The Impact of Debt Maturity and Financing Constraints on Corporate Investment: Evidence from China

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ABSTRACT:

This study attempts to investigate how the maturity structure of a firm's debt affects its investment decisions. Firms may want to issue long-term debt in order to reduce short-term refinancing risk. However, lack of commitment on the firms' part makes long-term debt costly relative to short-term debt. We argue that this trade-off is exacerbated by the financing constraints a firm faces. Using a panel dataset of Chinese non-financial firms between 1997 and 2018, we find that debt maturity has a positive impact on investment. This association is enhanced for firm's who face higher financial constraints. Specifically, firms with high financial constraints tend to use long-term debt to increase their investment levels, while less financially constrained firms do not seem concerned about the maturity structure of debt for investment behaviour. We also find that impact of debt maturity on investment is greater for high-growth firms.

1. INTRODUCTION

Firm investment is an important driver of economic and market activity, yet it is not clear which factors are the main influences on the level of investment. How a firm's investment level is affected by its capital structure is a widely covered topic in corporate finance. In their seminal paper, Modigliani and Miller (1958) argue that, in an efficient capital market, financing – including the maturity of debt – has no impact on investment decisions. This work relies on perfect capital markets, where there is an absence of agency costs and asymmetric information. However, since their work, various literature has attempted to relax these assumptions and investigate the theoretical and empirical relationship that exists between financing and investment. Policymakers often believe that when these assumptions are relaxed, there is a shortage of long-term finance, and this acts as a barrier to investment, industrial performance, and growth.

The theory that underpins the choice of the debt maturity structure of a firm is diverse. Diamond (1991) and Titman (1992) demonstrate that when credit market frictions exist, firms may have difficulties rolling over short-term debt that is close to maturing, particularly if the fundamentals of the firm or credit market conditions have deteriorated. This suggests that in certain market conditions, firms may lean towards the use of long-term debt instead of short-term debt. Gopalan et al. (2014) examine the relationship between debt maturity structure and credit quality. They find that firms with greater rollover risk[1] have lower credit quality, suggesting that reducing the amount of debt payable within a year will improve a firm's credit position. Crouzet (2016) provides a succinct summary of this tradeoff between the choice of using short-term debt or long-term debt. He explains that firms operate long-term assets, and may thus want to issue long-term debt in order to reduce short-term refinancing risk.[2] However, lack of commitment on the firms' part makes long-term debt issuance costly, relative to short-term debt. He argues that in theory, the optimal structure of debt should trade off these two forces.

Given the mixed theoretical roots underlying the maturity structure of a firm's debt, the empirical question remains whether the use of short-term debt or long-term debt is optimal for investment.

[1] Where rollover risk is measured as the amount of long-term debt payable within a year relative to assets. This approach is similar to the one employed in Almeida et al. (2004).

[2] The idea is that using short-term debt may create a mismatch between the maturity of assets and liabilities, and hence to problems when refinancing short-term debt (Crouzet, 2016). Long-term debt can help mitigate this problem.

While investment decisions might not be independent of the optimal debt structure, financing constraints can also have a large impact on this relationship when markets are imperfect. Financial constraints can diminish a firms' attractiveness to potential investors and in the long run, could have detrimental effects on financial performance and market value (Hoang et al., 2019). Phan (2018) argued that long-term debt decreases future external financing through increasing debt overhang risk. Thus, it can have a negative impact on investment in the long run. Based on these findings, it is clear that debt maturity plays a critical role in future financial constraints and firms' ability to access financing resources.

The importance of the role that corporate financing - and more specifically debt maturity and financing constraints have on corporate investment is apparent in previous literature. However, extant literature concentrates on the isolated effect of financing constraints or debt maturity on corporate investment. In this paper, we try to fill this gap. We jointly investigate the role of debt maturity, financial constraints and corporate investment. More specifically, this paper asks the following questions: Does debt maturity affect corporate investment decisions? And is this effect exacerbated by the financing constraints of the firms? In other words, will the effect of debt maturity on investment be higher for firms who face greater financial constraints? To the best of our knowledge, no empirical study has yet explored this question. In addition, we also explore how the investment-debt maturity relationship interacts with firm growth opportunities.

To investigate our hypothesis, we focus on Chinese firms. As the world's largest developing economy, and second largest global economy,[3] China presents an interesting case for examining the investment-debt maturity relationship. Growth in China has been phenomenal in the past three decades, and the economic outlook remains strong. However, total debt levels have surged since the global financial crisis, with a total debt-to-GDP ratio[4] that has almost doubled in the past decade to 270% (Lee, 2021).[5] Subsequently, Chinese companies' bond default rates are rising with debt levels, amounting to close to US$10 billion in defaults for the first half of 2021, the highest ever (Murugaboopathy & Galbraith, 2021).

The sample used in this study spans the period 1997-2018 and consists of all non-financial firms listed on the Shenzhen and Shanghai Stock Exchanges. We use the percentage

[3] When measured by the size of their Gross Domestic Product (GDP).
[4] Total debt is measured as the sum of government, corporate, and household debt.
[5] 160% is corporate debt.

of total debt a firm holds in long-term debt to determine its overall level of debt maturity.[6] Following the literature, we construct our first measure of investment as the change in fixed assets from the beginning of the year to the end of a year plus depreciation, scaled by the value of total assets at the start of the year. Alternatively, a second investment measure is calculated as capital expenditure less depreciation, normalised by total assets. Based on previous literature, we apply two proxies for the level of financial constraints a firm faces, the Kaplan and Zingales (1997) index (KZ) and the Whited and Wu (2006) index (WW).[7]

The main findings of this paper are as follows. We find that, in general, long-term debt is positively related to corporate investment, but this effect is not robust across alternative measures of firm investment. However, longer debt maturity is positively and significantly associated with higher levels of investment for firms with greater financial constraints. Specifically, a 1% increase in debt maturity leads to a 2% increase in the investment-to-total assets ratio for all firms, compared to a 2.1% to 2.6% increase in the investment ratio for those firms who are more financially constrained. In contrast, debt maturity does not have a significant impact on investment for firms facing low financial constraints. We also find that the impact of debt maturity on investment appears to be stronger particularly for the high-growth firms. These effects are strong and robust across different definitions of investment and alternative measures of firm financing constraints.

To test the robustness of our results, we employ different econometric techniques and tests. We note that debt maturity and leverage are potentially endogenous to investment, where investment opportunities may also be influencing the firm's capital structure. For example, if strong investment opportunities are in the forecast, and refinancing costs are low, firms may decrease debt maturity to mitigate the underinvestment problem. To address this potential "endogeneity bias", we use a dynamic panel data model. The system GMM estimators in the dynamic panel data models combine moment conditions for the model in first differences with moment conditions for the model in levels to overcome the "endogeneity bias" in the regressions. The results from these models also support our hypothesis.

