	-0.01	0.27	-0.04	0.13***	-0.03	0.28
		t-Stat	-1.05	2.61		-1.62	-0.34		-1.23	3.15	-0.60	
	Big	Coef	-0.09**	0.17**	0.28	-0.05	0.03*	0.28	-0.11**	0.18***	0.02	0.29
		t-Stat	-2.54	2.61		-1.50	1.94		-2.49	3.29	1.12	
$dLTD'^3_t$	Micro	Coef	-0.22	0.13	0.22	-0.15	-0.05	0.22	-0.21	0.10	0.05	0.24
		t-Stat	-1.13	0.95		-1.51	-1.16		-0.98	0.76	0.66	
	Small	Coef	0.12***	-0.12**	0.40	0.05*	-0.03	0.41	0.13***	-0.13*	0.01	0.41
		t-Stat	5.54	-2.09		1.94	-0.78		4.18	-2.00	0.21	
	Big	Coef	0.16***	-0.13***	0.44	0.13**	-0.10***	0.46	0.19***	-0.12***	-0.07**	0.45
		t-Stat	3.90	-3.70		2.70	-3.56		4.10	-3.67	-2.47	
$dMiscL_t$	Micro	Coef	-0.05	0.03	0.55	0.01	0.12***	0.57	-0.06	0.04**	0.11***	0.57
		t-Stat	-0.99	1.52		0.54	5.86		-1.02	2.24	4.87	
	Small	Coef	-0.08**	0.03	0.50	-0.01	0.04	0.50	-0.09*	0.00	0.02	0.50
		t-Stat	-2.16	0.58		-0.34	0.94		-1.86	-0.01	0.47	
	Big	Coef	-0.06*	-0.04	0.55	-0.08*	0.07**	0.55	-0.08**	-0.05	0.06*	0.56
		t-Stat	-1.93	-0.74		-1.85	2.15		-2.19	-1.12	2.00	

Panel C: Variance Inflation Factor (VIF) [38] for P/B_{t-1}, $EFWAMB_t$ and $FEFWAMB_t$

	Model 1		Model 2		Model 3		
	P/B_{t-1}	$EFWAMB_t$	P/B_{t-1}	$FEFWAMB_t$	P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$
Micro	1.36	1.17	1.33	1.40	1.41	1.19	1.12
Small	1.52	1.30	1.54	1.57	1.61	1.32	1.14
Big	1.71	1.44	1.59	1.75	1.81	1.45	1.15

[38] No variance inflation factor is found greater than 3 according to the annual cross-sectional regression results.

Table 3. 6 Timing and debt maturity decisions of firms: equity misevaluation versus credit misevaluation

This table presents the effect of credit misevaluation on debt maturity decisions of firms. Fama-Macbeth regression results are presented for the split of financing between short-term financial debt, long-term financial debt and miscellaneous operating liabilities. To address the credit misevaluation effect, we refer to the subsequent change in Altman's Z-score ($dZ\text{-}Score_{t+1}$ in Panel A) and subsequent change in Standard and Poor's domestic long-term issuer ratings ($dRating_{t+1}$ in Panel B). Proxies for firms' growth options ($EFWAMB_t$ together with $FEFWAMB_t$) are incorporated to distinguish equity misevaluation from growth options. A system of three equations is estimated as follows,

$$\begin{cases} dSTD'^{x}_t = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} + b_{10} STS'^{x}_{t-1} + b_{11} DD1_{t-1} + \beta_1 EFWAMB_t + \beta_2 FEFWAMB_t + \beta_3 Credit\ Misevaluation + e_t \\ dLTD'^{x}_t = c + d_1 dA_t + d_2 NegY_t + d_3 PosY_t + d_4 dS_t + d_5 D_t + d_6 NoD_t + d_7 MC_t + d_8 NegB_{t-1} + d_9 P/B_{t-1} + d_{10} STS'^{x}_{t-1} + d_{11} DD1_{t-1} + \lambda_1 EFWAMB_t + \lambda_2 FEFWAMB_t + \lambda_3\ Credit\ Misevaluation + \xi_t \\ dMiscL_t = -(a+c) + (1-b_1 - d_1) dA_t - (1+b_2 + d_2) NegY_t - (1+b_3 + d_3) PosY_t - (1+b_4 + d_4) dS_t + (1-b_5 - d_5) D_t - (b_6 + d_6) NoD_t - (b_7 + d_7) MC_t - (b_8 + d_8) NegB_{t-1} - (b_9 + d_9) P/B_{t-1} - (b_{10} + d_{10})\ STS'^{x}_{t-1} \\ + (1-b_{11} - d_{11})\ DD1_{t-1} - (\beta_1 + \lambda_1) EFWAMB_t - (\beta_2 + \lambda_2) FEFWAMB_t - (\beta_3 + \lambda_3)\ Credit\ Misevaluation - (e_t + \xi_t) \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. For brevity, results are only reported for P/B_{t-1}, $EFWAMB_t$, $FEFWAMB_t$ and $dZ\text{-}Score_{t+1}$/$dRating_{t+1}$. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. In Panel A, results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms. In Panel B, results are separately presented for speculative-grade firms whose S&P's domestic long-term issuer ratings averaged over fiscal year t-1 are inferior to "BBB-" and investment-grade firms whose S&P's domestic long-term issuer ratings averaged over fiscal year t-1 are superior to "BB+". The average annual sample represents 237 speculative-grade firms and 385 investment-grade firms. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: Credit misevaluation proxied by $dZ\text{-}Score_{t+1}$

			One-Year Debt Maturity Cutoff					Three-year Debt Maturity Cutoff				
			P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	$dZ\text{-}Score_{t+1}$	R^2	P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	$dZ\text{-}Score_{t+1}$	R^2
$dSTD'^{x}_t$	Micro	Coef	-0.07	0.08*	0.07	0.00	0.21	0.35	-0.17	-0.17*	0.00	0.40
		t-Stat	-0.90	1.91	0.76	-0.13		1.37	-1.03	-1.73	0.35	
	Small	Coef	-0.02	0.10**	-0.02	0.01	0.17	-0.04	0.13***	-0.02	-0.01	0.28
		t-Stat	-0.42	2.45	-0.56	0.34		-1.08	3.00	-0.45	-0.57	
	Big	Coef	-0.07*	0.13**	0.00	0.00	0.16	-0.13***	0.18***	0.02	-0.02	0.29
		t-Stat	-1.89	2.25	-0.27	0.11		-2.82	3.30	1.00	-0.82	
$dLTD'^{x}_t$	Micro	Coef	0.14	-0.10**	-0.18*	-0.01	0.24	-0.30	0.13	0.06	-0.01*	0.24
		t-Stat	1.60	-2.49	-1.86	-1.51		-1.05	0.81	0.66	-2.01	
	Small	Coef	0.09**	-0.09	0.01	-0.05*	0.52	0.11***	-0.12*	0.01	-0.04*	0.41
		t-Stat	2.61	-1.28	0.46	-1.73		3.65	-1.94	0.40	-1.94	
	Big	Coef	0.15***	-0.07*	-0.04	-0.08***	0.56	0.20***	-0.13***	-0.06*	-0.06*	0.45
		t-Stat	2.80	-1.95	-1.19	-3.07		4.40	-4.53	-2.04	-1.97	

Table 3.6 (*Continued*)

