The Impact of Cash Flow Volatility on Corporate Debt Decisions

by

Tural Karimli

Submitted to

Central European University

Department of Economics and Business

In the partial fulfillment of the requirements for the degree of

Master of Arts in Economics

Supervisor: Professor Adam Zawadowski

Budapest, Hungary

2018

Abstract

In this thesis, I study whether financial market imperfections influence the corporate debt decisions. The theoretical literature on optimal capital structure provides us with a unified framework on the relationship between the variance of company income stream and its leveraging level. However, the empirical work has not been able to reach conclusive results. I do empirical analysis on the response of corporate debt level and its maturity structure to the dynamics of cash flow volatility using most recent data and synthesis of previous findings. My empirical results confirm that firms debt decisions tend to be affected negatively by the increasingly volatile environment. Moreover, the marginal change in debt with longer maturity tends to be higher in absolute terms than the one with shorter maturity, which reflects increasing cost of financial distress. Consequently, financial imperfections contribute significantly to the firm leveraging decisions.

JEL Classifications: G32, G33, G17

Keywords: Capital structure, Leverage, Debt ratio, Debt maturity, Cash flow volatility

Contents

List of Tables

1 Introduction

"How do firms choose their capital structrue? ... We don't know".

Stewart Myers (1984, p.575)

How do firms decide about their financing? It has been half a century Modigliani and Miller (1958)[36] first started the work on this question. According to their irrelevance theory firm value does not change with respect to the capital structure. By then, it has been a subject of research and discussions in different frames in academia and also in industry. Since we live in the world with frictions, company value and performance depends a lot on the way it is financed. Asymmetric information models developed by scholars give plausible explanations to why it matters. For instance, Holstrom and Tirole (1997)[21] show that moral hazard can lead to credit rationing, and Myers and Majluf (1984)[38] argues that adverse selection can lead to costly external financing. Based on this generation of models, researchers derive the pros and cons of using debt vs. equity for company financing. Innes (1990)[23] argues that debt induces more effort, and Yang (2017)[45] states that debt saves on information costs. Furthermore, debt is more preferred due to corporate tax. However, increasing level of leverage can lead to debt overhangs (Myers, 1977)[37], increase financial distress risks (Leland (1994))[29]. At the same time, debt carries rollover risk (He and Xiong (2012), Brunnermeier and Oehmke (2013))[20, 8].

Despite the fact that the theoretical literature has made rich evidence on the determinants and shifters of decision-making on firm financing, empirical works have not been able to reach a unified agreement in many dimensions. For instance, Welch (2006)[44] criticises the proxy used for measuring leverage, and also the selection of the sample. Parsons and Titman (2007)[39] in their review paper on empirical capital structure argues that there is an ambiguity in the interpretations of dependent and independent variables in the standard linear regression. Graham and Leary (2011)[17] argue that the ability of standard proxies to explain leverage variation has declined over time.

Besides these, there is also disagreement among the scholars on the uncertainty measure as a determinant of the corporate capital structure. Tradeoff theories show that increasing volatility leads to drop in the leverage due to the bankruptcy cost. However, in the empirical work, there are two main issues with volatility in using it as the determinant of the capital structure. First one is the proxy for volatility. Some scholars measure it as standard deviation of stock return (Welch (2004)[43], Chen et al. (2014)[9]), some use absolute change of ROA (net income to total assets) (Leary and Robert (2005)[26]), and many others take the volatility of earnings before interest, depreciation, and taxes (Bradley et al. (1984))[6]. Additionally, scholars construct these measures using rolling windows ranging from 1 to 28 years. Survey results by Graham and Harvey (2001)[16] among the 392 CFOs of the U.S. firms show 81% of firms have some target debt ratio or range.

The other conflicting empirical result with earning volatility is that some papers do not find any statistical power of cash flow spread in the explanation of leverage variation (Leary (2014), Antoniou (2008))[27, 2] However, Bradley et al. (1984), Friend and Lang (1988)[13], and Keefe and Yaghoubi (2016)[24] find a strong negative relationship.

Thus, the objective of this paper is to re-examine the dynamics between the cash flow volatility and corporate debt decisions. To do so, I rely on prior theoretical foundations to motivate my hypotheses, and I construct empirical analysis in panel data framework using most up to date data and synthesis of previous works.

First, I examine the relationship between the level of leverage of cash flow volatility using two measures of debt and earnings variation. Then, I analyze this link further with a different sample, different volatility measures, and alternative estimation method.

Next, conditional on the results of the first hypothesis I further zoom into the leverage. That is, I check if the sensitivity of the firm debt with respect to the variation of income stream changes with its maturity structure. Intuitively, it is expected that long-term debt tends to decrease in response to volatility shocks. However, with the short-term debt, there can be two movements. First, firms decrease or do not change their debt with short life depending on whether they are financially constrained or not. Second, it increases if companies structure their long-term debt to short-term one or they initialize new debt with a shorter maturity. The results on this part were checked using different robustness methods as well.

Overall, the analysis shows that the financial frictions influence corporate debt decision making. I find that increasing cash flow volatility leads to the lower leverage ratio, which is in line with theoretical foundations. Additionally, my results exhibit strong support for the second hypothesis. Across all the robustness tests for both hypotheses, the results are qualitatively in line with my baseline findings.

The remainder of this paper is organized as follows. In Chapter 2, I go through the theoretical literature that explains the relationship between volatility and leverage, and the role of uncertainty on decisions with maturity structure of the debt. Then, I build my hypotheses based on those theoretical findings and outline the empirical design of the analysis. Chapter 3 presents the sample space, gives explanations to the variables used for the estimations, and provides the univariate statistics on the data. In Chapter 4, I present and analyze the baseline empirical results and introduce the robustness checks. Chapter 5 summarises the paper.

2 Hypotheses development

To develop the hypotheses to be tested, I first go through the theoretical literature on the relationship between cash flow volatility and corporate debt decisions. On the second part, I posit the hypotheses of my empirical analysis based on these findings. In the last subsection, I provide and discuss my empirical design.

2.1 Theoretical motivation

Traditional static and dynamic versions of optimal capital structure models do not allow us to see comparative static of the relationship between debt and variations in income streams since the debt instrument was taken with infinite life in those settings. The primary assumption is that the bond does not mature or it can be thought that debt with limited life is rolled infinitely. Furthermore, the main determinant in static or dynamic tradeoff theories of capital structure is a corporate tax, which gives an incentive to increase the leveraging level but the growing likelihood of financial distress will offset it.

These grounding models were not very useful in the identification of practical determinants. However, starting with pricing models by Black and Scholes (1973)[5] and Merton (1974)[35], optimal capital structure models had taken a new direction. Now, both the maturity and amount of debt choice by firms could be formulated. But yet this models did not have tax or financial distress component since they were built for option pricing purposes. For the first time in capital structure literature, Brennan and Schwartz (1978)[7] used an identical model to Merton (1974)[35] to explain the relationships between firm value, leverage, maturity of debt under different firm risk levels in a numerical setting. Their results of comparative static show that the leveraging level of the firm has a negative relationship with the increasing firm risk level. Also, they show that firm value goes down as the maturity of debt increases.

Leland (1994a)[30] brought the results of Merton (1974)[35] and Black and Cox (1976)[4] with the feature of tax, financial distress and debt covenants to explain the optimal structure of debt and optimal maturity of debt (Leland 1994b, Leland and Toft (1996))[31, 32].

