The impacts of cash flow volatility on Chinese firms: Investment, Debt Maturity, Cost of Capital

Zichen Yu

Business School

University of Nottingham

A thesis submitted for the degree of

Doctor of Philosophy

2018

Acknowledgements

The PhD life is a journey, a process of self-improving and refining. During this process, I learnt how to read a paper, how to program, how to do research and how to solve a problem by myself. This experience was an unforgettable and precious journey in my life. Along this journey, I would like to express my special appreciation and great thanks to my supervisors, Dr. Simona Mateut and Dr. Minjia Chen. I would like to thank them for their contributions of time, ideas and exceptional guidance. Without their help and encouragement, I would not finish my PhD.

Moreover, I would like to thank my father and my mother for their unconditional love, support and encouragement. I would also like to thank my friends in the Business School, my friends in China, as well as my flatmates during the four years.

Abstract

This thesis attempts to investigate cash flow volatility on Chinese listed firms. It mainly consists of three empirical chapters on the relation between cash flow volatility and Chinese firms' investment, debt maturity, cost of capital.

The first empirical chapter examines the relation between cash flow volatility and investment by Chinese listed firms. I find that, in China, cash flow volatility is negatively related to firms' investment. This effect of cash flow volatility is obvious for financially constrained firms. However, for financially unconstrained firms, the effects of cash flow volatility are relatively less importance. I also find that the market-to-book ratio has a greater impact on the sensitivity of investment to cash flow volatility than other proxies of financial constraints. Finally, financially constrained firms hold more cash to smooth cash flow, while financially unconstrained firms do not increase cash holdings when they experience high cash flow volatility.

The second empirical chapter examines the relation between cash flow volatility and the debt maturity of Chinese listed firms. The findings of this chapter show that cash flow volatility does not affect the debt maturity of Chinese firms. As the dependent

variables are proportional or fractional variables, I introduce two kinds of fractional response models. The first follows the Papke and Wooldridge (1993), while the second is an extension of the fractional response model proposed by Wooldridge et al. (2011). For the robustness tests, I use the Tobit model, OLS and the Fixed Effects model to estimate the specification. All the results demonstrate that cash flow volatility does not affect the debt maturity of listed Chinese manufacturing firms.

The last empirical chapter investigates the impact of cash flow volatility on the cost of capital in China, distinguishing between the cost of debt and the cost of equity. Four methods are introduced to measure the cost of capital. The industry method (Gebhardt et al., 2001), the PEG ratio (price-earnings ratio divided by short-term earnings growth rate) proposed by (Easton, 2004), and the average of these two methods (PEG ratio and industry method) are used to measure the cost of equity. The measure for the cost of debt is based on the method in Chen and Zhu (2013). To estimate the models, I use two different methods: Fama-Macbeth adjusted using a Newey-West procedure and OLS (clustering by firms). The empirical results show that cash flow volatility increases the cost of equity in China, while the cost of debt is not affected by the volatility of cash flow. The reason for the cost of debt not being affected by cash flow volatility is due to the immature bond market in China. Finally, this chapter finds that while state ownership decreases the cost of debt, it does not affect the cost of equity.

Contents

1 Introduction **1**

1.1 Motivations 1

1.2 Research questions and Empirical findings 4

1.3 Potential contribution 6

1.4 Thesis structure 8

2 Investment and cash flow volatility **9**

2.1 Introduction 9

2.2 Literature review 12

2.2.1 Cash flow and investment 12

2.2.2 Cash flow volatility and investment 17

2.2.3 Cash flow volatility in China 20

2.3 Methodology and Data 22

2.3.1 Specifications and Methodology 22

2.3.2 Sample separation criteria 25

2.3.3 Data set 28

2.3.4 Summary statistics 29

2.3.5 Univariate correlation 31

2.4 Empirical Results and Analysis 31

2.4.1 Investment and cash flow volatility 31

2.4.2 Investment opportunity and cash flow volatility . . . 35

2.4.3 Tangible assets and cash flow volatility 38

2.4.4 Cash flow volatility and cash holdings 39

2.4.5 Robustness test 40

2.5 Conclusion 41

2.6 Tables 44

2.7 Appendix 2A 54

2.7.1 Robustness test(using four rolling years) 54

2.7.2 Robustness test(using six rolling years) 59

2.7.3 Adding financial constraints dummy 64

3 Debt maturity and cash flow volatility 65

3.1 Introduction 65

3.2 Literature review 69

3.2.1 The cash flow volatility, capital structure and debt maturity 69

3.2.2 Capital structure and cash flow volatility of Chinese firms 72

3.3 The models: Specification, Fractional Response Model and Variables Construction 75

3.3.1 Specification 75

3.3.2 The dependent variables and Fractional Response Model 76

3.3.3 Variables Construction 78

3.3.3.1 Cash flow volatility measures 78

3.3.3.2 Other control variables 80

3.4 Sample and Univariate Statistics 82

3.4.1 Sample 82

3.4.2 Univariate Statistics 83

3.4.3 Univariate correlation 84

3.5 Empirical Results and Analysis 85

3.5.1 The Results of Fractional Response Model 85

3.5.2 Applying Fractional Response Model in panel data . 87

3.5.3 Alternative estimators 88

3.5.4 Alternative window length for the CFV measure . . . 89

3.5.5 Cash flow and debt ratio 90

3.6 Conclusion 91

3.7 Tables 94

3.8 Appendix 3A 106

3.8.1 The results of OLS, FE and tobit model 106

3.9 Appendix 3B 109

3.9.1 Robustness tests: Different window lengths of cash flow 109

3.10 Appendix 3C 114

3.10.1 Using cash flow instead of cash flow volatility 114

3.11 Appendix 3D 117

3.11.1 Long-term liability ratio 117

3.11.2 Short-term debt ratio 125

4 Cost of capital and cash flow volatility 133

4.1 Introduction 133

4.2 Literature review 137

4.2.1 Cash flow volatility and the cost of capital: theoretical work 137

4.2.2 Cash flow volatility and the cost of capital: empirical evidence 138

4.2.3 Cash flow volatility in China 141

4.3 Specification 142

4.4 Measuring the cost of capital 143

4.4.1 Cost of equity 143

4.4.1.1 The industry method, following Gebhardt et al. (2001) 145

4.4.1.2 The PEG ratio method, following Easton (2004) 146

4.4.2 Cost of debt 148

4.4.3 Estimation method 148

4.4.3.1 Fama-Macbeth and Newey-West standard Errors 148

4.4.3.2 OLS 149

4.5 Data, Univariate Statistics and correlation matrix 150

4.5.1 Data 150

4.5.2 Univariate Statistics 150

4.5.3 Univariate correlation 152

4.6 Empirical Results and Analysis 153

4.6.1 The results of PEG ratio 153

4.6.2 The results of industry method 155

4.6.3 The results of average of industry method and PEG ratio 155

4.6.4 The results for the cost of debt 156

4.7 Conclusion 157

4.8 Tables 160

5 Conclusion **167**

References **171**

List of Tables

2.1 Descriptive statistics 44

2.2 Descriptive statistics: continue 45

2.3 Correlation Matrix 46

2.4 The effects of cash flow volatility on investment 47

2.5 The effects of cash flow volatility on investment Continue . . 48

2.6 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility 49

2.7 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility Continue 50

2.8 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility Continue 51

2.9 The effects of tangible assets on the sensitivity of investment to cash flow volatility 52

2.10 The effects of cash flow volatility on cash holdings 53

2.11 The effects of cash flow volatility on investment 54

2.12 The effects of cash flow volatility on investment 55

2.13 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility 56

2.14 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility 57

2.15 The effects of tangible assets on the sensitivity of investment to cash flow volatility 58

2.16 The effects of cash flow volatility on investment 59

2.17 The effects of cash flow volatility on investment 60

2.18 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility 61

2.19 The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility 62

2.20 The effects of tangible assets on the sensitivity of investment to cash flow volatility 63

2.21 Adding interaction of cash flow volatility and financial constraints dummy 64

3.1 Summary statistics 94

3.2 Correlation Matrix 95

3.3 The fractional response model without time averages 96

3.4 Small and large firms (FRM without time averages) 97

3.5 Young and old firms (FRM without time averages) 98

3.6 Low and high cash flow firms (FRM without time averages) 99

3.7 Low and high leverage ratio firms (FRM without time averages) 100

3.8 fractional response model with time averages 101

3.9 Small and large firms (FRM with time averages) 102

3.10 Young and old firms (FRM with time averages) 103

3.11 Low and high cash flow firms (FRM with time averages) . . 104

3.12 Low and high leverage ratio firms (FRM with time averages) 105

3.13 The results of OLS 106

3.14 The results of FE 107

3.15 The results of Tobit 108

3.16 The results of fractional response model 109

3.17 The results of fractional response model with time averages . 110

3.18 The results of OLS 111

3.19 results of FE 112

3.20 The results of Tobit 113

3.21 The results of FRM and FRM with time averages 114

3.22 The results of OLS and FE models 115

3.23 The results of Tobit model 116

3.24 Small and large firms (FRM without time averages) 117

3.25 Young and old firms (FRM without time averages) 118

3.26 Low and high cash flow firms (FRM without time averages) 119

3.27 Low and high leverage ratio firms (FRM without time averages) 120

3.28 Small and large firms (FRM with time averages) 121

3.29 Young and old firms (FRM with time averages) 122

3.30 Low and high cash flow firms (FRM with time averages) . . 123

3.31 Low and high leverage ratio firms (FRM with time averages) 124

3.32 Small and large firms (FRM without time averages) 125

3.33 Young and old firms (FRM without time averages) 126

3.34 Low and high cash flow firms (FRM without time averages) 127

3.35 Low and high leverage ratio firms (FRM without time averages) 128

3.36 Small and large firms (FRM with time averages) 129

3.37 Young and old firms (FRM with time averages) 130

3.38 Low and high cash flow firms (FRM with time averages) . . 131

3.39 Low and high leverage ratio firms (FRM with time averages) 132

4.1 Summary statistics 160

4.2 Summary statistics 161

4.3 Correlation matrix 162

4.4 The empirical results of PEG ratio 163

4.5 The empirical results of industry method 164

4.6 The empirical results of average of PEG ratio and industry method 165

4.7 The empirical results of average of cost of debt 166

Chapter 1

Introduction

1.1 Motivations

Cash flow volatility measures the stability of cash flow, which implies that firms with high cash flow volatility are more likely to experience cash flow shortages in the future. In their seminal paper, Minton and Schrand (1999) show that low cash flow may throw budgets into disarray, delay debt repayment or defer capital expenditure. The main findings in the Minton and Schrand (1999)'s study are: cash flow volatility increases the cost of external funds, and lowers firms' investment and their leverage ratio. However, the impact of cash flow volatility is not the same for all firms. Firms with low cash flow have a lower ability to pay interest; and consequently these firms experience more obstacles in obtaining external funds. Firms with high cash flow or firms which can easily obtain external funds are less affected by cash flow volatility. Minton and Schrand (1999) find that large firms and firms with better S&P bond rating, lower total equity-price risk and

lower cost of accessing equity capital show lower sensitivity of investment to cash flow volatility. This means that financially constrained firms (firms with higher cost of external funds) are more sensitive to cash flow volatility. Similarly, Dudley and James (2015) find that cash flow volatility decreases the debt ratio, and this impact of cash flow volatility is more pronounced for the financially constrained firms. High cash flow volatility means high cost of external funds. Therefore, firms need to smooth their cash flow when they suffer high cash flow volatility. They have two ways to smooth cash flow: decreasing investment (Minton and Schrand, 1999) and issuing more debts. Keefe and Yaghoubi (2016) find high cash flow volatility firms hold more short-term debt).

The existing literature mainly focuses on US data and very few papers examine the impact of cash flow volatility in China. China is the second largest economy in the world; the Shanghai Stock Exchange and the Shenzhen Stock Exchange are the fourth and eighth largest stock exchange in the world, respectively. At the same time, despite being the third largest bond market in the world, the Chinese bond market is quite immature. Governmental institutions issue most of the bonds, and the majority of the government-issued bonds are sold to the state-owned commercial banks in China. Given the different institutional settings in the US and China, cash flow volatility may have different impacts on the activities of firms located in the two countries. This is probably one reason for the divergence of results in the empirical literature so far. On the one hand, some studies using Chinese data find results contrasting those obtained by studies employing US data. For instance, Deng et al. (2013) find that cash flow volatility does not affect the investment of Chinese listed firms, while Chen (2004) shows

that earnings volatility does not affect the leverage ratio of Chinese firms. These findings contrast the results in Minton and Schrand (1999) and Keefe and Yaghoubi (2016) which use US firm level data. On the other hand, Ying and Zhengfei (2006) find that earnings smoothness is an important factor on the cost of capital in China, which is consistent with Minton and Schrand (1999).

There are two main motivations of this thesis: firstly, cash flow volatility is an important proxy for firms' financial health. To some extent, cash flow volatility can proxy the expected future cash flow of the firms. The firms with high cash flow volatility are more likely to cut their investment in the future because of potential cash flow shortfall. Moreover, since cash flow volatility increases the cost of obtaining external funds, these firms have to spend more to obtain external funds to cover their future activities. Secondly, the Chinese capital market is underdeveloped. Chinese firms face stronger financial constraints than US firms. When Chinese firms experience high cash flow volatility they have more difficulty in raising external funds to smooth their cash flow or cover their investment. To some extent, cash flow volatility may be more important for Chinese firms than for US firms. Nonetheless, very few papers study the impacts of cash flow volatility on Chinese firms. This thesis sheds some light on how cash flow volatility affects Chinese firms.

1.2 Research questions and Empirical findings

My research focuses on the impacts of cash flow volatility on Chinese listed manufacturing firms. This thesis comprises three related but independent empirical analyses on this topic.

The first empirical chapter investigates whether cash flow volatility affects the investment behaviour of Chinese listed firms. I follow the specification of Minton and Schrand (1999) and add the lag of cash flow volatility. Methodologically, I use the Generalized Method of Moments (GMM) procedure to estimate the dynamic investment model. My results show that cash flow volatility lowers Chinese firms' investment. To test whether the impacts of cash flow volatility are different for the financially constrained and financially unconstrained firms, I split the firms into two groups (financially constrained firms and financially unconstrained firms) on the basis of firms' size, age, level of cash flow and debt ratio. I find that the financially constrained firms are affected by cash flow volatility, while the financially unconstrained firms are less or not affected by cash flow volatility. Finally, in order to test how cah flow volatility affects firms' investment, I follow the method of Han and Qiu (2007), and find that cash flow volatility increases the cash holdings of firms. After spitting the firms into two groups: financially constrained and financially unconstrained firms, I find cash flow volatility increases the cash holding of financially constrained firms , while does not affect financially unconstrained firms.

The second empirical chapter aims to find whether Chinese listed firms hold

more short-term debt to smooth their cash flow when cash flow volatility is high. In this chapter, I choose two proxies for cash flow volatility. One is the standard deviation of the last rolling five years cash flow, the other is the method of De Veirman and Levin (2012). As the dependent variable is a fractional variable bounded between one and zero, I use the Fractional Response Models of Papke and Wooldridge (1993) and Wooldridge et al. (2011) in this empirical chapter. The results show that cash flow volatility does not affect the debt maturity of Chinese listed firms. I also spilt the firms into two groups: financially constrained and financially unconstrained firms, the results remain the same, the debt mature of Chinese listed firms (both of financially constrianed and financially unconstrained firms) are not affected by cash flow volatility. To prove the robustness of my results, I use the OLS, the Tobit and the Fixed Effects estimators, and the results remain unaffected. The conclusion of my second empirical study is different from the study of Keefe and Yaghoubi (2016). This may be due to the fact that the Chinese bond market is underdeveloped, most bonds issued by the firms are sold to the major state-owned banks in China. Thereby, the debt maturity of Chinese listed firms is affected by the percentage of state-owned shares, not by cash flow volatility.

The third empirical chapter investigates how cash flow volatility affects the cost of capital in China, distinguishing between the cost of equity and the cost of debt. I use three methods to measure the cost of equity and one method to measure the cost of debt. In this chapter, I use Fama-Macbeth and OLS clustering by firms to estimate the specification. As the Fama-Macbeth procedure does not consider the time effect, I use the Fama-Macbeth adjusted using a Newey-West procedure in this chapter. My

third empirical study finds that cash flow volatility increases the cost of equity but does not affect the cost of debt in China. The reason why the results of the cost of debt and the cost of equity are different may be due to the immaturity of the bond market, while the equity market is relatively developed in China.

The main findings of this thesis are: 1) cash flow volatility lowers investment and increases the cost of equity in China. These results are in line with findings for US firms. Additionally, I find that the impact of cash flow volatility is more pronounced for financially constrained firms. When cash flow volatility is high, Chinese listed firms have more difficulty in obtaining external funds, and they have to cut their investment. 2) The cost of debt and debt maturity are not affected by cash flow volatility; Chinese firms cannot smooth their cash flow by holding more short-term debt. 3) Cash flow volatility increases the cost of equity, but does not affect the cost of debt in China.

1.3 Potential contribution

This thesis provides new insight into how cash flow volatility affects Chinese listed manufacturing firms. My thesis contributes to the literature in the following ways:

- The thesis complements the literature on the importance of cash flow volatility for firms by examining data for Chinese firms. Most existing studies examine data for the US. Due to the underdeveloped capital

market, Chinese firms have a higher cost of external funds. Cash flow volatility is an important proxy for internal funds and should be more important for Chinese firms. This thesis attempts to help Chinese firms to understand the importance of cash flow volatility, and manage their cash flow volatility.

- The first empirical chapter considers the impact of financial constraints on the sensitivity of investment to cash flow volatility. Minton and Schrand (1999) find cash flow volatility lowers firms' investment in US. However, they do not consider the impacts of financial constraints. This thesis attempts to find whether cash flow volatility affects financially constrained and financially unconstrained firms differently.

- The thesis contributes to the literature from a methodological point of view as well by using more new approaches which have not been employed in the previous studies of cash flow volatility. For instance, in the second empirical chapter, the dependent variables are fractional response variables which are bounded in the [0,1] interval, in addition, contain a significant amount of observations at the boundary values of one or zero. Linear estimation methods (e.g. OLS, Fixed Effects) may produce predicted values that lie outside the unit internal. Non-linear estimation methods (e.g. logit, probit) employ ad-hoc transformations for observations at the boundaries and use restrictive distributional assumptions. Therefore non-linear methods are not suitable when a significant amount of observations is at boundaries. The Fractional Response Model (FRM) of Papke and Wooldridge (1993) is the extension of Generalised Linear Model (GLM), this method overcomes the limitations of linear and non-linear estimation methods above. In

a recent paper, Papke and Wooldridge (2008) introduce Fractional Response Model for panel data. To address the problem of fractional response variables in my second empirical chapter, I employ the Fractional Response Model (Papke and Wooldridge, 1993) and adjusted Fractional Response Model (Papke and Wooldridge, 2008) to estimate the regression. For the third empirical chapter, I use OLS clustering by firms, Fama-Macbeth and Fama-Macbeth adjusted by using a Newey-West procedure to estimate the regression. However the OLS clustering by firms and the Fama-Macbeth do not treat data as panel data. As the data of this chapter is panel data, I use the Newey-West method for estimating standard errors modifies the Fama-Macbeth for use in panel data.

1.4 Thesis structure

The remainder of the thesis proceeds as follows. In Chapter 2, I examine the relation between cash flow volatility and investment in China. In Chapter 3, I examine the relation between cash flow volatility and debt maturity in China. In Chapter 4, I examine the relation between cash flow volatility and the cost of capital. In Chapter 5, I conclude the thesis. The further studies about cash flow volatility in China are also illustrated in this chapter.

Chapter 2

Investment and cash flow volatility

2.1 Introduction

Cash flow volatility is regarded as an important determinant of firms' investments in the study by Minton and Schrand (1999). In their study, they point out that, as explained below, in the US, cash flow volatility decreases firms' investments. It affects investment in two ways: firstly, cash flow volatility can predict future cash flow, secondly, cash flow volatility can affect the cost of external funds.

High cash flow volatility means the firms are more likely to experience cash flow shortfall, and this shortfall will cause a cash flow shortage. To a certain extent, cash flow volatility can proxy expected cash flow. Lewellen and Lewellen (2016) show that investment is strongly related to a firm's

expected cash flow. When firms experience high cash flow volatility, they are more likely suffer lower cash flow in future. As a result, they will not have sufficient internal funds to cover their investments. This is the first way in which cash flow volatility can decrease investments by firms.

The higher probability of a cash flow shortfall is not the only way that high cash flow volatility can affect the investment decisions. Cash flow volatility can also affect the cost of external funds. Minton and Schrand (1999) show that cash flow volatility is positively related to cost of obtaining external funds. Tang and Yan (2010) find that cash flow volatility is a significant explanatory factor for Credit Default Swap (CDS) spreads. Another study of Douglas et al. (2016) states that cash flow volatility has strong effects on bond yield spread. These papers indicate that cash flow volatility increases the cost of raising funds from external source. This is the second aspect that cash flow volatility can decrease investment.

As cash flow volatility proxy the firms' expected cash flow, the methods have been used to study the relation between cash flow and investment can also be used in my study. Cash flow can affect the firms' investments, and the impact of cash flow is different for the financially constrained and financially unconstrained firms. Fazzari et al. (1988) split firms into groups based on the several indexes (firms' size, age, dividend ratio, or information on whether they have access to commercial paper or/and a bond rating) of financial constraints, and find that the sensitivity of investment to cash flow can be used to measure financial constraints. However, Kaplan and Zingales (1997) reach the opposite conclusion when they used different proxies of financial constraints (integrate the information for annual report and management discussion of liquidity with quantitative data and with public news). Cash

flow volatility is calculated on the basis of cash flow, therefore the impact of cash flow volatility may differ for financially constrained and financially unconstrained firms.

Most existing papers study the relation between cash flow volatility and investment in the US. There are very few studies of cash flow volatility in China. This chapter attempts to address this research gap. First, this chapter uses the data of Chinese listed firms to ascertain whether cash flow volatility can lower investment in China. Second, it splits firms into various groups based on different measures of financial constraints to determine whether this effect of cash flow volatility is different for financially constrained and financially unconstrained firms. The results show that financially constrained firms are affected by cash flow volatility, while the financially unconstrained firms are not. Third, this chapter examines how tangible assets affect the sensitivity of investment to cash flow volatility. Finally, I find that cash flow volatility increase cash holdings of financially constrained firms, while financial unconstrained firms' cash holdings are not affected by cash flow volatility. This explains one way in which cash flow volatility affects investment, financially constrained firms hold more cash to smooth cash flow when cash flow volatility is high.

This chapter contributes to the field of study in two ways: 1) It uses data from Chinese listed manufacturing firms; no existing studies examine the relationship between cash flow volatility and investments by Chinese manufacturing firms. The results show that listed manufacturing firms in China lower their investments when cash flow volatility is high. 2) It also finds that financially constrained firms are more sensitive to cash flow volatility.

The rest of this chapter is organized as follows. Section 2 reviews the previous literature. Section 3 describes the data, sample separation criteria and methodology. Section 4 presents the results of how cash flow affects investment and cash holdings in China, and section 5 concludes this chapter.

2.2 Literature review

Cash flow volatility measures the stability of cash flow, and can proxy the expected future cash flow. The methods which have been used to study cash flow can also been used in the studies of cash flow volatility. The literature review has three subsections: the first is the relation between cash flow and investment, and the second is the relation between cash flow volatility and investment, and the last subsection is cash flow volatility in China.

2.2.1 Cash flow and investment

The sensitivity of investment to cash flow has been widely studied in previous papers. It has been regarded as an indicator of the financial constraint since the Fazzari et al. (1988)'s (hereafter,FHP,1988). In their paper, they find that firms with low dividend payout ratio (which are more likely to face financial constraints) show high sensitivity of investment to cash flow. On the other hand, Kaplan and Zingales (1997) (hereafter,KZ,1997) reach the opposite conclusion when they reclassify the same sample (using KZ index to measure the financial constraints) of FHP (1988). They point out that the firms which appear to suffer more financial constraints show the higher sensitivity of investment to cash flow than financially constrained.

Gomes (2001) also shows that the sensitivity of investment to cash flow is theoretically neither sufficient nor necessary to measure the financial constraints of firms.

The different methods of measuring financial constraints may be one of the reasons that have led to opposing conclusions. In examining the methods (different criteria how to split the sample) in previous studies, it is not difficult to ascertain which methods lead to the result of FHP (1988) and which do not. On the one hand, most studies that they define financial constraints using criteria such as payout ratio, firms' age, size, etc., reach the same conclusion of FHP (1988). These criteria are important proxies for showing which firms are more susceptible to information asymmetry, which means that young, small, low payout ratio firms have a higher cost of accessing external funds. These criteria can be seen as a measure of external financial constraints. On the other hand, the majority of studies that classify firms on the basis of indicators such as liquidity, current ratio, or coverage ratio, which are related to the level of internal funds available to the firms, reach the same conclusion as KZ (1997). These indicators can be defined as internal financial constraints.

In line with these categories, this chapter classifies financial constraints into two kinds: internal (the level of internally generated funds available) and external (difficulties in obtaining external funds) financial constraints. Previous papers suggest that internal and external financial constraints have differential impacts on the relation between investment and cash flow. Cleary et al. (2007) construct a model and present a U-shaped relation between available internal funds and investment. They state that the sensitivity of investment to cash flow is determined by two effects: the cost

effect and the revenue effect. The cost effect refers to the possibility that considerable investment may lead to substantial borrowing, which means high repayment costs and a high risk of default. The revenue effect refers to the fact that considerable investment generates substantial revenue, which this will lower the firm's risk of default. The former effect suggests a positive relation between cash flow and investment while the latter effect leads to a negative relationship. The work of Guariglia (2008) finds the similar empirical results to those of Cleary et al. (2007)'s theoretical model. She examines data from unquoted firms in UK and concludes that the relation between cash flow and investment is also U-shaped. These papers prove, reconciliation for FHP's (1988) and KZ's (1997) findings to some extent.

Sorting the sample based on the different periods will also produce different results. A significant challenge to FHP's (1988) work is the study of Chen and Chen (2012), they use the data from 1967 to 2006 in the US and divide these data into 8 groups (five years data for each group) and conclude the sensitivity of investment to cash flow has declined overtime significantly. The result for 2002 to 2006 shows the sensitivity of investment to cash flow is statistically and economically indistinguishable from zero. Hence, they conclude that the sensitivity of investment to cash flow cannot be a good measure of financial constraints.

However this is not the end of debate, the study of Lewellen and Lewellen (2016) indicates that the sensitivity of investment to cash flow does not disappear when they introduce a new measure of cash flow. They point that the standard measure (income before extraordinary items plus depreciation) has become substantially noisier over time as it reflects a variety of noncash expense (deferred taxes, the unremitted portion of earnings

in unconsolidated subsidiaries, losses from the sale of PP&E, and other funds from operations identified standard cash flow). Therefore, they start with standard measure but correct for the noncash items. They find the sensitivity of investment to cash flow is still significant in their sample. Lewellen and Lewellen (2016) show that the standard measure (the method which has been used in the most of existing papers) is incorrect, because it reflects a variety of non-cash expenses (asset write-downs and deferred taxes) which have become more important in recent years. This explain why the sensitivity of investment to cash flow disappear in recent year in the study of Chen and Chen (2012). Lewellen and Lewellen (2016) find that, after controlling the market-to-book ratio, past returns, cash holdings, and debt, the investment is more strongly related to a firm's expected cash flow.

Moshirian et al. (2017) find another important reason that can explain the disappearance of the sensitivity of investment to cash flow in the study of Chen and Chen (2012). Using the 41 countries from 1993 to 2013 period, Moshirian et al. (2017) find the asset tangibility affects the sensitivity of investment to cash flow through two channels: investment intensity and cash flow persistence. The first channel represents the interdependence of physical investment and tangible capital. Manufacturing firms that have higher proportion of tangible productive capital invest more intensively. The US economy experienced a major transformation from traditional industries to service-oriented and high-technology industries. This transformation leads firms to invest in intangible capital to a greater extent and less in tangible capital. Most manufacturing also engaged in research and development (R&D), which changed their productive capital structure. For

this reason, the role of tangible capital and investment has declined. Other developed countries show similar patterns. However, developing countries are structurally different. Their firms have more tangible assets and invest more intensively. In their empirical study, Moshirian et al. (2017) find that the firms with more tangible asset spend more on investment.

The second channel is investment can generate the future income. To some extent, investment can predict future cash flow. Riddick and Whited (2009) find that firms with more predictable cash flow have a stronger incentive to transfer liquid assets into more productive assets, that is, to invest. Intangible assets encompass greater uncertainty than tangible assets. More tangible asset structures support the persistence of cash flow, and a declining share of tangible assets leads to the decline of the sensitivity of investment to cash flow. Riddick and Whited (2009) conclude that the sensitivity of investment to cash flow is non-existent in developed countries because they use fewer tangible assets and adopt more intangible assets in production. In contrast, firms in developing countries operate with more tangible assets, and their sensitivity of investment to cash flow is non-diminishing. Overall, Moshirian et al. (2017) show that tangible assets both affect the information content of cash flow and the rate of physical investment, and determine the sensitivity of investment to cash flow.

Fazzari et al. (1988) and Chen and Chen (2012) use the static model in their studies, however most recent papers employ the dynamic model. Gatchev et al. (2010) point out that static models of financial decision-making produce inconsistent coefficient estimates, and that these models cannot acknowledge that the interdependence of decision variables produces inefficient estimates and provides an incomplete and potentially misleading

view of financial behaviour. Gatchev et al. (2010) employ a dynamic model to examine whether firms are constrained from accessing capital markets. They use nine variables in the dynamic model: capital expenditure, acquisitions, asset sales, equity issues, share repurchases, dividends, change in long-term debt, change in short-term debt, and change in cash flow. In order to properly separate firms into the different groups, they introduce the method of Shumway (2001)'s bankruptcy probabilities to measure the financial constraints. They also use other two criteria to sort the firms: KZ-index and Z-score of Cleary (1999). The conclusions of this study are as follows: 1) they do not find any evidence that firms invest sub-optimally because of an inability to raise external capital; and 2) financing-cash sensitivities are much larger than investment-cash flow sensitivities, regardless of financial health.

2.2.2 Cash flow volatility and investment

Cash flow volatility is calculated on the basis of cash flow and measures the stability of cash flow. Cash flow affects the investment of US firms, and cash flow volatility may affect firms' activities in a similar way. Some papers have studied the relation between cash flow volatility and firms' returns. For example, Huang (2009) uses standard deviations of cash flow to book equity and cash flow to sales to measure cash flow volatility. He concludes that, historically, cash flow is negatively related to future returns, and that this negative association is large, lasting up to five years in the US. Cash flow volatility can also be used to predict returns; for instance, Narayan and Westerlund (2014) employ the data of New York Stock Exchange and find

that cash flow volatility is better than cash flow when predicts the returns. Minton et al. (2002) use a model with and without cash flow volatility to forecast future firm performance and show that the model with cash flow volatility performs better. These results demonstrate that cash flow volatility can actually affect firms' future returns.