			One-Year Debt Maturity Cutoff					Three-year Debt Maturity Cutoff				
			P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	$dZ\text{-}Score_{t+1}$	R^2	P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	$dZ\text{-}Score_{t+1}$	R^2
$dMiscL_t$	Micro	Coef	-0.07	0.02	0.10***	0.01	0.57	-0.05	0.04**	0.11***	0.01	0.57
		t-Stat	-1.07	1.18	4.66	1.30		-0.87	2.19	5.01	1.15	
	Small	Coef	-0.07	-0.01	0.01	0.05**	0.50	-0.07	-0.01	0.01	0.05**	0.50
		t-Stat	-1.41	-0.24	0.22	2.70		-1.39	-0.13	0.15	2.66	
	Big	Coef	-0.07*	-0.05	0.04	0.08***	0.56	-0.08*	-0.05	0.05	0.08***	0.56
		t-Stat	-1.98	-1.06	1.54	3.69		-2.04	-1.02	1.56	3.71	

Panel B: Credit misevaluation proxied by $dRating_{t+1}$

			One-Year Debt Maturity Cutoff					Three-year Debt Maturity Cutoff				
			P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	$dRating_{t+1}$	R^2	P/B_{t-1}	$EFWAMB_t$	$FEFWAMB_t$	$dRating_{t+1}$	R^2
$dSTD'x_t$	Speculative	Coef	-0.01	-0.14	0.08	-0.75***	0.21	-0.11*	-0.08	0.02	-0.82***	0.29
		t-Stat	-0.24	-1.53	1.53	-3.29		-1.74	-0.82	0.22	-2.78	
	Investment	Coef	-0.15**	0.02	-0.01	-0.11	0.21	-0.17**	0.04	-0.01	-0.23**	0.33
		t-Stat	-2.54	0.38	-0.70	-1.55		-2.38	0.72	-0.36	-2.42	
$dLTD'x_t$	Speculative	Coef	0.07	0.20	-0.11***	-0.19	0.57	0.16**	0.14	-0.07	-0.14	0.45
		t-Stat	0.91	1.31	-2.69	-1.09		2.16	0.97	-1.09	-0.48	
	Investment	Coef	0.18***	0.10	-0.07***	-0.27*	0.54	0.20***	0.08	-0.06**	-0.15	0.42
		t-Stat	3.60	1.43	-4.16	-1.99		4.16	1.60	-2.70	-1.48	
$dMiscL_t$	Speculative	Coef	-0.06	-0.05	0.03	0.95***	0.49	-0.05	-0.06	0.05	0.96***	0.49
		t-Stat	-0.79	-0.81	0.59	5.10		-0.68	-0.87	0.89	4.93	
	Investment	Coef	-0.03	-0.12***	0.08***	0.38***	0.57	-0.03	-0.12***	0.08***	0.38***	0.57
		t-Stat	-0.45	-3.00	5.17	3.27		-0.55	-3.09	4.91	3.30	

Table 3. 7 Timing, herding and debt maturity decisions of firms: significant refinancing periods versus non refinancing periods

This table presents the differences in timing and herding effects on debt maturity decisions of firms between refinancing and non-refinancing periods. Significant debt refinancing period is defined as the year when total debt issued for financial purpose ($dSTD'^{x}_{t}$+$dLTD'^{x}_{t}$) exceeds five percent of the pre-issue value of total assets. Fama-Macbeth regression results are presented for the split of financing between short-term financial debt, long-term financial debt and miscellaneous operating liabilities for subgroups of firms at significant debt refinancing and non-refinancing periods. For brevity, results are only reported for P/B_{t-1}, $dZscore_{t+1}$ and STS'^{x}_{t-1}. In addition, we report the tests of the differences in the annual regression coefficients of P/B_{t-1}, $dZ\text{-}Score_{t+1}$ and STS'^{x}_{t-1} between significant debt refinancing and non-refinancing periods, and the magnitude effects of these variables in the long-term debt regressions. Same regression specification is implemented as in Panel A, Table 3.5. All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients and the student's t value for the average coefficients are reported. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. Results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 965 micro firms, 435 small firms and 511 big firms in non-refinancing periods and 699 micro firms, 248 small firms and 287 big firms in refinancing periods. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: One-Year Debt Maturity Cutoff

			Regression Results						Test of Difference between Significant Refinancing and Non-financing Periods		
			Non-refinancing Periods			Significant Refinancing Periods					
			P/B_{t-1}	$dZ\text{-}Score_{t+1}$	STS'^{1}_{t-1}	P/B_{t-1}	$dZ\text{-}Score_{t+1}$	STS'^{1}_{t-1}	P/B_{t-1}	$dZ\text{-}Score_{t+1}$	STS'^{1}_{t-1}
$dSTD'^{1}_{t}$	Micro	Coef	0.00	0.00	-4.37***	-0.15	0.12*	-13.41***	0.09	0.13*	-9.80***
		t-Stat	0.11	0.36	-7.39	-1.30	1.74	-9.04	1.13	1.88	-5.53
	Small	Coef	-0.02	0.00	-7.12***	0.01	0.07	-8.78***	0.00	0.10	-2.75
		t-Stat	-0.97	0.49	-6.25	0.28	0.82	-4.04	-0.12	1.15	-0.96
	Big	Coef	-0.05*	0.00	-8.60***	-0.06	0.11	-7.49***	-0.04	0.14**	2.28
		t-Stat	-1.95	-0.37	-11.04	-1.22	1.65	-2.94	-1.23	2.58	1.07
$dLTD'^{1}_{t}$	Micro	Coef	0.01	-0.00	3.34***	0.15	-0.18**	4.79***	0.02	-0.17**	0.12
		t-Stat	0.49	-0.62	4.81	1.08	-2.34	3.24	0.25	-2.22	0.07
	Small	Coef	0.05*	-0.00	6.61***	0.15	-0.15	6.32***	0.19**	-0.10	-1.86
		t-Stat	1.76	-0.22	6.42	1.65	-1.40	3.51	2.10	-1.13	-0.76
	Big	Coef	0.02	-0.02	7.97***	0.19***	-0.41***	4.14*	0.27***	-0.18**	-8.21***
		t-Stat	0.98	-1.28	10.99	2.85	-4.38	1.89	5.47	-2.02	-4.24
$dMiscL_{t}$	Micro	Coef	-0.02	0.00	1.03***	-0.01	0.06	8.62***	-0.11	0.03	9.68***
		t-Stat	-1.03	0.90	5.78	-0.08	1.66	19.72	-1.55	0.76	16.43
	Small	Coef	-0.03**	-0.00	0.51	-0.17	0.08	2.47***	-0.18**	0.01	4.61***
		t-Stat	-2.33	-0.15	1.34	-1.44	1.23	3.31	-2.25	0.10	3.74
	Big	Coef	0.03	0.02*	0.63**	-0.13**	0.30***	3.35**	-0.22***	0.04	5.93***
		t-Stat	1.42	1.97	2.62	-2.71	4.28	2.28	-4.62	0.51	3.65

Table 3.7 (*Continued*)