In his seminal paper, he addresses the questions on the direction of the relationship of leverage with taxes, default risk, variance of returns and fraction of asset lost in the scenario of bankruptcy. He categorised debt as protected and unprotected depending on its bankruptcy determinants. His derivations show that in both cases optimal leverage ratio drops down if the variance of earnings and fraction of asset value lost in the scenario of bankruptcy rise. Additionally, debt level increases if risk-free interest rate and corporate tax rate rises. Leland (1998) further extends this model to learn the role of agency cost in the optimal leverage and maturity decision-making problem of the firm. He argues that with higher average risk both leverage ratio and debt maturities will decrease. However, his model does not capture voluntary adjustment to debt maturity and debt level. Dangl and Zechner (2016)[10] using their voluntary debt reductions model calibrate company values with various parameter values. Their results show that higher cash flow volatilities induce lower firm value, and it shifts optimal maturity of leverage towards short-term debt.

2.2 Testable hypotheses

Based on the results of the discussed literature above, we can conclude that firms diminish their leveraging level as a response to increasing risk level. That is if firm experiences high earnings volatility it should pay more default premium for the debt. Formally, for my empirical analysis I state my first hypothesis as below:

$$H1: \ \frac{\partial Leverage_{it}}{\partial Cash\ flow\ volatility_{it-1}} < 0$$

Theoretical findings show that the cost of debt increase with time to maturity. Hence, increasing earnings volatility means increased costs of financial distress. Thus, I explicitly outline the second hypothesis as follows:

$$H2: \ \frac{\partial Leverage\ with\ long\ term\ maturity_{it}}{\partial Cash\ flow\ volatility_{it-1}} < \frac{\partial Leverage\ with\ short\ term\ maturity_{it}}{\partial Cash\ flow\ volatility_{it-1}}$$

2.3 Empirical specification

Petersen (2009)[40] show that Fama-Macbeth (1973)[11] and OLS standard errors will be downward biased in panel structure. Thus, one should not proceed with this method in capital structure analysis due to the prevalence of firm heterogeneity. Assuming that omitted variables are time-invariant then firm fixed effects estimator is the most robust one in this context. Additionally, I cannot proceed with random effects model since there will be correlations with individual effects (Greene (2003))[18]. Hausman test (Hausman (1978))[19] will suffice this argument. To do my analysis on the relationship of the leverage ratio and its maturity structure with earnings volatility, I use linear regression method with time and firm fixed effects following mass empirical literature (e.g. Frank and Goyal (2008)[12], Lemmon et al. (2008))[33]. The standard model is

$$L_{it} = \alpha + \beta * Volatility_{it-1} + \sum_{i} Firm_i + \sum_{t} Time_t + \gamma * X_{it-1} + \epsilon_{it} \quad (1)$$

where L_{it} stands for market and book leverage ratios, and leverage with short and long-term maturities, i and t denote firm and year respectively, α denotes constant, X is a matrix of control variables to be discussed in the next chapter. $Firm$ and $Time$ soak up the firm and time specific heterogeneity. To avoid simultaneity bias, I lag all the explanatory variables by one year. In all of the estimations, I cluster standard error on a firm level (Petersen (2009))[40] to have robust sandwich variance estimators. However, yet one should be cautious regarding the interpretation of the coefficient on the interest variables. That is, due to the possible reverse causality concern, saying "tend to" is more appropriate than "lead to" although I show that my estimation results are robust to different changes in the estimation. For instance, Giroud et al. (2011)[14] in their case study on the leverage of Austrian Ski hotels use an instrument on "unexpected snow" to control for endogeneity due to possible feedback effect. At the result, the sign changes on explanatory variable compared what they first estimated with OLS. Thus, the better interpretation of my interest variable would be a predictor.

3 Data

3.1 Sample space

To test the given hypotheses on cash flow volatility and corporate leveraging decisions, I use an unbalanced data of publicly traded US companies for years 1980-2016. I collected data on firm characteristics from Thomson Reuters Eikon, Datastream and Capital IQ with given accesses from CEU Library. Data on marginal rate of taxes was provided by Prof. John Graham[1]. One can state that unbalanced nature of panel data can lead to the loss of exogeneity assumption. However, I argue that this matter can be disregarded as data points are missing unsystematically. Hence, it does not lead to any endogeneity. The data from all the sources were merged using company CUSIP codes and fiscal year.

Before starting the analysis, I restricted the raw data following empirical capital structure literature. First, I excluded utility and financial services companies from the dataset (SIC codes: 4900-4999, 6000-6999) due to the regulatory measures on their capital structure. Second, I exclude firms with missing or negative information on total assets and total liabilities. Additionally, I dropped rows with common and ordinary equity values equal or less than zero, the book value of total assets less than 1 million. Third, I converted the missing points to zero on research and development expenditures, and long-term debt due to 1, 2 and 3 years, which are in line with the prior empirical literature. Finally, I winsorized data at 1 percentiles from below and above to avoid an outlier issue.

3.2 Variable construction

☐ *Leverage ratios*

Welch (2006)[44] argues that previous literature on the capital structure used a wrong measure for leverage ratio. The use of financial debt as the proxy for leverage ratio is not correct since its opposite is non-financial debt, not equity. Hence, following Welch (2006)[44]. I calculated the book value of total debt as the sum of debt in long-term

[1] I am thankful to Prof. John for the data.

liabilities and notes payable (debt in current liabilities). To calculate the market value of equity, I multiply stock price to common shares outstanding and sum it with the book value of total debt (for definitions see Table A1). Thus, for my analysis, the market leverage ratio is built as below:

$$LEV_m = \frac{Book\ Value\ of\ Total\ Debt}{Book\ Value\ of\ Total\ Debt + Market\ Value\ of\ Equity} \tag{2}$$

And book leverage ratio is measures as below:

$$LEV_b = \frac{Book\ Value\ of\ Total\ Debt}{Book\ Value\ of\ Total\ Assets} \tag{3}$$

☐ *Debt Maturity Measures*

Different proxies can be used to measure the maturity characteristics of firm leverage. Some measure it with the issuance of long-term or short debt using databases of different rating agencies. However, due to my limited access to the data I proxy them with more traditional ones. Following Barclay and Smith (1995)[3], leverage with long-term maturity (i.e., due to more than 3 years) is measured as below:

$$LMD = \frac{Total\ Long\ Term\ Debt - Debt\ due\ to\ 2\&3\ years}{Book\ Value\ of\ Total\ Debt} \tag{4}$$

And to construct debt with short term maturity variable (i.e. due to less than 1 year or notes payable), I follow Greenwood (2008):

$$SMD = \frac{Debt\ in\ Current\ Liabilities - Long\ Term\ Debt\ due\ to\ 1\ year}{Book\ Value\ of\ Total\ Debt} \tag{5}$$

☐ *Volatility measures*

There are different ways to proxy volatility offered by prior research. The most desired one would be an implied volatility extracted from derivative products. However, since most of the companies do not issue these derivative products, I turn to the alternative conventional measures.That is, the most used measure to proxy volatility in finance area is the standard deviation of the interest variable. In capital structure literature, researchers use this measure using different windows. The windows are considered because the previous literature shows that firms target some specific capital structure ratios (Graham and Harvey (2001), Hovakimian et al. (2001))[16, 22]. Thus, I will use rolling standard deviation of earnings before interest, taxes, depreciation, and amortization (EBITDA) with 5 years windows normalized by the market value of assets. I will also use rolling standard deviation of first differences of EBITDA over 5 years window as a baseline interest variable. For robustness checks, I will do the estimations with 1, 3 and 10 years windows.