The remainder of this paper is as follows: Section two discusses relevant previous literature and our empirical question. Section three is an overview of the dataset and variables

[6] Ideally, we could have used a proxy for rollover risk, such as a measure of how much of the firm's long-term debt was payable within the next twelve months, or detailed information on the duration of the firm's different debt instruments. However, given the constraints to data when using the CMSAR Financial Statements Database, we were limited to a more basic measure of debt maturity.

[7] Further details about the KZ index and WW index are provided in Section 3.

used in the study. Section four describes our empirical methodology and looks at the summary statistics of the key variables. Results from the fixed effect regressions are found in section five with endogeneity and robustness checks in section six. Finally, section seven contains the conclusions and discusses some limitations and further extensions of the paper.

2. LITERATURE REVIEW AND EMPIRICAL QUESTION

In what is considered the seminal paper on the investment-debt maturity relationship, Myers (1977) was the first to point out the potential impact of debt maturity on corporate investment. He splits firms into two groups based on growth opportunities to examine the underinvestment problem. He demonstrates that high-growth firms with long-term debt may forgo positive net present value projects due to a conflict of interest between debtholders and managers acting on behalf of shareholders, hence leading to an underinvestment or 'debt-overhang'[8] problem. This suggests that firms that are more highly leveraged with longer-term debt will have a larger underinvestment problem than those firms that are less leveraged with shorter-term debt. From a theoretical perspective, similar to Myers (1977), Barclay and Smith (1995) and Dennis et al. (2000) also suggest that short-term debt is considered a tool to mitigate the underinvestment problem. Alternatively, Jensen (1986) and Stulz (1990) examine the investment decisions for firms with large free cash flows. Similar to Myers (1977), they suggest that agency costs as a result of conflict of interest between shareholders, managers, and debtholders will create the potential underinvestment and overinvestment incentives. They emphasise that this problem is worse for firms who generate substantial free cash flow, and argue that leverage can be used as a disciplining tool for firms with large free cash flows, as it discourages managers from overinvesting in risky projects. More recently, Titman and Tsyplakov (2007) study a dynamic model of optimal capital structure and find that shorter-term debt mitigates underinvestment. In contrast, Diamond and He (2014) find that shorter-term debt may lead to a debt-overhang problem in the future, inconsistent with the findings of Myers (1977).

Based on Lang et al. (1996), various recent studies have explored the empirical relationship of corporate financing on investment. Aivazian et al. (2005a) show that leverage has a negative and significant relationship with investment.[9] This provides support for the overinvestment hypothesis. Following on from this study, various literature has attempted to better understand the investment-debt maturity relationship more specifically and how it

[8] Refers to such a large debt burden that an entity cannot take on additional debt to finance future projects.
[9] Similar findings are made by Ding et al. (2020) and Phan (2018).

interacts with a firm's growth opportunities. Aivazian et al. (2005b) undertake new research on the association between debt maturity and investment for a sample of US firms from 1982 to 2002. They find that debt maturity has a significantly negative impact on investment for firms with high growth opportunities, which is instead consistent with the underinvestment hypothesis. They also find that the effect of debt maturity is not significant for firms with low growth opportunities. The idea is that firms will attempt to free up future debt capacity by shortening their debt maturity if strong growth opportunities are recognised early. Dang (2011) examines the relationship between leverage, debt maturity, and firm investment for a panel of UK firms. The results show that firms control underinvestment incentives by reducing leverage but not by shortening debt maturity. Thus, debt maturity does not have a significant association with firm investment in this study. Khaw and Lee (2016) study a panel of Malaysian firms to understand how debt maturity can be used by firms as an underinvestment mitigation tool. The results of this study show that debt maturity is in fact used as a tool to mitigate the underinvestment problem, for firms with low Tobin's Q.[10]

When investigating the financing constraints and corporate investment relationship, most researchers would agree that financing constraints have some impact on the level of investment. The examination on the investment-financing constraints relationship started with Fazzari et al. (hereafter FHP) (1988), who use dividend payout ratios as a proxy for the financial constraints a firm is facing.[11] They find that firms with low-dividend payout ratios experience a greater sensitivity of investment to cash flow. Subsequently, further research was completed that focused on wider measures of investment, such as R&D investment (Brown et al., 2012; Carpenter and Petersen, 2002) and inventory investment (Guariglia, 2000). More recently, Guariglia (2008) studied a panel of UK firms and found that the sensitivity of investment to cash flow tends to increase with the degree of external financial constraints faced by firms. These findings supported those of FHP's (1988), indicating that investment is more sensitive for firms with higher financial constraints in place.

Kaplan and Zingales (1997) were the first in attempting to challenge the work of FHP (1988). They achieved this by moving away from the common approach of using a firm's dividend payout ratio as the measure of financial constraints that FHP (1988) and related

[10] Where Tobin's Q is a proxy for a firms' growth opportunities.

[11] Firm's with lower dividend payout ratios were considered to be firms that are more likely facing financial constraints.

literature had used.[12] The authors find that when using the sample identified by FHP (1988) as financially constrained, the opposite result holds when using a different measure of financial constraint. Therefore, they concluded that firms who are more financially constrained experience lesser sensitivity of investment to cash flow. Following this, similar findings were made by Kadapakkam et al. (1998) and Cleary (1999).[13] We acknowledge that the different conclusions reached by FHP (1988) and supporting papers compared to that of Kaplan and Zingales (1997) is driven by how financial constraints are being measured. When forming our hypothesis, we take this into consideration based on the type of financial constraint measure we use.

The aforementioned studies specifically examine the effect of leverage and debt maturity on investment, often based on a firm's growth opportunities through its Tobin's Q. Similarly, the effect of financing constraints on investment is treated individually and is measured through an investment-to-cash flow sensitivity. The empirical results remain mixed for both of these relationships, and relevant theoretical arguments exist for using both short-term debt and long-term debt. Hence, our empirical question remains how the investment-debt maturity relationship interacts with the financing constraints a firm is facing. Using a unified framework, this paper attempts to investigate the relationship between debt maturity structure, financing constraints, and investment. More specifically, will the effect of debt maturity on investment be greater for firms that are more financially constrained?

3. DATA AND VARIABLES

3.1 *Data*

This study investigates the investment-debt maturity relationship for Chinese firms. Specifically, the sample of the study consists of all firms except for financial firms[14] listed on the Shenzhen and Shanghai Stock Exchanges over the period from 1997 to 2018. Financial firms were excluded from the study due to a difference in financial structure (Rajan & Zingales, 1995). All financial statements, dividend, and industry data have been taken from the China Stock Market & Accounting Research Database (CSMAR). Data for the firm's market

[12] Note that subsequent studies that supported the findings of FHP have also used other similar firm characteristics. Common ones include firm size and age.