Panel B: Three-Year Debt Maturity Cutoff

			Regression Results						Test of Difference between Significant Refinancing and Non-financing Periods		
			Non Refinancing Periods			Significant Refinancing Periods					
			P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{3}_{t-1}$	P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{3}_{t-1}$	P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{3}_{t-1}$
dSTD'$^{3}_{t}$	Micro	Coef	0.00	0.00	-5.82 ***	0.39	-0.08	-22.08 ***	0.36*	-0.07	-11.22***
		t-Stat	0.11	0.71	-16.82	1.28	-0.82	-5.78	1.89	-0.64	-3.19
	Small	Coef	-0.04 *	0.01	-8.88 ***	0.05	0.02	-14.01 ***	0.18**	0.05	-4.60***
		t-Stat	-1.75	0.86	-17.16	0.58	0.19	-8.47	2.30	0.36	-2.70
	Big	Coef	-0.14 **	0.01	-9.53***	-0.14 **	0.01	-9.32 ***	-0.01	0.05	1.85
		t-Stat	-2.68	1.13	-10.58	-2.05	0.05	-8.56	-0.20	0.57	1.61
dLTD'$^{3}_{t}$	Micro	Coef	0.01	-0.00	5.30 ***	-0.41	0.01	13.97 ***	-0.25	0.03	6.51
		t-Stat	0.57	-1.17	13.08	-1.21	0.14	3.27	-1.46	0.30	1.61
	Small	Coef	0.07 **	-0.01**	8.59 ***	0.11	-0.10	10.38 ***	0.01	-0.05	1.28
		t-Stat	2.54	-2.25	17.59	1.34	-0.76	6.53	0.15	-0.50	0.99
	Big	Coef	0.11 ***	-0.03 *	9.31 ***	0.27 ***	-0.30 ***	7.72 ***	0.24***	-0.09	-3.91***
		t-Stat	2.85	-1.99	11.26	3.86	-2.93	9.55	6.18	-1.00	-4.29
dMiscL$_{t}$	Micro	Coef	-0.01	0.00	0.52 ***	0.01	0.07 *	8.11 ***	-0.11	0.04	4.72***
		t-Stat	-0.90	0.72	3.94	0.19	1.74	12.44	-1.40	0.92	6.61
	Small	Coef	-0.03 **	-0.00	0.29 *	-0.16	0.08	3.63 ***	-0.20**	0.01	3.32***
		t-Stat	-2.10	-0.16	2.04	-1.41	1.23	7.14	-2.46	0.11	3.91
	Big	Coef	0.03	0.02 *	0.23	-0.13 ***	0.29 ***	1.61 **	-0.23***	0.03	2.06**
		t-Stat	1.45	1.93	1.20	-2.86	4.27	2.09	-4.81	0.43	2.33

Panel C: Magnitude Effects

	One-Year Debt Maturity Cutoff						Three-Year Debt Maturity Cutoff					
	Non Refinancing Periods			Significant Refinancing Periods			Non Refinancing Periods			Significant Refinancing Periods		
	P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{1}_{t-1}$	P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{1}_{t-1}$	P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{1}_{t-1}$	P/B $_{t-1}$	dZ-Score$_{t+1}$	STS'$^{3}_{t-1}$
Micro	0.04	-0.04	0.39	0.63	-4.45	0.84	0.04	-0.05	1.86	-1.72	0.25	7.37
Small	0.18	-0.05	0.51	0.52	-1.61	0.72	0.25	-0.14	1.24	0.38	-1.07	1.84
Big	0.08	-0.14	0.60	0.69	-1.23	0.38	0.43	-0.24	1.12	0.99	-0.90	1.14

Table 3. 8 Robustness check: is the issuance of operating liabilities the consequence of growing sales or complying with industry rules and customs?

This table checks the robustness of whether the issuance of operating liabilities is just the consequence of growing sales or complying with industry rules and customs. Fama-Macbeth regression results are presented for the split of financing between short-term financial debt, long-term financial debt and miscellaneous operating liabilities. Sales growth ($dSALE_t$) and industry fixed effect (by Fama-French 10 industry classification) are incorporated to address the robustness of the effects of P/B_{t-1}, STS'^{x}_{t-1} and $dZscore_{t+1}$. Accordingly, a system of three equations is estimated as follows,

$$\begin{cases} dSTD'^{x}_t = a + b_1 dA_t + b_2 NegY_t + b_3 PosY_t + b_4 dS_t + b_5 D_t + b_6 NoD_t + b_7 MC_t + b_8 NegB_{t-1} + b_9 P/B_{t-1} + b_{10} STS'^{x}_{t-1} + b_{11} DD1_{t-1} + \beta_1 EFWAMB_t + \beta_2 FEFWAMB_t + \beta_3 dZ\text{-}Score_{t+1} + \beta_4 dSale_t + \gamma\ \text{Industry}_t + e_t \\ dLTD'^{x}_t = c + d_1 dA_t + d_2 NegY_t + d_3 PosY_t + d_4 dS_t + d_5 D_t + d_6 NoD_t + d_7 MC_t + d_8 NegB_{t-1} + d_9 P/B_{t-1} + d_{10} STS'^{x}_{t-1} + d_{11} DD1_{t-1} + \lambda_1 EFWAMB_t + \lambda_2 FEFWAMB_t + \lambda_3 dZ\text{-}Score_{t+1} + \lambda_4 dSale_t + \zeta \text{Industry}_t + \xi_t \\ dMiscL_t = -(a+c) + (1-b_1-d_1) dA_t - (1+b_2+d_2) NegY_t - (1+b_3+d_3) PosY_t - (1+b_4+d_4) dS_t + (1-b_5-d_5) D_t - (b_6+d_6) NoD_t - (b_7+d_7) MC_t - (b_8+d_8) NegB_{t-1} - (b_9+d_9) P/B_{t-1} - (b_{10}+d_{10})\ STS'^{x}_{t-1} \\ +(1-b_{11}-d_{11})\ DD1_{t-1} - (\beta_1+\lambda_1) EFWAMB_t - (\beta_2+\lambda_2) FEFWAMB_t - (\beta_3+\lambda_3) dZ\text{-}Score_{t+1} - (\beta_4+\lambda_4) dSale_t - (\gamma+\zeta)\ \text{Industry}_t - (e_t+\xi_t) \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. For brevity, results are only reported for P/B_{t-1}, STS'^{x}_{t-1}, $dZ\text{-}Score_{t+1}$ and $dSale_t$. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. Results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