☐ *Control variables*

Capital expenditure is added to the pool of control since it takes care of firm growth perspectives (Frank and Goyal (2008))[12]. Cash and short-term holdings are used to monitor for the buffer effects. For tax advantage of debt, I use Graham's (1996)[15] simulated marginal rate of tax. To control for liquidity or redeploy-ability I include tangibility, which is built as the tangible capital of firm divided by total assets. Log of the firm size is pulled to the list since larger firms are "too big to enter" to financial distress (Titman and Wessels, (1988)[42]). At the result, they can use more debt, especially with the longer maturity. Market to book ratio is added since firms higher market values tend to have less debt (Rajan and Zingales (1995)[41]). R&D intensity has been considered to take up the reins of product uniqueness (Titman and Wessels, (1988)[42]). Net equity issuance is considered to rule out the variations due to the possible feedback effects. I proxy the cost of the debt issuance with rating dummy on both long term and short term bonds following Lee et al. (1998)[28]. To cancel out the age effect, I throw in firm age as older firms tend to have more debt than the younger ones. Using first two digits of SIC industry code, I construct median industry leverage ratio to capture (MacKay and Phillips (2005)[34], Frank and Goyal (2008)[12]) industry wise heteroskedasticity and target industry leverage by managers. Altman's (1968)[1] Z-score is included to control for the likelihood of bankruptcy. To control for any macroeconomic trends and structural changes, I include time dummies (Korajczyk and Levy (2003)[25]). Definitions of all the control variables used in the estimations are given in Table A1 in Appendix.

3.3 Summary statistics

Table 1 reports the summary statistics. Mean for the market value of the leverage ratio is lower than that of the book value, and it is in line with the median ratios of debt of their respective industry. Higher than 1 average market to book ratio seemingly comes from the higher market value of equity. Average values on rating dummies reveal that around 70% of the bonds do not have any credit rating. This, in turn, will bring difficulty in the interpretation of the investment grade dummy. Having firm age of 7.5 years can be seen as the robustness of sample to survivorship bias, but its standard deviation reveals that there are firms in the sample with life range less than 1 year. Among the volatility measures, it can be seen that 1 year has bigger dispersion and mean, the rest is in line with each other.

Table 2 reports the pairwise correlation between the control variables. It can be identified that the sample is robust to multicollinearity concerns since high correlation is a usual suspect in financial data. Collinearity more than half a unit are between R&D expenditures and cash & short-term investments, and the log of the firm size and rating dummies. The negative correlation of earning volatility with median industry debt can be seen as an initial signal.

Table 1: Summary statistics of constructed variables

	n	μ	p25	p50	p75	σ
LEV_m	71865	0.17	0.02	0.12	0.26	0.17
LEV_b	73594	0.22	0.04	0.19	0.34	0.19
LMD	62734	0.52	0.13	0.59	0.86	0.36
SMD	62734	0.13	0.00	0.00	0.11	0.27
Capital expenditures	72965	0.10	0.02	0.04	0.08	0.27
Cash & short term invest	73673	0.17	0.02	0.08	0.23	0.20
Marginal rate of tax	60744	0.29	0.25	0.34	0.35	0.12
Tangibility	73584	0.28	0.10	0.22	0.40	0.23
Log of firm size	73719	5.53	3.99	5.47	7.00	2.11
Market to book ratio	71898	1.59	0.78	1.13	1.80	1.43
R&D	73719	0.04	0.00	0.00	0.05	0.09
Net equity issuance	67634	0.02	-0.00	0.00	0.01	0.11
Rating dummy	73719	0.26	0.00	0.00	1.00	0.44
Firm age	73719	7.48	2.00	5.00	11.00	7.35
Median industry debt	73719	0.16	0.07	0.13	0.23	0.11
Z-score	70753	1.05e+07	16.05	6883.42	250080.84	5.81e+07
Volatility 1Y	70314	0.14	0.04	0.07	0.14	0.25
Δ Volatility 1Y	67404	0.10	0.02	0.05	0.10	0.17
Volatility 3Y	61638	0.05	0.01	0.02	0.05	0.07
Δ Volatility 3Y	51447	0.06	0.01	0.03	0.06	0.09
Volatility 5Y	63508	0.06	0.02	0.04	0.07	0.07
Δ Volatility 5Y	53141	0.06	0.01	0.03	0.07	0.10
Volatility 10Y	62428	0.06	0.02	0.03	0.06	0.09
Δ Volatility 10Y	53837	0.06	0.01	0.03	0.07	0.10

Table 2: Correlation matrix of explanatory variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Capital expenditures	1												
(2) Cash & short term invest	0.011	1											
(3) Marginal rate of tax	-0.080	-0.280	1										
(4) Tangibility	0.076	-0.398	0.131	1									
(5) Log of firm size	-0.132	-0.248	0.363	0.200	1								
(6) Market to book ratio	0.023	0.398	-0.124	-0.155	-0.092	1							
(7) R&D	0.019	0.526	-0.352	-0.289	-0.248	0.364	1						
(8) Net equity issuance	0.055	0.277	-0.279	-0.072	-0.234	0.306	0.298	1					
(9) Rating dummy	-0.057	-0.238	0.169	0.190	0.636	-0.089	-0.187	-0.118	1				
(10) Firm age	-0.067	-0.074	0.057	-0.024	0.375	-0.043	-0.098	-0.185	0.242	1			
(11) Median industry debt	0.011	-0.333	0.136	0.404	0.221	-0.231	-0.375	-0.087	0.230	0.013	1		
(12) Z_score	-0.026	-0.059	0.088	0.061	0.400	0.020	-0.041	-0.078	0.281	0.221	0.051	1	
(13) Volatility 5Y	0.093	0.265	-0.381	-0.107	-0.375	0.194	0.375	0.211	-0.198	-0.116	-0.167	-0.079	1

4 Empirical results

I divided this chapter into four subsections to test the hypothesis I postulated in chapter 2, and to conduct the robustness checks on the estimation outputs. In the first two subparts, I explore the relationship between total leverage and cash flow volatility. In the last two subparts, I further learn the influence of cash flow on leverage maturity structure taking into account the result of the first part.

4.1 Hypothesis 1: Volatility and level of leverage

First, I begin with the test of Hypothesis 1 using two different measures of leverage and cash flow volatility, about which I talked in chapter 3, on panel data framework with time fixed effects. This allows me to see the difference between sensitiveness of market and book leverage ratios, and the performance of the different proxies for volatility. Columns 1 and 2 of Table 3 show that all the coefficients on volatilities have appropriate signs that are in line with theoretical findings, and both are statistically different from zero. The effect on market value of leverage is slightly higher than on book value on. It can be explained with more embedded information in the market value.