The sensitivity of investment to cash flow volatility has also been examined in previous papers. When firms experience high cash flow volatility, they are more likely to experience a cash flow shortfall. This shortfall may force firms to forgo their investment. Minton and Schrand (1999) employ data from the US and studied the impact of cash flow volatility on investment. In their paper, cash flow volatility is defined as the coefficient of variation of operating cash flow over the previous six years. The coefficient of variation is the standard deviation of operating cash flow scaled by the absolute mean value over the same period. Minton and Schrand (1999) point that the high cash flow volatility will lower investment in capital expenditure, R&D, and advertising. This means the firms prefer to forgo investment when they need to use external capital market to cover cash flow shortfall. Then Minton and Schrand (1999) examine the relation between cash flow volatility and the cost of accessing the capital market. They state that cash flow volatility does not only increase the likelihood that firms need to use external funds, it also increases the cost of obtaining it. A more recent paper by O'Connor Keefe and Tate (2013) divide firms in US into two groups (financially constrained and unconstrained firms) and analyse the impacts of cash flow uncertainty on them. They follow De Veirman and Levin (2012) to construct a conditional volatility measure that is different from the Minton and Schrand (1999)'s paper. They regress the growth of firm's operating

cash flow on the time, industry, size and related interactions, and then use the residual to calculate cash flow volatility. O'Connor Keefe and Tate (2013) suggest that financially constrained firms will decrease investment when they (1) suffer persistently high cash flow volatility, (2) experience both high volatility and negative cash flow growth realisations, and (3) hold low cash and experience both negative cash flow growth realisations and high volatility. All of these effects are of minimal economic importance or not found in financially unconstrained firms. Hence, whether firms are financially constrained is the key element in studying the impact of cash flow uncertainty on investment. If firms are financially unconstrained, cash flow uncertainty might not affect the investment behaviour.

Cash flow volatility can increase the costs of external funds. This is perhaps one of the reasons that cash flow volatility affects the firms' investments. Minton and Schrand (1999) show the cash flow volatility increase the cost of accessing the external capital market. Tang and Yan (2010) indicate cash flow volatility can affect CDS spreads. Douglas et al. (2016) point out that cash flow volatility has strong effects on bond yield spread. All three of these papers prove the that firms with higher cash flow volatility will experience a higher cost for external funds. Due to this effect of cash flow volatility, firms with greater cash flow volatility are more likely to be financially constrained. This will cause firms with greater cash flow volatility to reduce their investments.

Minton and Schrand (1999) show that high cash flow volatility mean that firms are more likely to experience a cash flow shortfall. In order to hedge the risk of cash flow shortfall, the firms tend to hold more cash. Han and Qiu (2007) prove that the firms increase their cash holdings in response to

increases in cash flow volatility. This impact of cash flow volatility on firms' cash holdings depends on the degree of financial constraints they experience. This effect is insignificant for the financially unconstrained firms. Greater current cash holdings mean that firms have less cash to invest; this may be another reason why firms decrease investment when they experience high cash flow volatility.

2.2.3 Cash flow volatility in China

Most of previous papers focus on the market in US, which has a developed capital market; however, the capital market in China is less developed. Hence, when firms in China experience great cash flow uncertainty, they may perform differently because they are more likely to suffer the high cost of obtaining outside funds. There are two main differences between these two markets in this study: first, the Chinese capital market is immature, and firms have more difficulty in raising external funds. Second, Chinese firms have more tangible capital than firms in the US. Riddick and Whited (2009) show that the decline and disappearance of the sensitivity of investment to cash flow is due to the declining share of the tangible assets. Investment in China is more sensitive, as firms in developing countries have a greater proportion of tangible assets. As cash flow volatility predicts future cash flow, I expect that the sensitivity of investment to cash flow volatility will be affected by the proportion of tangible assets.

Deng et al. (2013) examine how cash flow uncertainty affects the investments and dividends of Chinese listed firms. They measure the cash flow uncertainty in two ways: cash flow shortfall, which is calculated as the

expected investment plus expected dividend, minus available cash flow (net cash flow from operating activities); and the standard deviation of the ratio of the previous five years scaled by lagged total assets. They divide firms into groups on the basis of their levels of cash flow and cash flow volatility. Their results show that the Chinese listed firms that experience high cash flow volatility will neither cut their investments nor cut dividends. Their results are the opposite of those from US markets. However, I find there are some limitations to their study. First, they do not consider the effects of financial constraints. As O'Connor Keefe and Tate (2013) point out, financially constrained firms will be affected by cash flow volatility while financially unconstrained firms will not, and excluding the effects of financial constraints will bias the results. The second limitation is that Deng et al. (2013) employ the data from almost all Chinese listed firms; however, firms in different sectors behave quite differently; hence, if I follow the studies of Minton and Schrand (1999) and O'Connor Keefe and Tate (2013), and select manufacturing firms, the results will also be different. The last limitation is that Deng et al. (2013) use only a static model to analyse the data and do not consider the problem of endogeneity.

Chen and Zhao (2006) indicate that firms with higher market-to-book ratios face lower debt financing costs, which also means that firms with a high market-to-book ratio face fewer financial constraints. Two other studies point out that the market-to-book ratio affects firms' capital structure. Baker and Wurgler (2002) demonstrate a negative relation between market-to-book ratio and firms' debt ratio. Liu (2009) documents that the historical market-to-book value can affect firms' leverage. These three papers assert that the market-to-book ratio can affect the ability to raise funds from the

external capital market. In this chapter, I also split the sample on the basis of market-to-book ratio. The results are the same with other proxies for financial constraints.

Overall, there appears to be evidence that cash flow volatility can decrease firms' investment in the US, and that the effects of cash flow will vary according to the extent of financial constraints that firms face. The results of this chapter show that cash flow volatility has a similar impact on firms' investment in China.

2.3 Methodology and Data

2.3.1 Specifications and Methodology

Our main baseline specification is:

$$\frac{I_{i,t}}{T_{i,t-1}} = a_0 + a_1 \frac{I_{i,t-1}}{T_{i,t-2}} + a_2 \frac{CF_{i,t}}{T_{i,t-1}} + a_3 CFV_{i,t} + a_4 CONTROLS + \epsilon_{i,t} \quad (2.1)$$

where $I_{i,t}$ means the investment of firm i at year t, $T_{i,t-1}$ means total asset of firm i at year t-1, $CF_{i,t}$ means the cash flow of firm i at year t, $CFV_{i,t}$ represents the cash flow volatility of firm i at year t. The CONTROLS means control variables in the baseline which contains: the MB ratio(the ratio of market value to book value), sales growth, the percentage of state owned shares, the interaction of time and industry dummy. I will estimate this dynamic model for financially constrained and unconstrained firms

receptively. The criteria of spitting the samples into financially constrained and unconstrained firms have been presented in the sample separation criteria section.

In order to test whether the negative cash flow can has an extra impact on sensitivity of investment to cash flow volatility, the following specification has been used:

$$\frac{I_{i,t}}{T_{i,t-1}} = b_0 + b_1\frac{I_{i,t-1}}{T_{i,t-2}} + b_2\frac{CF_{i,t}}{T_{i,t-1}} + b_3 CFV_{i,t} + b_4 NEG * CFV_{i,t} + a_4 CONTROLS + \epsilon_{i,t} \tag{2.2}$$

where NEG [1] equal to 1 if the cash flow is negative.

I estimate the two models using a first difference generalized method of moments (GMM) approach (Arellano and Bond, 1991), and using two or more lags of each regressor as instruments. The interaction of time and industry dummy are also included in the instruments matrix. In all the specifications, the presence of nth-order correlation in the differenced residuals are tested by m(n) test, which is asymptotically distributed as a standard normal under the null of no nth-order serial correlation of the differenced residuals. Due to the serial correlation of order n in the differenced residuals, the instrument set should be restricted to lags n+1 and deeper. The latter instruments are valid in the absence of serial correlation of order n+1 in the difference residuals (Roodman, 2006). Meanwhile if our model is correct, the variables in the instrument set need to be uncorrelated with error term. Hansen test has been introduced to test the validity of

[1] In order to get rid of the effects of financial distressed firms, I exclude the firms which have two or more than two consecutive years negative cash flow

instruments. Under the null hypothesis, the Hansen test for over-identifying restrictions is asymptotically distributed as a χ^2 with degrees of freedom equal to number of instruments less than number of parameters.

Minton and Schrand (1999) present that high cash flow volatility firms are more likely to suffer from a cash flow shortfall, firms may forge their investment because of this shortfall. In order to solve this problem, the firms tend to hold more money to smooth the cash flow. Han and Qiu (2007) point that there is a benefit of holding more cash: this can hedge for the risk of future cash shortfalls. When they hold more money at present, they will have more cash for future investment, but they have to forgo some investment at present. Han and Qiu (2007) document that the firms increase their cash holdings in response to increases in cash flow volatility. And the cash holdings of financially constrained firms are more sensitive to cash flow volatility. This means when firms experience a high cash flow volatility, they will reserve more cash, this effect of cash flow volatility will be more obvious for financial constrained firms. This can be one of the reason that high cash flow volatility firms have lower level of investment. In order to examine this in China, I follow the method of Han and Qiu (2007):

$$\begin{aligned}\frac{Cash_{i,t}}{T_{i,t}} = c_0 + b_1 CFV_{i,t-1} + C_2 \frac{CF_{i,t-1}}{T_{i,t-1}} + c_3 SIZE_{i,t-1} + c_4 MB_{i,t-1} \\ + b_5 LEV_{i,t-1} + \sum_{j=1}^{3} d_j \frac{Cash_{i,t-j}}{T_{i,t-j}} + Y_t + V_i + \epsilon_{i,t}\end{aligned} \tag{2.3}$$

Where $Cash_{i,t}$ is firm i's cash holdings (measured by the cash and cash equivalent) at time t, $T_{i,t}$ is firm i's total asset at time t. Because the cash holdings could be highly persistent, so I use one to three lag term of cash holdings as explanatory variables. $SIZE_{i,t-1}$ is the lag of the natural

logarithm of firm i's total assets. $LEV_{i,t-1}$ is the lag of leverage ratio of firm i. $MB_{i,t-1}$ is the lag of MB ratio which is measured as the market-to-book ratio for firm i at time t-1. Y_t is the year dummy. V_i is the firm specific effect for firm i. I estimate this model for financially constrained and financially unconstrained firms respectively.

2.3.2 Sample separation criteria

In order to test whether cash flow volatility has a differential impact on the investment of different firms, I sort all the firms based on the degree of financial constraints they face, and compare the coefficients of the different groups. I use two kinds of financial constraints: internal and external. I use the average level of cash flow as an indicator of internal financial constraints. If firms have more cash flow, this means they have more internal funds, which in turn means that they are more likely to have sufficient cash to cover their investments. This proxy for internal financial constraint has also been used in Guariglia (2008). I have two groups: firms have high cash flow and firms have low cash flow. Low (high) cash flow means that a firm's average cash flow is below (above) the 50th percentile of the distribution of the cash flow belonging to the same industry in the same year.

The proxies for external financial constraints are the firms' age, size, and debt ratio. I have three kinds of debt ratio: the ratio of total debt to total assets, the ratio of short-term debt to total assets, and the ratio of long-term debt to total assets.

Firms' size is one of the most widely used proxy variables for the level of external financial constraints. Hovakimian and Titman (2006) document

that there are three reasons that small firms to be more likely to be financial constrained. First, empirical results show that the cost of new issues decreases with the size of the issue. This results in small firms having a higher cost of external funds. Second, small firms have less access to external capital because of adverse selection problems. Third, large firms can raise debt more easily than small firms because they are less prone to bankruptcy. Firms' age is similar to firms' size. Guariglia (2008) also uses these two variables to proxy external financial constraints. A firm is small (large) if its total assets are below (above) the 50th percentile of the distribution of the total assets of all the firms belonging to the same industry. A firm is young (old) if its age (in terms of the years it has been listed) is below (above) the 50th percentile of the distribution of the age of all firms belonging to the same industry.

With regard to Leverage, Lang et al. (1996) argue that leverage can decrease investment in a number of ways. First, it reduces the cash available for investment. Second, Myers (1977) and Jensen and Meckling (1976) show that highly leveraged firms may face greater hurdles in accessing external capital markets. To compare both effects separately I introduce three measures of leverage: the ratio of total liabilities to total assets, the ratio of short-term debt to total assets, and the ratio of long-term debt to total assets. A low (high) leverage ratio means that a firm's leverage ratio (the ratio of total liabilities to total assets) is below (above) the 50th percentile of the distribution of the leverage ratio belonging to the same industry and same year. A low short-term (high short-term) debt ratio means that a firm's short-term debt ratio (the ratio of short-term debt to total assets) is below (above) the 50th percentile of the distribution of the short-term debt

ratio belonging to the same industry and same year. A low long-term (high long-term) debt ratio means that a firm's long-term debt ratio (the ratio of long-term debt to total assets) is below (above) the 50th percentile of the distribution of the long-term debt ratio belonging to the same industry and same year.

Having used these criteria above to spilt the sample, I also use market-to-book ratio to spilt the sample. Chen and Zhao (2006) indicate that higher market-to-book ratio firms face lower debt financing costs, which also means that high market-to-book ratio firms face fewer financial constraints. A low (high) market-to-book ratio means that a firm's market-to-book ratio is below (above) the 50th percentile of the distribution of the market-to-book ratios of all firms belonging to the same industry. Then I also sort the firms based on two criteria independently to check whether the market-to-book ratio has an impact on the sensitivity of investment to cash flow volatility.

Finally, I use the ratio of fixed assets to total assets to split the firms. The greater the tangible assets, the easier it is for firms to obtain the debt. Tangible assets measure the financial constraints of firms. The expected result is that firms with fewer tangible assets have higher sensitivity of investment to cash flow volatility. However, Moshirian et al. (2017) show that declining shares of tangible assets can explain the disappearance of the sensitivity of investment to cash flow in the study of Chen and Chen (2012). Therefore, the ratio of tangible assets have two different effects on the sensitivity of investment to cash flow: one the the lower ratio of tangible assets means the higher sensitivity of investment to cash flow, the other is the lower ratio of tangible assets makes the sensitivity of investment to cash flow disappear. Firms in China are different from those in the US,

Chinese firms have a relatively high proportion of tangible assets than US firms. This means sensitivity of investment to cash flow is more likely exists in the Chinese market, and tangible assets may have differential effects on the sensitivity of investment to cash flow or cash flow volatility in China. In this chapter, I test whether the ratio of tangible assets can affect the sensitivity of investment to cash flow volatility in China.

2.3.3 Data set

The sample employed in this chapter comprises data from Chinese listed manufacturing firms from 2004 to 2013. All the data are collected from the China Stock Market Accounting Research (CSMAR) database. Cash flow statements in CSMAR are available from 1998 to 2013; however, I use the last 5 years cash flow to calculate cash flow volatility, so cash flow volatility is available from 2002 to 2013. As the first difference generalised method of moments (GMM) is used, and considering that the twice or more lagged terms are used as instruments, at least three consecutive cross-sectional observations are required for each firm. Hence, the sample which has been used to estimate the regression start from 2004. I also exclude the observations of financially distressed firms in my sample (the firms have two years' consecutive negative cash flow). To control the potential influence of outliers, all the variables are winsorized at 1% level in both tails of distribution. After clearing the data, I have 3660 firm-year observations.

I calculate investment as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets scaled by the total assets. Cash flow volatility is the

standard deviation of the last five years' operating cash flow scaled by the total assets. Market-to-book ratio and sales growth are introduced to proxy the investment opportunity. State ownership is the percentage of the shares owned by state. Due to the special institutional setting in China, ownership is a very important factor for Chinese firms. However, from the data, I find that the percentage of state-owned shares of Chinese manufacturing firms is relatively low. The highest average percentage of state-owned shares is only about 30%. Hence, I do not consider state ownership as a proxy for financial constraints. To control the effects of ownership, I use the percentage of state-owned shares as a control variable in our specification. Lastly, I use an interaction of time dummy and an industry dummy to control for the effects of time and industry (as I use first difference GMM to analyse the data, I cannot control the industry dummy independently).

2.3.4 Summary statistics

Table 2.1 and Table 2.2 report the descriptive statistics of the main variables for the full sample and for the sub-groups. Column 1 in Panel A shows that for the full sample of firms, cash flow volatility has a mean of 0.0542, with standard deviation of 0.0277. Columns 2 to 5 refer to the sub-groups based on the levels of cash flow and market-to-book ratios. Panel B and Panel C refer to the sub-groups based on the proxies for external financial constraints.

Firms with high level of cash flow invest (0.0657) more than the firms with low level of cash flow (0.0386); however, cash flow volatility of these firms is lower than cash flow volatility of firms with low cash flow (cash flow

volatility is 0.0543 and 0.0556 for high and low cash flow firms). This means that when firms experience the same level of cash flow volatility, those with low cash flow have much lower investment than those with high cash flow. I can assume that the investment of low cash flow firms will be more sensitive to cash flow volatility. Columns 4 and 5 indicate that the firms with lower market-to-book ratio invest more than firms with higher market-to-book ratio (0.058 and 0.0487, respectively). However, the lower market-to-book ratio firms have lower levels of cash flow volatility (0.0511 compared to 0.0577).

Examining Panel B and Panel C, I find a similar result to that of panel A. I can find that the higher level of cash flow volatility, the lower the investment. This is the same as Panel A, so I can expect that cash flow volatility is negatively related to investment. The results of cash flow show that the financially constrained firms (small, young, high leverage ratio and high short-term debt ratio firms) have lower level of cash flow. The market-to-book ratio are similar for the young (1.707) and old (1.609) firms. Small firms' market-to-book ratios is 2.087, which is muchhigher than the market-to-book ratios of large firms (1.275). Comparing the data descriptions of the debt ratio sub-groups, I find that firms with a higher debt ratio (total, short-term, and long-term debt ratio) show much lower market-to-book ratios. These findings are consistent with those of Chen and Zhao (2006). They argue that a higher market-to-book ratio means fewer financial constraints. Panel A shows that there is not much difference between firms with low cash flow and those with high cash flow as regards market-to-book ratio (1.673 compared to 1.662). This may because the market-to-book ratio matters more as regards the cost of external funds. Internally financially

constrained firms and internally financially unconstrained firms have similar market-to-book ratios.

2.3.5 Univariate correlation

Table 2.3 reports the pairwise correlation coefficients. While the three measures of cash flow volatility (CFV, CFV4 and CFV6) are strongly positively correlated among each other. At the same time, investment (Int) is negatively related to cash flow volatility (CFV, CFV4 and CFV6). These results are consistent with the empirical results of this chapter: cash flow volatility lower firms' investment. As expected, firms' total asset (TA), cash flow (CF) and market-to-book ratios (MB) are negatively correlated to cash flow volatility (CFV, CFV4 and CFV6). While leverage ratio (Lev) is positively related to cash flow volatility (CFV, CFV4 and CFV6).

2.4 Empirical Results and Analysis

2.4.1 Investment and cash flow volatility

I initially estimate Equal 2.1 and 2.2 using full sample. The results are reported in Table 2.4. In line with the literature (Minton and Schrand, 1999), I also find that cash flow volatility lowers the firms' investment in this chapter. The coefficient of cash flow volatility is -0.345 at a 1% level of significance. The coefficient of $NegCFV$ (negative cash flow times cash flow volatility) in column 2 is insignificant. This result shows that negative

cash flow does not have an extra impact on the sensitivity of investment to cash flow volatility. Therefore, Table 2.4 suggests that firms lower their investment when they experience high cash flow volatility; however, the negative cash flow does not have any extra effects.

Most of coefficients of cash flow in Table 2.4 are insignificant. In order to address the possibility of multicollinearity between cash flow and cash flow volatility, I estimate the regression without cash flow volatility, the results have been shown in column 3 of Table 2.4. The results show the coefficient of cash flow is 0.241 at a 10% level of significant.

The other columns in Table 2.4 show the different effects of cash flow volatility on firms' investment for financially constrained and unconstrained firms. The proxies for financial constraints in this chapter are firms' cash flow, size, age, leverage ratio, long-term debt ratio, and short-term debt ratio. These proxies occur as two classes: internal financial constraints and external financial constraints. The level of cash flow proxies the internal financial constraints firms face. Columns 4 and 5 in Panel A of Table 2.4 shows how the different levels of cash flow affect the sensitivity of investment to cash flow volatility. If firms have lower levels of cash flow, this means that they have less internal funds invest. The coefficient of cash flow volatility for lower cash flow firms is -0.166, and is significant at the 10% level. Firms that have high cash flow are not affected by cash flow volatility. These results demonstrate that firms that are internally financially constrained reduce their investments in response to increases in cash flow volatility, while internally financially unconstrained firms do not.

Panel B and Panel C in Table 2.5 present the results for externally financially

constrained and unconstrained firms. For young firms (column 1 in Panel B), the negative relationship between cash flow volatility and investment (-0.208) is significant at the 1% level. Old firms show the same result as high cash flow firms; cash flow volatility does not affect old firms' investment. This is consistent with the results of O'Connor Keefe and Tate (2013): externally financially unconstrained firms are not affected by cash flow volatility. However, columns 3 and 4 in Panel B show the opposite result. Large firms, which are assumed to be less externally financially constrained, show a very high coefficient of cash flow volatility, -0.470, which is significant at the 5% level. Small firms are not affected by cash flow volatility. This different result may be due to the small firms having a much higher market-to-book ratio (2.087) than the large firms (1.275). Two factors can explain this result. First, a high market-to-book ratio also means the firms have more investment opportunities. I then compared the investment and cash flow of small and large firms. I find that small firms have lower cash flow (0.0481 compared to 0.0604) and investment (0.0439 compared to 0.0617). This means that small firms have more investment opportunities, but they do not have sufficient cash flow to invest (less cash flow), therefore they cannot cut investment because their investment is relatively low. Second, as Cleary et al. (2007) point out, investment can generate profit, this revenue effect makes firms to invest more than they can.

Panel C shows how the firms with different debt ratios respond to cash flow volatility differently. The higher debt ratio means that the firms have more difficulty in obtaining external funds. Column 2 in Panel C shows that the investment of firms with a high leverage ratio (the ratio of total liabilities to total assets) are affected by cash flow volatility (the coefficient

is -0.257, significant at the 5% level). The coefficient of low leverage ratio firms (column 1) is insignificant. Columns 3 and 4 show the impact of cash flow volatility on different degree of short-term debt ratio (the ratio of long-term debt to total asset) firms. Firms with higher long-term debt ratio show higher sensitivity of investment to cash flow volatility, significant at the 1% level. The firms with low long-term debt ratio are not affected by cash flow volatility. The last two columns in Panel C show the results for firms with high and low short-term debt ratios (the ratio of short-term debt to total asset). Low short-term debt ratio firms are not affected by cash flow volatility, while the coefficient of firms having higher short-term debt ratio is -0.251, significant at the 5% level. The results in Panel C show the firms having a higher debt ratio (total liabilities, long-term liabilities, and short-term liability ratio) are affected by cash flow volatility. The more debt firms own, the less able they are to raise external funds; these firms are more affected by cash flow volatility [2].

Panels B and C show that firms that are externally financially constrained are affected by cash flow volatility; however, externally financially unconstrained firms are not affected at all. These results are consistent with those in Panel A; hence I can state that the internally and externally financially constrained firms are affected by cash flow volatility, and that this effect is large and significant. The only exception is using a firm's size to proxy external financial constraints. One possible reason for this is that small firms have a much higher market-to-book ratio, a much lower investment and cash

[2]The coefficient of cash flow in column 3 of Panel C in Table 2.5 is -0.140, significant at 10% level, this may be due to the cash flow has revenue effect (Cleary et al., 2007) : cash flow can generate revenue, this effect suggests a negative relation between cash flow and investment. I estimate the equation 2.1 without cash flow volatility using the same sample, the coefficient of cash flow is negative and significant.

flow, therefore small firms can not cut their investment. In order to check the impact of the market-to-book ratio on the sensitivity of investment to cash flow volatility, I use the market-to-book ratio to sort the sample in next section.

2.4.2 Investment opportunity and cash flow volatility

The results in Table 2.5 show that large firms are more affected by cash flow volatility, which is inconsistent with the results for the other groups. The data descriptions in Table 2.2 show that small firms have much higher MB ratio. On one hand, Chen and Zhao (2006) indicate that a higher market-to-book value can lower the cost of external funds. On the other hand, small firms have lower level of cash flow, this means that they have more investment opportunities than large firms though they do not have sufficient internal funds to invest. These maybe the reasons that large firms show higher sensitivity of investment to cash flow volatility in China. In order to check how the market-to-book ratio affects the sensitivity of investment to cash flow volatility, I introduce the market-to-book ratio as a criterion to split the sample.

First, I sort the firms based on their market-to-book ratio, and compare the sensitivity of investment to cash flow volatility for two groups. Then in each group, I split them into two sub-groups on the basis of the firms' size, cash flow, and leverage ratio. Now I have four sub-groups in each set. By comparing the results for four sub-groups, I can ascertain whether the market-to-book ratio makes a difference for each sub-sample. From Panel A in Table 2.6, I can see that firms that have more investment opportunities

(a higher market-to-book ratio) are not affected by cash flow volatility. The coefficient of cash flow volatility for lower market-to-book ratio firms is -0.360, significant at the 1% level. This result is consistent with that of Chen and Zhao (2006): lower market-to-book firms have higher sensitivity of investment to cash flow volatility.

From Table 2.6, Table 2.7 and Table 2.8, I find all the coefficients of cash flow volatility for higher market-to-book ratio sub-groups are insignificant. These results indicate that firms with higher market-to-book ratio are not affected by cash flow volatility. These results remain the same when I sort firms in the higher market-to-book ratio sub-groups independently based on their size, cash flow levels, and leverage ratio. For the lower market-to-book ratio sub-groups, the results in columns 3 and 4 in Panel A show that small firms are affected by cash flow volatility (-0.187, significant at the 1% level). Large firms are not affected by cash flow volatility. These results show higher market-to-book ratio can explain small firms being more sensitive to cash flow volatility in Table 2. Listed firms in China are relatively large firms, a firm's size maybe not an important proxy for financial constraints in China; the market-to-book ratio maybe a better proxy for the financial constraints on these firms. This explains why the small firms in Table 2.5 are not affected by cash flow volatility, while cash flow volatility lower the investment of small firms in Table 2.6.

From data description in Table 2.1 and Table 2.2, one can observe that high debt ratio firms have lower market-to-book ratios. Low cash flow firms have slightly lower market-to-book ratio than high cash flow firms. These findings confirm that financially constrained firms have a lower market-to-book ratio. To some extent, the market-to-book ratio can function as a

proxy for financial constraints. In the Table 2.7 and Table 2.8, the lower market-to-book ratio groups are split based on the other financial constraint indexes (firms' leverage ratio and level of cash flow), the results remain the same as the results in Table 2.4 and Table 2.5. The results in Table 2.6, Table 2.7 and Table 2.8 for the lower market-to-book ratio sub-groups will be same as the results in Table 2.4 and Table 2.5. Columns 1 and 2 in Panel B in Table 2.7 show that low cash flow firms are affected by cash flow volatility (the coefficient is -0.293, significant at the 5% level), while high cash flow firms are not affected. This is consistent with the results in Table 2.4 firms that are internally financially constrained are more sensitive to cash flow volatility. Columns 1 and 2 in Panel C in Table 2.8 show the same results: firms that are more externally financially constrained (have a high leverage ratio) show a higher sensitivity of investment to cash flow volatility (the coefficient is -0.553, significant at the 10% level).

All the coefficients of the high market-to-book ratio sub-groups are insignificant. These results show that the market-to-book ratio is a key variable for the sensitivity of investment to cash flow. Not even low cash flow firms and high debt ratio firms in the high market-to-book ratio group are affected by cash flow volatility. The results in Table 2.6 show that the market-to-book ratio may measure financial constraints, and that this variable may be a better indicator for measuring financial constraints than the size of firms in China.

2.4.3 Tangible assets and cash flow volatility

Tangible assets affect the sensitivity of investment to cash flow volatility in two aspects. First, having more tangible assets means that firms can obtain the external funds more easily. The less tangible the assets, the higher the sensitivity of investment to cash flow volatility. Second, firms that hold more tangible assets invest more intensely (Moshirian et al., 2017). When the ratio of tangible assets drops to a very low level, the sensitivity of investment to cash flow will disappear (Chen and Chen, 2012). Therefore, the sensitivity of investment to cash flow volatility will also disappear. The second aspect means the firms hold more tangible assets tend to invest more in fixed assets. The lower ratio of tangible assets makes the sensitivity of investment to cash flow volatility disappear. When the first effect is more important, firms with less tangible assets are more affected by cash flow volatility; if the second effect is more important, firms with more tangible assets show a higher sensitivity of investment to cash flow volatility.

From Table 2.9, the coefficient of cash flow volatility in column 1 is 0.370, significant at 1%, while the coefficient of cash flow volatility in column 2 is insignificant. This means firms with more tangible assets are not affected by cash flow volatility, while firms with less tangible assets are. Cash flow volatility decreases investment for the groups with the lower ratio of tangible assets. The results remain the same in column 3 and 4 in Table 2.9 (lower market-to-book ratio sub-groups).

2.4.4 Cash flow volatility and cash holdings

Minton and Schrand (1999) point out that high cash flow volatility means that firms are more likely suffer from a cash flow shortfall. In order to solve this problem, firms tend to hold more cash in response to the increase in cash flow volatility (Acharya et al., 2012). The two-period investment model states that the cash holdings of financially constrained firms are sensitive to cash flow volatility; financial constraints create an inter-temporal trade-off between current and future investment (Han and Qiu, 2007). This means if financially constrained firms experience high cash flow volatility, they will hold more cash to hedge against the risk of a cash flow shortfall. These excess cash holdings will reduce their current investments. Acharya et al. (2012) point out that larger retained cash holdings imply lower investment. The higher the cash flow volatility, the greater the cash holdings; this may cause a decrease in current investment, and this is one of reasons that cash flow volatility can reduce investment.

I follow the method of Han and Qiu (2007), and obtain the results presented in Table 2.10. I use only firms' age and leverage ratio to proxy the financial constraints in this model. I exclude the level of cash flow level as cash flow is highly correlated with cash holdings, and high cash flow firms hold more cash than low cash flow firms. Column 1 in Table 2.10 shows the positive relationship between cash flow volatility and cash holdings (the coefficient is 0.128, significant at the 1% level). This is consistent with the results of Han and Qiu (2007), higher cash flow volatility means that firms hold more cash to hedge against the risk of a cash flow shortfall. Columns 2, 4, and 6 show that financially constrained firms increase their cash holdings in response to

an increase in cash flow volatility (0.438, 0.279, and 0.202, respectively; all coefficients are significant at the 1% level). The cash holdings of financially unconstrained firms are not affected by cash flow volatility.

The results in Table 2.10 are consistent with the results of Han and Qiu (2007), financially constrained hold more cash when they experience a high cash flow volatility, but the financially unconstrained firm are not. As Acharya et al. (2012) point out, greater cash holdings mean a lower level of current investment. This is one of reasons that cash flow volatility lowers the investment of financial constrained firms. When firms experience high cash flow volatility, they tend to hold more cash, and this causes a decrease in firms' investment.

2.4.5 Robustness test

For the robustness test, I use the standard deviation of four and six rolling years to calculate cash flow volatility. Tables 2.11 to Table 2.15 show the results of using the standard deviation of the last four rolling years cash flow to measure cash flow volatility. Tables 2.16 to Table2.20 show the results of using the standard deviation of the last six rolling years to measure the same. The robustness tests also use data from Chinese listed manufacturing firms. As different rolling years are used to calculate cash flow volatility, the number of observations is different. When I use the standard deviation of the last four rolling years to calculate cash flow volatility, there are a greater number of observations. When using the standard deviation of the last six rolling years to measure this, the number of observations decreases slightly.