			Panel A: One-Year Debt Maturity Cutoff						Panel B: Three-year Debt Maturity Cutoff					
			P/B_{t-1}	STS'^{1}_{t-1}	$dZ\text{-}Score_{t+1}$	$dSale_t$	Industry FE	R^2	P/B_{t-1}	STS'^{3}_{t-1}	$dZ\text{-}Score_{t+1}$	$dSale_t$	Industry FE	R^2
$dSTD'^{x}_t$	Micro	Coef	-0.09	-12.32***	0.00	-0.24	Yes	0.21	0.35	-17.00***	0.00	-0.29	Yes	0.40
		t-Stat	-1.13	-8.23	-0.19	-0.95			1.31	-4.61	-0.09	-1.21		
	Small	Coef	0.01	-9.86***	0.01	-0.55*	Yes	0.18	-0.04	-12.46***	0.00	-0.41	Yes	0.30
		t-Stat	0.40	-7.99	0.83	-1.90			-0.83	-13.34	0.01	-1.33		
	Big	Coef	-0.06	-9.21***	0.02	-1.09***	Yes	0.18	-0.12**	-10.64***	0.00	-1.32***	Yes	0.30
		t-Stat	-1.55	-6.20	1.23	-3.18			-2.60	-10.58	-0.13	-3.84		
$dLTD'^{x}_t$	Micro	Coef	0.16	5.77***	-0.01*	-0.15*	Yes	0.24	-0.30	12.38***	-0.01*	-0.11	Yes	0.24
		t-Stat	1.68	4.06	-1.80	-1.81			-1.01	3.15	-1.81	-1.52		
	Small	Coef	0.06	8.00***	-0.06*	-0.06	Yes	0.53	0.10***	11.09***	-0.05**	-0.19	Yes	0.42
		t-Stat	1.44	10.14	-2.03	-0.25			3.23	12.55***	-2.23	-0.72		
	Big	Coef	0.14**	7.58***	-0.10***	-1.20**	Yes	0.57	0.20***	10.47***	-0.08**	-0.97*	Yes	0.47
		t-Stat	2.58	6.49	-2.92	-2.22			4.22	14.52	-2.29	-1.75		
$dMiscL_t$	Micro	Coef	-0.06	6.55***	0.02	0.38	Yes	0.57	-0.05	4.63***	0.01	0.40	Yes	0.57
		t-Stat	-1.09	16.76	1.64	1.32			-0.87	15.11	1.51	1.29		
	Small	Coef	-0.07	1.86***	0.05***	0.61***	Yes	0.51	-0.07	1.37***	0.05***	0.60***	Yes	0.51
		t-Stat	-1.31	2.93	2.91	3.02			-1.27	3.93	2.85	2.90		
	Big	Coef	-0.08**	1.62**	0.08**	2.29***	Yes	0.58	-0.08**	0.17	0.08***	2.30***	Yes	0.58
		t-Stat	-2.14	2.11	2.73	3.63			-2.15	0.41	2.76	3.59		

Table 3. 9 Robustness check: do operating liabilities behave more like short-term debts with respect to debt maturity timing?

This table checks whether the operating liabilities behave more like short-term debts with respect to the timing and herding behaviors. Fama-Macbeth regression results are presented for the split of financing between the adjusted short-term debt (short-term debt in current liabilities plus miscellaneous liabilities) and long-term financial debt. Accordingly, a system of two equations is estimated as follows,

$$\begin{cases} dSTD'^{x}_{t}=a+b_1dA_t+b_2NegY_t+b_3PosY_t+b_4dS_t+b_5D_t+b_6NoD_t+b_7MC_t+b_8NegB_{t-1}+b_9P/B_{t-1}+ b_{10}STS'^{x}_{t-1}+b_{11}DD1_{t-1}+\beta_1EFWAMB_t+\beta_2FEFWAMB_t+\beta_3 dZ\text{-}Score_{t+1}+e_t \\ dLTD'^{x}_{t}=-a-b_1dA_t-b_2NegY_t-b_3PosY_t-b_4dS_t-b_5D_t-b_6NoD_t-b_7MC_t-b_8NegB_{t-1}-b_9P/B_{t-1}- b_{10}STS'^{x}_{t-1}-b_{11}DD1_{t-1}-\beta_1EFWAMB_t-\beta_2FEFWAMB_t-\beta_3 dZ\text{-}Score_{t+1}- e_t \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. For brevity, results are only reported for P/B_{t-1}, STS'^{x}_{t-1} and $dZ\text{-}Score_{t+1}$. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. Results are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

			Panel A: One-Year Debt Maturity Cutoff				Panel B: Three-year Debt Maturity Cutoff			
			P/B_{t-1}	STS'^{1}_{t-1}	$dZ\text{-}Score_{t+1}$	R^2	P/B_{t-1}	STS'^{3}_{t-1}	$dZ\text{-}Score_{t+1}$	R^2
$dSTD'^{x}_{t}$	Micro	Coef	-0.14	-5.17***	0.01	0.61	0.30	-12.63***	0.01*	0.73
		t-Stat	-1.60	-5.11	1.51		1.05	-2.96	2.01	
	Small	Coef	-0.09**	-7.47***	0.05*	0.52	-0.11***	-10.72***	0.04*	0.59
		t-Stat	-2.61	-9.92	1.73		-3.65	-13.59	1.94	
	Big	Coef	-0.15***	-6.89***	0.08***	0.58	-0.20***	-9.87***	0.06*	0.65
		t-Stat	-2.80	-6.52	3.07		-4.40	-13.06	1.97	
$dLTD'^{x}_{t}$	Micro	Coef	0.14	5.17***	-0.01	0.24	-0.30	12.63***	-0.01*	0.24
		t-Stat	1.60	5.11	-1.51		-1.05	2.96	-2.01	
	Small	Coef	0.09**	7.47***	-0.05*	0.52	0.11***	10.72***	-0.04*	0.41
		t-Stat	2.61	9.92	-1.73		3.65	13.59	-1.94	
	Big	Coef	0.15***	6.89***	-0.08***	0.56	0.20***	9.87***	-0.06*	0.45
		t-Stat	2.80	6.52	-3.07		4.40	13.06	-1.97	

Table 3. 10 Robustness check: do alternatively financial constraints drive the differences in timing and herding effects?

This table checks whether alternatively financial constraints drive the differences in timing and herding behaviors. Fama-Macbeth regression results are presented for the split of financing between short-term financial debt, long-term financial debt and miscellaneous operating liabilities. A system of three equations is estimated as follows,

$$\begin{cases} dSTD'^{x}_{t}=a+b_1dA_t+b_2NegY_t+b_3PosY_t+b_4dS_t+b_5D_t+b_6NoD_t+b_7MC_t+b_8NegB_{t-1}+b_9P/B_{t-1}+ b_{10}STS'^{x}_{t-1}+b_{11}DD1_{t-1}+\beta_1EFWAMB_t+\beta_2FEFWAMB_t+\beta_3 dZ\text{-}Score_{t+1}+e_t \\ dLTD'^{x}_{t}=c+d_1dA_t+d_2NegY_t+d_3PosY_t+d_4dS_t+d_5D_t+d_6NoD_t+d_7MC_t+d_8NegB_{t-1}+d_9P/B_{t-1}+ d_{10}STS'^{x}_{t-1}+d_{11}DD1_{t-1}+\lambda_1EFWAMB_t+\lambda_2FEFWAMB_t+\lambda_3 dZ\text{-}Score_{t+1}+\xi_t \\ dMiscL_t =-(a+c)+(1-b_1- d_1)dA_t-(1+b_2+ d_2)NegY_t-(1+b_3 +d_3)PosY_t-(1+b_4+d_4)dS_t+(1-b_5-d_5)D_t-(b_6+ d_6)NoD_t-(b_7+ d_7)MC_t-(b_8+ d_8)NegB_{t-1}-(b_9+ d_9)P/B_{t-1}- (b_{10}+ d_{10}) STS'^{x}_{t-1} \\ +(1-b_{11}- d_{11}) DD1_{t-1} - (\beta_1+\lambda_1)EFWAMB_t - (\beta_2+\lambda_2)FEFWAMB_t- (\beta_3+\lambda_3) dZ\text{-}Score_{t+1}-(e_t+\xi_t) \end{cases}$$