Although the main interest of the analysis is on volatility it would be useful to look through the other controls if they are in line with our expectations. The coefficient on cash and short-term investments means that firms with more liquid assets tend to have less debt as expected. The estimates of tangibility, firm size and capital expenditures tell that companies which have higher redeploy-ability (liquidity) and growth perspectives are likely to have more leverage. Median industry debt might capture two things; (i) firms might target the industry median leverage ratio, (ii) since it is built using SIC code it can absorb industry-specific effect. In the end, it is not straightforward to give an interpretation of this estimate. The same concern can be applied to rating dummy. Rating dummy can soak up two kinds of information. On the one hand, we expect having a credit rating is costly, and at the result, it leads to less leverage ratio. On the other hand, having credit rating means access to more leverage. High market to book ratio and R&D intensive firm tend to have less debt, which is in line with empirical capital structure literature. The coefficient on firm age can be interpreted as young firms tend to have more leverage. However, practical knowledge tells older firm usually have more leverage as it is less costly for them. These make it difficult to give a correct meaning to the result. Firm high net equity issuance and Z-score is likely to have less debt.

Firms usually issue more debt to decrease the cost on corporate tax for financing their needs. However, my results on marginal tax rate show the reverse direction. But I am not the first who find this conflicting result. Faulkender and Petersen (2006) find the same result and argue that Graham's marginal tax rate is empirically weak.

The last two columns of Table 3 report the estimation result with firm fixed effects. Careful examination of the coefficients tells that there was possible firm-specific heterogeneity in the first two columns due to omitted variables. Since Hausman test rejects no correlation in random effects specification, this argument can be approved. Although some controls lost their explanatory power yet, Hypothesis 1 suffices. Firm fixed effect output shows that one standard deviation increase in the volatility measure with 5 years rolling window can lead to approximately 5% drop in market leverage ratio, which is not small in economic size.

Table 4 reports the analogous estimations as in Table 3, but with the first difference of standard deviation of cash flow volatility over 5 years rolling window. The results are mostly in line with previous ones. But, in firm fixed effects model although the volatility measure has expected sign, it is not statistically significant anymore. Additionally, it should be noted that the predictive power of this volatility measure is lower than the previous one. It can be argued with lost information and variation due to the first difference. The output on all other control variables has not changed much due to the alternating volatility measure, which can be translated as a good sign for the model exogeneity.

Table 3: Leverage regressions with cash flow volatility

	LEV_m	LEV_b	LEV_m	LEV_b
Volatility 5Y	-0.1185***	-0.0934***	-0.0543**	-0.0332*
	(-5.88)	(-3.91)	(-3.09)	(-1.98)
Capital expenditures	0.0102**	0.0019	0.0220***	0.0169***
	(3.10)	(0.51)	(6.72)	(4.73)
Cash & short term invest	-0.1965***	-0.2481***	-0.0919***	-0.1219***
	(-24.58)	(-25.73)	(-12.19)	(-12.86)
Marginal rate of tax	-0.0844***	-0.1078***	-0.0457***	-0.0563***
	(-8.71)	(-9.23)	(-5.97)	(-6.32)
Tangibility	0.0479***	0.0627***	0.0197*	0.0151
	(5.35)	(6.23)	(2.11)	(1.33)
Log of firm size	0.0031**	0.0014	0.0083***	0.0056***
	(2.83)	(1.13)	(7.18)	(4.08)
Market to book ratio	-0.0237***	-0.0075***	-0.0140***	-0.0061***
	(-26.65)	(-6.41)	(-18.39)	(-5.76)
R&D	-0.0281	-0.0048	-0.0180	-0.0188
	(-1.59)	(-0.21)	(-0.98)	(-0.70)
Net equity issuance	-0.1146***	-0.0885***	-0.0045	-0.0278**
	(-12.06)	(-7.31)	(-0.61)	(-2.72)
Rating dummy	0.0549***	0.0827***	0.0209***	0.0293***
	(12.71)	(16.85)	(5.38)	(6.57)
Firm age	-0.0018***	-0.0019***	-0.0015***	-0.0010***
	(-8.50)	(-7.37)	(-6.24)	(-3.91)
Median industry debt	0.2170***	0.1800***	-0.1003***	-0.0857***
	(10.74)	(8.26)	(-4.64)	(-3.56)
Z-score	-0.0000***	-0.0000**	-0.0000	-0.0000
	(-3.94)	(-2.83)	(-1.09)	(-0.11)
Constant	0.2312***	0.2175***	0.2202***	0.2160***
	(20.06)	(18.43)	(22.68)	(21.10)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Clustering	Firm level	Firm level	Firm level	Firm level
R^2	0.249	0.219	0.373	0.291
Observations	45788	46039	45788	46039

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Leverage regressions with Δ cash flow volatility

	LEV_m	LEV_b	LEV_m	LEV_b
Δ Volatility 5Y	-0.0473**	-0.0825***	-0.0056*	-0.0252
	(-3.14)	(-5.15)	(-2.22)	(-1.72)
Capital expenditures	0.0123***	0.0011	0.0243***	0.0199***
	(3.30)	(0.25)	(6.43)	(4.94)
Cash & short term invest	-0.1948***	-0.2449***	-0.0975***	-0.1258***
	(-22.62)	(-23.45)	(-11.56)	(-11.81)
Marginal rate of tax	-0.0896***	-0.1226***	-0.0496***	-0.0689***
	(-8.42)	(-9.60)	(-6.11)	(-7.19)
Tangibility	0.0475***	0.0612***	0.0150	0.0076
	(4.98)	(5.69)	(1.35)	(0.57)
Log of firm size	0.0028*	0.0014	0.0104***	0.0074***
	(2.32)	(0.99)	(7.78)	(4.63)
Market to book ratio	-0.0262***	-0.0103***	-0.0155***	-0.0077***
	(-25.29)	(-7.71)	(-17.99)	(-6.52)
R&D	-0.0353	-0.0059	-0.0013	-0.0110
	(-1.82)	(-0.23)	(-0.06)	(-0.34)
Net equity issuance	-0.1111***	-0.0779***	-0.0081	-0.0261*
	(-10.35)	(-5.59)	(-0.97)	(-2.26)
Rating dummy	0.0549***	0.0831***	0.0216***	0.0307***
	(11.95)	(15.86)	(5.02)	(6.18)
Firm age	-0.0017***	-0.0017***	-0.0014***	-0.0009**
	(-7.57)	(-6.42)	(-5.02)	(-2.88)
Median industry debt	0.2066***	0.1689***	-0.1032***	-0.0779**
	(9.66)	(7.28)	(-3.88)	(-2.62)
Z-score	-0.0000***	-0.0000*	-0.0000	-0.0000
	(-3.77)	(-2.56)	(-1.55)	(-0.17)
Constant	0.2367***	0.2311***	0.2090***	0.2079***
	(18.99)	(17.81)	(18.69)	(17.78)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Clustering	Firm level	Firm level	Firm level	Firm level
R^2	0.250	0.222	0.321	0.279
Observations	39938	40148	39938	40148

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Robustness checks: Hypothesis 1 results

In this part, I investigate the robustness of my results on Hypothesis 1 using different modification to baseline methodology. First, I exclude all the firms from the sample with age less than 3 years. Welch (2006)[44] argues that having firms with smaller lifetime can lead to selection bias due to firm survivorship. I do the second check with the changes of windows of the standard deviation of cash flow volatility from 5 years to 1, 3 and 10 years; (i) to support the first hypothesis, (ii) to show windows more than 1 year matter due to the target capital structure ratios. I do the final check with the change of the estimation method from firm fixed effects to first differencing to further argue that my results are robust to endogeneity concerns.

Table 5 provides the output of the estimation, which are done with the same approaches as in Table 3, but excluding firms younger than 3 years old from the sample. If we compare the results of Table 3 and Table 5 it can be observed that the estimation output is robust to selection bias.