Most of the results of the robustness test reach the same conclusion. Cash flow volatility reduces investment by Chinese listed manufacturing firms. The impact of cash flow volatility is more obvious for financially constrained firms (lower levels of cash flow, lower leverage ratio, lower market-to-book ratio, and young firms). However, some of the results in Table 2.12 show a different conclusion: for high long-term debt ratio firms, the coefficient of cash flow volatility is insignificant. The differences between the Table 2.5 and Table 2.12 are due to the different measures of cash flow volatility.

Finally, this chapter add the dummy variable of financial constraints in the equation 2.1. The financial constraints dummy variables is the interactions of financial constraints (firms' size, age, cash flow, leverage ratio, market-to-book ratio and tangibility) and cash flow volatility. The results has been shown in Table 2.21. The results show the coefficients of dummy variables are all negative and significant. These are consistent with the results in Table 2.4, Table 2.5 and Table 2.6.

2.5 Conclusion

This chapter empirically first examined the relation between cash flow volatility and investment of all Chinese listed manufacturing firms, and then examined the sensitivity of investment for financially constrained and unconstrained firms. The research is conducted using data from 2002 to 2013 from Chinese listed manufacturing firms. The results show that, in the presence of cash flow volatility, listed manufacturing firms in China lower their investment. This effect of cash flow volatility is different for financially

constrained and financially unconstrained firms. Firms that face greater financial constraints (lower cash flow, higher debt ratio, and younger firms) decrease their investment when they experience high cash flow volatility. The investments of financially unconstrained firms are not affected by cash flow volatility.

The only exception is the firm's size. Large firms are assumed to face fewer financial constraints; however, large firms show higher sensitivity of investment to cash flow volatility than small firms. Comparing the market-to-book ratio of large and small firms, I find the small firms have a much higher market-to-book ratio than large firms. Having sorted the firms based on their market-to-book ratios, I find that a low market-to-book ratio can explain the high sensitivity of investment to cash flow volatility. The results show the investment of all higher MB ratio subgroups are not affected by cash flow volatility, while for the lower MB ratio subgroups cash flow volatility lower the investment of financially constrained firms (small, young, low cash flow and high leverage ratio). The results show that the market-to-book ratio has a greater impact on the sensitivity of investment to cash flow volatility than a firm's size. This means that the market-to-book ratio may be a proxy for financial constraints in China.

Declining shares of tangible assets explain the disappearance of the sensitivity of investment to cash flow in the US. In this study, the sample is split into two groups based on the ratio of tangible assets to total assets; it tested whether the sensitivity of investment to cash flow volatility disappeared. The empirical results show the sensitivity of investment to cash flow volatility does not disappear for the firms with less tangible assets. Cash flow volatility reduces the investment of firms with less tangible assets, while

does not affect firms with a higher proportion of tangible assets. Possessing more tangible assets means that firms can obtain external funds more easily. These results support the contention that the sensitivity of investment to cash flow volatility is higher for financially constrained firms in China.

In order to examine how cash flow volatility affects firms' investment, I examined the relationship between cash flow volatility and cash holdings. I found that financially constrained firms increase their cash holdings in response to increases in cash flow volatility, while the cash holdings of financially unconstrained firms are not affected by cash flow volatility. Financially constrained firms tend to hold more cash in order to smooth cash flow. When firms hold more cash, they have to forgo current investment. This is one of the reasons that financially constrained firms decrease investment when they experience high cash flow volatility.

This chapter contributes to the existing literature in several important dimensions. First, I find that cash flow volatility can affect firms' investment in China, which has not been found in previous papers. Second, the sensitivity of investment to cash flow is higher for financially constrained firms; this sensitivity may be an indicator of financial constraints in China. Third, the market-to-book ratio has a greater impact on the sensitivity of investment to cash flow volatility, meaning that the market-to-book ratio can measure financial constraints in China. Further research should be conducted in this area. Finally, cash flow volatility increases the cash holdings of financially constrained firms in China. Firms hold more cash to smooth cash flow volatility, therefore they have less funds to invest. To some extent, this explains how cash flow volatility affects investment in China.

2.6 Tables

Table 2.1: Descriptive statistics

The Table reports the descriptive statistics. TA is total asset of firms; Int is investment; CF is cash flow; CFV is cash flow volatility; Lev is leverage ratio; MB is the ratio of market value to book value, N is the number of observations, the unit measurement of total asset is million RMB. Firms are separated into the level of cash flow (column 2-3), market-to-book ratio (column 4-5) according to the median value of the respective variable for all the firms belongings to the same industry

panel A	all firms	low CF	high CF	low MB	high MB
	(1)	(2)	(3)	(4)	(5)
TA	6030	3865	7869	9063	2679
	(15520)	(8589)	(19410)	(20490)	(4647)
Lev	0.505	0.527	0.49	0.557	0.445
	(0.179)	(0.189)	(0.173)	(0.158)	(0.183)
Int	0.0536	0.0386	0.0657	0.058	0.0487
	(0.0495)	(0.0428)	(0.0516)	(0.0523)	(0.0457)
CF	0.0548	0.0189	0.0783	0.0525	0.0574
	(0.0636)	(0.0562)	(0.0606)	(0.0592)	(0.0680)
CFV	0.0542	0.0556	0.0543	0.0511	0.0577
	(0.0277)	(0.0322)	(0.0295)	(0.0289)	(0.0316)
MB	1.645	1.673	1.662	0.929	2.443
	(1.401)	(1.621)	(1.611)	(0.562)	(1.907)
N	3660	1484	2176	2,080	1580

Table 2.2: Descriptive statistics: continue

The Firms are separated into size (column 1-2 in panel B), age (column 3-4 in panel B), leverage ratio (column 1-2 in panel C), short-term debt ratio (column 3-4 in panel C) and long-term debt ratio (column 5-6 in panel C) according to the median value of the respective variable for all the firms belongings to the same industry

panel B	small firms	large firms	young firms	old firms
	(1)	(2)	(3)	(4)
TA	1349	9995	6060	6013
	(859.6)	(20250)	(15970)	(15250)
Lev	0.470	0.533	0.481	0.519
	(0.186)	(0.168)	(0.178)	(0.178)
Int	0.0439	0.0617	0.0599	0.0498
	(0.0439)	(0.0524)	(0.0494)	(0.0492)
CF	0.0481	0.0604	0.0541	0.0552
	(0.0640)	(0.0627)	(0.0619)	(0.0645)
CFV	0.0566	0.0522	0.0517	0.0557
	(0.0310)	(0.0296)	(0.0291)	(0.0310)
MB	2.087	1.275	1.707	1.609
	(1.668)	(1.372)	(1.546)	(1.579)
N	1522	2138	1338	2322

	(1)	(2)	(3)	(4)	(5)	(6)
panel C	low lev	high lev	low short	high short	low long	high long
TA	4809	7174	5938	6118	4269	7640
	(16860)	(14060)	(18050)	(12620)	(13500)	(17000)
Lev	0.379	0.622	0.397	0.609	0.452	0.552
	(0.131)	(0.133)	(0.147)	(0.143)	(0.186)	(0.158)
Int	0.0521	0.0551	0.0605	0.0471	0.0420	0.0645
	(0.0454)	(0.0530)	(0.0513)	(0.0469)	(0.0401)	(0.0547)
CF	0.0594	0.0506	0.0630	0.0469	0.0542	0.0553
	(0.0634)	(0.0635)	(0.0632)	(0.0630)	(0.0660)	(0.0613)
CFV	0.0518	0.0565	0.0507	0.0576	0.0560	0.0526
	(0.0291)	(0.0313)	(0.0282)	(0.0320)	(0.0313)	(0.0293)
MB	2.031	1.281	1.918	1.380	1.934	1.381
	(1.720)	(1.309)	(1.661)	(1.422)	(1.717)	(1.365)
N	1784	1876	1827	1833	1710	1950

Table 2.3: Correlation Matrix

The Table reports the correlation matrix. The definitions of variables have been shown in Table 2.1 and 2.2. CFV4 is the standard deviations of last four years cash flow. CFV6 is the standard deviations of last six years cash flow.

	TA	Lev	Int	MB	CF	CFV	CFV4	CFV6
TA	1							
Lev	0.1442	1						
Int	0.0851	0.02	1					
MB	-0.1595	-0.3299	-0.0663	1				
CF	0.791	0.0366	0.1078	-0.0559	1			
CFV	-0.0292	0.074	-0.0188	0.1037	-0.0236	1		
CFV4	-0.0355	0.0752	-0.029	0.1076	-0.0251	0.9001	1	
CFV6	-0.0212	0.0725	-0.0074	0.1018	-0.0171	0.9112	0.8142	1

Table 2.4: The effects of cash flow volatility on investment

This Table reports the results of equation 2.1 and 2.2 (column 2 in Panel A). Column 3 is the result of estimating regression without cash flow volatility. L.Int is the lag term of investment. Sales is the sales growth of the firm. NegCFV is the interaction term of negative cash flow and cash flow volatility. Hansen are the results of Hansen test. The definitions of other variables and separation criteria have been listed in the Table 2.1 and 2.2. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel A	whole	whole	without CFV	low cash flow	high cash flow
	(1)	(2)	(3)	(4)	(5)
L.Int	0.119	0.110	0.360**	0.148**	0.296*
	(0.097)	(0.076)	(0.173)	(0.060)	(0.164)
CF	-0.037	-0.017	0.241*	-0.020	-0.275
	(0.056)	(0.054)	(0.129)	(0.031)	(0.224)
MB	0.001	0.002	0.002	0.004*	0.005
	(0.003)	(0.003)	(0.005)	(0.002)	(0.005)
Sales	0.016	0.011	0.005	0.004	0.026
	(0.011)	(0.008)	(0.025)	(0.006)	(0.028)
CFV	-0.345***	-0.345***		-0.166*	-0.178
	(0.130)	(0.110)		(0.098)	(0.242)
Lev	-0.002	0.031	0.203	-0.012	-0.074
	(0.058)	(0.039)	(0.137)	(0.030)	(0.126)
NegCFV		0.099			
		(0.113)			
N	3,660	3,653	3,854	1,484	2,176
Firms	762	761	762	381	381
m2(p)				0.409	
m3(p)	0.182	0.123	0.976		0.877
Hansen(p)	0.386	0.721	0.102	0.717	0.647

Table 2.5: The effects of cash flow volatility on investment Continue

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2 and 2.4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel B	young	old	small	large
	(1)	(2)	(3)	(4)
L.Int	0.057	0.369***	0.154	0.195
	(0.099)	(0.092)	(0.118)	(0.123)
CF	-0.045	0.005	-0.053	0.012
	(0.072)	(0.109)	(0.079)	(0.072)
MB	0.007	0.004	0.008*	0.002
	(0.005)	(0.004)	(0.004)	(0.006)
Sales	-0.004	0.031	0.019	0.024
	(0.013)	(0.022)	(0.015)	(0.016)
CFV	-0.208***	-0.045	0.094	-0.470**
	(0.016)	(0.165)	(0.185)	(0.186)
Lev	-0.069	-0.043	0.006	-0.088
	(0.051)	(0.089)	(0.104)	(0.085)
N	1,338	2,322	1,522	2,138
Firms	381	381	381	381
m2(p)		0.280	0.560	
m3(p)	0.982			0.775
Hansen(p)	0.895	0.480	0.917	0.598

Panel C	low lev	high lev	low long	high long	low short	high short
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.116	0.147**	0.046	0.081	0.344***	0.114*
	(0.092)	(0.071)	(0.146)	(0.074)	(0.106)	(0.067)
CF	0.047	0.050	-0.140*	-0.033	0.024	0.013
	(0.078)	(0.036)	(0.080)	(0.053)	(0.131)	(0.033)
MB	0.003	0.008***	-0.003	0.009**	0.004	0.007***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.002)
Sales	-0.002	0.012*	0.007	0.016	0.021	0.016**
	(0.011)	(0.007)	(0.015)	(0.010)	(0.021)	(0.007)
CFV	-0.222	-0.257**	-0.267	-0.464***	-0.011	-0.251**
	(0.138)	(0.116)	(0.202)	(0.158)	(0.215)	(0.107)
Lev	0.081	-0.048	-0.064	-0.001	-0.062	-0.009
	(0.072)	(0.035)	(0.088)	(0.054)	(0.103)	(0.030)
N	1,784	1,876	1,710	1,950	1,827	1,833
Firms	381	381	381	381	381	381
m2(p)						
m3(p)	0.384	0.100	0.495	0.327	0.780	0.273
Hansen(p)	0.222	0.602	0.265	0.722	0.483	0.420

Table 2.6: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility

This table reports the results of sample base on two-way independent sorts. I first sort all firms into two groups based on their market-to-book ratio, and independently sort firms into two groups based on their total asset, age, cash flow and leverage ratio. low(high) MB ratio mean the firm's market-to-book ratio is below(above) 50th percentile of the distribution of market-to-book ratio of all firms belonging to the same industry. In each sub-sample, the firms are separated into size (column 3-6) according to the median value of the respective variable for all the firms belonging to the same industry. The definitions of variables and sample separation criteria have been shown in Table 2.1, 2.2 and 2.4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel A	low MB	high MB	low MB		high MB	
			small	large	small	large
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.241***	0.214*	0.139	0.183**	-0.050	-0.131
	(0.078)	(0.116)	(0.113)	(0.092)	(0.080)	(0.173)
CF	0.009	0.053	-0.009	-0.065	0.018	-0.098
	(0.051)	(0.100)	(0.084)	(0.053)	(0.056)	(0.108)
MB	0.019***	0.004	0.014*	0.017**	0.006	0.003
	(0.005)	(0.004)	(0.008)	(0.007)	(0.004)	(0.007)
Sales	0.011	0.027	0.009	0.009	0.001	-0.020
	(0.010)	(0.018)	(0.019)	(0.011)	(0.009)	(0.023)
CFV	-0.360***	0.174	-0.187***	-0.081	-0.154	0.227
	(0.115)	(0.237)	(0.016)	(0.158)	(0.219)	(0.385)
Lev	-0.031	-0.006	0.032	0.102	0.033	-0.205**
	(0.058)	(0.105)	(0.092)	(0.068)	(0.067)	(0.084)
N	2,080	1,580	981	1,099	666	914
Firms	381	381	190	191	190	191
m2(p)						
m3(p)	0.483	0.396	0.0657	0.949	0.435	0.328
Hansen(p)	0.482	0.954	0.659	0.727	0.704	0.951

Table 2.7: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility Continue

This table reports the results of sample base on two-way independent sorts. The definitions of variables and sample separation criteria have been shown in Table 2.1, 2.2 and 2.4. In each sub-sample, the firms are separated into the level of cash flow (column 1-4 in panel B) according to the median value of the respective variable for all the firms belonging to the same industry. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel B	low MB		high MB	
	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
L.Int	0.250***	0.114	-0.098	0.007
	(0.089)	(0.123)	(0.104)	(0.080)
CF	-0.004	0.097	-0.065	-0.007
	(0.052)	(0.113)	(0.083)	(0.050)
MB	0.018**	0.021**	0.006*	0.002
	(0.008)	(0.009)	(0.004)	(0.004)
Sales	0.014	-0.014	0.006	-0.003
	(0.013)	(0.022)	(0.012)	(0.011)
CFV	-0.293**	0.059	-0.061	0.177
	(0.146)	(0.246)	(0.254)	(0.156)
Lev	-0.039	0.262*	0.076	-0.040
	(0.055)	(0.134)	(0.077)	(0.055)
N	861	1,219	618	962
Firms	190	191	190	191
m2(p)	0.213	0.235	0.664	
m3(p)				0.300
Hansen(p)	0.892	0.824	0.969	0.569

Table 2.8: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility Continue

This table reports the results of sample base on two-way independent sorts. The definitions of variables and sample separation criteria have been shown in Table 2.1, 2.2 and 2.4. In each sub-sample, leverage ratio (column 1-4 in panel C) according to the median value of the respective variable for all the firms belonging to the same industry. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel C	low MB		high MB	
	low lev	high lev	low lev	high lev
	(1)	(2)	(3)	(4)
L.Int	0.236	-0.110	0.104	0.136
	(0.178)	(0.169)	(0.119)	(0.151)
CF	0.038	0.027	0.195	-0.023
	(0.104)	(0.086)	(0.125)	(0.081)
MB	0.021	0.012	-0.000	0.008
	(0.016)	(0.015)	(0.005)	(0.006)
Sales	0.001	0.018	-0.016	0.013
	(0.019)	(0.025)	(0.021)	(0.012)
CFV	-0.344	-0.553*	-0.274	-0.073
	(0.308)	(0.289)	(0.322)	(0.238)
Lev	0.085	-0.013	0.078	0.059
	(0.103)	(0.113)	(0.125)	(0.075)
N	1,135	945	774	806
Firms	190	191	190	191
m2(p)			0.228	
m3(p)	0.648	0.0734		0.165
Hansen(p)	0.795	0.173	0.423	0.944

Table 2.9: The effects of tangible assets on the sensitivity of investment to cash flow volatility

This table reports the results of tangible assets on the sensitivity of investment to cash flow volatility. The definitions of variables and sample separation criteria have been shown in Table 2.1, 2.2 and 2.4. Low(high) fixed firms mean firm's ratio of fixed assets to total asset is below(above) 50th percentile of the distribution of ratio of fixed assets to total asset of all the firms belonging to the same industry. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

			low MB		high MB	
	low fixed	high fixed	low fixed	high fixed	low fixed	high fixed
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.117	0.248*	-0.014	0.215*	0.168	-0.028
	(0.090)	(0.137)	(0.090)	(0.121)	(0.119)	(0.132)
CF	-0.173	0.026	0.010	0.019	0.018	-0.023
	(0.193)	(0.055)	(0.040)	(0.106)	(0.082)	(0.108)
MB	0.014**	0.005	0.010*	0.023**	0.008	0.006
	(0.006)	(0.005)	(0.005)	(0.010)	(0.005)	(0.005)
Sales	-0.002	0.023*	0.007	-0.036**	0.002	0.009
	(0.014)	(0.012)	(0.009)	(0.018)	(0.019)	(0.016)
CFV	0.370***	0.199	-0.408***	-0.088	-0.367	0.374
	(0.130)	(0.160)	(0.133)	(0.226)	(0.249)	(0.286)
Lev	0.033	0.032	0.040	0.014	0.202**	0.091
	(0.080)	(0.054)	(0.053)	(0.110)	(0.099)	(0.088)
N	984	817	944	1,088	734	792
Firms	190	191	190	191	190	191
m2(p)	0.131	0.458	0.233	0.275	0.431	0.184
m3(p)						
Hansen(p)	0.500	0.991	0.372	0.912	0.776	0.312

Table 2.10: The effects of cash flow volatility on cash holdings

This table report the results of equation 2.3. C is the constant. The definitions of variables and sample separation criteria have been listed in Table 2.1, 2.2, and 2.4. Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

	whole	young	old	high lev	low lev	low MB	low MB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CFV	0.128***	0.438***	0.0108	0.279***	-0.0368	0.202***	0.0480
	(0.048)	(0.093)	(0.057)	(0.061)	(0.078)	(0.062)	(0.074)
CF	0.209***	0.161***	0.231***	0.146***	0.283***	0.162***	0.258***
	(0.018)	(0.033)	(0.021)	(0.022)	(0.028)	(0.022)	(0.027)
size	0.001	-0.011	0.003	-0.001	0.0044	-0.001	-0.003
	-0.003	-0.008	-0.003	(0.004)	-0.0052	-0.004	-0.005
MB	0.012***	0.013***	0.012***	0.009***	0.015***	0.016***	0.011***
	-0.001	-0.003	-0.002	-0.002	-0.002	-0.004	-0.002
Lev	-0.025**	0.011	-0.032***	-0.01	-0.046***	0.006	-0.04**
	(0.011)	(0.023)	(0.012)	(0.014)	(0.018)	(0.014)	(0.016)
C	0.098	0.321*	0.0529	0.104	0.022	0.108	0.154
	(0.065)	(0.168)	(0.071)	(0.085)	(0.113)	(0.091)	(0.103)
N	4,581	1,465	3,116	2,424	2,157	2,462	2,119
R-sq	0.114	0.135	0.120	0.110	0.139	0.085	0.169
Firms	742	371	371	371	371	371	371

2.7 Appendix 2A

2.7.1 Robustness test(using four rolling years)

Table 2.11: The effects of cash flow volatility on investment

This Table reports the results using 4 rolling years cash flow to calculate the cash flow volatility. The definitions of variables and sample separation criteria have been listed in Table 2.1, 2.2,2.3 and 2.4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel A	whole	whole	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
L.Int	-0.079	-0.091	0.220***	0.119
	(0.120)	(0.122)	(0.081)	(0.098)
CF	-0.042	-0.010	-0.000	-0.091
	(0.070)	(0.083)	(0.064)	(0.060)
MB	-0.003	-0.003	0.005	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Sales	0.012	0.013	0.005	0.011
	(0.014)	(0.014)	(0.013)	(0.012)
CFV4	-0.378**	-0.377**	-0.182***	-0.170
	(0.175)	(0.176)	(0.022)	(0.124)
Lev	-0.001	0.002	0.021	-0.019
	(0.068)	(0.068)	(0.049)	(0.055)
NnegCFV4		0.116		
		(0.157)		
N	3,746	3,746	1,526	2,220
Firms	763	763	381	382
m2(p)			0.796	
m3(p)	0.668	0.548	0.195	0.248
Hansen(p)	0.747	0.767	0.226	0.743

Table 2.12: The effects of cash flow volatility on investment

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4 and 2.5. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel B	young	old	small	large
	(1)	(2)	(3)	(4)
L.Int	0.100	0.121	0.179	0.174
	(0.095)	(0.085)	(0.117)	(0.120)
CF	-0.073	-0.055	-0.080	-0.004
	(0.072)	(0.055)	(0.086)	(0.069)
MB	0.005	0.007**	0.007*	0.001
	(0.005)	(0.003)	(0.004)	(0.006)
Sales	-0.004	-0.001	0.020	0.018
	(0.013)	(0.011)	(0.017)	(0.015)
CFV4	-0.241*	-0.157	0.076	-0.341**
	(0.141)	(0.127)	(0.151)	(0.143)
Lev	-0.078*	0.049	-0.018	-0.087
	(0.047)	(0.058)	(0.103)	(0.081)
N	1,368	2,378	1,562	2,184
Firms	381	382	381	382
m2(p)	0.104		0.351	
m3(p)		0.558		0.541
Hansen(p)	0.866	0.461	0.886	0.430

Panel C	low lev	high lev	low long	high long	low short	high short
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.048	-0.027	0.090	0.094	-0.002	-0.137
	(0.110)	(0.155)	(0.082)	(0.093)	(0.089)	(0.107)
CF	-0.070	0.174	-0.059	-0.096	0.077	-0.119
	(0.066)	(0.112)	(0.058)	(0.098)	(0.049)	(0.079)
MB	0.003	-0.001	0.011**	-0.000	-0.001	0.003
	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
Sales	-0.014	-0.043**	0.014	0.002	0.008	0.020
	(0.012)	(0.018)	(0.011)	(0.008)	(0.009)	(0.015)
CFV4	0.078	-0.200***	-0.103	-0.133	-0.050	-0.465**
	(0.139)	(0.082)	(0.131)	(0.111)	(0.163)	(0.185)
Lev	-0.068	0.219*	-0.035	0.027	0.027	0.019
	(0.059)	(0.123)	(0.054)	(0.043)	(0.042)	(0.071)
N	1,904	1,842	1,983	1,763	1,874	1,872
Firms	381	382	381	382	381	382
m2(p)			55			
m3(p)	0.469	0.179	0.39	0.468	0.884	0.229
Hansen(p)	0.310	0.792	0.387	0.333	0.226	0.948

Table 2.13: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4 and 2.6. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel A	low MB	high MB	low MB		high MB	
			small	large	small	large
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.231***	0.061	0.148	0.098	-0.002	-0.142
	(0.077)	(0.099)	(0.115)	(0.143)	(0.194)	(0.170)
CF	-0.017	-0.039	0.004	-0.003	0.037	-0.099
	(0.049)	(0.051)	(0.084)	(0.087)	(0.074)	(0.107)
MB	0.020***	0.004	0.017**	0.026***	-0.007	0.003
	(0.005)	(0.004)	(0.008)	(0.009)	(0.006)	(0.007)
Sales	0.013	-0.003	0.009	-0.010	-0.002	-0.030
	(0.010)	(0.010)	(0.020)	(0.018)	(0.013)	(0.024)
CFV4	-0.197**	0.066	-0.248***	-0.215	-0.286	-0.172
	(0.093)	(0.141)	(0.060)	(0.169)	(0.239)	(0.282)
Lev	0.001	0.040	0.019	0.344***	0.195*	-0.223**
	(0.056)	(0.064)	(0.092)	(0.111)	(0.102)	(0.087)
N	2,127	1,619	998	1,129	683	936
Firms	381	382	190	191	191	191
m2(p)				0.214	0.529	
m3(p)	0.558	0.124	0.116			0.119
Hansen(p)	0.404	0.286	0.516	0.866	0.665	0.894

Table 2.14: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4, 2.7 and 2.8. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	low MB		high MB	
Panel B	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
L.Int	0.427***	0.122	-0.096	0.190
	(0.162)	(0.133)	(0.111)	(0.123)
CF	-0.155	0.097	-0.056	-0.120
	(0.100)	(0.120)	(0.078)	(0.074)
MB	0.010	0.023**	0.006	0.009
	(0.009)	(0.009)	(0.004)	(0.006)
Sales	-0.004	-0.016	0.017	0.009
	(0.016)	(0.024)	(0.014)	(0.015)
CFV4	-0.142***	0.076	-0.070	0.187
	(0.048)	(0.206)	(0.180)	(0.174)
Lev	0.035	0.313**	0.102	-0.055
	(0.090)	(0.140)	(0.072)	(0.099)
N	886	1,241	635	984
Firms	190	191	191	191
m2(p)				
m3(p)	0.826	0.584	0.141	0.831
Hansen(p)	0.857	0.910	0.993	0.593
	low MB		high MB	
Panel C	low lev	high lev	low lev	high lev
	(1)	(2)	(3)	(4)
L.Int	0.165*	0.101	-0.185**	0.222
	(0.089)	(0.104)	(0.093)	(0.155)
CF	0.066	-0.076	-0.097	0.014
	(0.075)	(0.075)	(0.092)	(0.088)
MB	0.027***	0.011	0.005	0.009
	(0.007)	(0.012)	(0.004)	(0.006)
Sales	-0.007	0.007	0.007	0.011
	(0.016)	(0.013)	(0.013)	(0.012)
CFV4	-0.234	-0.179***	-0.089	-0.014
	(0.158)	(0.094)	(0.157)	(0.179)
Lev	0.141**	-0.054	0.031	0.052
	(0.065)	(0.076)	(0.052)	(0.080)
N	1,173	954	796	823
Firms	190	191	191	191
m2(p)	0.413	0.139		0.378
m3(p)			0.136	
Hansen(p)	0.675	0.919	0.729	0.939

Table 2.15: The effects of tangible assets on the sensitivity of investment to cash flow volatility

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4 and 2.9. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

			low MB		high MB	
	low fixed	high fixed	low fixed	high fixed	low fixed	high fixed
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	-0.077	0.199	0.074	0.195	0.158	-0.194
	(0.133)	(0.139)	(0.133)	(0.124)	(0.113)	(0.164)
CF	0.022	-0.019	-0.120	-0.014	0.021	-0.055
	(0.088)	(0.048)	(0.125)	(0.102)	(0.085)	(0.109)
MB	0.003	0.001	0.004	0.025**	0.005	-0.006
	(0.009)	(0.005)	(0.007)	(0.010)	(0.005)	(0.006)
Sales	-0.012	0.024**	0.011	-0.037**	-0.005	-0.000
	(0.013)	(0.011)	(0.014)	(0.018)	(0.021)	(0.019)
CFV4	-0.333*	0.192	-0.227*	0.060	-0.273	0.092
	(0.192)	(0.147)	(0.118)	(0.175)	(0.219)	(0.224)
Lev	0.096	0.039	0.094	0.011	0.136	-0.033
	(0.075)	(0.059)	(0.075)	(0.110)	(0.088)	(0.096)
N	1,008	848	971	1,106	753	811
Firms	381	382	191	191	191	191
m2(p)		0.343	0.189	0.277	0.180	
m3(p)	0.167					0.19
Hansen(p)	0.776	0.936	0.704	0.925	0.725	0.803

2.7.2 Robustness test(using six rolling years)

Table 2.16: The effects of cash flow volatility on investment

This Table reports the results using 6 rolling years cash flow to calculate the cash flow volatility. The definitions of variables and sample separation criteria have been listed in Table 2.1, 2.2, 2.3 and 2.4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

This Table reports the results using 6 rolling years to calculate the cash flow volatility. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel A	whole	whole2	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
L.Int	0.150	0.236***	0.115*	0.327*
	(0.095)	(0.059)	(0.061)	(0.167)
CF	-0.031	-0.005	0.004	-0.228
	(0.054)	(0.051)	(0.031)	(0.212)
MB	0.003	0.003	0.003	0.004
	(0.003)	(0.002)	(0.002)	(0.005)
Sales	0.015	0.019**	0.002	0.016
	(0.011)	(0.008)	(0.006)	(0.024)
CFV6	-0.436***	-0.346***	-0.351***	-0.014
	(0.139)	(0.094)	(0.128)	(0.264)
Lev	0.000	0.017	-0.003	-0.075
	(0.060)	(0.039)	(0.029)	(0.117)
NegCFV6		-0.004		
		(0.093)		
N	3,550	3,550	1,528	1972
Firms	761	761	380	381
m2(p)			0.344	0.116
m3(p)	0.263	0.464		
Hansen(p)	0.442	0.678	0.718	0.428

Table 2.17: The effects of cash flow volatility on investment

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4 and 2.5. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel B	young	old	small	large
	(1)	(2)	(3)	(4)
L.Int	0.202	0.410***	0.208	0.213*
	(0.188)	(0.092)	(0.129)	(0.123)
CF	-0.062	-0.084	-0.055	0.027
	(0.148)	(0.106)	(0.082)	(0.069)
MB	0.009	0.006	0.006	0.003
	(0.009)	(0.004)	(0.004)	(0.006)
Sales	0.003	0.035	0.017	0.032*
	(0.020)	(0.025)	(0.017)	(0.017)
CFV6	-0.148***	-0.051	0.185	-0.450**
	(0.049)	(0.160)	(0.241)	(0.175)
Lev	-0.079	0.077	-0.018	-0.093
	(0.117)	(0.108)	(0.106)	(0.077)
N	1,370	2180	1,549	1951
Firms	380	381	380	181
m2(p)	0.210		0.614	
m3(p)		0.719		0.989
Hansen(p)	0.821	0.675	0.951	0.766

Panel C	low lev	high lev	low long	high long	low short	high short
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	-0.004	0.192***	-0.012	0.072	0.385***	0.145**
	(0.102)	(0.073)	(0.152)	(0.093)	(0.107)	(0.070)
CF	0.011	0.052	-0.120	-0.016	-0.010	0.023
	(0.059)	(0.044)	(0.076)	(0.062)	(0.136)	(0.034)
MB	0.002	0.009***	-0.002	0.008	0.005	0.006**
	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.002)
Sales	-0.009	0.012	0.008	0.018	0.017	0.018**
	(0.013)	(0.008)	(0.016)	(0.012)	(0.019)	(0.007)
CFV6	0.109	-0.226*	-0.120	-0.138	-0.055	-0.266**
	(0.198)	(0.126)	(0.292)	(0.145)	(0.240)	(0.113)
Lev	0.063	-0.034	0.024	0.026	-0.023	-0.007
	(0.069)	(0.044)	(0.086)	(0.059)	(0.116)	(0.031)
N	1,740	1,810	1,701	1849	1,682	1868
Firms	380	381	380	381	380	381
m2(p)		0.219			0.312	0.163
m3(p)	0.140		0.455	0.513		
Hansen(p)	0.337	0.684	0.1782	0.702	0.530	0.491