All the variables are defined in Table 3.1. We run the cross-sectional regression for each year t during 1983-2009. The averages of the annual regression coefficients, the student's t value for the average coefficients, and the average value of the annual coefficients of determination (R^2) are reported. For brevity, results are only reported for P/B_{t-1}, STS'^{x}_{t-1} and $dZ\text{-}Score_{t+1}$. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. For a firm to be included in the sample, we require complete information on all the regression variables. In Panel A, we examine firm's financial constraint using Altman's Zscore and separately report results for financially constrained firms whose Zscore in fiscal year t are below the 30th percentile, financially unconstrained firms whose Zscore in fiscal year t are between the 30th and the 70th percentile, and financially flexible firms whose Zscore in fiscal year t are above the 70th percentile. The average annual sample represents 866 financially constrained firms, 1290 financially unconstrained firms and 910 financially flexible firms. In Panel B, we examine firm's credit access constraint using S&P's domestic issuer credit ratings and separately report results for firms who are constrained to public credit and have no credit ratings assigned by Standard&Poor's in fiscal year t, and firms who are not constrained to public credit and have credit ratings assigned by Standard&Poor's in fiscal year t. The average annual sample represents 2422 firms constrained to public credit and 750 firms unconstrained to public credit. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: Financial Constraint Measured by Altman's Zscore

			One-Year Debt Maturity Cutoff				Three-year Debt Maturity Cutoff			
			P/B_{t-1}	STS'^{1}_{t-1}	$dZ\text{-}Score_{t+1}$	R^2	P/B_{t-1}	STS'^{3}_{t-1}	$dZ\text{-}Score_{t+1}$	R^2
$dSTD'^{x}_{t}$	Constrained	Coef	-0.09	-15.21***	0.18	0.21	0.42	-19.60***	-0.07	0.37
		t-Stat	-1.18	-7.29	1.17		1.09	-5.24	-0.57	
	Unconstrained	Coef	0.04	-5.20***	-0.02	0.18	0.07**	-10.09***	-0.04	0.34
		t-Stat	1.66	-8.14	-0.59		2.19	-9.46	-1.26	
	Flexible	Coef	-0.02	-12.35***	0.00	0.25	-0.03	-10.41***	0.00	0.37
		t-Stat	-1.10	-9.53	-0.99		-0.81	-26.42	-0.85	
$dLTD'^{x}_{t}$	Constrained	Coef	0.12	8.01***	-0.31	0.32	-0.41	14.63***	-0.07	0.28
		t-Stat	1.18	3.82	-1.64		-1.03	3.93	-0.59	
	Unconstrained	Coef	0.10***	2.99***	-0.12**	0.36	0.06*	7.89***	-0.10**	0.27
		t-Stat	3.26	6.78	-2.72		1.80	7.46	-2.08	
	Flexible	Coef	0.09	5.04***	0.00	0.26	0.09*	4.78***	0.00	0.22
		t-Stat	1.50	7.13	-0.14		1.80	8.22	0.16	
$dMiscL_t$	Constrained	Coef	-0.03	7.20***	0.13*	0.53	-0.01	4.97***	0.13*	0.53
		t-Stat	-0.47	8.26	2.00		-0.21	12.57	2.02	
	Unconstrained	Coef	-0.14***	2.20***	0.14**	0.55	-0.13***	2.19***	0.14**	0.55
		t-Stat	-3.60	6.69	2.22		-3.49	8.31	2.17	
	Flexible	Coef	-0.07	7.31***	0.00	0.68	-0.06	5.64***	0.00	0.68
		t-Stat	-1.15	11.17	0.99		-1.02	12.31	0.67	

Table 3.10 (*Continued*)

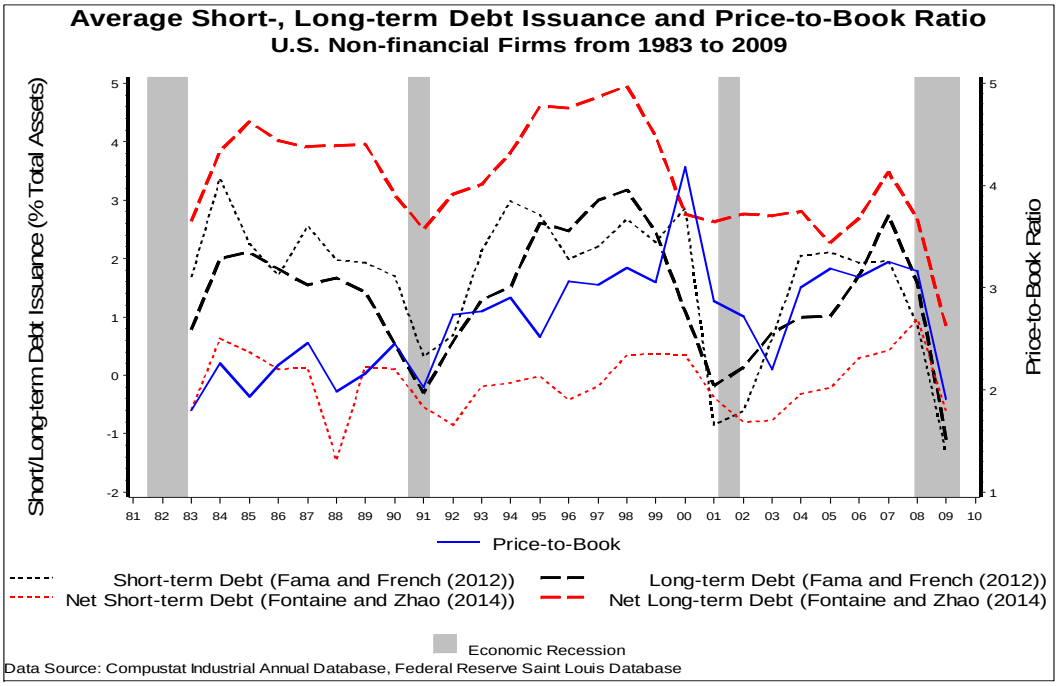
Panel B: Public Credit Constraint Measured by the Availability of S&P's Domestic Issuer Credit Rating

			One-Year Debt Maturity Cutoff				Three-year Debt Maturity Cutoff			
			P/B_{t-1}	STS'^{1}_{t-1}	$dZ\text{-}Score_{t+1}$	R^2	P/B_{t-1}	STS'^{1}_{t-1}	$dZ\text{-}Score_{t+1}$	R^2
$dSTD'^{x}_{t}$	Without Access	Coef	-0.09	-9.87***	0.00	0.19	0.31	-16.53***	0.00	0.40
		t-Stat	-1.21	-12.31	-0.92		1.19	-3.75	0.01	
	With Access	Coef	-0.07	-13.75***	0.13**	0.17	-0.07	-18.78***	0.06	0.27
		t-Stat	-1.68	-7.49	2.24		-1.34	-13.61	1.14	
$dLTD'^{x}_{t}$	Without Access	Coef	0.11**	4.88***	-0.01	0.25	-0.30	13.05***	-0.01*	0.27
		t-Stat	2.07	5.50	-1.29		-1.03	2.80	-1.84	
	With Access	Coef	0.15**	9.92***	-0.26***	0.56	0.15***	16.72***	-0.19**	0.45
		t-Stat	2.70	8.86	-3.00		2.79	16.99	-2.20	
$dMiscL_{t}$	Without Access	Coef	-0.02	5.00***	0.01	0.58	-0.01	3.48***	0.01	0.58
		t-Stat	-0.49	12.20	1.49		-0.32	11.04	1.43	
	With Access	Coef	-0.08**	3.83**	0.13**	0.49	-0.09**	2.06*	0.13**	0.49
		t-Stat	-2.11	2.72	2.18		-2.16	1.98	2.08	

Figure 3. 1 Short-term and long-term liability (debt) issuance, 1983-2009

This figure shows the year-by-year average short-term and long-term liability/financial debt issuance, and the average lagged price-to-book ratio. On the left axis, the black dashed lines are average changes in short- and long-term liabilities as factions of total assets (Fama and French (2012)'s measure based on the one-year debt maturity cutoff), and the red dashed lines are average issuance of short- and long-term financial debt as factions of total assets (our net issuance measure based on the one-year debt maturity cutoff). The solid line, plotted on the right axis is the year-by-year average price-to-book ratio (P/B). The shaded areas represent NBER-dated recessions. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. Panel A plots the pattern for the overall sample. In panel B, C and D, graphs are separately presented for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683small firms and 798 big firms.