Table 6 reports output of estimation with first differencing. First differencing is same as with fixed effects if $T = 2$, but in our analysis interval is longer. Hence, the estimates differ. First differencing allows taking care of feedback effect substantially. Cash flow volatility with 5 years window is not anymore statistically different from zero in the explanation of book leverage ratio, but it is robust with market debt ratio. The coefficients on the all other control have the same sign as we had before, and all is in line with intuition except those of marginal rate of tax and firm age.

Table 7 presents results of estimation with six different proxies for volatility. First look at all the coefficients can make us think that as the length of window rises the explanatory power of volatility estimates go up. However, this is not accidental. As I have talked on the above sections, this is the evidence of target leverage ratios. Additionally, checking the difference on the coefficients with and without firm fixed effect reveals that estimates eroded to downward bias due to omitted variables, and the correlation of invariant firm-specific effects with explanatory variables.

Table 5: Leverage regressions with limited sample

	LEV_m	LEV_b	LEV_m	LEV_b
Volatility 5Y	-0.1279***	-0.0927***	-0.0577**	-0.0381
	(-5.50)	(-3.32)	(-2.74)	(-1.41)
Capital expenditures	0.0114**	0.0002	0.0233***	0.0201***
	(2.89)	(0.05)	(5.96)	(4.97)
Cash & short term invest	-0.1951***	-0.2478***	-0.1043***	-0.1371***
	(-22.16)	(-22.97)	(-11.72)	(-12.22)
Marginal rate of tax	-0.0933***	-0.1149***	-0.0462***	-0.0583***
	(-8.50)	(-8.68)	(-5.49)	(-5.90)
Tangibility	0.0486***	0.0613***	0.0138	0.0031
	(4.89)	(5.43)	(1.15)	(0.21)
Log of firm size	-0.0035**	0.0016	0.0099***	0.0070***
	(-2.80)	(1.15)	(6.90)	(4.01)
Market to book ratio	-0.0240***	-0.0073***	-0.0156***	-0.0077***
	(-23.68)	(-5.41)	(-17.44)	(-6.29)
R&D	-0.0062	-0.0163	-0.0246	-0.0249
	(-0.30)	(-0.59)	(-1.02)	(-0.75)
Net equity issuance	-0.1174***	-0.0825***	-0.0106	-0.0266*
	(-10.43)	(-5.49)	(-1.20)	(-2.12)
Rating dummy	0.0568***	0.0843***	0.0232***	0.0322***
	(11.97)	(15.38)	(5.03)	(6.05)
Firm age	-0.0016***	-0.0016***	-0.0013***	-0.0006*
	(-6.70)	(-5.52)	(-4.37)	(-1.98)
Median industry debt	0.2037***	0.1672***	-0.1240***	-0.0961**
	(9.30)	(6.98)	(-4.11)	(-2.92)
Z-score	-0.0000***	-0.0000**	-0.0000	-0.0000
	(-3.67)	(-2.70)	(-1.51)	(-0.24)
Constant	0.2440***	0.2208***	0.2171***	0.2060***
	(18.50)	(16.24)	(17.61)	(15.71)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Clustering	Firm level	Firm level	Firm level	Firm level
R^2	0.250	0.222	0.395	0.303
Observations	36886	37081	36886	37081

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Leverage regressions with first differencing

	Δ LEV$_m$	Δ LEV$_b$
Δ Volatility 5Y	-0.0301*	-0.0051
	(-2.51)	(-0.42)
Δ Capital expenditures	0.0204***	0.0194***
	(6.75)	(6.23)
Δ Cash & short term invest	-0.0022	-0.0009
	(-0.29)	(-0.10)
Δ Marginal rate of tax	-0.0010	-0.0040
	(-0.19)	(-0.75)
Δ Tangibility	0.0708***	0.0938***
	(4.81)	(6.26)
Δ Log of firm size	0.0215***	0.0023
	(7.85)	(0.78)
Δ Market to book ratio	-0.0013**	-0.0019*
	(-2.60)	(-2.29)
Δ R&D	-0.0151	-0.0096
	(-1.00)	(-0.38)
Δ Net equity issuance	-0.0068	-0.0066
	(-1.29)	(-0.85)
Δ Rating dummy	0.0064*	0.0005
	(2.09)	(0.17)
Δ Firm age	-0.0013	-0.0029
	(-0.60)	(-1.19)
Δ Z-score	-0.0000	-0.0000
	(-1.34)	(-0.23)
Constant	0.0292***	0.0143***
	(7.13)	(3.35)
Time fixed effects	Yes	Yes
Firm fixed effects	No	No
Clustering	Firm level	Firm level
R^2	0.182	0.117
Observations	33105	33137

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Leverage regressions with alternative cash flow volatility windows

Variable	Time fixed effects LEV_m	Time fixed effects LEV_b	Firm & time fixed effects LEV_m	Firm & time fixed effects LEV_b
Volatility 1Y	-0.0441***	-0.0347***	-0.0021	-0.0149**
	(-9.47)	(-6.45)	(-0.51)	(-2.99)
Δ Volatility 1Y	-0.0598***	-0.0544***	-0.0137**	-0.0222***
	(-8.28)	(-6.40)	(-2.04)	(-2.74)
Volatility 3Y	-0.0825***	-0.1265***	-0.0323*	-0.0518***
	(-4.68)	(-6.60)	(-2.30)	(-3.41)
Δ Volatility 3Y	-0.0372**	-0.0770***	-0.0083	-0.0288*
	(-2.64)	(-5.13)	(-0.69)	(-2.12)
Volatility 10Y	0.0789***	-0.1029***	-0.0389**	-0.0530***
	(-5.20)	(-6.12)	(-2.80)	(-3.60)
Δ Volatility 10Y	-0.0380***	-0.0649***	-0.0158	-0.0294*
	(-2.63)	(-4.16)	(-1.14)	(-1.99)

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The robustness checks in three dimensions provide strong support for the baseline estimation results on Hypothesis 1, which are presented in the first subsection of this chapter. Therefore, I argue that volatility measures have an influence on corporate debt decisions.

4.3 Hypothesis 2: Volatility and maturity structure of leverage

In this section, I discuss the estimation output using the standard deviation of EBITDA with 5 years rolling window ($Volatility\ 5Y$) on Table 8, and with its first difference (Δ $Volatility\ 5Y$) on Table 9 as key variables of interest.The dependent variables are debt with long-term (LMD) and short-term maturity (SMD) have been estimated using time, and both time and firm fixed effects model specifications.

Going through Table 8, we can observe that the marginal effects of volatility on both long and short-term leverage support the proposition of Hypothesis 2. In both of the models, the uncertainty measure has statistically significant power in the explanation the variation of the leverage with longer time to mature. But cash flow spread does not show any significance when I regress it on short-term debt and exhibits positive marginal effect. The positive sign can be explained with simple maturity substitution argument. Firms would go for the debt with shorter maturity in an increasingly volatile environment at the result of increasing premiums due to growing default risk.

Table 9 reports the alternative results to ones given in Table 8, but as I reminded above with first difference of volatility measure. The results are to a great extent in line with previous ones, even stronger in economic and statistical size. Based on these results, we can tell ceteris paribus one standard deviation increase in cash flow volatility will lead to decrease in debt with long-term maturity by 11%, and at the same time debt with short-term maturity will increase by 10%.