[13] More recent studies have also explored the investment-debt maturity and investment-financial constraints relationship. See Ding et al. (2020), Phan (2018), Lemmon and Zender (2019), and Firth et al. (2012).

[14] A financial firm is classified as: monetary financial service, capital market service, insurance companies, and other finance.

capitalisation and foreign exchange rates were taken from Bloomberg. In the data filtering process, we excluded all quarterly and monthly data, leaving only annual data. Observations that have missing data for variables of interest are removed from the sample. The final unbalanced panel dataset comprises 3,120 non-financial firms yielding 42,271 firm-year observations. Finally, following the literature, we winsorise all variables at the 1st and 99th percentiles to diminish the effect of outliers (Aivazian et al., 2005a and 2005b; Cleary, 1999). This data is then used to calculate both the dependent, explanatory, and control variables.

3.2 *Measurement of Key Variables*

Firm investment is the dependent variable in this study and we use two commonly used measures of investment. Following Ding et al. (2020) our first measure of investment is calculated as the change in fixed assets from the beginning of the year to the end of a year plus depreciation, scaled by the value of total assets at the start of the year. Our second measure of investment is based on the study by Dang (2011), which is measured as capital expenditure less depreciation, normalised by total assets. We use both of these measures to test the robustness of our results.[15]

Debt maturity is the key independent variable in our study and is measured as the percentage of long-term debt in total debt. We calculate total debt as the sum of short-term loans, long-term loans, and bonds.[16] Short-term debt refers to any debt having maturity of less than one year, and long-term debt refers to debt having a maturity period of more than one year.

3.3 *Control Variables*

Leverage, Tobin's Q, and *Cash Flow* are used as the control variables in the investment equation. Leverage is measured as the book value of total debt divided by the book value of total assets. Following Aivazian et al. (2005), Tobin's Q is defined as the market value of the total assets of the firm divided by the book value of assets and acts as a proxy for growth opportunities. The market value of the firm is calculated as the sum of the book value of total liabilities and market value of equity (Antoniou et al., 2006; Cai et al., 2008). Cash flow is used

[15] These investment measures are also used in the following literature: Firth et al. (2012), Duchin et al. (2010) and Aivazian et al. (2005a and 2005b).

[16] Where total long-term debt is equal to the the sum of long-term loans and bonds. Long-term loans are loans the company borrows from banks or other financial institutions. Bonds payable is the principle and interest of bonds that the company has issued to raise long-term capital. As for convertible bonds, debt shall be separated from equity, and the debt generated after separation is included in this item.

to control for a firm's free cash flow, measured as the sum of revenue and depreciation, normalised by beginning of year total assets.

3.4 *Financial Constraints*

The next variable used in our study is a financial constraint measure. The literature has provided various ways of identifying the extent of financial constraints. However, the evidence is mixed, and no consensus has been made on what the best measure is for a proxy for financial constraints.

We use two widely used measures of financial constraints, the Kaplan and Zingales (KZ hereafter) (1997) index and the Whited and Wu (WW hereafter) (2006) index for sorting firms into financially constrained and financially unconstrained.[17] These measures are described below.[18]

3.4.1 *KZ Index*

We make use of the *KZ index* as the first measure of a firm's financial constraints. The KZ index serves as a relative measurement of reliance on external financing. The construction of the index also lends well to the dataset we have collected, enabling us to cover the majority of the sample set.

To calculate, we follow Lamont et al. (2001), where the KZ index is calculated as:

$$KZ = -1.0019(CF/K) + 0.2826(Q) + 3.1392(DEBT/CAP) - 39.3678(DIV/K) - 1.3148(CASH/K) \quad (1)$$

where *K* represents the beginning-of-period PPE. *CF* is measured as revenue plus depreciation; *Q* is Tobin's Q and is measured as the market value of the total assets of the firm divided by the book value of assets; *DEBT* is the total value of debt; CAP is measured as the total capital

[17] Various other financial constraint measures were considered. These include: Hadlock and Pierce (2010) Size-Age (SA) index, Cleary's (1999) three measures of constraint: dividend payout ratio, firm size, and a financial status index (Z_{fs}) which uses a regression of various variables, and Denis and Sibilkov (2010) four approach method which uses: annual dividend payout ratio, firm size, debt rating based on S&P credit rating, and paper rating based on S&P short-term credit ratings. Given the constraints we had on data accessibility, we decided on the KZ and WW index as they were easily constructible with the database and still widely used measures across literature.

[18] See Chan et al. (2017), Azmat and Ikbal (2017), Chen et al. (2021), and Altunok et al. (2020) for the use of the KZ index and WW index in a range of different formats.

and calculated as the sum of total equity and debt; *DIV* is total annual dividend payments;[19] and *CASH* is defined to be cash plus marketable securities. As seen, the KZ index loads negatively on cash flow, dividend payout, and cash levels, and positively on Tobin's Q and leverage.

We proceed to calculate a numerical value for the KZ index for each firm-year observation. Firms with lower KZ scores represent those who are more likely to avoid difficulties when financial conditions worsen. Observations are split into a high-constrained group if the KZ index value is above the median value of the KZ index from the sample. Similarly, observations are categorised as low-constrained if the KZ index is at or below the median value.

3.4.2 *WW Index*

We employ the use of the *WW index* as a second measure of financial constraint. The WW index is a linear combination of six variables: cash flow, a dividend payer dummy, leverage, firm size, industry sales growth, and firm sales growth. The WW index acts as an enhancement on the KZ index,[20] where the definitions of cash flow and leverage are slightly different to those in the KZ index. Hadlock and Pierce (2010) explain that the introduction of firm size in the WW index offers additional explanatory power on the level of financial constraint over the KZ index.

To calculate, we follow the original model created by Whited and Wu (2006), where the WW index is measured by the following:

$$WW = -0.091(CF) - 0.062(DIVDUMMY) + 0.021(LEV) - 0.044(SIZE) + 0.102(INDGROWTH) - 0.035(REVGROWTH) \qquad (2)$$

where *CF* is defined as operating income plus depreciation normalised by beginning-of-year book assets; *DIVDUMMY* indicates if a dividend was paid out that year for the firm; *LEV* is

[19] Dividend data was extracted from the CSMAR Cash and Stock Dividends Research Database. The database records the majority of dividends in Chinese Yuan (CNY), however, companies with stock codes beginning with 9 are Shanghai B shares and quoted in U.S dollars (USD), and companies with stock codes beginning with 2 are Shenzhen B shares and quoted in Hong Kong dollars (HKD). We used foreign exchange rate data for USD/CNY and HKD/CNY to make the conversions for those dividends quoted in HKD and USD so all financial data was quoted in CNY.