Panel A: Overall Sample



Panel B: Subsample of Micro Caps

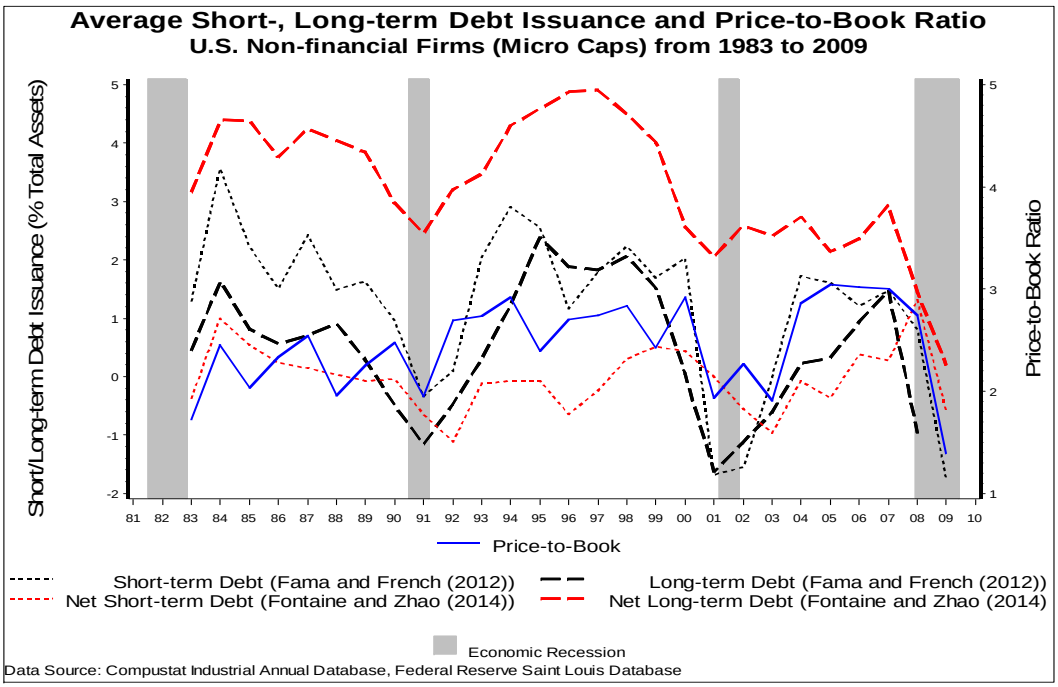
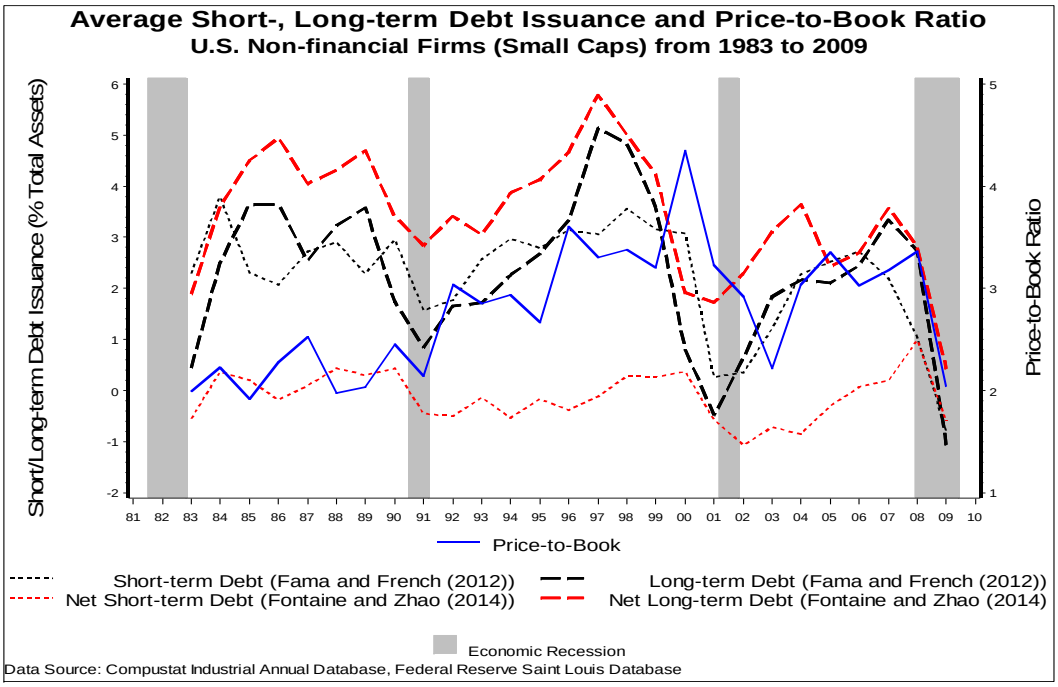


Figure 3.1 (*Continued*)