A quick look on the determinants of the maturity structure of the debt reveals that most of the estimates are in line with prior theoretical and empirical findings, besides those of for Graham's marginal rate of tax and firm age. For instance, firms with higher tangibility, capital expenditures, and bigger size are more likely to have debt with a longer maturity. Moreover, firms with higher Z-score of bankruptcy and cash holdings are less likely to have debts with a longer maturity. Also, we can observe that firms with high R&D intensity are more likely to have short-term debt than longer one as expected.

Table 8: Debt maturity regressions with cash flow volatility

	LMD	SMD	LMD	SMD
Volatility 5Y	-0.1204**	0.0747	-0.0494*	0.0643
	(-2.58)	(1.64)	(-1.97)	(1.39)
Capital expenditures	0.0521***	0.0481***	0.0221*	0.0174*
	(6.98)	(6.18)	(2.51)	(2.03)
Cash & short term invest	-0.0404	-0.1218***	-0.0016	-0.0623**
	(-1.67)	(-4.07)	(-0.07)	(-3.25)
Marginal rate of tax	0.0852***	-0.0703***	0.0188	-0.0287
	(3.66)	(-3.44)	(0.82)	(-1.67)
Tangibility	0.1760***	-0.1870***	0.0071	-0.0145
	(11.11)	(-13.52)	(0.34)	(-0.94)
Log of firm size	0.0389***	-0.0106***	0.0077**	-0.0003
	(17.21)	(-4.86)	(2.62)	(-0.12)
Market to book ratio	-0.0023	0.0066*	-0.0074*	0.0049
	(-0.78)	(2.23)	(-2.50)	(1.87)
R&D	-0.0886	-0.0106	-0.1425*	0.0950
	(-1.73)	(-0.22)	(-2.30)	(1.75)
Net equity issuance	-0.0363	-0.1091***	-0.0200	-0.0424*
	(-1.25)	(-4.47)	(-0.72)	(-2.16)
Rating dummy	0.1265***	-0.0318***	0.0482***	-0.0187**
	(15.44)	(-5.06)	(5.25)	(-2.95)
Firm age	-0.0016***	0.0005	-0.0011*	0.0005
	(-3.70)	(1.47)	(-1.97)	(1.07)
Median industry debt	0.0896*	-0.0774*	-0.0681	0.0448
	(2.56)	(-2.38)	(-1.40)	(1.15)
Z-score	-0.0000***	0.0000***	0.0000	-0.0000
	(-8.30)	(5.25)	(0.07)	(-1.60)
Constant	0.3386***	0.2973***	0.5184***	0.1587***
	(15.73)	(14.86)	(24.44)	(9.33)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Clustering	Firm level	Firm level	Firm level	Firm level
R^2	0.187	0.159	0.319	0.297
Observations	39969	39969	39969	39969

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Debt maturity regressions with Δ cash flow volatility

	LMD	SMD	LMD	SMD
Δ Volatility 5Y	-0.1576***	0.1375***	-0.1056**	0.0985**
	(-4.89)	(4.29)	(-2.78)	(2.77)
Capital expenditures	0.0563***	0.0449***	0.0328**	0.0243*
	(6.74)	(5.22)	(3.20)	(2.51)
Cash & short term invest	-0.0361	-0.1171***	-0.0054	-0.0643**
	(-1.35)	(-3.53)	(-0.19)	(-2.91)
Marginal rate of tax	0.0714**	-0.0471*	0.0044	-0.0223
	(2.78)	(-2.15)	(0.18)	(-1.16)
Tangibility	0.1716***	-0.1784***	0.0125	0.0012
	(10.03)	(-12.02)	(0.52)	(0.07)
Log of firm size	0.0375***	-0.0082***	0.0089*	-0.0009
	(15.11)	(-3.42)	(2.55)	(-0.32)
Market to book ratio	-0.0022	0.0106**	-0.0059	0.0068*
	(-0.65)	(3.18)	(-1.73)	(2.20)
R&D	-0.0677	-0.0086	-0.1367	0.0799
	(-1.17)	(-0.16)	(-1.83)	(1.21)
Net equity issuance	-0.0432	-0.1222***	-0.0253	-0.0499*
	(-1.28)	(-4.55)	(-0.78)	(-2.26)
Rating dummy	0.1269***	-0.0344***	0.0520***	-0.0218**
	(14.37)	(-5.08)	(5.06)	(-3.02)
Firm age	-0.0015**	0.0005	-0.0010	0.0006
	(-3.17)	(1.30)	(-1.60)	(1.20)
Median industry debt	0.0664	-0.0740*	-0.0948	0.0420
	(1.76)	(-2.11)	(-1.62)	(0.90)
Z-score	-0.0000***	0.0000***	-0.0000	-0.0000
	(-7.87)	(4.58)	(-0.06)	(-1.55)
Constant	0.3712***	0.2587***	0.5381***	0.1443***
	(15.99)	(12.53)	(21.63)	(7.32)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Clustering	Firm level	Firm level	Firm level	Firm level
R^2	0.164	0.153	0.327	0.299
Observations	34831	34831	34831	34831

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.4 Robustness checks: Hypothesis 2

To check the consistency of my results from firm fixed effects regression, I do robustness checks with a change in sample space, and also using different volatility windows and first differencing estimation method similar to the checks of Hypothesis 1. Again with the modification to sample space, I exclude firm with age less than 3 to avoid selection bias due to company survivorship (Welch (2006)[44]).

Table 10 shows replicated estimation same as with Table 8, but with the companies that have aged more than 3 years in my sample. Estimation results show that my analysis is robust to selection bias. That is, qualitatively interpretations are the same with the small change in the coefficient values.

Table 11 reports the result of first differencing estimation on the relationship of long and short-term leveraging with cash flow spread of rolled over 5 years. The output gives institution that volatility negatively affects both maturity structure, but in absolute terms, it is higher for debt with maturity more than 3 years. That is in line with hypotheses 2, which tells increasing uncertainty leads to higher cost with longer debt maturity. Additionally, the output shows that for shorter maturity the impact is not statistically different from zero.

Table 12 provides the results on the sensitivity analysis between maturity structure of debt and standard deviation of earnings volatility rolled over 1, 3 and 10 years window. The evidence shows that increasing uncertainty uniformly affects the level of long term debt in diminishing direction. This is especially, correct for the longer windows, which again supports Graham and Harvey (2001)[16] survey results and Hovakimian et al. (2001)[22] empirical results. However, the results for the debt with maturity less than a year are not consistent across the various windows. But in absolute value, the downside effect on leverage with maturity more than 3 years is higher than the short maturity one. Consequently, this supports the proposition of Hypothesis 2.