[20] Some studies suggest that the use of the KZ index does a relatively poor job of characterising the cross-sectional variation of cash policies for financially constrained versus unconstrained firms (see Almeida et al., 2004).

the percentage of long-term debt in total assets; *SIZE* represents the natural logarithm of a firm's total assets; *INDGROWTH* is defined as the most recent annual percentage change in inflation-adjusted three-digit industry sales;[21] and *REVGROWTH* is the individual firm's most recent annual percentage change in inflation-adjusted sales.[22]

Following the approach we take on the KZ index, we proceed to split firms into high- and low-constraints based on the median value of the WW index for further analysis.

4. EMPIRICAL METHODOLOGY

4.1 *Sample Statistics*

Table 1 provides the descriptive statistics on the variables used in this study. The mean value of investment (*Investment1*) is 0.071, which suggests that the investment ratio to total assets is 7.1% for non-financial Chinese listed firms. The standard deviation of Investment1 is 0.488, almost seven times the mean, suggesting a high variation in the investment rate exists. The alternative measure of investment (*Investment2*) produces a mean value of 0.044 and a standard deviation of 15.1%, which suggests that the investment-to-total assets ratio is 7.1% and supports the high variation in the investment rate. The mean value of leverage is 0.194, which suggests that Chinese firms' capital structure comprises 19.4% of leverage. Interestingly, this is slightly lower than the mean in the US of 25% (Aivazian et al., 2005b) and the UK of 23% (Dang, 2011). The sample mean of Tobin's Q is 2.568, which suggests that the market value well exceeds the cost of its assets, and reflects market expectations of strong growth opportunities for Chinese firms over this sample period. The mean value of cash flow is 0.800. The average proportion of total long-term debt to total debt (Maturity) is 28.8% with a standard deviation of 32.6%, indicating that, on average, short-term debt is the major source of debt capital for Chinese firms. This is consistent with the Bae (2009) study, which showed that Chinese industrial companies hold approximately 75% of short-term debt. In contrast, this figure is significantly higher than developed countries such as the mean in the US of 34% (Aivazan et al., 2005b) and Australia of 26% (Alcock et al., 2012).

[21] The definition of industry sales growth was adjusted in our study. SIC codes for the firm's in the dataset were not accessible, so instead we applied the industry classification codes that CSMAR provides. More specifically, based on the 2012 CSRC classification of industry codes, which is the most recent classification of industries recorded on CSMAR. Additionally, we have made an assumption that the growth in sales is already inflation-adjusted as it is a panel dataset and all firms are Chinese.

[22] Similar to the industry sales growth, an assumption is made that sales are already inflation-adjusted.

Table 1: Descriptive Statistics

Variable	*Obs*	*Mean*	*Std Dev.*	*Min*	*Max*
Investment1	38,561	0.071	0.488	-0.802	64.925
Investment2	38,561	0.044	0.151	-3.827	13.867
Maturity	36,696	0.288	0.326	0	1
Leverage	42,271	0.194	0.196	0	3.748
Tobin's Q	42,271	2.568	2.322	0.018	92.361
Cash Flow	38,561	0.800	1.831	0.004	204.701

Notes:
This table reports the descriptive statistics of the key variables. Definitions of the variables can be found in Table A1 in the Appendix.

4.2 *Correlation Analysis*

As mentioned earlier, a high correlation may exist between the regressors used in our estimation process. Firms with strong growth opportunities may reduce their level of leverage and adjust the debt maturity structure before undertaking investment. As a result, this may lead to a multicollinearity problem among the regressors. We test this degree of multicollinearity by performing a correlation analysis on all key variables. Table 2 reports the correlation matrix. The correlation between debt maturity and leverage is 0.112. The correlation between Tobin's Q and leverage is -0.110, and the correlation between Tobin's Q and debt maturity is -0.132. The correlation between variables is not high, and therefore, multicollinearity is not a serious problem in our study.

Table 2: Correlation Matrix

	Investment	*Maturity*	*Leverage*	*Tobin's Q*	*Cash Flow*
Investment	1.000				
Maturity	0.038*	1.000			
Leverage	0.020*	0.112*	1.000		
Tobin's Q	-0.023*	-0.132*	-0.110*	1.000	
Cash Flow	0.555*	-0.046*	-0.018*	-0.020*	1.000

Notes:
This table reports the correlation between key variables for *Investment1*. * shows significance at the 1% level. Definitions of the variables are given in Table A1 in the Appendix.

4.3 Baseline Regressions

Next, we proceed to formal regression analysis. To test the effect of debt maturity on Investment, we run the following regression:

$$Investment_{i,t} = \beta_0 + \beta_1 DebtMaturity_{i,t-1} + \beta_2 Leverage_{i,t-1} + \beta_3 Tobin's\ Q_{i,t-1} + \beta_4 CashFlow_{i,t-1} + \alpha_i + \mu_t + \varepsilon_{i,t} \quad (3)$$

where $Investment_{i,t}$ represents firm investment in period *t*; $DebtMaturity_{i,t-1}$ is the debt maturity of firm *i* at period *t-1,* measured as the percentage of long-term debt in total debt*;* $Leverage_{i,t-1}$ is the total level of leverage for firm *i* at period *t-1,* measured as the ratio of total debt to total assets*;* $Tobin's\ Q_{i,t-1}$ represents the growth opportunities of firm *i* in period *t-1* and is measured as the market value of the total assets of the firm divided by the book value of assets; $CashFlow_{i,t-1}$ is the cash flow for company *i* in period *t-1* and is measured as revenue plus depreciation, normalised by total assets; α_i is the firm fixed effect for firm *i*; μ_t is a time specific effect; and $\varepsilon_{i,t}$ is the error term. All regressions in Section 5 are run with firm and year fixed effects and standard errors are clustered at the firm-level. Further details on the variables used in the regression can be found in the Appendix.