Panel C: Subsample of Small Caps



Panel D: Subsample of Big Caps

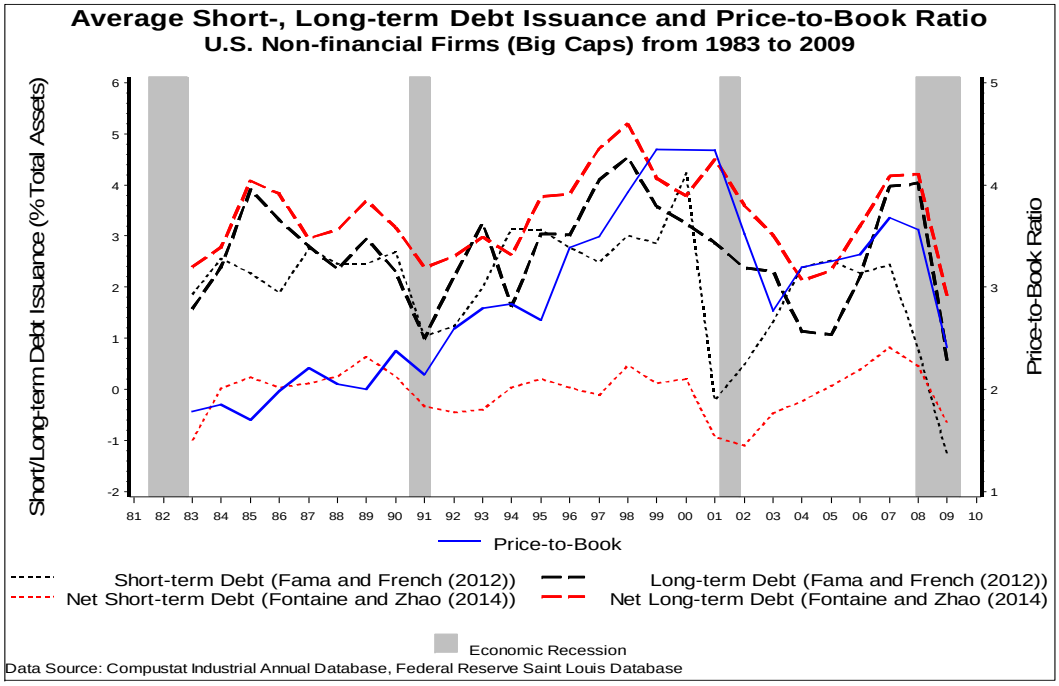
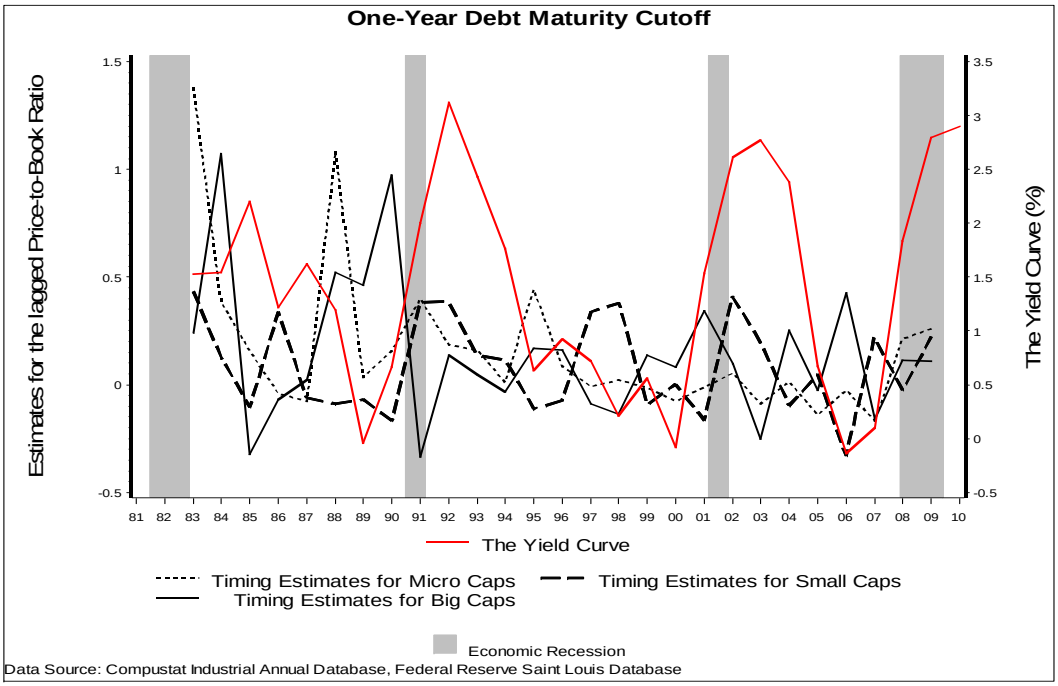


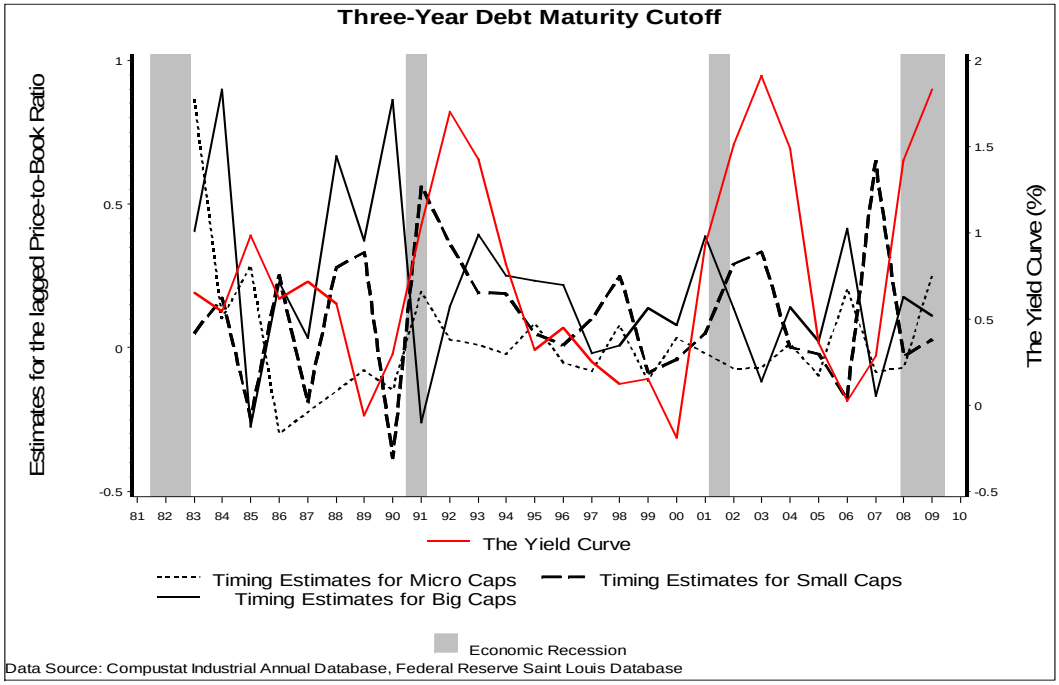
Figure 3. 2 Robustness check: Shift in the yield curve and equity misevaluation

This figure shows the year-by-year estimates for P/B_{t-1} for the $dLTD'x_t$ regression as in Table 3.5. Panel A employs the one-year debt maturity cutoff. Panel B employs the three-year debt maturity cutoff. The black lines, plotted on the left axis, are yearly estimates for P/B_{t-1} (the short dashed line for micro caps, the long dashed line for small caps, and the solid line for big caps). The red solid line, plotted on the right axis, is the yield curve (or known as the term structure of interest rates, defined in Table 3.1). The shaded areas represent NBER-dated recessions. The sample is drawn from the CRSP and Compustat Merged database for non-financial U.S. firms over the period from 1983 through 2009, on a fiscal year basis. Observations with common equity value superior to total assets at the end of fiscal year t-1 are excluded. Graphs are separately plotted for micro firms whose market capitalizations in June of year t are below the 20th NYSE percentile, small firms whose market capitalizations in June of year t are between the 20th and the 50th NYSE percentile and big firms whose market capitalizations in June of year t are above the 50th NYSE percentile. The average annual sample represents 1664 micro firms, 683 small firms and 798 big firms.

Panel A: One-Year Debt Maturity Cutoff



Panel B: Three-Year Debt Maturity Cutoff



General Conclusion

This dissertation concentrates on examining the effects of firm characteristics, managerial herding and timing behaviors on corporate debt maturity decisions, based on a panel of U.S. firms drawn from the CRSP/Compustat Merged database. Our findings bring important implications to both academics and practitioners from three novel perspectives.

In the first chapter, we investigate the heterogeneous effects of the previously identified factors across the debt maturity distribution with an emphasis on the extremely short and long debt maturity cases. We address the question of whether these factors affect debt maturity choices of the short maturity firms in the same way as the long maturity firms. Intriguingly, we show that the effects of the conventional determinants (e.g., growth option) vary substantially at various debt maturity quantiles, in both magnitude and sign. Important effect attenuation is present in the lower and the higher debt maturity percentiles. Additionally, we find that large cash reserves are related to extremely short debt maturity, in line with the argument that firms hold cash to mitigate refinancing risk (e.g., Harford et al. (2014)). Further, we discern that financial constraint and public credit access play an essential part in moderating the effects of the included factors along the debt maturity distribution and in the extremes. In the short-maturity extreme, high asset volatility compels constrained firms to rely even more heavily on short-term debt, but

inclines flexible firms to use more long-term debt. For firms with flexible credit access, high growth options and future abnormal earnings lean them to employ extremely short debt maturities, even when they are bearing heavy debt burdens.