Table 2.18: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4 and 2.6. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Panel A	low MB	high MB	low MB		high MB	
			small	large	small	large
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.277***	0.272**	0.202**	0.180	-0.078	-0.119
	(0.077)	(0.117)	(0.090)	(0.115)	(0.082)	(0.158)
CF	0.013	0.018	-0.077	-0.040	0.014	-0.151
	(0.054)	(0.103)	(0.058)	(0.073)	(0.054)	(0.189)
MB	0.017***	0.003	0.017**	0.012	0.006	-0.003
	(0.005)	(0.004)	(0.007)	(0.009)	(0.004)	(0.007)
Sales	0.015	0.024	0.014	0.006	-0.008	-0.013
	(0.010)	(0.021)	(0.012)	(0.019)	(0.010)	(0.019)
CFV6	-0.255**	0.025	-0.239***	0.073	-0.158	-0.064
	(0.129)	(0.247)	(0.094)	(0.186)	(0.230)	(0.318)
Lev	0.013	0.019	0.118**	0.005	0.131	-0.152*
	(0.053)	(0.105)	(0.057)	(0.085)	(0.081)	(0.092)
N	2,032	1,518	1,031	1,001	602	916
Firms	380	381	190	190	190	191
m2(p)	0.321	0.237				
m3(p)			0.864	0.126	0.165	0.254
Hansen(p)	0.328	0.952	0.917	0.877	0.766	0.842

Table 2.19: The effects of market-to-book ratio on the sensitivity of investment to cash flow volatility

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2, 2.3, 2.4, 2.7 and 2.8. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	low MB		high MB	
Panel B	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
L.Int	-0.104	0.188	-0.097	0.235*
	(0.118)	(0.120)	(0.110)	(0.133)
CF	-0.055	0.015	-0.100	-0.122
	(0.061)	(0.123)	(0.077)	(0.078)
MB	0.013	0.018**	0.006	0.006
	(0.010)	(0.008)	(0.004)	(0.006)
Sales	0.012	-0.009	0.011	0.003
	(0.015)	(0.024)	(0.015)	(0.018)
CFV6	-0.414*	-0.073	-0.069	0.516*
	(0.243)	(0.247)	(0.317)	(0.276)
Lev	0.135	0.094	0.013	-0.112
	(0.085)	(0.103)	(0.078)	(0.108)
N	891	1,141	616	902
Firms	190	191	190	191
m2(p)		0.484	0.683	
m3(p)	0.679			0.907
Hansen(p)	0.734	0.697	0.732	0.462
	low MB		high MB	
Panel C	low lev	high lev	low lev	high lev
	(1)	(2)	(3)	(4)
L.Int	0.349**	0.316***	0.040	0.085
	(0.166)	(0.102)	(0.135)	(0.155)
CF	-0.014	-0.024	0.048	-0.043
	(0.092)	(0.052)	(0.120)	(0.081)
MB	0.025	0.012	0.004	0.004
	(0.015)	(0.010)	(0.006)	(0.006)
Sales	0.009	0.008	-0.040	0.006
	(0.021)	(0.016)	(0.025)	(0.012)
CFV6	0.033	-0.410***	-0.504	0.036
	(0.371)	(0.188)	(0.112)	(0.230)
Lev	0.122	-0.054	0.094	0.113
	(0.103)	(0.072)	(0.142)	(0.071)
N	1,070	962	798	717
Firms	190	194	190	191
m2(p)		0.572	0.141	0.128
m3(p)	0.760			
Hansen(p)	0.927	0.946	0.295	0.883

Table 2.20: The effects of tangible assets on the sensitivity of investment to cash flow volatility

This Table reports the results of equation 2.1. The definitions of variables and separation criteria have been listed in the Table 2.1, Table 2.2, 2.3, 2.4 and 2.9. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

			low MB		high MB	
	low fixed	high fixed	low fixed	high fixed	low fixed	high fixed
	(1)	(2)	(3)	(4)	(5)	(6)
L.Int	0.058	0.272*	0.042	0.188*	0.194	0.118
	(0.089)	(0.146)	(0.100)	(0.104)	(0.124)	(0.157)
CF	-0.006	-0.047	0.020	-0.062	0.019	0.012
	(0.057)	(0.054)	(0.042)	(0.112)	(0.078)	(0.115)
MB	0.004	0.003	0.010*	0.022**	0.007	0.003
	(0.007)	(0.005)	(0.006)	(0.010)	(0.006)	(0.004)
Sales	-0.005	0.029**	0.012	-0.037*	-0.022	0.004
	(0.011)	(0.013)	(0.009)	(0.020)	(0.023)	(0.014)
CFV6	-0.312***	0.155	-0.419***	-0.269	-0.185	0.358
	(0.119)	(0.243)	(0.150)	(0.296)	(0.257)	(0.298)
Lev	0.081*	0.038	0.041	0.029	0.182*	0.061
	(0.048)	(0.059)	(0.050)	(0.112)	(0.102)	(0.088)
N	1,003	841	975	1,109	756	810
Firms	190	191	190	191	190	191
m2(p)				0.172	0.381	0.421
m3(p)	0.135	0.752	0.674			
Hansen(p)	0.927	0.971	0.741	0.689	0.777	0.304

2.7.3 Adding financial constraints dummy

Table 2.21: Adding interaction of cash flow volatility and financial constraints dummy

This Table reports adding interaction of cash flow volatility and financial constraints dummy. The definitions of variables and separation criteria have been listed in the Table 2.1, 2.2 and 2.4. Column 1-6 is using firms' size, year, cash flow, leverage ratio, MB ratio and tangibility to proxy financial constraints. dummycfv is interaction of cash flow volatility and financial constraints dummy. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	size	year	CF	Lev	MB	tangibility
L.Int	0.158**	0.231***	0.158**	0.159**	0.159**	0.118
	(0.070)	(0.059)	(0.070)	(0.070)	(0.070)	(0.076)
CV	0.060	0.024	0.060	0.066	0.066	0.076
	(0.100)	(0.099)	(0.100)	(0.100)	(0.100)	(0.097)
MB	0.004	0.004**	0.004	0.004	0.004	0.005*
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Sales	0.012	0.020**	0.012	0.013	0.013	0.016*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
CFV	-0.081**	-0.055	-0.081**	-0.088**	-0.088**	-0.080*
	(0.039)	(0.037)	(0.039)	(0.040)	(0.040)	(0.041)
lev	0.014	-0.013	0.014	0.008	0.008	-0.024
	(0.040)	(0.036)	(0.040)	(0.040)	(0.040)	(0.041)
dummycfv	-0.495***	-0.367***	-0.345***	-0.389***	-0.217*	-0.532***
	(0.117)	(0.109)	(0.096)	(0.097)	(0.122)	(0.134)
N	3,660	3,660	3,660	3,660	3,660	3,660
Firms	762	762	762	762	762	762
m3(p)	0.257	0.478	0.257	0.280	0.280	0.212
Hansen(p)	0.647	0.498	0.647	0.676	0.676	0.575

Chapter 3

Debt maturity and cash flow volatility

3.1 Introduction

Firms have more current funds if they raise external funds, however they have to pay debt, which makes them have less funds in the future. When firms decide how to use debt financing, they are reallocating their expected future cash flow and their current internal funds. Low cash flow firms tend to have more short-term debt and less long-term debt. Cash flow volatility measures the stability of cash flow, and high cash flow volatility means that these firms are more likely to experience low cash flow in the future. If firms suffer high cash flow volatility, they have to hold more short-term debt to smooth cash flow.

Many previous papers have focused on the factors affecting firms' capital structure and debt maturity. However, very few papers consider the impacts of cash flow volatility on firms' capital structure and debt maturity. Some research has found that cash flow volatility does not have influence on the

capital market. For example, Frank and Goyal (2009) show that cash flow volatility does not robustly explain firms' capital structure in the US. In contrast, Keefe and Yaghoubi (2016) reach the opposite conclusion; they use several different methods to measure cash flow volatility and conclude that it has a strong effect on the capital market and on debt maturity in the US.

The majority of existing studies focus on the behaviour of US firms, though some researchers use data from other developed countries to analyze which variables will affect firms' leverage. Rajan and Zingales (1995) employ data from the G-7 countries and conclude that the variables that affect firms' leverage in the US also affect the leverage of firms in the G-7 countries. Caglayan and Rashid (2014) investigate the effects of idiosyncratic and macroeconomic uncertainty on firms' leverage. They use the data of public and non-public firms in UK, and find both of idiosyncratic and macroeconomic uncertainty lower the leverage of firms in UK. However, Wald (1999) argues that the different institutional settings in different countries create different outcomes. China is the largest developing economy in the world and has a less developed capital market than US. The special institutional settings in China may affect Chinese listed firms' capital choice decisions. Chen (2004) uses firm-level panel data to study the determinants of the capital structure of Chinese listed firms. He finds that Chinese firms have much lower long-term debt, which shows that they prefer short-term finance to long-term finance. Chen (2004) concludes that the trade-off model and the pecking order hypothesis, which are derived from Western settings, cannot robustly explain the capital choice preferences of Chinese listed firms. He finds that they follow a new pecking order: retained profit, then equity,

and lastly, debt. As equity financing is not binding, firms prefer equity finance to debt finance. Chen (2004) also considers earnings volatility (the absolute value of the first difference of the percentage change of operation income) in his study, and he finds that earnings volatility does not affect capital structure in China. However, the impacts of cash flow volatility and earnings volatility on capital structure are different. There are no papers that study the impact of cash flow volatility on the capital structure and debt maturity of Chinese listed firms. To fill this gap, this chapter studies how cash flow volatility affects debt maturity in China.

The variable of interest in this study is cash flow volatility, and I use two different measures of cash flow volatility. The first is the standard deviation of the last five rolling years' cash flow. This method has been widely used in previous studies; most existing papers which focus on cash flow volatility use this method. For the robustness test, I use the standard deviation of the last four and six rolling years' cash flow, the results remain the same. The second is the method followed by De Veirman and Levin (2012), which has only been used on data from the US and Japan. Due to the different industry classifications and distribution of listed firms' size between Chinese firms and US firms, this method may lead some bias.

The dependent variables in this study are bounded between zero and one. Linear estimation methods (the OLS and fixed-effect models) are not appropriate in such cases. The major problem is that the linear model may lead to predict values of the dependent variables that lie outside the natural internal. This chapter employs fractional response models (FRMs) to address the problems of fractional response dependent variables. Two types of FRMs are used in this study: the first is that proposed by Papke

and Wooldridge (1993). However, this FRM treats the data as pooled cross-sectional data and does not consider time effects. The other estimation method used in this chapter is the extension of the FRM proposed by Wooldridge et al. (2011). This method adds the time average of all time varying regressors to capture the time effect. For the robustness test, I use the Tobit model, OLS, and the Fixed Effects model to estimate the specification. All of the results reach the same conclusions.

There are three main contributions stemming from this chapter. The first is that it studies the relation between cash flow volatility and debt maturity in China. The Chinese capital market is less developed than the US capital market, and especially the bond market in China is quite immature. Most of firms' debt is issued by the major banks in China. The second contribution is that I use several different methods to calculate cash flow volatility. The last contribution is that this chapter employs two kinds of FRMs to solve the problem of bounded variables.

This chapter is organized as follows: Section 2 reviews the existing literature. Section 3 introduces the models used in this paper. Section 4 reviews the data, introduces the variables and specification in the paper, and then reports the univariate statistics. Section 4 presents the relation between cash flow volatility and debt maturity in China. Section 5 concludes this chapter.

3.2 Literature review

3.2.1 The cash flow volatility, capital structure and debt maturity

The factors affecting firms' capital structure and debt maturity have been widely discussed over the last 40 years. Frank and Goyal (2009) use US data from 1950 to 2003 to ascertain which factors are relatively important for capital structure. They find that a set of six factors from twenty-five variables are reliable for explaining market leverage. These variables are: median industry leverage, market-to-book assets ratio, tangibility, profits, log of assets, and expected inflation. In addition to these six variables, others have also been examined in previous studies. Shenoy and Koch (1996) point out that leverage and cash flow are negatively related, while across-time leverage increases when future cash flow increases.

Cash flow is an important proxy for firms' health as greater cash flow means that the firms have more internal funds to adjust its capital structure. Cash flow does not only affect firms' leverage (Shenoy and Koch, 1996), but also affects the speed of adjustment towards the leverage target. Faulkender et al. (2012) demonstrate that firms with high leverage ratios and high cash flow make larger capital structure adjustments than firms with low leverage ratios and low cash flow. Financial constraints can also affect the speed with which firms adjust to target leverage ratios. Financially unconstrained firms adjust much faster than constrained firms when they are under-levered, but slower when they are over-levered (Faulkender et al., 2012).

Cash flow volatility measures the stability of cash flow, and high cash flow

volatility means less stable cash flow. Prior studies have investigated the relation between cash flow volatility and the cost of external funds, and have found that cash flow volatility increases the cost of external funds. Minton and Schrand (1999) show that cash flow volatility can increase the cost of accessing the external capital market. Tang and Yan (2010) indicate that cash flow volatility can affect CDS spreads. Douglas et al. (2016) point that cash flow volatility has strong effects on bond yield spread. These three papers all show that firms with higher cash flow volatility experience higher costs for external funds. Due to this effect, firms with higher cash flow volatility are more likely to be financially constrained. Higher cost of external funds can change the capital structure of firms.

The relation between cash flow volatility and capital structure has also been examined in previous studies. Existing studies reach two opposite results. On the one hand, Antoniou et al. (2008) and Leary and Roberts (2005) show that cash flow volatility cannot explain capital structure. On the other hand, some studies find that cash flow volatility can affect capital structure: Bradley et al. (1984) and Friend and Lang (1988) find a negative relation between cash flow volatility and leverage.

A more recent study by Keefe and Yaghoubi (2016) reaches the same conclusion as Bradley et al. (1984) and Friend and Lang (1988). Keefe and Yaghoubi (2016) construct a theoretical model based on Black and Scholes (1973)'s model to illustrate a positive relationship between cash flow volatility and the cost of debt. On the basis of this model, Keefe and Yaghoubi (2016) make two hypotheses: that firms with high cash flow volatility use less debt, and that firms with high cash flow volatility use less (more) longer-term (shorter-term) debt. Having constructed the theoretical

model, Keefe and Yaghoubi (2016) empirically examine the relationship between cash flow volatility and capital structure. They summarise prior studies and classify measures of cash flow into two kinds: operational income before depreciation and cash-based operational profit. They use net assets to scale these two kinds of cash flow. Then they use two methods to estimate volatility: the last five rolling years' standard deviation of cash flow, and the method of De Veirman and Levin (2012). Lastly, they estimate the regression using annual US data from 1974 to 2012. Across all the approaches, Keefe and Yaghoubi (2016) conclude that cash flow volatility is an important determinant of firm' capital structure. For the robustness tests, they first measure cash flow volatility over different window lengths. Second, they use panel, zero-inflated beta, and OLS estimation methods. Using different measures of cash flow volatility and econometric methods in their research, Keefe and Yaghoubi (2016) show that cash flow volatility is negatively related to leverage.

Dudley and James (2015) obtain a similar result to that of Keefe and Yaghoubi (2016), that firms with high cash flow volatility have a lower debt ratio. Dudley and James (2015) use a different way to measure cash flow volatility. They use a generalised autoregressive conditional heteroskedasticity (GARCH) process on quarterly data to measure cash flow volatility. They argue that the GARCH model estimates are better than those of other measures of cash flow volatility. Most previous studies calculate cash flow volatility based on a moving average of past cash flow. This method makes cash flow volatility change very slowly over time and treats all past cash flow as having the same weighting. Using equal weighting leads to the situation where recent changes in cash flow are no more relevant

than changes in cash flow two or five years previously. In addition, they introduce the effects of financial constraints and ascertain whether financial constraints make a difference. The results of their study show that cash flow volatility has a greater impact on financially constrained firms. Dudley and James (2015) state that the reason for this is that financially constrained firms suffer positive shocks of cash flow volatility, and hence they perform differently from financially unconstrained firms. Financially constrained firms aggressively issue debt when cash flow is low, but have trouble lowering the leverage when cash flow volatility is high.

Firms that experience high cash flow volatility decrease their leverage ratio; however, this does not smooth their cash flow volatility. Keefe and Yaghoubi (2016) focus on the relationship between cash flow volatility and debt maturity. They find that cash flow volatility decreases (increases) the long-term (short-term) debt ratio in the US. This means that highly volatile firms hold more short-term debt to smooth their cash flow.

3.2.2 Capital structure and cash flow volatility of Chinese firms

The capital market in China is different from the capital market in the US. As China is a developing country, Chinese firms have more difficulty obtaining external funds. The bond market especially in China is quite immature, and most firms can only obtain debt from major banks. This special institutional setting can affect how cash flow volatility affects capital structure and debt maturity in China.

Chen (2004) uses the annual data of 88 listed Chinese firms from 1995 to 2000, and finds that the capital choices of Chinese firms are different from those from developed economies. Chinese firms prefer short-term debt and have a much lower long-term debt ratio. Chen (2004) also shows that the firm-specific factors (firms' size, growth opportunities, tangibility, and profitability) that affect the capital structure of Western countries can also affect the capital structure of Chinese firms. The results of Chen (2004) indicate that the pecking order model seems to provide partial explanations. However, a further investigation of Chen (2004) shows that neither the pecking order hypothesis nor the trade-off model derived from Western settings can robustly explain the capita choice preferences of listed Chinese firms. These rather seem to follow a 'new Pecking order': retained profit, equity, and debt. Chen (2004) also considers the impact of earnings volatility (measured as the absolute value of the first difference of the percentage change in operational income) on capital structure, though the results show that it does not affect capital structure in China.

Huang et al. (2006) use data from more than 1,200 Chinese listed firms from 1994 to 2003 to study the capital structure of Chinese firms. They document that the leverage of Chinese listed firms increases with fixed assets, firms' size, and non-debt tax shields, and decreases with firm profitability. In addition, Huang et al. (2006) indicate that the ownership structure can affect a firm's leverage. Lastly, they find that more volatile firms have much lower long-term debt ratio.

Ownership is also an important factor in the Chinese capital market. Li et al. (2009) use data from manufacturing firms in China over the 2000 to 2003 period to study the relation between ownership and the capital structure of

Chinese listed firms. They find that ownership and the governance structure have very strong impacts on firms' financing decisions. Firms with more state and private shares have higher leverage, and this matters more for small firms than for large firms.

Qian et al. (2007) use data from Chinese listed firms with an improved model, and document that a firm's leverage ratio is positively associated with firm size, tangibility, and ownership structure, and negatively related to profitability, non-debt tax shields, growth, and volatility. Qian et al. (2009) reach a similar conclusion as Qian et al. (2007), but also indicate that lagged profitability has a small positive influence on firms' leverage ratio.

The studies above examine which factors affect the capital structure of Chinese firms, with most of them focusing on the variables of tangibility, profitability, firm size, non-debt tax shields, growth, and ownership. However, no previous paper has studied the relation between cash flow volatility and the capital structure or debt maturity of Chinese firms. A previous study finds a negative relationship between cash flow volatility and the long-term debt ratio in the US (Keefe and Yaghoubi (2016)). I extend its specification and examine whether cash flow volatility can affect debt maturity in China.

There appears to be evidence that cash flow volatility can decrease firms' debt maturity in the US. However, the results of this chapter find that cash flow volatility does not have a similar impact on firms' debt maturity in China.

3.3 The models: Specification, Fractional Response Model and Variables Construction

3.3.1 Specification

Our main baseline specification follows Keefe and Yaghoubi (2016)'s method:

$$DebtRatio_{i,t} = \alpha + \beta_1 X_{i,t-1} + \beta_2 LnCFV_{i,t-1} + Dummies + \epsilon_{i,t} \quad (3.1)$$

$DebtRatio_{i,t}$ are the short-term or long-term debt ratios: shortdebt, longdebt1 and longdebt2 list in Section 3.3.2,

$X_{i,t-1}$ is a matrix of lagged control variables listed in Section 3.3.3.1, and

$LnCFV_{i,t-1}$ is the lag of the natural logarithm of the volatility measures.

$Dummies$ include time and industry dummies.

To control for simultaneity, all explanatory variables are lagged. As the dependent variables in this chapter are proportion-bounded between zero and one, using linear methods has drawbacks as it causes common specification errors. Hence, I use the FRM to estimate the specification. Furthermore, to address the problems of treating the data as pool data, I then use the adjusted FRM of Wooldridge et al. (2011) to estimate the specification.

3.3.2 The dependent variables and Fractional Response Model

In this chapter, I construct three main capital structure variables: two long-term debt ratios and one short-term debt ratio. The long-term debt ratios are the ratio of total long-term debt to total liability (longdebt1) and the ratio of total long-term liability to total liability (longdebt2). I use the ratio of total current liability to total liability to proxy the short-term debt ratio (shortdebt). Current liability is the liability that matures in less than one year. These three debt ratios are used to proxy the debt maturity of Chinese firms in this study.

The dependent variables in this chapter are proportion variables, which means, as indicated above, that the dependent variables are bounded between zero and one. Linear methods such as OLS are not appropriate for estimating bounded dependent variables. The major limitation is that linear models allow the predicted values to lie outside the natural internal. Furthermore, as Gallani et al. (2015) point out, OLS estimates constant partial effects which are incompatible with bounded dependent variables. Lastly, the residuals estimated using OLS are typically heteroskedastic and the estimated parameters are inefficient, which makes traditional significance test statistics unreliable (Noreen, 1988).

Logit and probit regressions are the most common econometric solutions for dealing with bounded dependent variables. However, probit and logit models require strict assumptions about the distribution of the dependent variables. Morse and Richardson (1983) indicate that the distribution of the observed dependent variables should be either binomial or normal.

Futhermore, Stone and Rasp (1991) show that when predictor variables are skewed and collinear, the necessary assumptions of probit and logit regression models are violated. In addition, Noreen (1988) points out that when the sample size is small, probit regressions may not be better than OLS. Lastly, these models require ad-hoc transformations, such as log-odds ratio often been applied to allow for tractability of values at the extremes (Gallani et al., 2015). Due to these reasons, the Logit and probit models are not suitable for this empirical chapter.

To address the problems of bounded dependent variables, I use the FRM in this study. The FRM proposed by Papke and Wooldridge (1993) is an extension of the General Linear Model (GLM). Papke and Wooldridge (1993) use this model to analyze a data set of employee participation rates in 401(k) pension plans and conclude that it is more appropriate for fractional dependent variables. Gallani et al. (2015) point that the FRM model has four main advantages: 1) It does not require any special correction of values at extremes. 2) The FRM can predict response variables within the internal determined by the measurement scale and capture the non-linear relationship of the data. 3) FRM model's parameters is based on the quasi-maximum likelihood method, which generates relatively efficient and fully robust estimates under the assumptions of the generalised linear model (GLM). 4) It allows for direct recovery of the regression function for the dependent variable given the set of predictors.

Gallani et al. (2015) compare the results of OLS and find that the FRM outperforms the OLS. They argue that the FRM provides improved fit while accounting for the non-constant returns of the dependent variable along the range of predictors. Gallani et al. (2015) point out the FRM supports more

precise inferences, especially when the observations are at the corners.

The FRM can solve the problems of bounded variables in this research; however, this model treats the data as pooled cross-sectional data, not as panel data. The data in this chapter is panel data. To address this problem, Papke and Wooldridge (2008) use correlated random effects approaches to estimate FRMs. However, their model is only for balanced panel data, and the data in this research is unbalanced panel data. Therefore, I follow the method of Wooldridge et al. (2011) who construct non-linear unobserved effects models with unbalanced panel data. Wooldridge et al. (2011) add time averages of all time-varying regressors to their models. These time averages include all the averages of the regressors. This adjusted FRM can be applied to unbalance panel data.

In this chapter, I first use the standard FRM to estimate the specification, then use the method proposed by Wooldridge et al. (2011). To show robustness to the choice of estimator, I also use OLS, and the Tobit and Fixed-effect models.

3.3.3 Variables Construction

3.3.3.1 Cash flow volatility measures

Cash flow volatility is the key variable of interest in this study. I use the net cash flow from operating activities to measure cash flow. Then I mainly calculate cash flow volatility in two ways: first, the standard deviations of last five rolling years' cash flow, and, second, the method of De Veirman and Levin (2012).

The first measure is to use the last five rolling years' cash flow to calculate the standard deviation, a method that has been widely used in previous studies. For the robustness tests, I use the standard deviation of last rolling four and six years' cash flow to measure cash flow volatility; the same conclusion is reached (the results are reported in the appendix).

The second measure is that of De Veirman and Levin (2012). First I estimate:

$$\omega_{i,t} = \beta_1\alpha_i + \beta_2 Year + Ind_i + \beta_3 SizeTercile_{i,t} + \beta_4 Year * Ind_i + \beta_5 Year * SizeTercile_{i,t} + \epsilon_{i,t} \tag{3.2}$$

1) $\omega_{i,t}$ represents cash flow growth from t-1 to t;

2) $Year$ is a matrix of year dummies;

3) Ind_i is a matrix of industry classification dummies;

4) $SizeTercile_{i,t}$ is a matrix of size tercile dummies based on the total assets;

5) $Year * Ind_i$ is a matrix of interactions between the indsutry and year dummies; and

6) $Year * SizeTercile_{i,t}$ is a matrix of interactions between the size and year dummies.

The residual $\epsilon_{i,t}$ represents the difference between the observed and the estimated value of operating cash flow of firm i when controlling for time, industry, size and related interactions. De Veirman and Levin (2012) show

that $\hat{\sigma^{i,t}}$ is an unbiased estimator of true conditional volatility

$$\sigma_{i,t} = \sqrt{\pi/2} \cdot |\epsilon_{i,t}| \tag{3.3}$$

where $\epsilon_{i,t}$ is the estimated residual from Eq 3.2. [1]

Keefe and Yaghoubi (2016) show that volatile firms hold more short-term debt when cash flow volatility is high. Therefore the expected results are that cash flow volatility decreases the long-term debt ratio and increases the short-term debt ratio.

3.3.3.2 Other control variables

To test whether cash flow volatility affects capital structure in China, I construct the reliable factors that follow from Frank and Goyal (2009). There are six control variables in this chapter: tangibility, firms' size, MB ratio, profitability, firms' age and state-ownership.

Tangibility is the ratio of fixed assets to total assets. This control variable is negatively related to the short-term debt ratio in Keefe and Yaghoubi (2016). In this chapter, I expect tangibility to decrease the short-term debt ratio.

Firm's size is the natural logarithm of the total assets of the firm. The studies of Keefe and Yaghoubi (2016) and Chen (2004) show the different results: firms' size increases firms' leverage ratio in the US (Keefe and

[1] From the study of De Veirman and Levin (2012), taking the expectation of equation of 3.1, but assuming that I know the true error term $\epsilon_{i,t}$, I obtain $E(\sigma_{i,t}) = \sqrt{\pi/2}E(|\epsilon_{i,t}|)$. If $\epsilon_{i,t}$ is normal distribution with mean 0 and variance $\sigma^2_{i,t}$, then $|\epsilon_{i,t}|$ is half-normal distributed with $E(|\epsilon_{i,t}|) = \sqrt{2/\pi}\sigma_{i,t}$

Yaghoubi, 2016), and decreases firms' leverage ratio in China (Chen, 2004). As this chapter uses data from Chinese listed firms, I expect that firms' size increases the long-term debt ratio in this study.

MB ratio is the ratio of market value to book value (a proxy for the growth opportunity of firms). Chen (2004) finds that growth opportunities (measured as sales growth/total asset growth) increase firms' leverage ratios. However, the market-to-book ratio decreases firms' leverage ratios in US (Keefe and Yaghoubi, 2016). In this study, I expect the market-to-book ratio to be negatively related to short-term debt.

Profitability shows the profitability of the firm; this is the ratio of the firm's operating income before depreciation to total assets. In both Keefe and Yaghoubi (2016) and Chen (2004), profitability decreases firms' leverage ratios. The expected result is that profitability increases Chinese listed firms' short-term debt ratio.

Firm's age is the number of years that a firm has been listed with China Stock Market Accounting Research (CSMAR). Keefe and Yaghoubi (2016) include this control variable to lessen the effect of possible omitted variable bias. The expected sign of a firm's age is negative when the dependent variable is short-term debt ratio (the same as the results of Keefe and Yaghoubi (2016)).

Due to the special institutional setting in China, I follow Chen (2004) to add state-ownership to the specification. Ownership is the percentage of a firm's shares that is state-owned. Li et al. (2009) find that firms with more state-owned shares have higher leverage ratios. Therefore, in my study, I expect ownership to decrease the short-term debt ratio.

Frank and Goyal (2009) also include inflation (the expected change in the consumer price index over the coming year) and median industry leverage (the median of total debt to market value of assets by year and industry). However, in my specification, I include time and industry dummies that can proxy these two control variables (following the study of Frank and Goyal (2009)).

3.4 Sample and Univariate Statistics

3.4.1 Sample

The sample used in this chapter comprises data from Chinese listed manufacturing firms from 2003 to 2013. All the data are from the CSMAR database. Cash flow statements are available from CSMAR for 1998 to 2013; however, I use the last 5 rolling years' cash flow to calculate cash flow volatility; I cannot use the data from 1998 to 2002 to estimate the model. As I use the lagged terms in the specification, the sample starts from 2003. To control for the potential influence of outliers, all the variables are winsorized at 1% level in both tails of distribution. Having cleaned the data, I have 5,554 firm-year observations. For the robustness test, I use the standard deviation of the last four and six rolling years' cash flow to calculate cash flow volatility. The results of the four and six years' cash flow volatility generate same conclusions as the other two calculations of cash flow volatility.

The number of annual observations for each of the 811 firms in our sample are different. About half of them have 11 observations, i.e. they are observed

every single year during the sample period 2003-2013. The other half of the firms have fewer than 11 annual observations. This means that my panel data is unbalanced.

3.4.2 Univariate Statistics

Table 3.1 reports the summary statistics. The mean value of the (percentage of) state-owned shares is only 0.103, and the 25th percentile, median, and 75th percentile of state-owned shares are 0, 0, and 0.152, respectively. This result shows that most of the firms in my sample do not have many state-owned shares. This is in contrast to the sample of Chen (2004) who shows that the government still holds the majority of the shares of Chinese listed firms in his sample (from 1995 to 2000). The 1999 to 2004 data of Qian et al. (2009) shows a higher percentage of state-owned shares (0.2714).

Profitability has a mean of 0.02, with a standard deviation of 0.068. Qian et al. (2009) use data from 1999 to 2004, while my sample covers the period 2003 to 2013. I find that the mean of profitability is the same in my sample. Tangibility has a mean of 0.292, with a standard deviation of 0.156. This ratio is much lower than the 0.5 ratio in Qian et al. (2009). This is because more and more firms invest more in research and development. Market-to-book ratio has a mean of 1.565, with a standard deviation of 1.336.