5. RESULTS

5.1 *Effect of Debt Maturity on Investment*

Table 3 reports the results of the estimation of Eq. (3) using the two measures of investment. In columns (1) to (5), we use Investment1, where column (5) reports the estimators with all control variables included. Similarly, columns (6) to (10) use Investment2 as the dependent variable, where column (10) makes use of all control variables collectively. The effects on investment of leverage and Tobin's Q have expected signs. The results show that leverage level has a negative impact on investment at the 1% significance level for both measures of investment. The estimated coefficients of leverage are -0.105 and -0.050 for Investment1 and Investment2, which implies that a 1% increase in the leverage level will lead to a 10.5% and 5% decrease in investment. These results are consistent with those of previous studies on investment and leverage (Aivazian et al., 2005 and Lang et al., 1996). Tobin's Q has a significant and positive impact on investment. The effects of cash flow on investment are insignificant. The variable of particular interest in this study is debt maturity. The results show that while debt maturity has a positive significant impact on Investment1 at the 5% level, it loses its significance for Investment2. The estimated coefficient for debt maturity on Investment1 is 0.020, which implies that a 1% increase in the debt maturity structure increases the firm investment-to-total assets ratio by 2%. Given the debt maturity coefficient is significant at the 5% level for one investment measure and insignificant for the other, we conclude a positive effect of debt maturity on investment.[23] Our results are not surprising given we expect the association to be significant and strongest when financial constraints are introduced.

[23] Our results are inconsistent with the findings of Aviazian et al. (2005b) who show a significant and negative relationship exists between debt maturity and investment.

Table 3: Investment and Debt Maturity – FE Regressions

	Investment1					Investment2				
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Maturity $_{t-1}$	0.001	0.004	0.016*	0.002	0.020**	-0.003	-0.001	0.001	-0.003	0.002
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Leverage $_{t-1}$		-0.091***			-0.105***		-0.053***			0.050***
		(0.031)			(0.035)		(0.008)			(0.007)
Tobin's Q $_{t-1}$			0.038***		0.041***			0.010***		0.011***
			(0.013)		(0.014)			(0.003)		(0.003)
Cash Flow $_{t-1}$				-0.007*	-0.006				0.000	0.000
				(0.004)	(0.004)				(0.001)	(0.000)
Constant	0.067***	0.087***	-0.029	0.070***	-0.009	0.043***	0.054***	0.018***	0.040***	0.024***
	(0.002)	(0.008)	(0.033)	(0.005)	(0.031)	(0.001)	(0.002)	(0.006)	(0.001)	(0.006)
Adjusted R^2	0.000	0.001	0.02	0.001	0.022	0.000	0.004	0.025	0.000	0.033
Obs.	33591	33591	33591	30773	30773	33591	33591	33591	30773	30773
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes:
See Table 1 for definition of variables. All the estimates have been carried out using the fixed-effects regressions. Standard errors are given in parenthesis. In all panels, the standard errors are robust to heteroskedasticity and are clustered at the firm level. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

5.2 *Debt Maturity, Financial Constraints, and Investment*

Debt maturity may have a differential impact on investment for firms facing different financing constraints. We expect that the effect of debt maturity on investment will be greater for firms that are more financially constrained. To test this hypothesis, we split firms into high- and low-constrained groups and test the impact of debt maturity on the two groups separately. Table 4 reports the results of the estimation of Eq. (3) and splits the sample into the following two categories: high and low constrained firms. The categories are based on the KZ index, where highly-constrained observations are those that have KZ index values above the median of the sample. Low-constrained firms are those observations that fall at or below the KZ index median.

Table 4: Investment, Debt Maturity, and Financial Constraints (KZ index) - FE Regressions

	Investment1			**Investment2**		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	All	High	Low	All	High	Low
Maturity $_{t-1}$	0.020**	0.026***	0.034*	0.002	0.013***	-0.003
	(0.009)	(0.007)	(0.018)	(0.003)	(0.003)	(0.005)
Leverage $_{t-1}$	-0.105***	-0.031***	0.048	-0.050***	-0.042***	0.007
	(0.035)	(0.011)	(0.042)	(0.007)	(0.005)	(0.014)
Tobin's Q $_{t-1}$	0.041***	0.002**	0.058**	0.011***	0.004***	0.013**
	(0.014)	(0.001)	(0.023)	(0.003)	(0.001)	(0.005)
Cash Flow $_{t-1}$	-0.006	0.001**	-0.002	0.000	0.002**	-0.000
	(0.004)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)
Constant	-0.009	0.046***	-0.080	0.024***	0.029***	0.014
	(0.031)	(0.004)	(0.060)	(0.006)	(0.002)	(0.013)
Adjusted R^2	0.022	0.003	0.074	0.033	0.015	0.051
Obs.	30773	17015	13758	30773	17015	13758
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes:

See Table A1 in the Appendix for definition of variables. All the estimates have been carried out using the fixed-effects regressions. Standard errors are given in parenthesis. In all panels, the standard errors are robust to heteroskedasticity and are clustered at the firm level. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Columns (1) to (3) report the results for all firms, high-constrained firms, and low-constrained firms respectively for the measure Investment1. Similarly, columns (4) to (6) report the same results for measure Investment2. The coefficients for debt maturity are positive and significant at the 1% level for high-constrained firms. This result is robust across both investment measures. Importantly, the debt maturity coefficients for both investment measures are larger than for the entire sample in columns (1) and (4), suggesting that greater financial constraints elevate the impact of debt maturity on investment. Columns (3) and (6) report the results for firm-year observations that are classified as low-constrained. It appears that for low-constrained firms, the effect of debt maturity is mixed, and significance only exists at the 10% level for Investment1. Thus, the effect of debt maturity is significantly positive and robust for firms with high financial constraints, while it is weak and not robust for firms with low financial constraints. When applying Investment1 for firms with high financial constraints, a 1% increase in debt maturity increases the investment ratio by 2.6%. This compares with the increase of 2.0% in investment when debt maturity increases by 1% for the entire sample. Therefore, these findings support the hypothesis that the effect of debt maturity will be greater for firms facing higher financial constraints.

In Table 5 we investigate the same hypothesis as in Table 4 but instead, use an alternative measure of financing constraints to test the robustness of our hypothesis. Table 5 serves as an improvement to Table 4, where instead of the KZ index, the WW index is used to split observations into high- and low-constrained categories. The methodology for splitting firms remains the same as the KZ approach but instead uses the median values of the WW index. Columns (1) to (3) report the results for all firms, high-constrained firms, and low-constrained firms respectively for the measure Investment1. Similarly, columns (4) to (6) report the same results for measure Investment2. Consistent with the findings of the KZ index for high-constrained firms, the value of debt maturity has positive and significant coefficients at the 1% level across both investment measures. In contrast, for low-constrained firms, the coefficient is insignificant for Investment1 and negative and significant at the 1% level for Investment2.