Table 10: Debt maturity regressions with limited sample

	LMD	SMD	LMD	SMD
Volatility 5Y	-0.1542**	0.0720	-0.0728	0.0866
	(-2.76)	(1.32)	(-1.07)	(1.45)
Capital expenditures	-0.0600***	0.0405***	-0.0361***	0.0250*
	(-6.95)	(4.52)	(-3.42)	(2.46)
Cash & short term invest	0.0269	-0.1139***	-0.0129	-0.0671**
	(0.97)	(-3.32)	(-0.42)	(-2.86)
Marginal rate of tax	0.0841**	-0.0625**	0.0058	-0.0132
	(3.14)	(-2.69)	(0.22)	(-0.65)
Tangibility	0.1641***	-0.1647***	-0.0017	0.0152
	(9.20)	(-10.63)	(-0.06)	(0.76)
Log of firm size	0.0394***	-0.0106***	0.0116**	-0.0014
	(15.30)	(-4.24)	(3.09)	(-0.47)
Market to book ratio	0.0025	0.0078*	0.0083*	0.0048
	(0.71)	(2.28)	(2.37)	(1.48)
R&D	-0.0386	-0.0207	-0.0905	0.0840
	(-0.63)	(-0.36)	(-1.11)	(1.11)
Net equity issuance	0.0582	-0.1536***	-0.0286	-0.0636**
	(1.59)	(-5.46)	(-0.82)	(-2.84)
Rating dummy	0.1231***	-0.0313***	0.0512***	-0.0205**
	(13.30)	(-4.44)	(4.59)	(-2.68)
Firm age	-0.0018***	0.0005	-0.0014*	0.0008
	(-3.58)	(1.32)	(-1.97)	(1.52)
Median industry debt	0.0778*	-0.0917*	-0.1094	0.0447
	(1.99)	(-2.51)	(-1.69)	(0.86)
Z-score	-0.0000***	0.0000***	-0.0000	-0.0000
	(-7.96)	(4.74)	(-0.12)	(-1.48)
Constant	0.3578***	0.2806***	0.5410***	0.1363***
	(14.57)	(12.91)	(20.63)	(6.63)
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Clustering	Firm level	Firm level	Firm level	Firm level
R^2	0.163	0.156	0.335	0.316
Observations	32105	32105	32105	32105

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Debt maturity regressions with first differencing

	Δ LMD	Δ SMD
Δ Volatility 5Y	-0.0508*	-0.0032
	(-1.97)	(-0.71)
Δ Capital expenditures	0.0174	-0.0037
	(1.86)	(-0.42)
Δ Cash & short term invest	-0.0690*	0.0182
	(-2.39)	(0.83)
Δ Marginal rate of tax	-0.0074	-0.0138
	(-0.33)	(-1.01)
Δ Tangibility	0.0729	0.0221
	(1.82)	(0.87)
Δ Log of firm size	0.0102	-0.0119*
	(1.26)	(-2.18)
Δ Market to book ratio	-0.0047	0.0052*
	(-1.51)	(2.03)
Δ R&D	-0.1151	0.0973
	(-1.25)	(1.07)
Δ Net equity issuance	-0.0588*	0.0109
	(-2.19)	(0.66)
Δ Rating dummy	-0.0104	0.0042
	(-0.93)	(0.79)
Δ Firm age	-0.0223**	0.0011
	(-3.12)	(0.21)
Δ Z-score	-0.0000	0.0000
	(-1.58)	(0.06)
Constant	0.0308*	-0.0082
	(2.55)	(-0.86)
Time fixed effects	Yes	Yes
Firm fixed effects	No	No
Clustering	Firm level	Firm level
R^2	0.195	0.173
Observations	28311	28311

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Debt maturity regressions with alternative cash flow volatility windows

	Time fixed effects		Firm & time fixed effects	
	LMD	SMD	LMD	SMD
Volatility 1Y	-0.0280**	-0.0066	-0.0404***	0.0084
	(-2.59)	(-0.67)	(-3.52)	(0.92)
Δ Volatility 1Y	-0.0117	0.0121	-0.0522**	0.0096
	(-0.68)	(0.82)	(-2.88)	(0.63)
Volatility 3Y	-0.1556***	0.1514***	-0.0497	0.0476
	(-3.97)	(3.98)	(-1.22)	(1.31)
Δ Volatility 3Y	-0.1509***	0.1490***	-0.0951**	0.1006**
	(-4.65)	(4.60)	(-2.67)	(2.97)
Volatility 10Y	-0.0945**	0.1050**	-0.0488	-0.0822*
	(-2.79)	(3.12)	(-1.26)	(2.48)
Δ Volatility 10Y	-0.1178***	0.1118***	-0.0791*	0.0760*
	(-3.77)	(3.61)	(-2.08)	(2.24)

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Overall, using different modifications to the baseline estimation approach for Hypothesis 2, I conclude that the proposed sensitivity of debt maturity structure to cash flow volatilities is robust.

5 Conclusions

Theoretical studies on optimal capital structure have learned the role of financial market imperfections due to information asymmetries or agency costs and provided us with a robust framework to further study it in the empirical settings.

The primary interest of this thesis has been cash flow volatility and corporate debt decisions. Following the results of theoretical literature, I built two hypotheses to test the impact of the market imperfections due to increased earnings volatility to the capital structuring behavior of the firms.

I draw my empirical outcomes using two sets of regression. First, I do estimation on the relationship of cash flow volatility with total leverage ratio. The first hypothesis argues that increasing earnings volatility can lead to a decrease in the leveraging level by the firms. The simple intuition behind this argument is that increasing volatility in income flow gives rise to the cost of financial distress , which in turn raises the cost of borrowing. Then using the same empirical setting, I analyze the behavior of maturity structure in response to growing earnings variance. For this, I split the debt into two categories: liabilities with long-term and short-term maturity. The logic here is analogous to the previous one. Increasing uncertainty means higher default risk with the debt that has a longer life to mature. Consequently, this adds us to the premium of borrowing cost.

To conclude, the empirical evidence I provided in this paper supports the argument that the financial market imperfections have a significant role in corporate leveraging. That is, growing earnings volatility tend to draw down the total leveraging level of the companies. Also, this relationship is more prevalent in debt that has maturity than 3 years. Companies should be aware of the marginal effects coming through this channel in their strategic financing decisions.

This thesis contributes to empirical capital structure literature with the analysis of most recent data and also with the synthesis of multiple grounding papers. The results also shed further light on the relationship of leveraging decisions with volatilities in income streams, which is not conclusive yet. Not taking into account this exposure by decision-makers on the company capital structure would result with the built up of systemic risk.

I believe research in empirical corporate finance should further break down the impact of the volatility on the choice debt vs. equity by the firms.

References

[1] Edward I Altman. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The journal of finance*, 23(4):589–609, 1968.

[2] Antonios Antoniou, Yilmaz Guney, and Krishna Paudyal. *The Determinants of Capital Structure: Capital Market-Oriented versus Bank-Oriented Institutions*, volume 43. CEU Library, 2008.

[3] Michael J Barclay and Clifford W Smith. The maturity structure of corporate debt. *the Journal of Finance*, 50(2):609–631, 1995.

[4] F Black and J Cox. Valueing corporate securities: Some effects of bond indenture provisions. *The Journal of Finance*, 31(2):351–367, 1976.

[5] Fischer Black and Myron Scholes. The Pricing of Options and Corporate Liabilities. *Journal of Political Economy*, 81(3):637–654, 1973.

[6] Michael Bradley, Gregg A Jarrell, and E Han Kim. On the existence of an optimal capital structure: Theory and evidence. *The journal of Finance*, 39(3):857–878, 1984.

[7] Michael J Brennan and Eduardo S Schwartz. Corporate income taxes, valuation, and the problem of optimal capital structure. *Journal of Business*, pages 103–114, 1978.

[8] Markus K Brunnermeier and Martin Oehmke. The maturity rat race. *The Journal of Finance*, 68(2):483–521, 2013.

[9] Hui Chen, Hao Wang, and Hao Zhou. Stock Return Volatility and Capital Structure Decisions. *SSRN Electronic Journal*, pages 1–40, 2014.

[10] Thomas Dangl and Josef Zechner. Debt Maturity and the Dynamics of Leverage. *SSRN Electronic Journal*, 2016.