The means of the long-term debt ratio (longdebt1) and the long-term liability ratio (longterm2) are 0.091 and 0.122, respectively. The 25th percentile of the long-term debt ratio and the long-term liability ratio are both 0. These

figures mean that about one quarter of the firms do not hold any long-term debt or long-term liability. The short-term liability ratio has a mean of 0.852, with a 75th percentile value of 0.977. The three debt ratios show that most firms hold more short-term debt than long-term debt. These results are in line with those of Chen (2004). He argues that firms tend to hold more short-term debt, because this allows the supplier of capital to monitor and control the loans of the firms more effectively.

3.4.3 Univariate correlation

Table 3.2 reports the pairwise correlation coefficients. The two measures of cash flow volatility (lncfv and lncfv2) are positively correlated to each other, but are not very positively correlated (only 0.0477). This may be due to two different measures of cash flow volatility are quite different, one is the standard deviation of last five rolling years, the other is the method followed De Veirman and Levin (2012). Both of cash flow volatility are positively correlated to long-term debt ratio (ldebt1 and ldebt2) and negatively correlated to short-term debt (sdebt) ratio. These are consistent with Keefe and Yaghoubi (2016) (cash flow volatility increase the long-term debt ratio and decreases the short-term debt ratio). Firms' market-to-book (MB) and profitability (Prof) are positively correlated to cash flow volatility, while firms' size (TA) and tangibility (Tang) are negatively correlated to cash flow volatility.

3.5 Empirical Results and Analysis

3.5.1 The Results of Fractional Response Model

I initially estimated Equation 3.1 using the full sample with the FRM. The results are reported in Table 3.3. Then I split the firms into two groups based on the financial constraints proxies (firms' size, age, level of cash flow and leverage ratio). The results of sub-groups are reported in the Table 3.4, 3.5, 3.6 and 3.7.

Two methods have been used to measure cash flow volatility in this study: one is the standard deviations of last five rolling years' cash flow (lncfv), and the other is the method that follows De Veirman and Levin (2012) (lncfv2). Both of these measures have been used in previous studies. Table 3.3 shows that the coefficients of cash flow volatility (of both lncfv and lncfv2) are all insignificant. These mean that cash flow volatility does not affect Chinese listed firms long-term and short-term debt ratios. These results are inconsistent with that of Keefe and Yaghoubi (2016). They find that cash flow volatility is positively related to the short-term debt ratio in the US. The results of my study are similar to those of Chen (2004), who shows that earnings volatility does not affect Chinese listed firms' leverage. This may be due to the fact that short-term debt is quite high in China. Recall from Table 3.1 that the mean value of short-term debt is about 0.852. Chinese listed firms can neither increase nor decrease their short-term debt when they experience high cash flow volatility.

The coefficients of MB ratio in columns 1, 2, 3, and 4 are negative and significant at the 1% level. These results show that Chinese firms tend to

use less long-term debt if they have a higher market-to-book ratio; these results are similar to those of Keefe and Yaghoubi (2016). The coefficients of tangibility and firm's size are positive and significant at the 1% level in columns 1, 2, 3, and 4 in Table 3.3. This means that larger Chinese listed firms or firms with more tangible assets tend to use more long-term debt. These results are also consistent with those of Keefe and Yaghoubi (2016): they find long-term debt ratio are positively related to the tangibility and firms' size. The coefficients of firm's profitability show results opposite to those of Keefe and Yaghoubi (2016): the short-term debt ratio is positively related to a firm's profitability.

The coefficients of firms' age are all insignificant in Table 3.3. This shows that a firm's age does not affect the long-term or short-term debt ratio. This may explain why the studies of Qian et al. (2009) and Chen (2004) do not include firms' age. The coefficients of state-owned shares are also insignificant in columns 1, 2, 5, and 6 in Table 3.3. While the values in columns 3 and 4 are 0.235 and 0.236, respectively; however, these are only significant at the 10% level. The proportion of state-owned shares has been widely used in previous studies of debt ratios in China. Chen (2004) and Huang et al. (2006) conclude that ownership structure is positively correlated to leverage in China. However, in my research, state-ownership is not a reliable independent variable. This may be due to the government tending to hold fewer shares in Chinese listed manufacturing firms in the last decade (the average of state-owned shares is only 0.103). The sharp drop in the percentage of state-owned shares means that the influences of state-ownership have been much diminished for the Chinese listed manufacturing firms in my sample.

Table 3.4, 3.5, 3.6 and 3.7 show the results of financially constrained and financially unconstrained firms. The dependent variable is the ratio of long-term debt to total liability. I also use the ratio of long-term liability to total liability and the ratio of short-term debt to total liability as dependent variables, the results have been reported in Appendix 3.11. All the coefficients of cash flow volatility are insignificant. The results are consistent with the results in Table 3.3: cash flow volatility does not affect long-term debt ratio. Therefore, whether firms are financially constrained or not does not affect the relation between cash flow volatility and debt maturity.

3.5.2 Applying Fractional Response Model in panel data

To solve the problem of the standard FRM in the previous section (treating data as pooled cross-sectional data), I then follow the method of Wooldridge et al. (2011), adding the time averages of all time-varying regressors, and estimate the specification again (adding the time effects in the FRM). The results are reported in Table 3.8.

The results of cash flow volatility remain insignificant in Table 3.8. It shows that even though the time averages have been added to the FRM, the results of cash flow volatility still show that there is no impact on the debt maturity of Chinese listed firms. Therefore, I can conclude that the impact of cash flow volatility is different in China, that firms do not adjust their debt maturity when they experience high cash flow volatility.

The coefficients of state shares are still insignificant. The results for total

assets and profitability are also the same as in Table 3.3. These two control variables are positively associated with the long-term debt ratio. The market-to-book ratio becomes insignificant in Table 3.8, and the coefficients of tangibility are only significant at the 1% level in columns 3 and 6. The results for firm age are all significant at the 1% level, as they are in Table 3.3.

The difference between these two tables may be due to the FRM with the time averages, which adds the time averages of each of the independent variables, thereby adding too many regressors. The time average variables take too much information from the other control variables; this is what makes the difference between these two models.

Table 3.9, 3.10, 3.11 and 3.12 show the results of financially constrained and financially unconstrained firms. The dependent variable is the ratio of long-term debt to total liability (the results of using the ratio of long-term liability to total liability and the ratio of short-term debt to total liability as dependent variables are reported in Appendix 3.11). All the coefficients of cash flow volatility are insignificant. The results are consistent with the results of using FRM without time averages.

3.5.3 Alternative estimators

In this section, I use OLS, the Fixed-effects (FE) and the Tobit models to estimate the specification as robustness tests. These results are reported Tables 3.13, 3.14, and 3.15. I examine all the control variables in the specification. The results of OLS are similar to those of the FRM: 1)

tangibility, total assets, and profitability are positively related to the long-term debt ratio, while the market-to-book ratio is negatively related to it. The other two variables, firms' age and ownership, remain insignificant.

The results of the Fixed-effects and Tobit models show that a firm's size can increase its long-debt ratio. The other control variables do not have strong effects on the capital structure of Chinese firms.

All the coefficients of cash flow volatility are insignificant. These results are the same as those using the FRMs, with and without the time averages, in the above sections. Therefore, I conclude that cash flow volatility does not affect the debt maturity in China.

3.5.4 Alternative window length for the CFV measure

Table 3.16 to Table 3.20 are the results of the robustness test, which uses the standard deviation of last four and six rolling years' cash flow to measure cash flow volatility. All the coefficients of cash flow volatility are insignificant. These results are the same as those in Table 3.3 to Table 3.15. These confirm the result that cash flow volatility does not affect the debt ratio in China.

Most of the results concerning firms' age and state-owned shares show that these two factors do not affect firms' debt ratio (the coefficients of these two variables are insignificant). The coefficients of total assets in Table 3.16 to Table 3.20 allow the same conclusion: larger firms have higher (lower) long-term (short-term) debt ratios. This is consistent with the results of Table 3.3 to Table 3.15 and with Keefe and Yaghoubi (2016).

3.5.5 Cash flow and debt ratio

Cash flow volatility is calculated from cash flow, and can predict firms' future cash flow. The previous empirical results show cash flow volatility does not affect debt maturity in China, to some extent, the future cash flow does not affect the debt maturity of Chinese firms. In this section, I use cash flow instead of cash flow volatility, and test whether cash flow affects debt maturity in China.

The results have been reported in the Table 3.21, 3.22 and 3.23. I use five estimation methods to estimate the regression: FRM, FRM with time average, OLS, FE and Tobit models. All the coefficients of cash flow are significant are 1% level. These results show that cash flow can affect firms' debt maturity in China. Column 1, 2, 4, 5 in Table 3.21, 3.22, 3.23 show the coefficients of cash flow are positive and significant at 1% level. Column 3, 6 in Table 3.21, 3.22, 3.23 show the coefficients of cash flow are negative and significant at 1% level. Comparing to the results in previous sections (cash flow volatility does not affect firms' debt maturity), the results in Table 3.21, 3.22 and 3.23 show that firms with more cash flow use more short-term debt and less long-term debt.

The empirical results of this chapter show the firms use more short-term debt when they have high cash flow, and this can also smooth their cash flow. Recalling the correlation matrix in the first empirical chapter (chapter 2 in this thesis), the cash flow is negatively related to cash flow volatility, this means firms with more cash flow have a relatively lower level of cash flow volatility. However, cash flow volatility does not affect debt maturity. This may be due to that when firms decide to use short-term debt or long-term

debt, they consider the current internal funds (i.e. cash flow). Cash flow volatility which predicts future cash flow is not an important index for them.

3.6 Conclusion

This chapter has examined the relationship between cash flow volatility and capital structure in China. I use data from Chinese listed manufacturing firms from 2002 to 2013. The results show that cash flow volatility does not affect the debt maturity of Chinese listed manufacturing firms. In contrast to previous research (Chen, 2004), I find that ownership does not affect capital structure in China. This may be due to the percentage of state-owned shares in China dropping to a very low level.

The results of my research show that a firm's size and tangibility are positively related to its long-term debt ratio. This means that larger firms or firms that have more tangible assets hold more long-term debt than short-term debt. These is the same as the results of Keefe and Yaghoubi (2016). Profitability in China is similar to a firm's size and tangibility. Firms which are more profitable tend to use more long-term debt. This is the opposite of the results attained in the US (Keefe and Yaghoubi, 2016).

Keefe and Yaghoubi (2016) conclude that firms in the US tend to use more long-term debt if they experience high cash flow volatility. However, this effect of cash flow volatility is not found in China. I have used two kinds of methods to measure cash flow volatility: the standard deviation of the rolling last five years' cash flow, and the method of De Veirman

and Levin (2012). Both of these measures produce the same results. Cash flow volatility does not affect the debt maturity of Chinese listed firms. The different results in my chapter may be due to two reasons: the first is that the less developed capital market and immature bond market in China make it very difficult for Chinese listed firms to issue bonds; the high level of short-term debt leads firms to hardly change their debt ratios. The second reason is that when firms experience high cash flow volatility and need to smooth their cash flow, they can either issue debt or issue equity. As Chen (2004) points out, Chinese firms prefer equity financing to debt financing because the former is not binding. Firms in China tend to issue equity to smooth cash flow. Preferring to use equity financing is the second reason that the debt maturity of Chinese firms are not affected by cash flow volatility. This chapter also spilt the sample into two groups based on the financial constraints proxies (firms' age, size, cash flow and leverage ratio), the results of all sub-samples reach the same conclusion: cash flow volatility does not affect debt maturity in China.

As the dependent variables are fractional variables, they are bounded between 0 and 1. To address the problem of fractional response variables, I first used the FRM to estimate the specification. Then I added the time averages (as proposed by Wooldridge et al. (2011)) to estimate the regression to solve the problem involving the standard FRM not considering time effects. However, this adjusted FRM still has some drawbacks, as there are too many time average-dependent variables in this model. In the robustness test, I employed OLS, and the Fixed effects and Tobit models to estimate the coefficients. All the models reached the same conclusion: cash flow volatility does not affect the debt ratio in China.

This chapter makes three contributions to the literature. The first is that while previous papers have only use standard deviations of the last five years to measure cash flow volatility in China, I also use method of De Veirman and Levin (2012) to do so. The second is that this chapter considers the problems of the fractional response variables by using the FRM with and without time averages, which makes the results more reliable. The third contribution is there has been no paper that examines the relationship between cash flow volatility and debt maturity in China. I fill this gap with this research.

3.7 Tables

Table 3.1: Summary statistics

The table reports the summary statistics of the study for the manufacturing Chinese listed firms from 2003-2013. All the variables are winsorized at 1% level in both tail of the distribution before the summary statistics are calculated. The tables shows the number of observations(N), mean, min, max, standard deviation(sd), 25th percentile(p25), median and 75th percentile. TA is the total asset of the firm, the unit measurement of total asset is million RMB. owner is the percentage of state-owned shares. MB is the ratio of market value to book value. Tang is the asset tangibility which measure as the ratio of fixed assets-to-total assets. Prof is the ratio of the firm operating income before depreciation to total assets. ldebt1 is the ratio of total long-term debt to total liability, ldebt2 is the ratio of total long-term liability to total liability, sdebt is ratio of total current liability to total liability. lncfv1 is the natural logarithm of standard deviation of last five rolling years cash flow. lncfv2 is the natural logarithm of cash flow volatility calculate from the method of De Veirman and Levin (2012)

VAR	N	mean	min	max	sd	p25	median	p75
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TA	5,616	6950	113	374000	16900	1330	2700	5810
owner	5,616	0.103	0	0.821	0.183	0	0	0.152
MB	5,616	1.565	0.209	7.4	1.336	0.675	1.147	1.994
lncfv	5,616	0.054	0.009	0.187	0.034	0.031	0.046	0.069
lncfv2	5,616	7.397	0.063	69.52	9.062	1.413	7.125	9.201
Tang	5,616	0.292	0.032	0.68	0.156	0.171	0.265	0.4
Prof	5,616	0.02	-0.21	0.214	0.068	-0.005	0.019	0.052
ldebt2	5,616	0.122	0	0.626	0.151	0.003	0.058	0.191
ldebt1	5,616	0.091	0	0.582	0.13	0	0.029	0.133
sdebt	5,616	0.852	0.354	1	0.158	0.772	0.91	0.977

Table 3.2: Correlation Matrix

The Table reports the correlation matrix. The definition of variables have been shown in Table 3.1. CFV4 is the cash flow volatility: the standard deviation of last 4 rolling years. CFV6 is the cash flow volatility: the standard deviation of last six rolling years

	TA	MB	Tang	Prof	lncfv	lncfv2	ldebt1	ldebt2	sdebt
TA	1								
MB	-0.3543	1							
Tang	0.0813	-0.1569	1						
Prof	0.2205	0.2062	-0.0752	1					
lncfv	-0.0915	0.1043	-0.1029	0.0029	1				
lncfv2	-0.0515	0.0385	-0.0101	0.0267	0.0477	1			
ldebt1	0.3177	-0.1888	0.3105	0.0111	-0.0685	-0.0198	1		
ldebt2	0.2467	-0.1608	0.3437	0.0142	-0.0511	-0.0022	0.87	1	
sdebt	-0.2886	0.152	-0.2456	0.0102	0.0811	0.0352	-0.93	-0.8004	1

Table 3.3: The fractional response model without time averages

This table reports the results of equation 3.1 using fractional response model. All explanatory variables are lagged by one year. The definition of variables have been shown in Table 3.1. Age is firms' age. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv	-0.030		0.003		0.070	
	(0.030)		(0.034)		(0.127)	
lncfv2		0.008		-0.007		-0.009
		(0.018)		(0.021)		(0.016)
MB	-0.068***	-0.070***	-0.091***	-0.091***	0.023	0.026
	(0.023)	(0.023)	(0.029)	(0.029)	(0.017)	(0.017)
Tang	1.523***	1.545***	2.014***	2.008***	-1.062***	-1.106***
	(0.149)	(0.149)	(0.167)	(0.167)	(0.137)	(0.136)
TA	0.265***	0.265***	0.211***	0.211***	-0.212***	-0.214***
	(0.019)	(0.019)	(0.022)	(0.022)	(0.017)	(0.017)
Profit	0.936***	0.930***	0.967**	0.971**	-0.238	-0.228
	(0.350)	(0.349)	(0.395)	(0.395)	(0.307)	(0.305)
Age	-0.007	-0.007	-0.010	-0.010	-0.001	-0.001
	(0.006)	(0.006)	(0.007)	(0.007)	(0.005)	(0.005)
Owner	0.084	0.078	0.235*	0.236*	-0.056	-0.045
	(0.113)	(0.113)	(0.129)	(0.129)	(0.102)	(0.102)
Constant	-8.119***	-8.037***	-7.584***	-7.590***	6.721***	6.532***
	(0.435)	(0.419)	(0.514)	(0.496)	(0.381)	(0.371)
N	5,554	5,554	5,554	5,554	5,554	5,554

Table 3.4: Small and large firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' size. The dependent variable is the ratio of total long-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' total asset according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	small	large	small	large
	(1)	(2)	(3)	(4)
lncfv	0.177	-0.122		
	(0.160)	(0.134)		
lncfv2			0.042	-0.006
			(0.029)	(0.022)
MB	0.020	-0.070***	0.026	-0.077***
	(0.039)	(0.024)	(0.038)	(0.024)
Tang	0.643**	1.867***	0.551*	1.925***
	(0.281)	(0.180)	(0.284)	(0.178)
TA	0.702***	0.131***	0.679***	0.131***
	(0.071)	(0.026)	(0.071)	(0.026)
Profit	0.357	0.686	0.415	0.677
	(0.588)	(0.437)	(0.602)	(0.435)
Age	0.028**	-0.032***	0.030***	-0.032***
	(0.011)	(0.007)	(0.011)	(0.007)
Owner	0.184	0.133	0.188	0.101
	(0.223)	(0.128)	(0.224)	(0.127)
Constant	-17.012***	-5.164***	-17.082***	-4.790***
	(1.491)	(0.614)	(1.506)	(0.598)
N	2,449	3,105	2,449	3,105

Table 3.5: Young and old firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' age. The definition of variables have been shown in Table 3.1. The dependent variable is the ratio of total long-term debt to total liability. Firms are separated into the level of firms' age according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	young	old	young	old
	(1)	(2)	(3)	(4)
lncfv	0.018	-0.073		
	(0.046)	(0.079)		
lncfv2			0.023	0.007
			(0.026)	(0.025)
MB	-0.066	-0.060**	-0.064	-0.065**
	(0.040)	(0.027)	(0.040)	(0.027)
Tang	1.150***	1.585***	1.155***	1.632***
	(0.279)	(0.181)	(0.278)	(0.180)
TA	0.365***	0.212***	0.366***	0.214***
	(0.031)	(0.023)	(0.031)	(0.023)
Profit	0.065	1.474***	0.036	1.457***
	(0.612)	(0.440)	(0.612)	(0.437)
Age	-0.017	-0.030***	-0.017	-0.030***
	(0.016)	(0.011)	(0.016)	(0.011)
Owner	-0.139	0.196	-0.136	0.178
	(0.173)	(0.147)	(0.172)	(0.147)
Constant	-9.903***	-6.758***	-9.996***	-6.583***
	(0.708)	(0.565)	(0.684)	(0.549)
N	1,924	3,630	1,924	3,630

Table 3.6: Low and high cash flow firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' cash flow. The definition of variables have been shown in Table 3.1. The dependent variable is the ratio of total long-term debt to total liability. Firms are separated into the level of firms' cash flow according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
lncfv	0.052	-0.096		
	(0.043)	(0.093)		
lncfv2			0.007	0.015
			(0.022)	(0.029)
MB	0.049	-0.119***	0.052	-0.124***
	(0.034)	(0.030)	(0.033)	(0.030)
Tang	0.948***	1.617***	0.928***	1.692***
	(0.243)	(0.213)	(0.243)	(0.211)
TA	0.364***	0.211***	0.363***	0.213***
	(0.030)	(0.025)	(0.030)	(0.025)
Profit	2.258***	0.497	2.271***	0.511
	(0.583)	(0.506)	(0.586)	(0.503)
Age	0.008	-0.021***	0.008	-0.022***
	(0.009)	(0.008)	(0.009)	(0.008)
Owner	-0.105	0.175	-0.104	0.146
	(0.192)	(0.139)	(0.192)	(0.139)
Constant	-9.998***	-7.083***	-10.151***	-6.827***
	(0.698)	(0.604)	(0.674)	(0.579)
N	2,755	2,799	2,755	2,799

Table 3.7: Low and high leverage ratio firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' leverage ratio. The dependent variable is the ratio of total long-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' leverage ratio according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	high leverage	low leverage	high leverage	low leverage
	(1)	(2)	(3)	(4)
lncfv	-0.073	-0.015		
	(0.140)	(0.047)		
lncfv2			0.002	0.026
			(0.022)	(0.030)
MB	-0.003	-0.082**	-0.009	-0.082**
	(0.030)	(0.033)	(0.030)	(0.033)
Tang	1.906***	1.006***	1.946***	1.030***
	(0.191)	(0.240)	(0.191)	(0.241)
TA	0.261***	0.274***	0.264***	0.275***
	(0.025)	(0.030)	(0.025)	(0.030)
Profit	2.751***	-0.239	2.703***	-0.246
	(0.492)	(0.531)	(0.485)	(0.532)
Age	-0.025***	0.006	-0.025***	0.006
	(0.007)	(0.010)	(0.007)	(0.010)
Owner	0.137	0.072	0.123	0.066
	(0.147)	(0.171)	(0.147)	(0.170)
Constant	-8.113***	-8.311***	-7.941***	-8.282***
	(0.588)	(0.666)	(0.573)	(0.642)
N	2,843	2,711	2,843	2,711

Table 3.8: fractional response model with time averages

This table reports the results of equation 3.1 using fractional response model with time averages. All explanatory variables are lagged by one year. The definition of variables have been shown in Table 3.1. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv	0.049		0.011		-0.024	
	(0.047)		(0.050)		(0.042)	
lncfv2		0.011		-0.004		-0.011
		(0.018)		(0.021)		(0.016)
MB	-0.002	-0.002	0.006	0.007	-0.010	-0.008
	(0.028)	(0.028)	(0.034)	(0.034)	(0.021)	(0.021)
Tang	-0.307	-0.310	0.086	0.079	0.470**	0.456**
	(0.256)	(0.255)	(0.291)	(0.291)	(0.234)	(0.232)
TA	0.591***	0.586***	0.533***	0.534***	-0.419***	-0.414***
	(0.051)	(0.051)	(0.061)	(0.061)	(0.047)	(0.047)
Profit	1.124**	1.107**	1.578***	1.590***	-0.684*	-0.655
	(0.459)	(0.455)	(0.510)	(0.512)	(0.410)	(0.405)
Age	-0.257***	-0.255***	-0.229***	-0.230***	0.137**	0.134**
	(0.073)	(0.075)	(0.079)	(0.079)	(0.065)	(0.067)
Owner	-0.040	-0.033	-0.001	0.000	0.028	0.023
	(0.133)	(0.133)	(0.148)	(0.149)	(0.123)	(0.123)
Constant	-6.217***	-6.054***	-5.822***	-5.895***	7.060***	6.813***
	(1.247)	(1.239)	(1.391)	(1.388)	(1.124)	(1.117)
N	5,554	5,554	5,554	5,554	5,554	5,554

Table 3.9: Small and large firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' size. The dependent variable is the ratio of total long-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' total asset according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	small	large	small	large
	(1)	(2)	(3)	(4)
lncfv	0.051	0.053		
	(0.093)	(0.052)		
lncfv2			0.032	-0.002
			(0.030)	(0.022)
MB	0.046	-0.034	0.051	-0.043
	(0.045)	(0.033)	(0.044)	(0.033)
Tang	-1.115**	0.092	-1.239***	0.071
	(0.454)	(0.295)	(0.459)	(0.292)
TA	0.620***	0.592***	0.615***	0.586***
	(0.134)	(0.057)	(0.133)	(0.057)
Profit	0.996	0.801	0.953	0.784
	(0.793)	(0.563)	(0.809)	(0.552)
Age	-0.207**	-0.285***	-0.242***	-0.290***
	(0.102)	(0.108)	(0.094)	(0.108)
Owner	-0.038	-0.047	-0.041	-0.034
	(0.263)	(0.148)	(0.264)	(0.149)
Constant	-10.539***	-6.603***	-11.069***	-6.187***
	(2.786)	(1.450)	(2.764)	(1.453)
N	2,449	3,105	2,449	3,105

Table 3.10: Young and old firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' age. The dependent variable is the ratio of total long-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' age according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	young	old	young	old
	(1)	(2)	(3)	(4)
lncfv	0.093	0.026		
	(0.077)	(0.057)		
lncfv2			0.023	0.008
			(0.026)	(0.025)
MB	0.036	0.001	0.037	-0.001
	(0.053)	(0.031)	(0.053)	(0.031)
Tang	0.083	-0.457	0.065	-0.447
	(0.445)	(0.299)	(0.445)	(0.297)
TA	0.994***	0.497***	1.000***	0.492***
	(0.102)	(0.058)	(0.102)	(0.059)
Profit	0.988	1.024*	0.987	0.989*
	(0.808)	(0.565)	(0.808)	(0.557)
Age	2.744***	-0.387***	2.751***	-0.395***
	(0.963)	(0.106)	(0.951)	(0.110)
Owner	-0.145	-0.019	-0.128	-0.010
	(0.213)	(0.169)	(0.213)	(0.169)
Constant	-2.007	-5.111***	-1.763	-5.178***
	(3.174)	(1.550)	(3.167)	(1.533)
N	1,924	3,630	1,924	3,630

Table 3.11: Low and high cash flow firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' cash flow. The dependent variable is the ratio of total long-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' cash flow according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
lncfv	0.091	0.037		
	(0.071)	(0.063)		
lncfv2			0.022	0.002
			(0.023)	(0.029)
MB	0.055	-0.027	0.059	-0.031
	(0.042)	(0.038)	(0.041)	(0.037)
Tang	-0.604	-0.112	-0.637	-0.096
	(0.419)	(0.330)	(0.419)	(0.324)
TA	0.506***	0.676***	0.509***	0.673***
	(0.081)	(0.065)	(0.081)	(0.065)
Profit	1.119*	1.280**	1.120*	1.229*
	(0.673)	(0.645)	(0.678)	(0.634)
Age	-0.133*	-0.482***	-0.116*	-0.505***
	(0.069)	(0.178)	(0.068)	(0.185)
Owner	-0.112	-0.033	-0.110	-0.028
	(0.223)	(0.166)	(0.224)	(0.166)
Constant	-7.414***	-4.499***	-7.331***	-4.560***
	(2.058)	(1.583)	(2.050)	(1.562)
N	2,755	2,799	2,755	2,799

Table 3.12: Low and high leverage ratio firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' leverage ratio. The dependent variable is the ratio of total long-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' leverage ratio according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	high leverage	low leverage	high leverage	low leverage
	(1)	(2)	(3)	(4)
lncfv	0.029	0.043		
	(0.062)	(0.073)		
lncfv2			0.010	0.018
			(0.022)	(0.029)
MB	0.008	-0.000	0.006	0.000
	(0.036)	(0.041)	(0.036)	(0.041)
Tang	0.049	-0.742*	0.052	-0.727*
	(0.322)	(0.425)	(0.321)	(0.423)
TA	0.507***	0.685***	0.504***	0.684***
	(0.072)	(0.076)	(0.072)	(0.076)
Profit	1.850***	0.286	1.819***	0.271
	(0.591)	(0.692)	(0.586)	(0.691)
Age	-0.286***	-0.293*	-0.269***	-0.310*
	(0.076)	(0.172)	(0.080)	(0.171)
Owner	0.125	-0.253	0.127	-0.239
	(0.173)	(0.204)	(0.173)	(0.204)
Constant	-7.121***	-6.022***	-6.919***	-6.147***
	(1.583)	(2.012)	(1.581)	(2.000)
N	2,843	2,711	2,843	2,711

3.8 Appendix 3A

3.8.1 The results of OLS, FE and tobit model

Table 3.13: The results of OLS

This table reports the results of equation 3.1 using OLS. All explanatory variables are lagged by one year. The definition of variables have been shown in Table 3.1. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv	-0.002		0.000		0.008**	
	(0.003)		(0.003)		(0.003)	
lncfv2		0.001		-0.001		-0.001
		(0.002)		(0.002)		(0.002)
MB	-0.004**	-0.004**	-0.004***	-0.004***	0.002	0.002
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Tang	0.181***	0.183***	0.185***	0.184***	-0.146***	-0.151***
	(0.014)	(0.014)	(0.012)	(0.012)	(0.015)	(0.015)
TA	0.032***	0.032***	0.020***	0.020***	-0.029***	-0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Profit	0.055*	0.054*	0.057**	0.057**	-0.003	-0.002
	(0.031)	(0.031)	(0.027)	(0.027)	(0.033)	(0.033)
Age	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Owner	0.011	0.011	0.025**	0.025**	-0.008	-0.007
	(0.012)	(0.012)	(0.010)	(0.010)	(0.013)	(0.013)
Constant	-0.592***	-0.572***	-0.360***	-0.347***	1.543***	1.497***
	(0.047)	(0.047)	(0.041)	(0.040)	(0.050)	(0.050)
N	5,554	5,554	5,554	5,554	5,554	5,554
R-sq	0.203	0.203	0.187	0.187	0.161	0.161

Table 3.14: The results of FE

This table reports the results of equation 3.1 using FE. All explanatory variables are lagged by one year. The definition of variables have been shown in Table 3.1. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv	0.001		-0.002		0.001	
	(0.003)		(0.003)		(0.004)	
lncfv2		-0.000		-0.001		0.000
		(0.001)		(0.001)		(0.001)
MB	0.000	0.000	-0.001	-0.001	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Tang	-0.070***	-0.070***	-0.022	-0.021	0.077***	0.077***
	(0.019)	(0.019)	(0.017)	(0.017)	(0.020)	(0.020)
TA	0.038***	0.038***	0.020***	0.020***	-0.031***	-0.031***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Profit	0.033	0.033	0.097***	0.097***	-0.023	-0.022
	(0.031)	(0.031)	(0.027)	(0.027)	(0.033)	(0.033)
Age	-0.025*	-0.025*	-0.010	-0.011	0.015	0.015
	(0.013)	(0.013)	(0.011)	(0.011)	(0.014)	(0.014)
Owner	0.002	0.002	0.009	0.009	-0.004	-0.004
	(0.011)	(0.011)	(0.010)	(0.010)	(0.012)	(0.012)
Constant	-0.339*	-0.343*	-0.217	-0.212	1.297***	1.295***
	(0.198)	(0.198)	(0.172)	(0.172)	(0.207)	(0.207)
N	5,554	5,554	5,554	5,554	5,554	5,554
R-sq	0.041	0.041	0.028	0.028	0.062	0.062
Firms	811	811	811	811	811	811