These results suggest that when applying Investment1 for high-constrained firms, a 1% increase in debt maturity increases the investment-to-total assets ratio by 2.1%. It is worth noting that the coefficient for debt maturity is lower when using the WW index for high-constrained firms compared to the KZ index. This remains consistent across both investment measures. Specifically, for Investment1, a coefficient of 0.026 was found when applying the KZ index, compared to 0.021 in the WW. Similarly, the coefficient for Investment2 of 0.013 in the KZ model compared to 0.009 for the WW. This isn't an unusual result as we expect that the WW index acts as a more accurate estimator of financial constraints than the KZ index. However, more importantly, in line with the KZ index, these findings support the argument that debt maturity will have a larger impact on investment for firms who face higher financial constraints and robustness holds across both investment measures. Interestingly, for low-constrained firms, debt maturity does not appear to have a significant impact on the investment-to-total assets ratio when observing Investment1. However, when observing Investment2, the association appears to be significant and negative, and a 1% increase in debt maturity suggests a 1.5% decrease in the investment-to-total assets ratio.

Table 5: Investment, Debt Maturity, and Financial Constraints (WW index) – FE Regressions

	Investment1			**Investment2**		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	All	High	Low	All	High	Low
Maturity $_{t-1}$	0.020**	0.021***	-0.021	0.002	0.009***	-0.015***
	(0.009)	(0.004)	(0.024)	(0.003)	(0.003)	(0.006)
Leverage $_{t-1}$	-0.105***	-0.040***	-0.165	-0.050***	-0.030***	-0.064***
	(0.035)	(0.007)	(0.127)	(0.007)	(0.005)	(0.024)
Tobin's Q $_{t-1}$	0.041***	0.002	0.092***	0.011***	0.004***	0.020***
	(0.014)	(0.001)	(0.025)	(0.003)	(0.001)	(0.005)
Cash Flow $_{t-1}$	-0.006	0.006***	-0.020	0.000	0.006***	-0.002
	(0.004)	(0.001)	(0.013)	(0.000)	(0.001)	(0.002)
Constant	-0.009	0.029***	-0.032	0.024***	0.020***	0.030***
	(0.031)	(0.004)	(0.051)	(0.006)	(0.003)	(0.011)
Adjusted R^2	0.022	0.008	0.058	0.033	0.016	0.065
Obs.	30773	14545	16228	30773	14545	16228
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes:
See Table A1 in the Appendix for definition of variables. All the estimates have been carried out using the fixed-effects regressions. Standard errors are given in parenthesis. In all panels, the standard errors are robust to heteroskedasticity and are clustered at the firm level. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The latter result is similar to the findings of Aivazian et al. (2005b) who show empirical evidence of investment falling as debt maturity increases, with the effect being larger for firms with higher growth opportunities. However, this negative effect for low-constrained firms is not robust in our analysis.

5.3 *Debt Maturity, Firm Growth, and Investment*

Various literature explains that debt maturity could have a differential impact on investment for firms with different growth opportunities (Aivazian et al., 2005b and Ding et al., 2020). This is explained through the theory that firms with low-growth opportunities are less likely to face an underinvestment problem than those firms with high-growth opportunities. One can also hypothesize that fast-growing firms are often younger and start-up firms. In contrast, the lower growth firms are often older and more mature. This hypothesis supports the findings of Fitzsimmons et al. (2005) who found that higher growth firms were on average younger. Thus, we expect the financing constraints to be higher for younger firms who are experiencing higher industry growth, compared to those firms with lower growth. If this holds, the effect of debt maturity will be stronger for firms with high-growth opportunities. To test this hypothesis, we split the sample by median industry growth rates taking the same approach as described for the KZ and WW index.[24]

Table 6 reports the findings of Eq. (3) for high- and low-growth firms, based on industry growth rates. Columns (1) to (3) report the results for all firms, high-growth firms, and low-growth firms respectively for the measure Investment1. Similarly, columns (4) to (6) report the same results for measure Investment2. Debt maturity appears to have a significant and positive impact on investment for high-growth firms when using Investment1. This result is not consistent when using Investment2, where no significant relationship exists. When analysing Investment1, we expect that a 1% increase in debt maturity will cause a 2.3% increase in the investment-to-total assets ratio for high-growth firms. Given these results, we conclude that the effect of debt maturity on investment is significant and positive for high-growth firms but the association is not very

[24] Other measures were considered to measure high- and low-growth firms. Following Aivazian et al. (2005b) we also ran regressions using a sub-sample based on Tobin's Q, a proxy for a firm's growth opportunities. Similarly, individual firm sales growth was also used as an alternative measure. Results for these regressions showed similar results to Table 7 and aren't reported here but can be made available on request.

strong, nor robust across both measures. In line with the findings of Aivazian et al. (2005b), no significant relationship exists between debt maturity and investment for low-growth firms.

Overall, these results support our hypothesis that the impact of debt maturity on investment is greater for high-growth firms. If these firms are usually the younger and more financially constrained firms, then the effect of debt maturity on investment becomes more sensitive for these firms.

Table 6: Investment, Debt Maturity, and Industry Growth – FE Regressions

	Investment1			**Investment2**		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	All	High	Low	All	High	Low
Maturity $_{t-1}$	0.020**	0.023**	0.010	0.002	-0.001	0.003
	(0.009)	(0.011)	(0.013)	(0.003)	(0.004)	(0.004)
Leverage $_{t-1}$	-0.105***	-0.165**	-0.046**	-0.050***	-0.059***	-0.038***
	(0.035)	(0.068)	(0.021)	(0.007)	(0.013)	(0.007)
Tobin's Q $_{t-1}$	0.041***	0.052**	0.025**	0.011***	0.014***	0.006***
	(0.014)	(0.021)	(0.012)	(0.003)	(0.004)	(0.001)
Cash Flow $_{t-1}$	-0.006	-0.014	-0.001	0.000	-0.001	0.002*
	(0.004)	(0.011)	(0.001)	(0.000)	(0.001)	(0.001)
Constant	-0.009	-0.013	0.009	0.024***	0.023**	0.028***
	(0.031)	(0.049)	(0.028)	(0.006)	(0.010)	(0.003)
Adjusted R^2	0.022	0.024	0.027	0.033	0.043	0.016
Obs.	30773	14228	16545	30773	14228	16545
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes:
See Table A1 in the Appendix for definition of variables. All the estimates have been carried out using the fixed-effects regressions. Standard errors are given in parenthesis. In all panels, the standard errors are robust to heteroskedasticity and are clustered at the firm level. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

6. ENDOGENEITY ISSUES AND ROBUSTNESS CHECKS

In this section, we consider the potential endogeneity issues between debt maturity, leverage, and investment. Both debt maturity and leverage may be affected by the expected investment opportunities of a firm. The logic underpinning this is that if firms are forecasting strong investment opportunities to come, they might adjust their capital structure before undergoing new investment. Additionally, one could argue that investment in the previous year could have an impact on the current year's investment. This might often be the case, particularly for firms undergoing multi-stage capital expenditure projects. Thus lagged investment should be included as an explanatory variable for current investment.[25] To address these problems, we treat leverage and debt maturity as endogenous variables, and re-run our regressions using a new dynamic panel specification.