The contribution of the first chapter is both methodological and practical. First, different from the existing studies that model the average effects, we hypothesize and examine the heterogeneous effects of the relevant forces across the debt maturity distribution, applying the conditional quantile regression. Secondly, to the best of our knowledge, this is the first study investigating extreme debt maturity policies of firms. This study therefore helps to enhance the understanding of corporate debt maturity decisions by guiding financial academics to "the short-maturity puzzle". Third, our results shall shed light on the 2007-2008 crisis in steering researchers again to the role that short-term borrowing exerts in amplifying refinancing risk and default probability. Indeed, rating agencies like Standard & Poor's have adjusted their approach to rating credits by giving greater weight to refinancing risk associated with the short debt maturity. As pointed out in their 2008 report, titled "*Leveraged finance: Standard & Poor's revises its approach to rating speculative-grade credits*," *"a company with heavy debt maturities over the near term (especially considering the current market conditions) would face more credit risk, notwithstanding benign long-term prospects."*

In the second chapter, we turn our attention to the time series variation in corporate debt maturity and aim to draw implications for the driven forces of debt maturity dynamics. To do so, in addition to including the factors studied in the first chapter, a potentially important economic force is introduced into our analytical framework, that is, firm's attempt to herd its industry peers in making debt maturity decisions. Our results show that the dynamics in debt maturity is driven more by the herding behavior than the

conventional factors that are previously deemed important in the literature. Ruling out the impact of market-level shocks (the yield curve changes) reveals that firms respond to the changes in peer firms' debt maturity to a larger degree. Firms with high asset volatilities are likely to herd towards the debt maturity levels of their peers in the same industry and within the same volatility group, i.e., the high volatility group. In correspondence with the first study, we find inertia in originally short debt maturity firms whose debt maturities continue to be short over the horizon under investigation. This pattern is especially evident in survivor firms.

The contribution of the second chapter is threefold. First, as far as we know, peer effects are never explicitly tested in the debt maturity literature, especially from a dynamic point of view. By demonstrating a central role of debt maturity herding toward peer firms, we add to the literature by highlighting the fact that debt maturity choices are actually dependent of their peer firms, rationally or not. The second contribution is methodological. Some have added industry dummies to identify the role of industry in determining debt maturity policies in cross sections. This exercise is however not equivalent to ours. The reason is that the incorporated industry dummies are likely to be related to firm characteristics and the unobserved fixed effects in regression residuals, and therefore induce multicollinearity and endogeneity problems. Our measures for herding separate out a "net" peer effect by excluding the observed firm. By conducting analysis further in time series, the peer effect is modeled exogenous. Moreover, our measures track not only a herding towards levels but also a herding towards changes. Thirdly, we developed the portfolio analysis of Lemmon et al. (2008) to trace the even-time debt maturity evolution, which enables us to draw implications for the herding behavior as well as the persistence in short-term debt maturity.

In the third chapter, we attach importance to the issuance decision of long-term versus short-term debt and probe into a market timing force. Specifically, we ask whether security misevaluation affects a firm's debt fund allocation decision between short-term and long-term debts. In short, the evidence is only found for a group of big size firms with strong fundamentals. Particularly, for these firms, the timing behavior dominates over the herding behavior during significant debt refinancing periods. For small firms with weak fundamentals, no evidence is found for debt maturity timing with respect to temporary mispricing in stocks and creditworthiness. By contrast, the herding is found prevalent. In debt refinancing times, small firms respond further to short-term debt surplus (the positive deviation from industry peers' short-term debt ratio) to allocate less debt to short-term. Again, this evidence indicates firms' attempt to hedge from refinancing risk.

This study is an extension to the recent paper of Fama and French (2012). Specifically, they test the general predictions of the tradeoff model, the market conditions model and the pecking order model for capital structure choices of firms. Our analyses have been confined to testing the security mispricing-related market timing argument considering debt maturity choices. Our contributions to the literature are to provide more convincing evidence by (1) separating operating liabilities from financing liabilities, (2) taking into account natural retirement of debts, (3) disentangling, in the commonly used market timing proxy (price-to-book), the mispricing and future growth option components. Notably, different from Fama and French (2012) who find marginal evidence in support of the market conditions model for debt maturity choices of firms, we show that the practice of timing market mispricing plays an important role in debt maturity determination of big firms. Our analysis also complements their results by showing

distinct financing patterns for weak and strong firms and in different debt financing states.

Taken together, this dissertation provides a novel picture of firms' debt maturity choices by (1) modeling the entire distribution with a focus on extreme cases (whereby binding refinancing risk is embedded); (2) addressing the issue in both static and dynamic environments (based on the idea that debt maturity choice can be passive rather than active); (3) developing prior literature from studying the effects of conventional debt maturity determinants to considering the economic forces of herding and timing behaviors.

Some issues remain to be investigated. There is reason to believe that firm-level shocks like mergers and acquisitions may radically change a firm's debt maturity structure; family firms may hold different debt maturity attitude; and debt characteristics such as callability and covenants would moderate the role of classical frictions in affecting debt maturity. These aspects are certainly important. However, due to limited availability of data, we have not been able to address these issues in this dissertation. These could serve as important directions for future research.

Overall, this dissertation offers a hierarchy in debt maturity research concerning three types of effects: firm characteristics, peer firms' debt maturity policy, and market timing, which offers a natural guidance to future research.

First, the results we obtained in this dissertation point to the significance of the exogenous shocks in influencing firms' debt maturity decisions: the mimicking concerns for constrained firms and the timing attempts for flexible firms. To better understand the

mechanism, an important direction in the future could be to study whether the herding in constrained firms and the timing in unconstrained ones enhance firms' values.

Second, we find evidence that firms heavily reliant on bank loans behave distinctively different from those with access to public debt market, indicating an essential supply-side effect. The former firms are closely monitored by creditors and are screened out of the long-term debt market when exposed to asset shocks. It means that they may have very few choices in response to firm, industry and market-level shocks. In comparison, there may be a lack of supervision for the latter firms who have a tendency to use excessively short-term debts through cheap commercial paper programs. Hence they are more likely to take risk-shifting decisions at the cost of creditors. An alternative direction is therefore to examine the underlying mechanism for the observed short-term debt persistence considering supply-side effects. In an analogous way, the short debt maturity puzzle, especially the fact that some firms (re)finance a large portion of assets with extremely short-term debts (i.e. debts maturing in one year), deserves further investigation.

Corporate decisions have to been made by managers. Another related topic is how a firm's board and governance structure affect the herding and the timing patterns of firms. A growing literature highlights the dramatic increase in executive compensation and shows how such phenomenon has altered managers' exposure to risk (Hall and Liebman (1998), Bergstresser and Philippon (2006), among others). Notably, this literature suggests a potential link between the design of managers' compensation packages, managerial herding and market timing behaviors. In this respect, particular attention should be paid to proving clarity on this issue for future research.

Bibliography of General Conclusion

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