Table 3.15: The results of Tobit

This table reports the results of equation 3.1 using tobit. All explanatory variables are lagged by one year. The definition of variables have been shown in Table 3.1. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv	-0.001		-0.005		0.004	
	(0.004)		(0.004)		(0.004)	
lncfv2		0.001		-0.002		-0.000
		(0.002)		(0.002)		(0.002)
MB	-0.003	-0.003	-0.005**	-0.005**	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tang	0.014	0.014	0.057***	0.058***	0.012	0.010
	(0.020)	(0.020)	(0.021)	(0.021)	(0.019)	(0.019)
TA	0.051***	0.051***	0.044***	0.044***	-0.035***	-0.036***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Profit	0.048	0.048	0.114***	0.115***	-0.037	-0.037
	(0.036)	(0.036)	(0.039)	(0.039)	(0.033)	(0.033)
Age	-0.001	-0.001	-0.001	-0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Owner	0.001	0.001	0.003	0.003	-0.007	-0.006
	(0.013)	(0.013)	(0.014)	(0.014)	(0.012)	(0.012)
Constant	-1.019***	-1.018***	-0.968***	-0.958***	1.610***	1.601***
	(0.081)	(0.080)	(0.087)	(0.087)	(0.075)	(0.075)
N	5,554	5,554	5,554	5,554	5,554	5,554
Firms	811	811	811	811	811	811

3.9 Appendix 3B

3.9.1 Robustness tests: Different window lengths of cash flow

Table 3.16: The results of fractional response model

This table reports the results of equation 3.1 using fractional response model. lncfv4 is log of the standard deviation of last four rolling years cash flow. lncfv6 is log of the standard deviation of last six rolling years cash flow. The definition of other variables have been shown in Table 3.1. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv4	-0.047		-0.019		0.076	
	(0.045)		(0.027)		(0.073)	
lncfv6		-0.010		0.034		0.063
		(0.035)		(0.040)		(0.061)
MB	-0.063***	-0.080***	-0.080***	-0.103***	0.016	0.037**
	(0.021)	(0.024)	(0.027)	(0.031)	(0.016)	(0.018)
Tang	1.603***	1.502***	2.112***	1.946***	-1.165***	-0.998***
	(0.137)	(0.165)	(0.153)	(0.186)	(0.127)	(0.150)
TA	0.270***	0.258***	0.217***	0.204***	-0.218***	-0.205***
	(0.018)	(0.020)	(0.020)	(0.024)	(0.016)	(0.018)
Profit	0.886***	0.917**	0.959***	0.965**	-0.205	-0.210
	(0.322)	(0.376)	(0.360)	(0.423)	(0.288)	(0.328)
Age	-0.006	-0.011	-0.008	-0.019**	-0.002	-0.000
	(0.005)	(0.007)	(0.006)	(0.008)	(0.005)	(0.006)
Owner	0.109	0.078	0.255**	0.207	-0.074	-0.051
	(0.109)	(0.116)	(0.125)	(0.134)	(0.099)	(0.105)
Constant	-8.318***	-7.830***	-7.844***	-7.181***	6.928***	6.503***
	(0.406)	(0.473)	(0.475)	(0.564)	(0.359)	(0.414)
N	6,428	4,811	6,408	4,792	6,428	4,811

Table 3.17: The results of fractional response model with time averages

This table reports the results of equation 3.1 using fractional response model with time averages. The definition of variables have been shown in Table 3.1 and Table 3.16. All explanatory variables are lagged by one year. Robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv4	0.026		0.011		-0.010	
	(0.034)		(0.037)		(0.031)	
lncfv6		0.066		-0.010		-0.031
		(0.061)		(0.066)		(0.055)
MB	-0.017	0.008	-0.004	0.012	-0.005	-0.016
	(0.026)	(0.030)	(0.031)	(0.037)	(0.020)	(0.023)
Tang	-0.248	-0.321	0.114	0.081	0.425*	0.484*
	(0.242)	(0.274)	(0.271)	(0.313)	(0.221)	(0.249)
TA	0.497***	0.693***	0.432***	0.639***	-0.348***	-0.509***
	(0.049)	(0.053)	(0.058)	(0.062)	(0.044)	(0.049)
Profit	1.117***	1.082**	1.570***	1.651***	-0.644*	-0.649
	(0.419)	(0.494)	(0.463)	(0.550)	(0.380)	(0.438)
Age	-0.214***	-0.338***	-0.181***	-0.333***	0.106**	0.218***
	(0.057)	(0.083)	(0.060)	(0.092)	(0.054)	(0.078)
Owner	0.019	-0.103	0.082	-0.083	-0.017	0.071
	(0.127)	(0.141)	(0.142)	(0.157)	(0.117)	(0.130)
Constant	-6.678***	-5.758***	-6.511***	-5.480***	7.153***	6.748***
	(1.157)	(1.327)	(1.286)	(1.475)	(1.052)	(1.192)
N	6,428	4,811	6,408	4,792	6,428	4,811

Table 3.18: The results of OLS

This table reports the results of equation 3.1 using OLS The definition of variables have been shown in Table 3.1 and Table 3.16. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv4	-0.004		-0.001		0.009	
	(0.005)		(0.002)		(0.013)	
lncfv6		0.000		0.003		0.007
		(0.004)		(0.003)		(0.014)
MB	-0.003**	-0.005***	-0.004***	-0.005***	0.001	0.003*
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Tang	0.188***	0.179***	0.194***	0.179***	-0.157***	-0.139***
	(0.013)	(0.015)	(0.011)	(0.013)	(0.014)	(0.016)
TA	0.032***	0.031***	0.020***	0.019***	-0.029***	-0.028***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Profit	0.053*	0.051	0.060**	0.054*	0.000	0.000
	(0.028)	(0.033)	(0.025)	(0.028)	(0.030)	(0.035)
Age	-0.000	-0.001	-0.000	-0.001	-0.001	-0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Owner	0.013	0.010	0.026***	0.023**	-0.010	-0.007
	(0.012)	(0.013)	(0.010)	(0.011)	(0.012)	(0.013)
Constant	-0.586***	-0.544***	-0.328***	-0.331***	1.545***	1.500***
	(0.044)	(0.050)	(0.038)	(0.044)	(0.047)	(0.053)
N	6,428	4,811	6,408	4,792	6,428	4,811
R-sq	0.202	0.206	0.189	0.189	0.162	0.161

Table 3.19: results of FE

This table reports the results of equation 3.1 using FE The definition of variables have been shown in Table 3.1 and Table 3.16. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv4	-0.001		-0.001		0.002	
	(0.003)		(0.002)		(0.003)	
lncfv6		0.002		-0.004		0.002
		(0.004)		(0.004)		(0.005)
MB	-0.001	0.000	-0.001	-0.001	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Tang	-0.050***	-0.082***	-0.005	-0.028	0.066***	0.078***
	(0.018)	(0.021)	(0.016)	(0.018)	(0.019)	(0.022)
TA	0.035***	0.041***	0.017***	0.022***	-0.029***	-0.034***
	(0.004)	(0.005)	(0.003)	(0.004)	(0.004)	(0.005)
Profit	0.041	0.028	0.105***	0.098***	-0.022	-0.026
	(0.029)	(0.034)	(0.025)	(0.029)	(0.030)	(0.035)
Age	-0.024*	-0.026**	-0.010	-0.012	0.014	0.017
	(0.013)	(0.013)	(0.011)	(0.011)	(0.014)	(0.014)
Owner	0.006	-0.005	0.015	0.007	-0.006	-0.001
	(0.011)	(0.012)	(0.010)	(0.010)	(0.011)	(0.012)
Constant	-0.291	-0.383*	-0.176	-0.248	1.262***	1.339***
	(0.192)	(0.206)	(0.167)	(0.178)	(0.201)	(0.214)
N	6,428	4,811	6,408	4811	6,428	4,811
R-sq	0.037	0.046	0.026	0.033	0.057	0.064
Firms	813	733	813	733	813	733

Table 3.20: The results of Tobit

This table reports the results of equation 3.1 using tobit The definition of variables have been shown in Table 3.1 and Table 3.16. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	ldebt1	ldebt1	ldebt2	ldebt2	sdebt	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
lncfv4	-0.002		-0.005		0.003	
	(0.003)		(0.003)		(0.003)	
lncfv6		-0.004		-0.011		0.007
		(0.004)		(0.015)		(0.008)
MB	-0.003	-0.003	-0.005**	-0.005**	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tang	0.013	0.013	0.057***	0.055***	0.012	0.013
	(0.020)	(0.020)	(0.021)	(0.021)	(0.019)	(0.019)
TA	0.051***	0.051***	0.044***	0.044***	-0.035***	-0.035***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Profit	0.049	0.049	0.114***	0.115***	-0.037	-0.037
	(0.036)	(0.036)	(0.039)	(0.039)	(0.033)	(0.033)
Age	-0.001	-0.001	-0.001	-0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Owner	0.001	0.001	0.003	0.004	-0.007	-0.007
	(0.013)	(0.013)	(0.014)	(0.014)	(0.012)	(0.012)
Constant	-1.021***	-1.027***	-0.965***	-0.984***	1.608***	1.619***
	(0.081)	(0.081)	(0.087)	(0.087)	(0.075)	(0.075)
N	5,554	5,554	5,554	5,554	5,554	5,554
Firms	811	811	811	811	811	811

3.10 Appendix 3C

3.10.1 Using cash flow instead of cash flow volatility

Table 3.21: The results of FRM and FRM with time averages

This table reports the results of equation 3.1 using FRM and FRM with time averages, but using cash flow instead of cash flow volatility. CF is the ratio of cash flow to total asset. The definition of variables have been shown in Table 3.1. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Model		FRM		FRM with time average		
VARIABLES	ldebt1	ldebt1	sdebt	ldebt1	ldebt1	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
CF	-1.494***	-1.282***	0.959***	-1.074***	-1.071***	0.622**
	(0.323)	(0.347)	(0.281)	(0.345)	(0.364)	(0.305)
MB	-0.062***	-0.083***	0.022	0.002	0.011	-0.011
	(0.022)	(0.029)	(0.017)	(0.027)	(0.034)	(0.021)
Tang	1.720***	2.166***	-1.214***	-0.175	0.178	0.367
	(0.152)	(0.172)	(0.138)	(0.261)	(0.295)	(0.236)
TA	0.267***	0.212***	-0.214***	0.561***	0.511***	-0.399***
	(0.019)	(0.022)	(0.017)	(0.051)	(0.062)	(0.047)
Profit	1.720***	1.635***	-0.727**	1.786***	2.147***	-1.065**
	(0.404)	(0.446)	(0.350)	(0.501)	(0.557)	(0.438)
Age	-0.006	-0.008	-0.002	-0.258***	-0.229***	0.137**
	(0.006)	(0.007)	(0.005)	(0.075)	(0.079)	(0.068)
Owner	0.073	0.232*	-0.040	-0.008	0.013	0.007
	(0.113)	(0.129)	(0.102)	(0.134)	(0.150)	(0.123)
Constant	-8.082***	-7.633***	6.557***	-5.945***	-5.834***	6.730***
	(0.420)	(0.498)	(0.372)	(1.255)	(1.395)	(1.125)
N	5,554	5,554	5,554	5,554	5,554	5,554

Table 3.22: The results of OLS and FE models

This table reports the results of equation 3.1 using OLS and FE models, but using cash flow instead of cash flow volatility. The definition of variables have been shown in Table 3.1 and 3.21. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Model		OLS			FE	
VARIABLES	ldebt1	ldebt1	sdebt	ldebt1	ldebt1	sdebt
	(1)	(2)	(3)	(4)	(5)	(6)
CF	-0.134***	-0.089***	0.106***	-0.094***	-0.079***	0.077***
	(0.027)	(0.023)	(0.029)	(0.022)	(0.019)	(0.023)
MB	-0.003**	-0.004***	0.002	0.000	-0.001	0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Tang	0.197***	0.194***	-0.162***	-0.064***	-0.016	0.072***
	(0.014)	(0.012)	(0.015)	(0.019)	(0.017)	(0.020)
TA	0.032***	0.020***	-0.029***	0.036***	0.019***	-0.030***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
Profit	0.122***	0.102***	-0.056	0.070**	0.127***	-0.052
	(0.034)	(0.029)	(0.036)	(0.032)	(0.028)	(0.034)
Age	-0.000	-0.000	-0.000	-0.024*	-0.010	0.014
	(0.001)	(0.001)	(0.001)	(0.013)	(0.011)	(0.014)
Owner	0.009	0.024**	-0.006	0.001	0.008	-0.003
	(0.012)	(0.010)	(0.013)	(0.011)	(0.010)	(0.012)
Constant	-0.591***	-0.364***	1.529***	-0.324	-0.194	1.279***
	(0.046)	(0.040)	(0.050)	(0.198)	(0.172)	(0.206)
N	5,554	5,554	5,554	5,554	5,554	5,554
Firms				811	811	811
R-sq	0.206	0.189	0.162	0.045	0.031	0.064

Table 3.23: The results of Tobit model

This table reports the results of equation 3.1 using Tobit model, but using cash flow instead of cash flow volatility. The definition of variables have been shown in Table 3.1 and 3.21. All explanatory variables are lagged by one year. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Model		Tobit	
VARIABLES	ldebt1	ldebt1	sdebt
	(1)	(2)	(3)
CF	-0.119***	-0.134***	0.079***
	(0.027)	(0.029)	(0.024)
MB	-0.002	-0.005**	0.001
	(0.002)	(0.002)	(0.002)
Tang	0.025	0.071***	0.004
	(0.020)	(0.021)	(0.019)
TA	0.051***	0.043***	-0.035***
	(0.004)	(0.004)	(0.003)
Profit	0.099***	0.172***	-0.069**
	(0.037)	(0.041)	(0.034)
Age	-0.001	-0.001	0.001
	(0.001)	(0.001)	(0.001)
Owner	-0.001	0.002	-0.005
	(0.013)	(0.014)	(0.012)
Constant	-1.002***	-0.936***	1.590***
	(0.080)	(0.087)	(0.075)
N	5,554	5,554	5,554
Firms	811	811	811

3.11 Appendix 3D

3.11.1 Long-term liability ratio

Table 3.24: Small and large firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' size. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' total asset according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	small	large	small	large
	(1)	(2)	(3)	(4)
lncfv	0.167	-0.066		
	(0.165)	(0.069)		
lncfv2			0.048	-0.046
			(0.034)	(0.025)
MB	-0.031	-0.056**	-0.023	-0.061**
	(0.055)	(0.027)	(0.054)	(0.027)
Tang	1.027***	2.403***	0.945***	2.416***
	(0.302)	(0.206)	(0.305)	(0.204)
TA	0.683***	0.067**	0.661***	0.067**
	(0.080)	(0.030)	(0.080)	(0.030)
Profit	0.421	0.163	0.471	0.184
	(0.664)	(0.490)	(0.677)	(0.490)
Age	0.015	-0.028***	0.017	-0.027***
	(0.012)	(0.008)	(0.012)	(0.008)
Owner	0.300	0.287**	0.307	0.276*
	(0.253)	(0.146)	(0.254)	(0.146)
Constant	-17.059***	-4.541***	-17.121***	-4.336***
	(1.699)	(0.720)	(1.715)	(0.703)
N	2,449	3,105	2,449	3,105

Table 3.25: Young and old firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' age. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' age according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	young	old	young	old
	(1)	(2)	(3)	(4)
lncfv	0.066	-0.041		
	(0.054)	(0.043)		
lncfv2			0.020	-0.027
			(0.031)	(0.028)
MB	-0.074	-0.083**	-0.071	-0.087**
	(0.050)	(0.035)	(0.050)	(0.035)
Tang	1.491***	2.093***	1.471***	2.103***
	(0.329)	(0.199)	(0.326)	(0.200)
TA	0.286***	0.168***	0.290***	0.170***
	(0.038)	(0.026)	(0.038)	(0.027)
Profit	-0.867	1.784***	-0.896	1.775***
	(0.727)	(0.484)	(0.728)	(0.483)
Age	-0.008	-0.046***	-0.010	-0.046***
	(0.020)	(0.012)	(0.019)	(0.012)
Owner	0.079	0.259	0.088	0.251
	(0.194)	(0.169)	(0.192)	(0.169)
Constant	-8.768***	-6.285***	-9.041***	-6.193***
	(0.865)	(0.659)	(0.849)	(0.639)
N	1,924	3,630	1,924	3,630

Table 3.26: Low and high cash flow firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' cash flow. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' cash flow according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
lncfv	0.074	-0.048		
	(0.047)	(0.049)		
lncfv2			-0.017	-0.007
			(0.026)	(0.032)
MB	0.030	-0.142***	0.033	-0.146***
	(0.044)	(0.037)	(0.043)	(0.036)
Tang	1.755***	2.046***	1.715***	2.076***
	(0.264)	(0.249)	(0.264)	(0.248)
TA	0.310***	0.153***	0.310***	0.154***
	(0.035)	(0.030)	(0.035)	(0.030)
Profit	2.535***	0.264	2.571***	0.278
	(0.610)	(0.587)	(0.616)	(0.583)
Age	0.011	-0.027***	0.011	-0.028***
	(0.010)	(0.009)	(0.010)	(0.009)
Owner	0.024	0.309*	0.026	0.295*
	(0.218)	(0.159)	(0.219)	(0.160)
Constant	-9.562***	-6.445***	-9.780***	-6.315***
	(0.819)	(0.715)	(0.782)	(0.692)
N	2,755	2,799	2,755	2,799

Table 3.27: Low and high leverage ratio firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' leverage ratio. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' leverage ratio according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	high leverage	low leverage	high leverage	low leverage
	(1)	(2)	(3)	(4)
lncfv	-0.032	-0.028		
	(0.043)	(0.054)		
lncfv2			-0.019	0.011
			(0.024)	(0.037)
MB	0.007	-0.120***	0.003	-0.121***
	(0.033)	(0.046)	(0.033)	(0.046)
Tang	2.385***	1.397***	2.394***	1.419***
	(0.205)	(0.279)	(0.205)	(0.281)
TA	0.213***	0.190***	0.214***	0.190***
	(0.028)	(0.035)	(0.028)	(0.035)
Profit	3.050***	-0.415	3.038***	-0.418
	(0.497)	(0.662)	(0.495)	(0.662)
Age	-0.029***	0.002	-0.029***	0.002
	(0.008)	(0.011)	(0.008)	(0.011)
Owner	0.262*	0.275	0.255	0.268
	(0.156)	(0.212)	(0.156)	(0.212)
Constant	-7.683***	-7.226***	-7.606***	-7.148***
	(0.655)	(0.794)	(0.639)	(0.767)
N	2,843	2,711	2,843	2,711

Table 3.28: Small and large firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' size. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' total asset according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	small	large	small	large
	(1)	(2)	(3)	(4)
lncfv	0.039	0.009		
	(0.097)	(0.058)		
lncfv2			0.035	-0.036
			(0.035)	(0.025)
MB	0.014	-0.006	0.019	-0.012
	(0.061)	(0.036)	(0.060)	(0.036)
Tang	-0.631	0.479	-0.752	0.458
	(0.485)	(0.342)	(0.495)	(0.340)
TA	0.507***	0.562***	0.500***	0.563***
	(0.159)	(0.065)	(0.157)	(0.065)
Profit	2.201**	0.465	2.179**	0.481
	(0.859)	(0.631)	(0.875)	(0.628)
Age	-0.194*	-0.130	-0.251***	-0.126
	(0.099)	(0.121)	(0.094)	(0.121)
Owner	0.128	-0.124	0.125	-0.119
	(0.289)	(0.168)	(0.290)	(0.169)
Constant	-11.829***	-6.362***	-12.715***	-6.037***
	(3.216)	(1.625)	(3.195)	(1.640)
N	2,449	3,105	2,449	3,105

Table 3.29: Young and old firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' age. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' age according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	young	old	young	old
	(1)	(2)	(3)	(4)
lncfv	0.118	-0.036		
	(0.085)	(0.062)		
lncfv2			0.023	-0.027
			(0.031)	(0.028)
MB	0.060	-0.005	0.065	-0.006
	(0.066)	(0.038)	(0.065)	(0.038)
Tang	0.169	0.049	0.126	0.063
	(0.548)	(0.336)	(0.549)	(0.336)
TA	1.001***	0.412***	1.012***	0.416***
	(0.122)	(0.069)	(0.123)	(0.069)
Profit	0.633	1.710***	0.638	1.710***
	(0.963)	(0.620)	(0.972)	(0.619)
Age	3.116**	-0.284**	3.122**	-0.303**
	(1.338)	(0.126)	(1.330)	(0.128)
Owner	-0.087	0.042	-0.064	0.041
	(0.234)	(0.190)	(0.233)	(0.191)
Constant	-3.989	-5.088***	-3.884	-5.304***
	(3.418)	(1.735)	(3.418)	(1.718)
N	1,924	3,630	1,924	3,630

Table 3.30: Low and high cash flow firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' cash flow. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' cash flow according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
lncfv	0.103	-0.030		
	(0.075)	(0.069)		
lncfv2			0.005	-0.020
			(0.027)	(0.033)
MB	0.054	-0.018	0.056	-0.017
	(0.052)	(0.045)	(0.050)	(0.045)
Tang	-0.193	0.330	-0.232	0.352
	(0.453)	(0.375)	(0.453)	(0.373)
TA	0.443***	0.656***	0.450***	0.662***
	(0.096)	(0.076)	(0.096)	(0.076)
Profit	1.810**	1.215*	1.847**	1.190
	(0.719)	(0.730)	(0.729)	(0.730)
Age	-0.063	-0.298**	-0.040	-0.320**
	(0.078)	(0.152)	(0.076)	(0.151)
Owner	-0.036	-0.056	-0.039	-0.060
	(0.249)	(0.186)	(0.250)	(0.187)
Constant	-8.060***	-3.158*	-8.090***	-3.506*
	(2.205)	(1.824)	(2.200)	(1.807)
N	2,755	2,799	2,755	2,799

Table 3.31: Low and high leverage ratio firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' leverage ratio. The dependent variable is the ratio of total long-term liability to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' leverage ratio according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	high leverage	low leverage	high leverage	low leverage
	(1)	(2)	(3)	(4)
lncfv	0.044	-0.071		
	(0.066)	(0.081)		
lncfv2			-0.006	0.004
			(0.024)	(0.037)
MB	0.030	-0.018	0.029	-0.016
	(0.037)	(0.058)	(0.037)	(0.057)
Tang	0.459	-0.617	0.453	-0.581
	(0.342)	(0.525)	(0.343)	(0.526)
TA	0.430***	0.625***	0.430***	0.626***
	(0.079)	(0.093)	(0.079)	(0.092)
Profit	2.299***	0.217	2.306***	0.195
	(0.601)	(0.848)	(0.604)	(0.854)
Age	-0.256***	0.062	-0.239***	0.035
	(0.086)	(0.195)	(0.089)	(0.194)
Owner	0.262	-0.346	0.263	-0.361
	(0.183)	(0.238)	(0.183)	(0.239)
Constant	-6.233***	-6.800***	-6.071***	-7.229***
	(1.668)	(2.330)	(1.657)	(2.331)
N	2,843	2,711	2,843	2,711

3.11.2 Short-term debt ratio

Table 3.32: Small and large firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' size. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' total asset according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	small	large	small	large
	(1)	(2)	(3)	(4)
lncfv	-0.102**	0.158***		
	(0.052)	(0.031)		
lncfv2			-0.040*	0.007
			(0.024)	(0.020)
MB	-0.043	0.034*	-0.047*	0.042**
	(0.027)	(0.020)	(0.026)	(0.020)
Tang	-0.291	-1.361***	-0.244	-1.435***
	(0.249)	(0.169)	(0.248)	(0.168)
TA	-0.477***	-0.076***	-0.464***	-0.077***
	(0.060)	(0.025)	(0.060)	(0.025)
Profit	0.167	0.029	0.142	0.045
	(0.491)	(0.402)	(0.497)	(0.401)
Age	-0.026***	0.018***	-0.027***	0.017***
	(0.009)	(0.006)	(0.009)	(0.006)
Owner	-0.338*	-0.002	-0.338*	0.037
	(0.196)	(0.116)	(0.196)	(0.116)
Constant	11.947***	3.767***	11.998***	3.292***
	(1.264)	(0.588)	(1.272)	(0.578)
N	2,449	3,105	2,449	3,105

Table 3.33: Young and old firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' age. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' age according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	young	old	young	old
	(1)	(2)	(3)	(4)
lncfv	0.002	0.125***		
	(0.040)	(0.036)		
lncfv2			-0.020	-0.007
			(0.022)	(0.022)
MB	0.028	0.017	0.027	0.025
	(0.029)	(0.021)	(0.029)	(0.021)
Tang	-0.879***	-1.050***	-0.892***	-1.127***
	(0.255)	(0.167)	(0.254)	(0.165)
TA	-0.295***	-0.170***	-0.295***	-0.175***
	(0.028)	(0.021)	(0.028)	(0.021)
Profit	0.522	-0.752*	0.544	-0.717*
	(0.518)	(0.394)	(0.516)	(0.390)
Age	0.022	0.011	0.022	0.012
	(0.014)	(0.010)	(0.014)	(0.010)
Owner	0.073	-0.132	0.073	-0.104
	(0.156)	(0.133)	(0.155)	(0.132)
Constant	7.842***	5.884***	7.855***	5.595***
	(0.605)	(0.501)	(0.593)	(0.491)
N	1,924	3,630	1,924	3,630

Table 3.34: Low and high cash flow firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' cash flow. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' cash flow according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
lncfv	0.004	0.129		
	(0.038)	(0.139)		
lncfv2			-0.010	-0.013
			(0.019)	(0.025)
MB	-0.044*	0.051**	-0.044*	0.057**
	(0.026)	(0.023)	(0.026)	(0.023)
Tang	-0.307	-1.306***	-0.314	-1.400***
	(0.225)	(0.192)	(0.223)	(0.189)
TA	-0.257***	-0.194***	-0.257***	-0.197***
	(0.027)	(0.023)	(0.027)	(0.023)
Profit	-0.639	-0.282	-0.634	-0.299
	(0.500)	(0.441)	(0.499)	(0.437)
Age	-0.016**	0.018**	-0.016**	0.019***
	(0.007)	(0.007)	(0.007)	(0.007)
Owner	0.148	-0.201	0.148	-0.164
	(0.170)	(0.128)	(0.170)	(0.128)
Constant	7.394***	6.471***	7.390***	6.144***
	(0.608)	(0.527)	(0.595)	(0.508)
N	2,755	2,799	2,755	2,799

Table 3.35: Low and high leverage ratio firms (FRM without time averages)

This table reports the results of equation 3.1 using fractional response model, and spilt all firms into two group on the basis of firms' leverage ratio. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' leverage ratio according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	high leverage	low leverage	high leverage	low leverage
	(1)	(2)	(3)	(4)
lncfv	0.075	0.082		
	(0.077)	(0.091)		
lncfv2			-0.005	-0.020
			(0.020)	(0.024)
MB	-0.027	0.044*	-0.022	0.047*
	(0.023)	(0.025)	(0.023)	(0.025)
Tang	-1.653***	-0.342	-1.696***	-0.392*
	(0.180)	(0.209)	(0.179)	(0.210)
TA	-0.217***	-0.227***	-0.220***	-0.229***
	(0.023)	(0.027)	(0.023)	(0.027)
Profit	-1.795***	0.919**	-1.747***	0.937**
	(0.446)	(0.463)	(0.441)	(0.463)
Age	0.009	-0.008	0.009	-0.009
	(0.006)	(0.008)	(0.006)	(0.008)
Owner	-0.079	-0.078	-0.067	-0.064
	(0.135)	(0.153)	(0.135)	(0.152)
Constant	6.986***	6.882***	6.813***	6.668***
	(0.527)	(0.583)	(0.518)	(0.571)
N	2,843	2,711	2,843	2,711

Table 3.36: Small and large firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' size. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' total asset according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	small	large	small	large
	(1)	(2)	(3)	(4)
lncfv	-0.031	-0.030		
	(0.083)	(0.047)		
lncfv2			-0.030	0.004
			(0.025)	(0.020)
MB	-0.056*	0.033	-0.058*	0.043
	(0.032)	(0.028)	(0.032)	(0.028)
Tang	0.843**	0.262	0.910**	0.281
	(0.396)	(0.276)	(0.397)	(0.275)
TA	-0.498***	-0.388***	-0.488***	-0.383***
	(0.110)	(0.053)	(0.109)	(0.054)
Profit	-0.202	-0.690	-0.160	-0.651
	(0.675)	(0.517)	(0.679)	(0.507)
Age	0.156**	-0.018	0.177***	-0.018
	(0.067)	(0.133)	(0.065)	(0.142)
Owner	-0.015	0.059	-0.018	0.049
	(0.234)	(0.138)	(0.235)	(0.139)
Constant	7.142***	7.141***	7.562***	6.797***
	(2.334)	(1.351)	(2.310)	(1.356)
N	2,449	3,105	2,449	3,105

Table 3.37: Young and old firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' age. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' age according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	young	old	young	old
	(1)	(2)	(3)	(4)
lncfv	-0.103	0.016		
	(0.066)	(0.053)		
lncfv2			-0.017	-0.010
			(0.023)	(0.022)
MB	-0.050	-0.011	-0.049	-0.005
	(0.038)	(0.025)	(0.038)	(0.025)
Tang	-0.190	0.696**	-0.178	0.668**
	(0.413)	(0.271)	(0.412)	(0.269)
TA	-0.765***	-0.337***	-0.767***	-0.331***
	(0.092)	(0.054)	(0.092)	(0.054)
Profit	-0.311	-0.715	-0.315	-0.654
	(0.701)	(0.513)	(0.698)	(0.503)
Age	-2.580***	0.241***	-2.570***	0.249***
	(0.896)	(0.088)	(0.885)	(0.090)
Owner	0.047	0.036	0.033	0.029
	(0.193)	(0.157)	(0.193)	(0.157)
Constant	4.289	6.638***	4.043	6.693***
	(2.790)	(1.412)	(2.777)	(1.404)
N	1,924	3,630	1,924	3,630
N	1,924	3,630	1,924	3,630

Table 3.38: Low and high cash flow firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' cash flow. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' cash flow according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	low cash flow	high cash flow	low cash flow	high cash flow
	(1)	(2)	(3)	(4)
lncfv	-0.037	-0.035		
	(0.064)	(0.056)		
lncfv2			-0.018	-0.004
			(0.020)	(0.025)
MB	-0.044	0.001	-0.045	0.009
	(0.032)	(0.029)	(0.032)	(0.030)
Tang	0.689*	0.282	0.696*	0.262
	(0.388)	(0.298)	(0.387)	(0.292)
TA	-0.335***	-0.537***	-0.335***	-0.534***
	(0.073)	(0.059)	(0.073)	(0.060)
Profit	-0.196	-1.262**	-0.189	-1.199**
	(0.584)	(0.569)	(0.584)	(0.558)
Age	-0.011	0.334**	-0.026	0.356**
	(0.075)	(0.141)	(0.076)	(0.150)
Owner	0.079	0.026	0.078	0.022
	(0.202)	(0.154)	(0.202)	(0.154)
Constant	7.346***	5.991***	7.208***	5.857***
	(1.801)	(1.437)	(1.793)	(1.425)
N	2,755	2,799	2,755	2,799

Table 3.39: Low and high leverage ratio firms (FRM with time averages)

This table reports the results of equation 3.1 using fractional response model with time averages, and spilt all firms into two group on the basis of firms' leverage ratio. The dependent variable is the ratio of total short-term debt to total liability. The definition of variables have been shown in Table 3.1. Firms are separated into the level of firms' leverage ratio according to the median value of the variable for all the firms belongings to the same industry. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	high leverage	low leverage	high leverage	low leverage
	(1)	(2)	(3)	(4)
lncfv	-0.056	0.033		
	(0.056)	(0.065)		
lncfv2			-0.014	-0.012
			(0.020)	(0.024)
MB	-0.031	0.009	-0.030	0.010
	(0.027)	(0.032)	(0.027)	(0.033)
Tang	0.057	1.003***	0.057	0.943***
	(0.303)	(0.368)	(0.302)	(0.365)
TA	-0.363***	-0.498***	-0.358***	-0.499***
	(0.065)	(0.069)	(0.065)	(0.069)
Profit	-1.374***	-0.161	-1.345**	-0.153
	(0.533)	(0.619)	(0.527)	(0.617)
Age	0.135*	0.151	0.115	0.163
	(0.080)	(0.137)	(0.082)	(0.137)
Owner	-0.121	0.249	-0.126	0.249
	(0.162)	(0.187)	(0.162)	(0.186)
Constant	6.697***	8.943***	6.465***	8.830***
	(1.440)	(1.817)	(1.438)	(1.796)
N	2,843	2,711	2,843	2,711

Chapter 4

Cost of capital and cash flow volatility

4.1 Introduction

High volatility of a firm's cash flow is associated with a high probability of a cash flow shortfall, and enhances the probability of default. Graham et al. (2005) point out corporate executives have a strong desire to keep cash flow volatility constant. In the survey article by Graham et al. (2005), the executives state a willingness to sacrifice long-term value to ensure smoother cash flow. An important motivation for achieving lower cash flow volatility is that the executives think that investors perceive volatile firms to be riskier, and thus demand a higher expected return, or cost of equity. According to the studies cited above, cash flow volatility is a potential reason that may increase the cost of equity. High cash flow volatility may also increase the cost of debt because of the higher probability of cash flow shortfall. As regards the cost of debt, the volatility of cash flow is occasionally cited as the basis for a rating.[1] Nonetheless, the empirical

[1]On February 18, 2014, Fitch maintained a BBB - rating for Wyndham Worldwide , noting that the affirmation reflected that Wyndham has modified its business model to

literature has paid relatively little attention to the relation between cash flow volatility and the cost of capital. The main purpose of this chapter is to shed further light on this topic.