In particular, we estimate the following dynamic panel regression:

$$Investment_{i,t} = \beta_0 + \beta_1 Investment_{i,t-1} + \beta_2 DebtMaturity_{i,t-1} + \beta_3 Leverage_{i,t-1} + \beta_4 Tobin's\ Q_{i,t-1} + \beta_5 Cash\ Flow_{i,t-1} + \alpha_i + \mu_t + \varepsilon_{i,t} \qquad (4)$$

where $Investment_{i,t-1}$ is equal to lagged investment for firm *i* in period *t-1*, and all other variables have the same definition as in Eq. (3)

A problem when using a fixed-effects model within a dynamic setting is that estimators are biased. To overcome this, we employ the use of the system GMM estimator, outlined by Arrelano and Bover (1995) and fully developed by Blundell and Bond (1998) to estimate the above specification. The system GMM combines moment conditions for the model in first differences with moment conditions for the model in levels to overcome the "endogeneity bias" in the regressions. It is important to note that the accuracy of the system GMM model is directly related to the validity of the instruments used in the regression. We take into consideration the validity of these instruments through the use of various statistical tests. The Sargan test is used for testing if an over-identification of instruments exists, under the null hypothesis that instruments as a group are exogenous and therefore valid. If this test fails, it suggests that instruments are not exogenous

[25] The use of lagged investment as an explanatory variable in a dynamic model follows the work of Aivazian et al. (2005b), Ding et al. (2020) and Dang (2011).

to the regressors and therefore are not valid. The Arellano-Bond (AR) tests are also used to test the validity of instruments used, where it instead tests the serial correlation in the residual values.[26]

Table 7 reports the baseline regression results for Eq. (4). Column (1) represents the regression for Investment1 and column (2) represents the regression for Investment2. Lagged debt maturity, leverage, and investment are treated as endogenous variables.

Table 7: Investment and Debt Maturity – Dynamic Panel Regressions

Variables	**Investment1** (1)	**Investment2** (2)
Investment1 $_{t-1}$	0.654*** (0.083)	
Investment2 $_{t-1}$		0.524*** (0.029)
Maturity $_{t-1}$	0.015 (0.028)	0.009 (0.007)
Leverage $_{t-1}$	-0.028 (0.047)	-0.009 (0.011)
Tobin's Q $_{t-1}$	0.021*** (0.008)	0.010*** (0.002)
Cash Flow $_{t-1}$	-0.065* (0.036)	-0.015*** (0.005)
Constant	0.017 (0.039)	0.002 (0.008)
Obs.	30773	30773
AR(1) p-value	0.087	0.000
AR(2) p-value	0.062	0.005
Sargan p-value	0.903	0.256

Notes:
See Table A1 in the Appendix for definition of variables. All the estimates have been carried out using the dynamic panel regressions. Values of standard errors are given in parenthesis. Arrellano-Bond tests are represented by AR(1) and AR(2) for serial correlation in residuals. Sargan p-value refers to the p-value of Sargan test to check the over-identification of instruments. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

[26] Arellano and Bond (1991) and Blundell and Bond (1998) suggest that Sargan p-values and AR(2) values above 10% are a good indicator to support the validity of a model.

Lagged investment is statistically significant and positive across both investment models at the 1% confidence level. This supports the findings of Dang (2011) and Ding et al. (2020) and suggests that a large accelerator effect exists, where past investment has a strong effect on current investment. The remainder of the findings are generally in line with the signs of the basic fixed effects model, however, these results show no significant relationship exists between debt maturity and investment. We test the validity of the dynamic model by using the Sargan and Arellano-Bond tests and find that while the Sargan p-values are high, the AR(2) values are reasonably low, suggesting a problem of serial correlation between residuals.

Table 8: Investment, Debt Maturity, and Financial Constraints (KZ index) – Dynamic Panel Regressions

	Investment1		**Investment2**	
Variables	(1)	(2)	(3)	(4)
Investment1 $_{t-1}$	-0.022***	-0.008		
	(0.005)	(0.011)		
Investment2 $_{t-1}$			0.223***	0.248***
			(0.016)	(0.040)
Maturity $_{t-1}$	0.104***	0.011	0.029***	0.007
	(0.020)	(0.053)	(0.008)	(0.011)
Leverage $_{t-1}$	-0.132***	-0.168	-0.039***	-0.039
	(0.030)	(0.147)	(0.008)	(0.042)
Tobin's Q $_{t-1}$	-0.001	-0.013	0.002***	0.011***
	(0.001)	(0.013)	(0.001)	(0.003)
Cash Flow $_{t-1}$	0.015***	0.001	-0.009***	-0.001***
	(0.003)	(0.001)	(0.001)	(0.000)
Constant	0.051***	0.105***	0.025***	0.011
	(0.011)	(0.040)	(0.004)	(0.010)
Obs.	17015	13758	17015	13758
AR(1) p-value	0.000	0.054	0.000	0.001
AR(2) p-value	0.379	0.169	0.688	0.053
Sargan p-value	0.000	0.000	0.000	0.000

Notes:
See Table A1 in the Appendix for definition of variables. All the estimates have been carried out using the dynamic panel regressions. Values of standard errors are given in parenthesis. Arrellano-Bond tests are represented by AR(1) and AR(2) for serial correlation in residuals. Sargan p-value refers to the p-value of Sargan test to check the over-identification of instruments. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The results in Table 8 represent the dynamic model split into high- and low-constrained firms, using the KZ index, replicating a variation of Table 4 in a dynamic setting.[27] In this table, we choose to focus on the sample of high- and low-constrained firms only, and exclude reporting the results for the entire sample. Columns (1) and (3) represent high-constrained firms, whereas columns (2) and (4) represent low-constrained firms. The impact of lagged investment appears to be mixed across the different investment measures. In line with the findings of Table 4, the coefficients of debt maturity are positive and significant at the 1% level for both investment measures for high-constrained firms. Similarly, we also find that debt maturity does not have an impact on the low-constrained firms. However, it is important to note that the diagnostic tests reveal that the results are not robust and could be subject to the problems of "serial correlation" and "weak instruments". Thus, we do not put much weight into these results alone. These results are only used in conjunction with the fixed effect regression results to provide an overall support of our hypothesis.

7. CONCLUSIONS

Investment decisions are not independent of the optimal debt structure for a firm. Long-term debt can have a positive impact on a firm investment since it reduces the short-term refinancing risk. However, a lack of commitment by a firm makes issuance costly relative to short-term debt. The net effect of debt maturity on investment depends on the trade-off between the two opposing forces. In this study, we examine how the maturity structure of a firm's debt affects its investment decisions. We also argue that firm financing constraints will exacerbate the relationship between debt maturity and investment. Using a panel dataset of Chinese non-financial firms over the period 1997-2018, we find that an increase in debt maturity has a positive impact on corporate investment, and this relationship depends strongly on the financing constraints of the firms. Specifically, firms that face high financial constraints tend to use long-term debt to increase their investment levels, while less financially constrained firms do not seem concerned about the maturity structure of debt for its investment behavior.