[11] Eugene F Fama and James D MacBeth. Risk, return, and equilibrium: Empirical tests. *Journal of political economy*, 81(3):607–636, 1973.

[12] Murray Z Frank and Vidhan K Goyal. Chapter 12 - Trade-Off and Pecking Order Theories of Debt* A2 - Eckbo, B. Espen BT - Handbook of Empirical Corporate Finance. In *Handbooks in Finance*, pages 135–202. Elsevier, San Diego, 2008.

[13] Irwin Friend and Larry H.P. Lang. American Finance Association An Empirical Test of the Impact of Managerial Self-Interest on Corporate Capital Structure Author (s): Irwin Friend and Larry H . P . Lang Published by : Wiley for the American Finance Association Stable URL : http://www.jst. *The Journal of Finance*, 43(2):271–281, 1988.

[14] Xavier Giroud, Holger M. Mueller, Alex Stomper, and Arne Westerkamp. Snow and leverage. *Review of Financial Studies*, 25(3):680–710, 2012.

[15] John R. Graham. Proxies for the corporate marginal tax rate. *Journal of Financial Economics*, 42(2):187–221, 1996.

[16] John R. Graham and Campbell R. Harvey. The theory and practice of corporate finance: Evidence from the field. *Journal of Financial Economics*, 60(2-3):187–243, 2001.

[17] John R Graham and Mark T Leary. A review of empirical capital structure research and directions for the future. *Annu. Rev. Financ. Econ.*, 3(1):309–345, 2011.

[18] William H Greene. *Econometric analysis*. Pearson Education India, 2003.

[19] J A Hausman. Specification Tests in Econometrics. *Source: Econometrica*, 46(46):1251–1271, 1978.

[20] Zhiguo He and Wei Xiong. Dynamic debt runs. *Review of Financial Studies*, 25(6):1799–1843, 2012.

[21] Bengt Holmstrom and Jean Tirole. Financial intermediation, loanable funds, and the real sector. *the Quarterly Journal of economics*, 112(3):663–691, 1997.

[22] Armen Hovakimian, Tim Opler, Sheridan Titman, Source The, Quantitative Analysis, No Mar, Armen Hovakimian, Tim Opler, and Sheridan Titman. The

Debt-Equity Choice Published by : Cambridge University Press on behalf of the University of Washington School of Business Administration Stable URL : http://www.jstor.org/stable/2676195 The Debt-Equity Choice. 36(1):1–24, 2001.

[23] Robert D. Innes. Limited liability and incentive contracting with ex-ante action choices. *Journal of Economic Theory*, 52(1):45–67, 1990.

[24] Michael O.Connor Keefe and Mona Yaghoubi. The influence of cash flow volatility on capital structure and the use of debt of different maturities. *Journal of Corporate Finance*, 38:18–36, 2016.

[25] Robert A. Korajczyk and Amnon Levy. Capital structure choice: Macroeconomic conditions and financial constraints. *Journal of Financial Economics*, 68(1):75–109, 2003.

[26] MARK T. LEARY and MICHAEL R. ROBERTS. Do Firms Rebalance Their Capital Structures? *The Journal of Finance*, 60(6):2575–2619, 2005.

[27] Mark T. Leary and Michael R. Roberts. Do Peer Firms Affect Corporate Financial Policy? *Journal of Finance*, 69(1):139–178, 2014.

[28] Inmoo Lee and Tim Loughran. Performance following convertible bond issuance. *Journal of Corporate Finance*, 4(2):185–207, 1998.

[29] Hayne E Leland. Corporate debt value, bond covenants, and optimal capital structure. *The journal of finance*, 49(4):1213–1252, 1994.

[30] Hayne E Leland. Corporate debt value, bond covenants, and optimal capital structure. *The journal of finance*, 49(4):1213–1252, 1994a.

[31] Hayne E. Leland. Bond prices, yield spreads, and optimal capital structure with default risk. *Research Program in Finance Working Papers*, (December 1994):1–52, 1994b.

[32] Hayne E Leland and Klaus Bjerre Toft. Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads. *The Journal of Finance*, 51(3):987–1019, 1996.

[33] Michael L. Lemmon, Michael R. Roberts, and Jaime F. Zender. Back to the beginning: Persistence and the cross-section of corporate capital structure. *Journal of Finance*, 63(4):1575–1608, 2008.

[34] Peter MacKay and Gordon M. Phillips. How does industry affect firm financial structure? *Review of Financial Studies*, 18(4):1433–1466, 2005.

[35] Robert C. Merton. On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *The Journal of Finance*, 29(2):449, 1974.

[36] Franco Modigliani and Merton H Miller. The cost of capital, corporation finance and the theory of investment. *The American economic review*, 48(3):261–297, 1958.

[37] Stewart C Myers. Determinants of corporate borrowing. *Journal of financial economics*, 5(2):147–175, 1977.

[38] Stewart C. Myers and Nicholas S. Majluf. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2):187–221, 1984.

[39] Christopher Parsons and Sheridan Titman. *Empirical Capital Structure: A Review*, volume 3. 2007.

[40] Mitchell A. Petersen. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies*, 22(1):435–480, 2009.

[41] Raghuram G Rajan and Luigi Zingales. What Do We Know about Capital Structure? Some Evidence from International Data What Do We Know about Capital Structure? Some Evidence from International Data. *Source: The Journal of Finance THE JOURNAL OF FINANCE*, 50(5):1421–1460, 1995.

[42] SHERIDAN TITMAN and ROBERTO WESSELS. The Determinants of Capital Structure Choice. *The Journal of Finance*, 43(1):1–19, 1988.

[43] Ivo Welch. Capital Structure and Stock Returns. *Journal of Political Economy*, 112(1):106–132, 2004.

[44] Ivo Welch. Common Flaws in Empirical Capital Structure Research. *Working Paper*, (1):1–17, 2006.

[45] Liyan Yang and Haoxiang Zhu. Nonfundamental Speculation Revisited. *Journal of Finance*, 72(6):2759–2772, 2017.

Appendix

Table A1: Variable Definitions

Variables	Proxy
Book value of total debt	Sum of total long term liabilities and debt in current liabilities
Market value of equity	Price of the stock multiplied by the common share outstanding
Market value of total assets	Sum of book value of total debt and market value of equity
Book value of total assets	Total assets from balance sheet of companies
Capital expenditures	Capital expenditures from balance sheet of company normalized by book value of total assets
Cash & short term invest	Cash and short term investments from balance sheet of company normalized by book value of total assets
Marginal rate of tax	Simulated rate of corporate tax provided by Prof. John Graham
Tangibility	Property, plant and equipment from balance sheet of company normalized by book value of total assets
Log of firm size	Log of book value of total assets
Market to book ratio	Market value of total asset of company divided by book value of its total assets
R&D	Research and development expenditures from balance sheet of company normalized by book value of total assets
Net equity issuance	Difference between sale of common & preferred stock and purchase of common & preferred stock normalized by book value of total assets
Rating dummy	Equals to 1 if company has credit rating on its long or short-term debt instruments, otherwise 0
Firm age	Age of company
Median industry debt	Median of industry leverage ratio (total book value of debt divided by book value of total assets) constructed using the 2 digits of SIC industry code
Z-score	Altman's Z-score (1968) computed as [3.3*operating income+sales+1.4*retained earnings + 1.2*(current assets-current liabilities)]