Existing empirical studies show that cash flow volatility can lower the investment of US firms and it can increase the cost of obtaining external funds (Minton and Schrand, 1999). Furthermore, Keefe and Yaghoubi (2016) find evidence that cash flow volatility may affect the firms' capital structure. Another recent paper by Douglas et al. (2016) proves that cash flow volatility is positively associated with the bond yield spreads. All these studies use US data and find that higher cash flow volatility is associated with a higher cost of capital. In contrast, there are only a handful of papers studying the relation between cash flow volatility and the cost of capital in China. One cannot but note some striking differences between the capital markets in the US and China: firstly, the bond market in China is relatively immature; secondly, most Chinese firms can only raise debt from the major banks. Given these differences, one may wonder whether the empirical results found for the US are valid for China as well. This chapter attempts to investigate the relation between cash flow volatility and the cost of capital in China.

Firms can raise additional capital either through equity or debt. Therefore, studies investigating the cost of capital make distinction between the cost of equity and the cost of debt. This study uses three methods to measure the cost of equity: the industry method (Gebhardt et al., 2001), the PEG ratio (Easton, 2004), and the average of these two. Gebhardt et al. (2001) show that a firm's implied cost of equity is a function of its industry membership,

reduce its cash flow volatility

book-to-market (B/M) ratio, forecasted long-term growth rate, and the dispersion in the analyst earnings forecasts. They use a discounted residual income model to estimate the implied cost of equity. Easton (2004) describes a model of earnings and earnings growth, and uses this model to estimate the expected return on the equity market. Unfortunately, data for forecasting returns is not available for the Chinese capital market. For this reason, I follow the study of Chen et al. (2011) and use realised data instead. In what regards the measure of the cost of debt I follow the method of Chen and Zhu (2013) and calculate the ratio of financial expenses to the average of long and short term liabilities.

To examine the relation between the cost of capital and cash flow volatility, I use two estimation methods: Fama-Macbeth adjusted by Newey and West (McInnis, 2010) and OLS (standard errors clustered at the firm level). The Fama-Macbeth approach is widely used in the empirical studies of asset pricing models. However, this approach does not correct the standard errors for the time-series autocorrelation, and is usually used for cross-sectional data. To address this problem, I use the Fama-Macbeth approach adjusted by Newey and West (McInnis, 2010) instead. As my data have both time and firm specific effects, I follow Petersen (2009), and therefore 1) include time dummies, and 2) estimate the standard errors clustered at the firm level.

My empirical results reveal that the impact of cash flow volatility on the cost of equity in China is similar to the impact of cash flow volatility on the cost of capital in the US (Minton and Schrand, 1999). The main analysis defines cash flow volatility as the standard deviation of the last five rolling years. Alternatively, I measure cash flow volatility using the standard deviation of

the last four or six rolling years instead. All the empirical results show that cash flow volatility increases the cost of equity in China. Another interesting result unveiled by this paper is that firm ownership does not affect the cost of equity in China. The first explanation for this result can be found in the data descriptives: firms with lower state-owned shares have a better performance. Consequently, firms with lower number of state-owned shares have lower cost of equity. The second reason is that the manufacturing firms in my sample have a relatively low ratio of state-owned shares; therefore, whether the firms have state-owned shares or not is not an important factor for the cost of equity.

In contrast, my empirical results show that the cost of debt is not affected by cash flow volatility in China, which is different from the US capital market (Douglas et al., 2016). The difference in results may be related to the characteristics of the Chinese capital market: the bond market in China is quite immature; most firms can only obtain loans from the major banks, and the interest rate for loans is not determined by cash flow volatility. Moreover, due to data availability, this study uses only one method to measure the cost of debt. My empirical results also reveal that having state-owned shares can lower the cost of debt in China. This result can also be found in the study by Li et al. (2009), who show that state ownership is positively associated with the leverage ratio in China. State-owned firms have more advantages when they borrow money from outside. It is easier for firms with more state-owned shares to raise funds from major banks.

The stock market in China has grown rapidly since 1990s; however, the bond market is quite immature. This explains the different results for the cost of equity and the cost of debt in this chapter. Cash flow volatility

is one of the financial proxies for firms; if they experience high cash flow volatility, they have to spend more when they raise money from the stock market. For the cost of debt, in contrast to the bond market in the US, most debt comes from the major banks in China. The interest rate of bank is a very important factor for the cost of debt. If China had a large bond market, the results of the cost of debt may change.

This chapter is organised as follows. Section 2 reviews the existing literature. Section 3 introduces the specifications used in this chapter. Section 4 introduces the four methods of measuring the cost of capital and the two estimation methods used in this chapter. Section 5 introduces the data, describes the variables, presents some univariate analysis and the correlation matrix. Section 6 reports all the empirical results regarding the relation between cash flow volatility and the cost of capital in China. Section 7 concludes the chapter.

4.2 Literature review

4.2.1 Cash flow volatility and the cost of capital: theoretical work

In traditional asset-pricing models, such as CAPM, the idiosyncratic return volatility can not affect the variance in a well-diversified portfolio. Earnings volatility and cash flow volatility are not considered in the CAPM model. However, some studies argue that there is a link between cash flow volatility and the cost of capital. Trueman and Titman (1988) construct a model that

shows firms smooth their earnings to reduce the probability of bankruptcy, and thereby lower their borrowing rates. The drawbacks of this model are that it does not consider the cost of equity, and it does not allow investor diversification across multiple securities. Easley and O'hara (2004) develop a model based on information risk and the risk premium. This model indicates that investors demand a risk premium for securities when they lack information. Easley and O'hara (2004) point out that income smoothness lowers information asymmetry, thereby lowering the cost of equity capital. In summary, firms may benefit from a earnings smoothening. Finally, Keefe and Yaghoubi (2016) construct a theorical model based on the Black and Scholes (1973)'s model to illustrate a positive relation between the cost of debt and the cash flow volatility. These studies state that cash flow volatility can theoretically increase the cost of capital.

4.2.2 Cash flow volatility and the cost of capital: empirical evidence

The empirical literature on the cash flow volatility is vast, dating back to the 1990s. Minton and Schrand (1999) use quarterly data of US firms and find that the cash flow volatility can lower the level of firm investment. They also demonstrate that cash flow volatility has a strong positive impact on the cost of obtaining external funds. In their study, cash flow volatility is measured as the coefficient of variation of quarterly operating cash flow over the previous six years. Molina (2005) uses the coefficient of variation of operating income over the previous three-year period to measure the cash flow volatility, and concludes that cash flow volatility has a strong

positive impact on the yield spread. This conclusion is based on the annual data from 1988 to 2002. The study of Tang and Yan (2010) focuses on the relation between the firm-specific characteristics and credit default swaps. Using quarterly data from 1997 to 2006 in US, they indicate that the cash flow volatility (measured as the coefficient of variation of quarterly operating cash flow over the previous six years) increases the credit default swap spread. However, this conclusion is based on a regression that does not control for spread-informative variables (coverage ratio and credit rating). To summarise, the previous studies have used different methods to measure cash flow volatility and different data frequencies (Minton and Schrand (1999) and Tang and Yan (2010) use quarterly data, while Molina (2005) uses annual data). Nevertheless, all studies have reached the same conclusion: cash flow volatility can increase the cost of capital in the US

A more recent paper by Douglas et al. (2016) finds a positive relation between cash flow volatility and bond yield spreads, using both forward-looking and historical cash flow volatility. This conclusion is based on the quarterly data from 1994 to 2009 in US There are four main conclusions in the study of Douglas et al. (2016). First, cash flow volatility has more impact on the bond price than a number of commonly used factors (interest coverage ratios and leverage ratios). Second, when firms are at a great risk of default, the impact of cash flow volatility is dramatically higher. Third, cash flow volatility predicts yield spread inter-temporally. Finally, up-to-date information is an important factor for yield spread. When using more recent cash flow (short-window cash flow) to measure cash flow volatility, the impact of short-window cash flow volatility on bond yield spread is greater than when using long-window cash flow volatility.

In addition to the papers cited above, there are many studies that focus on earnings volatility. Both cash flow volatility and earnings volatility reflect the firm's stability and are affected by its risk management policies and managerial decisions. To some extent, cash flow volatility and earnings volatility are similar. Francis et al. (2004) examine the relation between earnings volatility and the implied cost of equity and conclude that earnings volatility has a positive effect on the cost of equity. The latter is based on the forecasts of the future stock price and dividends, which are provided by Value Line.[2] The result of Francis et al. (2004) shows that the volatile firms have a higher future stock return than the firms with smooth earnings. As a robustness test, Francis et al. (2004) utilise the method of Easton (2004) to measure the cost of equity and reach the same conclusion. However, the study of Verdi (2005) reaches a different result. This study uses a principal components analysis and replicates the study of Francis et al. (2004). The relation between the earnings volatility and the cost of equity in his study reverses in sign and becomes insignificant when the cost of equity is estimated using the method of Gebhardt et al. (2001). McInnis (2010) also replicates the study of Francis et al. (2004) and finds that the earnings volatility can increase the implied cost of equity but does not lower the average stock returns. Francis et al. (2004) state that this may be due to the optimism of analysts' long-term earnings forecasts.

Bhattacharya et al. (2003) use data from 34 countries from 1984 to 1998, and find that countries with higher earnings volatility have a lower cost of capital

[2]The Value Line Investment Survey, a stock analysis newsletter, is among the most highly regarded and widely used independent investment research resources in global investment and trading markets, tracking approximately 1,700 publicly traded stocks in over 99 industries.

(estimates from dividend yields); however, this result becomes insignificant when they introduce an international factor-pricing model to calculate the cost of capital. Amidu and Abor (2006) use the data from Ghana and find that firms with higher earnings volatility pay fewer dividends, and that higher earnings volatility implies lower returns.

In summary, the literature on the cash flow volatility does not reach a consensus. One the one hand, Minton and Schrand (1999) and Francis et al. (2004) indicate that the cash flow volatility increases the cost of capital, while, on the other hand, the studies of Bhattacharya et al. (2003) and Verdi (2005) conclude that the impact of cash flow volatility on the cost of capital is a matter of the different methods used for measuring the cost of equity.

4.2.3 Cash flow volatility in China

As China is a developing country, Chinese firms have more difficulty in obtaining external funds relative to their US counterparts. Therefore, when Chinese firms experience high cash flow uncertainty, they may behave differently relative to US firms. The vast majority of prior studies that focus on the cash flow volatility and cost of capital are based on analyses of US data. There are, however, very few studies that focus on the cash flow volatility and cost of capital in China. Safdar and Yan (2016) examine the relation between accruals quality and cost of capital in China. They find that poor accruals quality increases the non state-owned firms' cost of equity, but does affect the cost of debt in China.

Similar to Minton and Schrand (1999), Ying and Zhengfei (2006) find that cash flow volatility can decrease the cost of capital for Chinese firms. Ying and Zhengfei (2006) use the income residual model to measure the cost of equity and find that total disclosure and the earnings smoothness are the main influential factors on the cost of capital in China. However, there are no other papers that study the relation between cash flow volatility and the cost of capital in China. I attempt to fill this gap in the literature. This chapter uses four different methods to measure the cost of capital and tests whether the impact of cash flow volatility on the cost of capital in China is different from that in US.

4.3 Specification

In order to examine the effect of cash flow volatility on the cost of capital, this study follows the model of McInnis (2010), as described below:

$$\begin{aligned} K_{it} = a_0 + a_1 CFV_{it-1} + a_2 Beta_{it-1} + a_3 Size_{it-1} \\ + a_4 MB_{it-1} + a_5 ownership_{it-1} + \epsilon_{i,t} \end{aligned} \tag{4.1}$$

The dependent variable K denotes the cost of capital. Section 4.4.1 discusses the four methods used to measure the cost of capital K. The main variable of interest is cash flow volatility CFV. In the main analysis CFV is calculated using the standard deviation of cash flow in the previous 5 rolling years. Alternatively, robustness checks use a 4 or 6 year rolling window instead. Douglas et al. (2016) and Francis et al. (2004) show that cash flow volatility can increase the cost of capital in US, so I expect that the

coefficient associated with this variables is positive and significant also when I use Chinese data. *Beta* is the slope coefficient from the regression of a firm's raw return on the monthly value-weighted over five rolling years. Volatile firms have more difficulty in raising money from outside, so the expected results should be positive. *Size* is the natural logarithm of total assets. Large firms are assumed to have a lower cost of capital, hence the expected coefficients of this variable should be negative. MB is the natural logarithm of the ratio of the market value to book value. Firms with a higher MB ratio are expected to be less financially constrained. The coefficient of this variable is expected to be negative. Finally, *ownership* is a dummy variable equal to 1 if the firm has any state-owned shares. State-owned firms in China face fewer financial constraints. The expected sign for this coefficient should be negative. All the independent variables are lagged by one period to avoid possible endogeneity.

4.4 Measuring the cost of capital

4.4.1 Cost of equity

There is no consensus regarding the way the cost of equity should be measured. Four models have been widely used in previous studies: the models of Gebhardt et al. (2001), Claus and Thomas (2001), Easton (2004), and Ohlson and Juettner-Nauroth (2005). However, due to the nature of the data in China, I cannot use the models of Claus and Thomas (2001) and Ohlson and Juettner-Nauroth (2005). For the method of Claus and Thomas (2001), CSMAR does not have five years forecast data of earnings

and earning growth, this method is not available. The method of Ohlson and Juettner-Nauroth (2005) is based on the expected earning per share and dividend per share, however I do not have complete data for dividends per share. Therefore, this method is also not available in this chapter. I can only use the method of Gebhardt et al. (2001) and the method of Easton (2004) in this paper. Additionally, I use the average value of the industry method (Gebhardt et al., 2001) and the PEG ratio (Easton, 2004) to measure the cost of equity. Overall, three different methods are used to measure the cost of equity.

The industry method assumes that a firm's return on equity (ROE) reverts to the industry median ROE beyond the forecast horizon. The PEG ratio assumes zero growth in abnormal earnings beyond the forecast horizon. While Botosan and Plumlee (2005) point out that the PEG ratio approach is preferable for measuring the cost of equity in a US capital market setting, there are no papers indicating that the PEG ratio is appropriate for Chinese listed firms. Zhengfei and Kangtao (2004) indicate that the industry method is the most appropriate for Chinese listed firms. Both methods have been used in the study of Chen et al. (2011). They focus on the relation between the cost of equity and audit quality in China. The reason for using the average of the two methods is to reduce the possibility of spurious results stemming from a particular cost of equity model (Dhaliwal et al., 2006). Based on this evidence, I utilise the above-mentioned three methods to measure the cost of equity in my study.

4.4.1.1 The industry method, following Gebhardt et al. (2001)

Gebhardt et al. (2001) use the residual income model, according to the dividend discount model, the stock price is the present value of its expected future dividends:

$$P_t = \sum_{i=1}^{\infty} \frac{E_t(D_{i+1})}{(1 + r_{GLS})^i} \tag{4.2}$$

where P_t is the stock price per share at time t, $E_t(D_{i+1})$ is the expected future dividends for the periods $t + i$ conditional on the information at time t, and r_{GLS} is the estimated implied cost of equity.

Then I can then transfer the equation as follows:

$$P_t = B_t + \sum_{i=1}^{\infty} \frac{E_t(ROE_{t+i} - r_{GLS})B_{t+i-1}}{(1 + r_{GLS})^i} \tag{4.3}$$

where B_t is the book value of equity per share at time t, and ROE_{t+i} is the return on book equity for the period $t + i$. Equation 4.3 requires an infinite series of earnings forecasts; however, this can also convert to the following finite-horizon with a terminal value:

$$P_t = B_t + \sum_{i=1}^{11} \frac{FROE_{t+i} - r_{GLS}}{(1 + r_{GLS})^i} B_{t+i-1} + \frac{FROE_{t+12} - r_{GLS}}{r_{GLS}(1 + r_{GLS})^{11}} B_{t+11} \tag{4.4}$$

where $FROE$ is the forecast ROE (return on equity). Gebhardt et al. (2001) use a two-stage approach to calculate the forecasting ROE: 1) use the earnings forecast data for the first three years, and 2) forecast the earnings beyond year three explicitly, by mean of reverting the period $t + 3$ ROE to the median industry ROE in the periods that follow using a simple linear interpolation [3] between them to calculate the forecast earnings. According

[3] If last three years median industry ROE are given $(1, ROE_1)$, $(2, ROE_2)$ and

to the method of Gebhardt et al. (2001), I need the $FROE$ for 12 future years in equation 4.5. However, earnings forecast data are not available in China. For this reason, I follow the method of Chen et al. (2011), and use reported the ROE instead. I then forecast $FROE$ for the remaining years using a linear interpolation of the industry median ROE over previous three-year period.

I assume that the book value of equity, earnings, and dividends satisfies the 'clean surplus relation', which means that $B_{t+i} = B_{t+i-1} + FROE_{t+i} * B_{t+i-1} * (1 - pout_{it})$, where $pout_{it}$ is the expected dividend payout ratio (measured as the median payout ratio of the previous three years).

Equation 4.4 uses the forecast earnings up to 12 future years. Gebhardt et al. (2001) use more forecast earnings (6, 9, 15, 18, and 21 years) in their study, and they find that the results are very similar. Given that I only have only 16 years data, in this study, I use 12 future years earnings to calculate the implied cost of equity.

4.4.1.2 The PEG ratio method, following Easton (2004)

The second method used to calculate the cost of equity is the PEG ratio, following Easton (2004). The PEG ratio, r_{PEG}, is calculated as follows:

$$r_{PEG} = \sqrt{\frac{eps_{t+2} - eps_{t+1}}{P_t}} \tag{4.5}$$

where r_{PEG} is the implied cost of equity capital according to the PEG ratio approach, eps_{t+1} is the one-year-ahead realised EPS (earnings per share),

$(3, ROE_3)$, Then the fourth years forecasting ROE is: $ROE_4 = ROE_1 * \frac{(4-2)*(4-3)}{(1-2)*(1-3)} + ROE_2 * \frac{(4-1)*(4-3)}{(2-1)*(2-3)} + ROE_3 * \frac{(4-1)*(4-2)}{(2-1)*(2-3)}$

eps_{t+2} is the two-year-ahead realized EPS, and P_t is price per share at the end of year t. I use realised eps_{t+2} and eps_{t+1} instead of expected earnings per share because, as mentioned above, earnings forecast data is not available in China. The PEG ratio method requires that $eps_{t+2} > eps_{t+1} > 0$. Some of the observations have been lost because of this constraint.

To assess the validity of the cost of equity, Chen et al. (2011) regress these two cost of equity methods on three risk proxies: size, beta, and book-to-market ratio. They show that these two cost of equity measures are positively related to firm size, beta, and the market-to-book ratio. These results are consistent with the studies of Francis et al. (2004).

Following the method of Dhaliwal et al. (2006) and Boubakri et al. (2012), this chapter also uses the average of the PEG ratio and the industry method to measure the cost of equity. These studies use the average of four cost of equity models. However, this chapter uses the average of two methods as the other two methods cannot be used for Chinese data.

To summarise, according to the theoretical model of Trueman and Titman (1988) and Easley and O'hara (2004), cash flow volatility can increase the cost of equity. Existing empirical studies prove that cash flow volatility can increase the cost of equity in US (Francis et al., 2004). In this chapter, I use industry method (Gebhardt et al., 2001), PEG ratio (Easton, 2004) and the average of these two (industry method and PEG ratio) to measure the cost of equity and expect that cash flow volatility can also increase the cost of equity in China.

4.4.2 Cost of debt

I follow the method of Chen and Zhu (2013) to measure the cost of debt as the ratio of financial expenses to the average of long and short term liability. Financial expenses is the sum of interest expenses, foreign exchange loss, and related fees. The US market usually uses interest payments to proxy the cost of debt. However, in CSMAR, the interest payment item loses about 90% of the observations. Hence, I use the financial expenses instead. As indicated, in the US market, cash flow volatility can increase the cost of debt (Douglas et al., 2016). Hence, I expect cash flow volatility to increase the cost of debt in China too.

4.4.3 Estimation method

4.4.3.1 Fama-Macbeth and Newey-West standard Errors

The Fama-Macbeth approach is widely used in the study of asset pricing models. This method estimates the betas and risk premium for any risk factors. However, this method treats the data as cross-sectional data, not as panel data. Fama-Macbeth provides standard errors corrected only for cross-sectional correlation; the standard errors are not corrected for time-series autocorrelation. In the study of asset-pricing, stock trading data are usually weekly or monthly data which have weak time-series. An alternative method of addressing standard errors for time-series is the Newey-West procedure (Newey and West, 1986). This method is introduced to account for unknown forms of serial correlation in the residual of time series. The Newey-West procedure is modified for panel data. The data in this chapter

are annual data which have strong time-series. Thus, this chapter follows the method of McInnis (2010), and uses the Fama-Macbeth adjusted by means of a Newey-West procedure. This chapter use two lag length of the Newey-west standard errors.

4.4.3.2 OLS

It is well known that when the residuals are independent and identically distributed, OLS standard errors are correct; OLS standard errors are biased if the residuals are correlated across observations. Petersen (2009) shows that several alternative approaches address this problem. There are three main alternative approaches: the first is the Fama-Macbeth; the second is to add a firm dummy or time dummy; the last is to cluster the standard errors by firms or time. Petersen (2009) points out that when both a time and a firm effect are present in the data, research can add a time (or firm) dummy to the regression and estimate the standard errors clustered in the other dimension. The sample of this chapter comprises panel data which contains many firms, but there are only approximately 11 years' worth of data. There are insufficient numbers of cluster in the time dimension in my sample. Hence, for my research, I add the time dummy and estimate the standard errors clustered by firms.

4.5 Data, Univariate Statistics and correlation matrix

4.5.1 Data

The sample of this study comprises Chinese listed manufacturing firms observed over the period 2003 to 2011. All the data are from the China Stock Market Accounting Research (CSMAR) database. Cash flow statements in the CSMAR database are available from 1998 to 2013. However, I need the previous five rolling years cash flow to calculate cash flow volatility. Therefore, cash flow volatility data is available from 2003. As both the industry method (proposed by Gebhardt et al. (2001)) and the PEG ratio require two years of forecast data, I use two years' worth of realised data instead. The sample that I can use for the regression stretches from 2002 to 2011. To control for the potential influence of outliers, all the variables are winsorized at 1% level in both tails of distribution. For the robustness test, I also use the standard deviations of four and six rolling years of cash flow to calculate the cash flow volatility. The results of four and six years cash flow volatility generate a similar conclusion.

4.5.2 Univariate Statistics

Table 4.1 reports the descriptive statistics of the firm characteristics for the full sample. The mean value of the implied cost of equity (Rpeg) with the PEG ratio approach is 0.15, and the mean value of the implied cost of equity with the industry approach (Rgls) is 0.07. These results are

consistent with prior studies of Chinese listed firms (Zhengfei and Kangtao, 2004). The variable COE represents the average of the industry method and the PEG ratio; the mean of this variable is 0.104. The cost of debt follows the method of Chen and Zhu (2013). As the cost of debt cannot be negative, this chapter drops all observations with negative values for the cost of debt. The mean of the cost of debt is 0.057. The mean of cash flow volatility (standard deviation of last 5 rolling years) is 0.055, which is quite similar to the mean of cash flow volatility which is calculated from the standard deviation of the last four and six rolling years. This means the three different measures of cash flow volatility are similar. The mean of the leverage ratio is 0.497, which is similar to the results of Chen et al. (2011). Comparing the mean of the two methods of cost of equity (PEG ratio and industry method), the PEG ratio is much higher than the cost of equity using the industry method. The results show that the cost of debt is lower than the cost of equity.

Table 4.2 shows the descriptive statistics separately for two groups of firms. These two groups are firms that have any state-owned shares and those that do not have any state-owned shares. Comparing the means of total assets of the two groups, I note that the mean of total assets of the firms that have state-owned shares is 6,183 million. This is a little lower than the mean of total assets of firms that do not have state-owned shares (6,253 million). However, a t-test shows that the difference between the two groups is not significant. The means of leverage ratio shows that private firms have a lower leverage ratio than firms that have state-owned shares. Firms that do not have state-owned shares have a higher market-to-book (MB) ratio and earnings per share (EPS) than those that have state-owned shares. These

results show that firms that do not have state-owned shares perform better than firms that do (higher EPS and MB ratios, and lower leverage ratio). The means of the three measures of cost of equity shows that firms that do not have state-owned shares have a lower cost of equity. These three average values show that firms without state-owned shares have a lower cost of equity. This is in contrast to the conclusion of Cull et al. (2015). However, the average cost of debt is lower for the group of state-owned firms. This is opposite to the results for the cost of equity. The t-test shows that the difference between the two groups regarding the cost of capital is significant. The two groups have similar mean values for cash flow volatility (according to the three measures), and the t-test proves that there is no difference between the two groups.

The summary statistics discussed above show that the firms without state-owned shares perform better, which is in contrast to previous studies. This may be one of reasons why firm ownership does not affect the cost of equity in the empirical analysis below.

4.5.3 Univariate correlation

Table 4.3 reports the pairwise correlation coefficients. While the three measures of the cost of equity are positively correlated among each other, only two of them, namely Rpeg (PEG ratio) and COE (the average of the PEG ratio and Rgls), are strongly positively correlated with cash flow volatility. At the same time, Rgls (the implied cost of equity under the industry method) and the cost of debt are negatively related to cash flow volatility. These correlations coefficients maintain sign and magnitude

irrespective of the cash flow volatility measure used (4, 5, 6 year rolling window). These results may explain the difference in the empirical results below (i.e., the cost of debt is not affected by cash flow volatility, and the coefficients of cash flow volatility with the industry method are small). As expected, firms' size and MB ratios are negatively correlated to the cost of capital. However, only the cost of debt is negatively related to state-ownership.

4.6 Empirical Results and Analysis

This study uses four methods to measure the cost of capital. Sections 4.6.1, 4.6.2 and 4.6.3 present the empirical results for the three measures of the cost of equity. Section 4.6.4 reports the empirical results for the cost of debt. In order to examine the relation between cash flow volatility and the cost of capital (equity and debt, respectively), all sections report estimates obtained with two estimation methods, namely the Fama-Macbeth approach adjusted using a Newey-West procedure and the ordinary least squares estimator (clustered standard errors by firms).

4.6.1 The results of PEG ratio

The estimates in Table 4.4 show the relation between the cost of equity measured as the PEG ratio and cash flow volatility measured as the standard deviation of cash flow within a five year rolling window. Columns 1 and 2 report the results obtained with different estimation methods: the adjusted Fama-Macbeth procedure and OLS clustering by firms, respectively. The

coefficients associated with CFV are positive (0.309 and 0.240, respectively) and highly significant at the 1% level. Columns 3 to 6 prove that the found positive correlation is robust to using a four year rolling window (columns 3 and 4) or a six year rolling window (columns 5 and 6) to measure cash flow volatility. All of these coefficients are positive and significant. Altogether, these results show that cash flow volatility can increase the cost of equity (using PEG ratio to measure cost of equity) in China. These findings are consistent with the results from the US in the prior studies (Minton and Schrand, 1999). The quoted firms in China also suffer from a higher cost of equity if their cash flow is volatile.

Looking at the other controls, the results in Table 4.4 suggest that larger firms face fewer financial constraints and have a lower cost of capital. This finding is consistent with the literature starting with (Fazzari et al., 1988) which uses firms' size as a proxy for financial constraints in the US. These results support the conclusion reached by McInnis (2010) for US firms, as large Chinese firms also have a lower cost of equity. Chen and Zhao (2006) point out that a higher MB ratio leads to lower costs for external funds in US. The coefficients of MB ratio in Table 4.4 are negative and significant, and these results are consistent with those of McInnis (2010). Hence, in China, firms with a lower MB ratio experience a higher cost of equity. However, the coefficients of the beta variable in Table 4.4 are positive and insignificant across columns 1 to 6. These results differ from those of McInnis (2010). Finally, the results in Table 4.4 show that state-ownership does not affect the cost of equity in China. Ownership status is a 1/0 indicator of any number of state-owned shares. For robustness purposes, I use the percentage of state owned shares instead of the dummy variable

and find that the results are the same. All the coefficients of the ownership variable are insignificant in these additional unreported results.

4.6.2 The results of industry method

Table 4.5 shows the relation between the industry method and cash flow volatility using two different estimation methods (Fama-Macbeth adjusted using a Newey-West procedure and OLS clustering by firm). The coefficients of cash flow volatility in column 1 and 2 are 0.093 and 0.085 (significant at the 10% and 1% level, respectively). These are the similar to the results in Table 4.4. Cash flow volatility increase the cost of equity in China. However, the value of the coefficients in Table 4.5 are much lower than the value of the coefficients in Table 4.4. For the robustness check, I also use the standard deviations of four and six rolling years to measure cash flow volatility (shown in columns 3 to 6). The results are similar to those in columns 1 and 2. The coefficients of ownership and MB ratio in Table 5 are similar to those in Table 4.4.

4.6.3 The results of average of industry method and PEG ratio

Table 4.6 shows the results of cost of the equity calculated using the average of the industry method and the PEG ratio. Columns 1 and 2 show the results of cash flow volatility measured as the standard deviations of five rolling years. Both coefficients (0.127 and 0.134) are highly significant at the 1% level. Columns 3 to 6 use the alternative measures of cash flow

volatility. The results in columns 3 to 6 prove that the findings in columns 1 and 2 are robust to the measure of cash flow used. These results in Table 4.5 are the same as those in Tables 4.3 and 4.4 cash flow volatility increases the cost of equity in China. The other coefficients in Table 4.6 are the same as those in the Table 4.3. Larger firms (those with higher MB ratio firms) have a lower cost of equity. The ownership dummy does not affect the cost of equity.