[27] We also ran regressions of the dynamic panel model which was split based on the WW index. The results are similar in spirit to Table 8. To save space, these results are not reported in the main paper and can be found in the Appendix. The sub-sample analysis based on industry growth rates was also excluded from our discussion.

These results are robust to two alternative definitions of investment, where investment is measured as the change in fixed assets from the beginning of the year to the end of a year plus depreciation, scaled by the value of total assets at the start of the year.

In addition, we construct two alternative measures of financial constraints for the firms – the KZ index and the WW index. Our results show that, on average, a 1 percent increase in debt maturity leads to a 2.1% to 2.6% increase in investment for high-constrained firms. In contrast, debt maturity does not have a significant impact on investment for low-constrained firms.

We also investigate whether the relationship between debt maturity and investment depends on a firm's growth opportunities. Under the hypothesis that that fast-growing firms are often younger and start-up firms and lower growth firms are often older and more mature, we find that the effect of debt maturity on investment is greater for fast-growing firms. Specifically, a 1% increase in debt maturity results in a 2.3% average increase in investment for fast-growing firms. In contrast, debt maturity does not have a significant impact on investment for lower-growth firms.

To address the issue of endogeneity, we test our hypothesis using dynamic panel data models. The results from these models broadly support our hypothesis. In most specifications, we do find that debt maturity has a positive impact on corporate investment for the high-constrained firms, and has no effect on the low-constrained firms. However, these results of the dynamic specifications are not robust since our regression specifications did not satisfy some of the diagnostic tests of the models. In general, our paper shows that a shortage of long-term finance can act as a barrier to investment, industrial performance, and growth.

As the conclusions are not without potential shortfalls, it is worth discussing a limitation in this paper that will provide guidance for future research. This limitation primarily arises due to data unavailability from the vendor of the dataset that we used for our research. Given the endogeneity between leverage, debt maturity, and investment that is present in our study, the first and most important limitation worth discussing is the instrumental variable (IV) approach we took. As explained previously, the system GMM estimators in the dynamic panel data models combine moment conditions for the model in first differences with moment conditions for the model in levels to overcome the "endogeneity bias" in the regressions. These can often lead to the problem of "weak instruments" (Bun & Windmeijer, 2010). An alternative approach could be to apply 2SLS regressions, similar to that of Aivazian et al. (2005b), where the maturity and tangibility of the firm's assets are used as instrumental variables for debt maturity and leverage, respectively.[28] Unfortunately, we were unable to construct the IVs required to run such a procedure given the constraints of the CSMAR Financial Statements database. Future research can make use of these IVs to attempt to overcome the endogeneity issue and provide additional robustness of our findings.

We also propose two potential extensions of our study for future research. Out database lacked additional information around the debt of the firms. Short-term loans, long-term loans, and bonds payable made up the total debt for a firm. This financial data was limited to what was recorded on a firm's balance sheet and didn't provide any detailed information on the breakdown of the debt. If we had additional information regarding the composition of this debt, for example, the percentage that was foreign and domestic, or information on the debt covenants, we could have completed a useful analysis. Specifically, firms could have been split into sub-samples based on their level of foreign and domestic borrowing to understand if this has a differential impact on corporate investment.

Secondly, given the large percentage of Government ownership of Chinese firms,[29] it may have been useful to perform further analysis based on the ownership structure of a firm. Specifically, following the recent work of Phan (2018),[30] it would be interesting to observe how State-shareholding firms versus Private firms might interact with the financial constraints of a firm, and how the association between investment and debt maturity differs between ownership structure and financial constraints.

[28] Aivazian et al. (2005b) uses the proportion of the value of property, plant, and equipment plus the value of inventory in total assets as the instrumental variable for leverage. Similarly, following Stohs and Mauer (1996), an instrumental variable for debt maturity could be measured as the weighted average maturity of long-term and current assets. Jaramillo and Schiantarelli (1997) support this approach and find that a strong positive association exists between asset maturity and debt maturity, and therefore asset maturity serves as a strong instrumental variable for debt maturity.

[29] See Bae (2009) and Tu et al. (2021).

[30] He found that the impact of debt maturity on investment was significant and positive for state-owned firms compared to a negative and non-significant impact for privately owned firms.

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APPENDIX

Table A1: Description of Variables

Variable	Description
Investment1	Change in fixed assets from the beginning of the year to the end of the year plus depreciation, normalised by total assets at the beginning of the year
Investment2	Capital expenditures minus depreciation, normalised by total assets at the beginning of the year
Maturity	The ratio of total long-term debt to total debt
Leverage	Total debt / total assets
Tobin's Q	Market value of total assets of the firm / book value of assets
Cash Flow	Total revenue plus depreciation normalized by beginning of year total assets

Table A2: Investment, Debt Maturity, and Financial Constraints (WW index)
Dynamic Panel Regressions

	Investment1		**Investment2**	
Variables	(1)	(2)	(3)	(4)
Investment1 $_{t-1}$	0.005	-0.001		
	(0.004)	(0.003)		
Investment2 $_{t-1}$			0.149***	0.109***
			(0.013)	(0.016)
Maturity $_{t-1}$	0.033***	0.100**	0.013	0.012
	(0.012)	(0.051)	(0.008)	(0.012)
Leverage $_{t-1}$	-0.085***	0.078	-0.019*	-0.013
	(0.016)	(0.074)	(0.010)	(0.020)
Tobin's Q $_{t-1}$	0.001	0.047***	0.003***	0.015***
	(0.001)	(0.013)	(0.001)	(0.004)
Cash Flow $_{t-1}$	0.006***	-0.001	-0.005***	-0.002***
	(0.002)	(0.001)	(0.001)	(0.000)
Constant	0.041***	-0.060*	0.018***	0.011
	(0.005)	(0.036)	(0.004)	(0.010)
Obs.	14545	16228	14545	16228
AR(1) p-value	0.000	0.160	0.000	0.018
AR(2) p-value	0.211	0.496	0.228	0.000
Sargan p-value	0.000	0.927	0.000	0.000

Notes:
See Table A1 for definition of variables. All the estimates have been carried out using the dynamic panel regressions. Values of standard errors are given in parenthesis. Arrellano-Bond tests are represented by AR(1) and AR(2) for serial correlation in residuals. Sargan p-value refers to the p-value of Sargan test to check the over-identification of instruments. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.