All of these three tables show cash flow volatility increase the cost of equity, and the state-owned shares do not affect the cost of equity in China.

4.6.4 The results for the cost of debt

This section turns attention to the cost of debt. Table 4.7 shows the relation between cash flow volatility and the cost of debt. In contast to the results in Tables 4.4 to 4.6, cash flow volatility does not affect the cost of debt in China. All the coefficients of cash flow volatility are positive but insignificant. There are two potential reasons for this. The first is the special institutional setting in China. The bond market in China is quite immature and loans from banks are the main source of debt for firms. The cost of debt is mainly dependent on the interest rate of banks. The other reason is that the measure of the cost of debt is not very accurate. CSMAR do not have complete data for the interest on debt. This is why I follow the method of Chen and Zhu (2013) to measure the cost of debt as financial expenses (the sum of interest expenses, foreign exchange loss and related fees) over the average of short-term and long-term liability. Financial expenses are larger than interest expenses and this may have an

impact on my findings.

The coefficients of ownership are all negative and significant in Table 4.7; this proves that state-owned firms have a lower cost of debt. Previous studies have found similar results, namely that state ownership is positively associated with leverage and long-term debt in China (Li et al., 2009). The data descriptive statistics have also shown that firms with state-owned shares have lower cost of debt. Table 4.2 shows that firms without state-owned shares have higher cost of debt than firms with state-owned shares. The results for the MB ratio and firms' size are similar to those in Tables 4.4 and 4.6. The coefficients of these two variables are negative and significant, meaning that larger / higher MB ratio firms have a lower cost of debt in China.

4.7 Conclusion

This chapter investigates the relationship between cash flow volatility and firms' cost of capital. The analysis distinguishes between the cost of equity and the cost of debt. Consistent with the literature, given the lack of consensus regarding the best measure, the chapter employs three different methods to measure the cost of equity: the PEG ratio, the industry method, and the average of the two methods. The empirical results show that cash flow volatility increases the cost of equity in China. These results are consistent with those found for the US (Minton and Schrand, 1999). However, the cost of debt (calculated following the method of Chen and Zhu (2013)) is not affected by cash flow volatility in China. Throughout the analysis, two

different estimation methods have been used: the Fama-Macbeth approach adjusted using a Newey-West procedure and OLS clustering by firms. The results obtained with both methods reach the same conclusion. Moreover, the results are qualitatively similar when I use the standard deviation of cash flow within a four or six years rolling window to measure cash flow volatility.

Empirical studies of US show that cash flow volatility can increase the cost of capital (Minton and Schrand, 1999). In contrast, the results of this chapter show that cash flow volatility only increases the cost of equity in China but does not affect the cost of debt. These different results are due to the fact that the capital market in the US is mature, while the Chinese capital market is not. In China, the stock market has grown rapidly since the 1990s, while the bond market remains quite immature. This explains why the results for the cost of debt and the cost of equity in this chapter are different. If the bond market in China were relatively mature, like the stock market, the results have been different.

State ownership is an important variable in previous studies of the Chinese capital market. Li et al. (2009) show that state ownership increases the leverage ratio and long-term debt in China. The results of this chapter show the state ownership does not affect the cost of equity. This is due to firms that have state-owned shares performing better than firms without state-owned shares. However, this chapter reaches the same conclusion as Sapienza (2004) in what regards the relationship between state ownership and the cost of debt. Sapienza (2004) finds that state-owned firms receive a lower interest rate from state-owned banks. In China, the bond market is immature and loans from state-owned banks are a major source of external

funds. For this reason, state-owned firms have a lower cost of debt in China.

There are three main contributions from this chapter. First, although several papers have studied the relation between cash flow volatility and the cost of capital in the US, there are very few papers studying the relation between cash flow volatility and the cost of capital in China. This chapter fills a gap in the literature as it focuses on a less developed capital market. Second, the chapter uses four different methods to measure the cost of capital and two estimation methods to estimate the specification. Third, I study separately the cost of debt and the cost of equity, and find that the results are different. These different results prove that the bond market in China is quite immature.

The findings of this chapter may suffer from some limitations. As explained in detail earlier, the literature uses several alternatives measures for the cost of equity given the lack of consensus regarding the "best" measure. Due to data limitations, this study has only used the PEG ratio and the industry method. To address this limitation to some extent, the chapter has also used a third measure given by the average value of the first two. Similarly, the definition of the cost of debt measure had to be adjusted given data availability in CSMAR. Therefore, access to better quality data for Chinese firms may facilitate the construction of alternatives measures of the cost of equity and cost of debt, respectively.

4.8 Tables

Table 4.1: Summary statistics

The table reports the summary statistics of the study for the manufacturing Chinese listed firms from 2003-2011. All the variables are winsorized at 1% level in both tail of the distribution before the summary statistics are calculated. The tables shows mean, min, max,standard deviation (sd). ta is the total asset of the firm, the unit measurement of total asset is 1 million RMB. MB is the ratio of market value to book value. CFV is the standard deviation of last five rolling years cash flow. CFV4 is the standard deviation of last four rolling years cash flow. CFV6 is the standard deviation of last six rolling years cash flow. leverage ratio is the firms' leverage ratio which measure as the ratio of total liability to total asset. Rpeg is PEG ratio introduce by Easton (2004). Rgls is cost of equity introduced by the Gebhardt et al. (2001).COE is the average of industry method and PEG ratio. debtcost is the cost of debt follow the Chen and Zhu (2013), EPS is earnings per share.

VAR	mean	sd	min	max
	(1)	(2)	(3)	(4)
Rpeg	0.15	0.138	0.015	1.199
Rgls	0.07	0.072	0.0001	0.997
COE	0.104	0.074	0.001	0.739
debtcost	0.057	0.036	0.00001	0.841
MB	1.745	1.594	0.189	9.189
CFV	0.055	0.032	0.012	0.183
CFV4	0.054	0.036	0.007	0.236
CFV6	0.059	0.036	0.011	0.25
ta	6222	16390	17.961	414900
lev	0.497	0.196	0.051	1.223
EPS	0.27	0.645	-4.32	14.58

Table 4.2: Summary statistics

The table reports the summary statistics of the study for the manufacturing Chinese into two groups.state-owned(no state-owned) in the brackets means the the firms have(do not have) state-owned shares. ttest is the p-value for t-test, the null Hypothesis is there is no the difference between two groups.

VARIABLES	ta(state)	ta(no-state)	lev(state)	lev(no-state)
	(1)	(2)	(3)	(4)
mean	6183	6253	0.514	0.483
sd	16730	16110	0.181	0.206
min	27.154	17.961	0.056	0.051
max	373600	414900	1.223	1.215
ttest	0.832		0	
VARIABLES	q(state)	q(no-state)	cfvta(state)	cfvta(no-state)
	(1)	(2)	(3)	(4)
mean	1.53	1.91	0.055	0.055
sd	1.45	1.67	0.032	0.032
min	0.189	0.189	0.012	0.012
max	9.718	9.178	0.182	0.183
ttest	0		0.842	
VARIABLES	cfvta4(state)	cfvta4(no-state)	cfvta6(state)	cfvta6(no-state)
	(1)	(2)	(3)	(4)
mean	0.054	0.053	0.059	0.058
sd	0.036	0.036	0.037	0.035
min	0.007	0.007	0.011	0.011
max	0.236	0.234	0.244	0.25
ttest	0.507		0.147	
VARIABLES	Rpeg(state)	Rpeg(no-state)	eps(state)	eps(no-state)
	(1)	(2)	(3)	(4)
mean	0.173	0.144	0.259	0.276
sd	0.17	0.126	0.595	0.667
min	0.022	0.015	-3.54	-4.32
max	1.199	0.981	6.28	14.58
ttest	0		0	

Table 4.3: Correlation matrix

The table reports correlation matrix for all the variables. beta is the slope coefficient from the regression of a firm's raw return on the monthly value-weight over a rolling five year. The definition of other variables have been shown in Table 4.1.

	Rgls	Rreg	COE	debtcost	CFV	CFV4	CFV6	beta	ownership	MB ratio	size
Rgls	1.0000										
Rreg	0.2006	1.0000									
COE	0.5744	0.9172	1.0000								
debtcost	0.0954	0.1620	0.1742	1.0000							
CFV	-0.0238	0.0320	0.0170	-0.0157	1.0000						
CFV4	-0.0364	0.0341	0.0137	-0.0242	0.9083	1.0000					
CFV6	-0.0220	0.0277	0.0142	-0.0180	0.9090	0.8195	1.0000				
beta	-0.0105	0.0576	0.0438	0.0837	0.1228	0.0980	0.1360	1.0000			
ownership	0.1396	0.0495	0.0981	-0.0166	0.0132	0.0070	0.0240	0.1448	1.0000		
MB	-0.4534	-0.3261	-0.4569	-0.2011	0.0901	0.0945	0.1055	-0.0536	-0.0477	1.0000	
size	-0.1293	-0.2400	-0.2532	-0.2475	-0.0315	-0.0411	-0.0345	0.0640	0.0827	0.2144	1.0000

Table 4.4: The empirical results of PEG ratio

This table reports the results of equation 4.5, the dependent vartiable is the PEG ratio (Easton, 2004). The definition of variables have been shown in Table 4.1. Column 1 and 2 are the results of cash flow volatility which use five rolling years to calculate. Column 3 and 4 are the results of cash flow volatility which use four rolling years to calculate. Column 5 and 6 are the results of cash flow volatility which use six rolling years to calculate.Column 1, 3 and 5 use the adjusted Fama-Macbeth estimation. Column 2, 4 and 6 use the Ols clustering by the firms estimation. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	fama	ols	fama4	ols4	fama6	ols6
	(1)	(2)	(3)	(4)	(5)	(6)
cfvta	0.309***	0.240***				
	(0.055)	(0.090)				
cfvta4			0.254***	0.198**		
			(0.046)	(0.084)		
cfvta6					0.281**	0.211**
					(0.080)	(0.097)
beta	0.018	0.014	0.020	0.016	0.018	0.013
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
owner	-0.005	-0.015	-0.004	-0.014	-0.004	-0.012
	(0.015)	(0.017)	(0.014)	(0.020)	(0.013)	(0.021)
MB	-0.046***	-0.044***	-0.046***	-0.044***	-0.048***	-0.045***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)
size	-0.021***	-0.023***	-0.022***	-0.024***	-0.023***	-0.025***
	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)	(0.005)
Constant	0.435***	10.991	0.460***	1.832*	0.470***	1.822*
	(0.031)	(8.998)	(0.036)	(1.000)	(0.031)	(1.035)
N	2,519	2,450	2,564	2,494	2,425	2,357
R-squared	0.111	0.164	0.114	0.163	0.116	0.171
Groups	7		7		7	

Table 4.5: The empirical results of industry method

This table reports the results of equation 4.5, the dependent variable is the cost of equity under the industry method (Gebhardt et al., 2001). The definition of variables have been shown in Table 4.1 and Table 4.3. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	fama	ols	fama4	ols4	fama6	ols6
	(1)	(2)	(3)	(4)	(5)	(6)
cfvta	0.093*	0.085***				
	(0.048)	(0.030)				
cfvta4			0.028***	0.030***		
			(0.007)	(0.004)		
cfvta6					0.054***	0.060**
					(0.014)	(0.028)
beta	-0.008**	-0.006*	-0.007*	-0.005*	-0.008*	-0.006*
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
owner	-0.001	-0.003	-0.002	-0.004	-0.003	-0.005
	(0.003)	(0.005)	(0.003)	(0.005)	(0.003)	(0.005)
MB	-0.034***	-0.034***	-0.034***	-0.034***	-0.034***	-0.034***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
size	0.003	0.002*	0.003*	0.002*	0.003*	0.002*
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Constant	0.035	-13.239***	0.037	-13.097***	0.033	-1.641***
	(0.023)	(1.821)	(0.020)	(1.802)	(0.021)	(0.259)
N	5,421	5,421	5,511	5,511	4,795	4,795
R-squared	0.151	0.330	0.150	0.330	0.158	0.328
Groups	11		11		10	

Table 4.6: The empirical results of average of PEG ratio and industry method

This table reports the results of equation 4.5, the dependent variable is the cost of equity which is the average of industry method and PEG ratio. The definition of variables have been shown in Table 4.1 and Table 4.3. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	fama	ols	fama4	ols4	fama6	ols6
	(1)	(2)	(3)	(4)	(5)	(6)
cfvta	0.127***	0.134***				
	(0.027)	(0.038)				
cfvta4			0.110**	0.109**		
			(0.040)	(0.043)		
cfvta6					0.139**	0.121**
					(0.042)	(0.049)
beta	-0.002	0.000	-0.001	0.001	-0.004	-0.001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
owner	-0.006	-0.006	-0.005	-0.005	-0.006	-0.005
	(0.008)	(0.010)	(0.009)	(0.011)	(0.008)	(0.011)
MB	-0.038***	-0.037***	-0.039***	-0.038***	-0.039***	-0.038***
	(0.006)	(0.003)	(0.006)	(0.003)	(0.006)	(0.003)
size	-0.005**	-0.008***	-0.006**	-0.009***	-0.006**	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.188***	0.366	0.198***	0.358	0.208***	1.622
	(0.019)	(0.564)	(0.026)	(0.565)	(0.026)	(5.340)
N	2,117	2,117	2,154	2,154	2,040	2,040
R-squared	0.168	0.330	0.175	0.330	0.175	0.332
Groups	7		7		7	

Table 4.7: The empirical results of average of cost of debt

This table reports the results of equation 4.5, the dependent variable is the cost of debt follow the method of Chen and Zhu (2013). The definition of variables have been shown in Table 4.1 and Table 4.3. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

VAR	fama	ols	fama4	ols4	fama6	ols6
	(1)	(2)	(3)	(4)	(5)	(6)
cfvta	0.027	0.034				
	(0.027)	(0.038)				
cfvta4			0.033	0.041		
			(0.027)	(0.030)		
cfvta6					-0.012	-0.005
					(0.015)	(0.033)
beta	0.007**	0.007*	0.006**	0.006	0.008**	0.008**
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
owner	-0.017***	-0.017***	-0.018***	-0.018***	-0.018***	-0.018***
	(0.003)	(0.004)	(0.004)	(0.005)	(0.003)	(0.005)
MB	-0.013***	-0.015***	-0.013***	-0.015***	-0.011***	-0.012***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
size	-0.009***	-0.008***	-0.009***	-0.008***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Constant	0.176***	2.599	0.174***	0.449*	0.185***	0.939
	(0.010)	(2.149)	(0.010)	(0.235)	(0.004)	(2.378)
N	8,706	8,474	8,871	8,634	7,773	7,560
R-squared	0.080	0.111	0.079	0.110	0.082	0.113
Groups	13		13		12	

Chapter 5

Conclusion

This thesis investigates the impact of cash flow volatility on Chinese listed manufacturing firms activities. Three empirical chapters focus separately on firm investment, debt maturity and cost of capital, respectively.

Chapter 2 examined the relation between cash flow volatility and firm investment. My results show that cash flow volatility lowers Chinese firms' investment, and these results are consistent with the study of Minton and Schrand (1999). Additionally, in this chapter, I sort firms according to several proxies of financial constraints (firms' size, age, level of cash flow and debt ratio), and investigate whether financial constraints affect the sensitivity of investment to cash flow volatility. These additional results suggest that financially constrained firms (young, low cash flow and high debt ratio firms) have a higher sensitivity of investment to cash flow volatility than financially unconstrained firms (old, high cash flow and low debt ratio firms). The only exception are large firms, assumed to face lower financial constraints, who are more sensitive to cash flow volatility. This can be explained, however, by the market-to-book ratio. When I sort firms based

on their market-to-book ratio and their size, I find that the market-to-book ratio has a greater impact on the sensitivity of investment to cash flow volatility. In order to examine how cash flow volatility affects firms' investment, I further investigate the relation between cash flow volatility and cash holdings. My results show that financially constrained firms hold more cash when they experience high cash flow volatility.

Chapter 3 examined the impact of cash flow volatility on firms' debt maturity. This chapter makes a methodological contribution to the literature as I employed the Fractional Response Model to address the problem of fractional dependent variables. This has not been done in the literature so far. My empirical results reveal that cash flow volatility does not seem to affect debt maturity in China. My results contrast the findings in Keefe and Yaghoubi (2016), who find that US firms hold more short-term debt and less long-term debt when they suffer high cash flow volatility.

In Chapter 4, I examined the relation between cash flow volatility and the cost of capital. I introduced four methods to measure the cost of capital: three methods to measure the cost of equity and one method to measure the cost of debt. I find that cash flow volatility increases the cost of equity in China. This is consistent with the results of Minton and Schrand (1999) for US firms. However, my results suggest that cash flow volatility does not affect the cost of debt in China, which comes at odds with the results of Douglas et al. (2016). The reason why cash flow volatility cannot affect debt maturity and the cost of debt is the bond market in China is underdeveloped. Although China has a large bond market, most bonds are issued by government institutions,and the majority of bonds are sold to state-owned banks.

The different results for the cost of equity and the cost of debt in Chapter 4 can also be explained by the differences between the bond market and the equity market in China. The shares are free to trade in the Shanghai Stock Exchange and Shenzhen Stock Exchange, while most bonds cannot be easily bought and sold on the bond market. Therefore, whether firms can obtain debt is not determined by their performance but by whether they are state-owned firms. This exactly what Chapter 4 finds: a larger proportion of state-owned shares decreases the cost of debt.

The results of Chapters 2, 3 and 4 show that state-owned shares do not affect firms' investment, debt maturity and cost of equity in China. There are two reasons for this: the first is that the firms with state-owned shares do not perform better than the firms without state-owned shares (this can be found in Chapter 3, the firms without state-owned shares have higher earnings per share, market-to-book ratio and lower leverage ratio). Secondly, the manufacturing listed firms in my sample do not have many state-owned shares. Most firms are non-state-owned. The low ratio of state-owned shares does not have a significant impact on firms.

Overall, this thesis finds that cash flow volatility significantly affects Chinese listed firms' activities. Similar to Minton and Schrand (1999), I find that cash flow volatility lowers firms' investment and increases their cost of equity. However, Chinese firms cannot smooth their cash flow by holding more short-term debt like US firms do (Keefe and Yaghoubi, 2016). Due to the immature bond market in China, issuing bonds to raise external funds is very hard for Chinese listed manufacturing firms (the majority of bonds are issued by state-owned institutions and my sampled firms have a very low ratio of state-owned shares). They can only raise external funds by

issuing more equity. As a result, the cost of equity is affected by cash flow volatility, while the cost of debt and debt maturity are not. Chinese listed manufacturing firms have more difficulty in obtaining external funds than US firms; hence, internal funds are more important for them to cover future activities. Therefore, Chinese listed firms need to decrease their cash flow volatility to make sure that they will not experience a cash flow shortfall in the future.

One limitation of this thesis is that the data sample is drawn from the CSMAR database which covers only Chinese listed firms. These firms are likely to face weaker financial constraints than firms not quoted on the stock exchange. This would probably imply that our findings for financially constrained firms are likely to be even stronger if data for unlisted firms were available. Another limitation of the data regards the unavailability of information for interest payments. For this reason, in Chapter 4 I can only use financial expenses to construct a measure of the cost of debt. Future studies could employ an index of the cost of debt, should the relevant data be available, to further check the robustness of the findings in this thesis.

References

Acharya, V., S. A. Davydenko, and I. A. Strebulaev (2012). Cash holdings and credit risk. *Review of Financial Studies 25*(12), 3572–3609.

Amidu, M. and J. Abor (2006). Determinants of dividend payout ratios in ghana. *The Journal of Risk Finance 7*(2), 136–145.

Antoniou, A., Y. Guney, and K. Paudyal (2008). The determinants of capital structure: capital market-oriented versus bank-oriented institutions. *Journal of Financial and Quantitative Analysis 43*(01), 59–92.

Arellano, M. and S. Bond (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies 58*(2), 277–297.

Baker, M. and J. Wurgler (2002). Market timing and capital structure. *The Journal of Finance 57*(1), 1–32.

Bhattacharya, U., H. Daouk, and M. Welker (2003). The world price of earnings opacity. *The Accounting Review 78*(3), 641–678.

Black, F. and M. Scholes (1973). The pricing of options and corporate liabilities. *The Journal of Political Economy*, 637–654.

Botosan, C. A. and M. A. Plumlee (2005). Assessing alternative proxies for the expected risk premium. *The Accounting Review 80*(1), 21–53.

Boubakri, N., O. Guedhami, D. Mishra, and W. Saffar (2012). Political connections and the cost of equity capital. *Journal of Corporate Finance 18*(3), 541–559.

Bradley, M., G. A. Jarrell, and E. Kim (1984). On the existence of an optimal capital structure: Theory and evidence. *The Journal of Finance 39*(3), 857–878.

Caglayan, M. and A. Rashid (2014). The response of firms'leverage to risk: Evidence from uk public versus nonpublic manufacturing firms. *Economic Inquiry 52*(1), 341–363.

Chen, C. and S. Zhu (2013). Financial reporting quality, debt maturity, and the cost of debt: Evidence from China. *Emerging Markets Finance and Trade 49*(sup4), 236–253.

Chen, H., J. Z. Chen, G. J. Lobo, and Y. Wang (2011). Effects of audit quality on earnings management and cost of equity capital: Evidence from China. *Contemporary Accounting Research 28*(3), 892–925.

Chen, H. J. and S. J. Chen (2012). Investment-cash flow sensitivity cannot be a good measure of financial constraints: Evidence from the time series. *Journal of Financial Economics 103*(2), 393–410.

Chen, J. J. (2004). Determinants of capital structure of Chinese-listed companies. *Journal of Business Research 57*(12), 1341–1351.

Chen, L. and X. Zhao (2006). On the relation between the market-to-book ratio, growth opportunity, and leverage ratio. *Finance Research Letters 3*(4), 253–266.

Claus, J. and J. Thomas (2001). Equity premia as low as three percent? evidence from analysts' earnings forecasts for domestic and international stock markets. *The Journal of Finance 56*(5), 1629–1666.

Cleary, S. (1999). The relationship between firm investment and financial status. *The Journal of Finance 54*(2), 673–692.

Cleary, S., P. Povel, M. Raith, et al. (2007). The U-shaped investment curve: Theory and evidence. *Journal of Financial and Quantitative Analysis 42*(1), 1.

Cull, R., W. Li, B. Sun, and L. C. Xu (2015). Government connections and financial constraints: Evidence from a large representative sample of Chinese firms. *Journal of Corporate Finance 32*, 271–294.

De Veirman, E. and A. T. Levin (2012). When did firms become more different? time-varying firm-specific volatility in Japan. *Journal of the Japanese and International Economies 26*(4), 578–601.

Deng, L., S. Li, M. Liao, and W. Wu (2013). Dividends, investment and cash flow uncertainty: Evidence from China. *International Review of Economics & Finance 27*, 112–124.

Dhaliwal, D., S. Heitzman, and O. Zhen Li (2006). Taxes, leverage, and the cost of equity capital. *Journal of Accounting Research 44*(4), 691–723.

Douglas, A. V., A. G. Huang, and K. R. Vetzal (2016). Cash flow volatility and corporate bond yield spreads. *Review of Quantitative Finance and Accounting 46*(2), 417–458.

Dudley, E. and C. M. James (2015). Cash flow volatility and capital structure choice. *Available at SSRN 2492152*.

Easley, D. and M. O'hara (2004). Information and the cost of capital. *The Journal of Finance 59*(4), 1553–1583.

Easton, P. D. (2004). PE ratios, PEG ratios, and estimating the implied expected rate of return on equity capital. *The Accounting Review 79*(1), 73–95.

Faulkender, M., M. J. Flannery, K. W. Hankins, and J. M. Smith (2012). Cash flows and leverage adjustments. *Journal of Financial Economics 103*(3), 632–646.

Fazzari, S. M., R. G. Hubbard, B. C. Petersen, A. S. Blinder, and J. M. Poterba (1988). Financing constraints and corporate investment. *Brookings papers on economic activity 1988*(1), 141–206.

Francis, J., R. LaFond, P. M. Olsson, and K. Schipper (2004). Costs of equity and earnings attributes. *The Accounting Review 79*(4), 967–1010.

Frank, M. Z. and V. K. Goyal (2009). Capital structure decisions: which factors are reliably important? *Financial Management 38*(1), 1–37.

Friend, I. and L. H. Lang (1988). An empirical test of the impact of managerial self-interest on corporate capital structure. *The Journal of Finance 43*(2), 271–281.

Gallani, S., R. Krishnan, and J. Wooldridge (2015). Applications of fractional response model to the study of bounded dependent variables in accounting research. *Harvard Business School Accounting & Management Unit Working Paper* (16-016).

Gatchev, V. A., T. Pulvino, and V. Tarhan (2010). The interdependent and intertemporal nature of financial decisions: An application to cash flow sensitivities. *The Journal of Finance 65*(2), 725–763.

Gebhardt, W. R., C. Lee, and B. Swaminathan (2001). Toward an implied cost of capital. *Journal of Accounting Research 39*(1), 135–176.

Gomes, J. F. (2001). Financing investment. *American Economic Review*, 1263–1285.

Graham, J. R., C. R. Harvey, and S. Rajgopal (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics 40*(1), 3–73.

Guariglia, A. (2008). Internal financial constraints, external financial constraints, and investment choice: Evidence from a panel of UK firms. *Journal of Banking & Finance 32*(9), 1795–1809.

Han, S. and J. Qiu (2007). Corporate precautionary cash holdings. *Journal of Corporate Finance 13*(1), 43–57.

Hovakimian, G. and S. Titman (2006). Corporate investment with financial constraints: sensitivity of investment to funds from voluntary asset sales. *Journal of Money, Credit & Banking 38*(2), 357–375.

Huang, A. G. (2009). The cross section of cashflow volatility and expected stock returns. *Journal of Empirical Finance 16*(3), 409–429.

Huang, G. et al. (2006). The determinants of capital structure: Evidence from China. *China Economic Review 17*(1), 14–36.

Jensen, M. C. and W. H. Meckling (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics 3*(4), 305–360.

Kaplan, S. N. and L. Zingales (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *The Quarterly Journal of Economics*, 169–215.

Keefe, M. O. and M. Yaghoubi (2016). The influence of cash flow volatility on capital structure and the use of debt of different maturities. *Journal of Corporate Finance 38*, 18–36.

Lang, L., E. Ofek, and R. Stulz (1996). Leverage, investment, and firm growth. *Journal of Financial Economics 40*(1), 3–29.

Leary, M. T. and M. R. Roberts (2005). Do firms rebalance their capital structures? *The Journal of Finance 60*(6), 2575–2619.

Lewellen, J. and K. Lewellen (2016). Investment and cash flow: New evidence. *Journal of Financial and Quantitative Analysis 51*(4), 1135–1164.

Li, K., H. Yue, and L. Zhao (2009). Ownership, institutions, and capital structure: Evidence from China. *Journal of Comparative Economics 37*(3), 471–490.

Liu, L. X. (2009). Historical market-to-book in a partial adjustment model of leverage. *Journal of Corporate Finance 15*(5), 602–612.

McInnis, J. (2010). Earnings smoothness, average returns, and implied cost of equity capital. *The Accounting Review 85*(1), 315–341.

Minton, B. A. and C. Schrand (1999). The impact of cash flow volatility on discretionary investment and the costs of debt and equity financing. *Journal of Financial Economics 54*(3), 423–460.

Minton, B. A., C. M. Schrand, and B. R. Walther (2002). The role of volatility in forecasting. *Review of Accounting Studies 7*(2-3), 195–215.

Molina, C. A. (2005). Are firms underleveraged? an examination of the effect of leverage on default probabilities. *The Journal of Finance 60*(3), 1427–1459.

Morse, D. and G. Richardson (1983). The lifo/fifo decision. *Journal of Accounting Research*, 106–127.

Moshirian, F., V. Nanda, A. Vadilyev, and B. Zhang (2017). What drives investment–cash flow sensitivity around the world? an asset tangibility perspective. *Journal of Banking & Finance 77*, 1–17.

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics 5*(2), 147–175.

Narayan, P. K. and J. Westerlund (2014). Does cash flow predict returns? *International Review of Financial Analysis 35*, 230–236.

Newey, W. K. and K. D. West (1986). A simple, positive semi-definite, heteroskedasticity and autocorrelationconsistent covariance matrix.

Noreen, E. (1988). An empirical comparison of probit and ols regression hypothesis tests. *Journal of Accounting Research*, 119–133.

O'Connor Keefe, M. and J. Tate (2013). Is the relationship between investment and conditional cash flow volatility ambiguous, asymmetric or both? *Accounting & Finance 53*(4), 913–947.

Ohlson, J. A. and B. E. Juettner-Nauroth (2005). Expected EPS and EPS growth as determinantsof value. *Review of Accounting Studies 10*(2-3), 349–365.

Papke, L. E. and J. Wooldridge (1993). Econometric methods for fractional response variables with an application to 401 (k) plan participation rates.

Papke, L. E. and J. M. Wooldridge (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics 145*(1), 121–133.

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

Qian, Y., Y. Tian, and T. S. Wirjanto (2007). An empirical investigation into the capital-structure determinants of publicly listed Chinese companies: a static analysis. *University of Zhejiang, Hangzhou China and Waterloo, Canada*.

Qian, Y., Y. Tian, and T. S. Wirjanto (2009). Do Chinese publicly listed companies adjust their capital structure toward a target level? *China Economic Review 20*(4), 662–676.

Rajan, R. G. and L. Zingales (1995). What do we know about capital structure? some evidence from international data. *The Journal of Finance 50*(5), 1421–1460.

Riddick, L. A. and T. M. Whited (2009). The corporate propensity to save. *The Journal of Finance 64*(4), 1729–1766.

Roodman, D. (2006). How to do xtabond2: An introduction to difference and system gmm in stata. *Center for Global Development working paper* (103).

Safdar, R. and C. Yan (2016). Information risk, stock returns, and the cost of capital in china. *China Finance Review International 6*(1), 77–95.

Sapienza, P. (2004). The effects of government ownership on bank lending. *Journal of Financial Economics 72*(2), 357–384.

Shenoy, C. and P. D. Koch (1996). The firm's leverage-cash flow relationship. *Journal of Empirical Finance 2*(4), 307–331.

Shumway, T. (2001). Forecasting bankruptcy more accurately: A simple hazard model*. *The Journal of Business 74*(1), 101–124.

Stone, M. and J. Rasp (1991). Tradeoffs in the choice between logit and OLS for accounting choice studies. *Accounting Review*, 170–187.

Tang, D. Y. and H. Yan (2010). Market conditions, default risk and credit spreads. *Journal of Banking & Finance 34*(4), 743–753.

Trueman, B. and S. Titman (1988). An explanation for accounting income smoothing. *Journal of Accounting Research*, 127–139.

Verdi, R. S. (2005). Information environment and the cost of equity capital.

Wald, J. K. (1999). How firm characteristics affect capital structure: an international comparison. *Journal of Financial Research 22*(2), 161–187.

Wooldridge, J. M. et al. (2011). Fractional response models with endogeneous explanatory variables and heterogeneity. In *CHI11 Stata Conference*, Number 12. Stata Users Group.

Ying, Z. and L. Zhengfei (2006). The relationship between disclosure quality and cost of equity capital of listed companies in China [j]. *Economic Research Journal 2*(7), 2–17.

Zhengfei, L. and Y. Kangtao (2004). The puzzle of equity financing preference in China's listed companies [j]. *Economic Research Journal 4*, 50–59.