Does monetary policy tightening reduce the maturity mismatch of investment and financing: Empirical evidence from China

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Abstract

Using the financial data of A-share listed companies in 2003-2018, this paper studies the maturity mismatch of investment and financing in China based on the sensitivity of investment to change of short-term loans. This study finds that corporate investment relies on short-term loans rather than long-term loans, so the maturity mismatch of investment and financing is widespread. In addition, we examine the mechanism of the heterogeneity between state-owned enterprises and private enterprises. We find that tightening monetary policy exacerbates the financing constraints faced by enterprises, in the meanwhile, strengthens the role of loan supervision. Because of the existence of credit discrimination, more credit resources fly to state-owned enterprises during period of monetary policy tightening and loan supervision is strengthened, so the problem of maturity mismatch of investment and financing is weakened. However, private enterprises face severe shortage in supply of short-term loans during the period of monetary policy tightening, so the role of financing constraints dominates, which makes the maturity mismatch of investment and financing intensified.

1 Introduction

Money shortage has been widely discussed in recent years. The fragmentation between the financial system and the real economy, as well as the difficulty and high cost of financing are still important factors restricting the development of China's real economy. Especially for small and medium-sized enterprises, financial constraint is still one of the vital problems encountered in their business development. At the same time, the efficiency of financing is always a big issue in business management. In recent years, the maturity mismatch of investment and financing, in other words, investing in long-term project by lending short-term loans, has begun to flourish and has become topical in academic studies.

In the theory of corporate finance, the term structure of investment and financing mainly includes three types: radical, stable and conservative. How to reasonably and effectively arrange the investment and financing term structure is related to the sustainable development of the enterprise. Generally speaking, enterprises should avoid the aggressive investment and financing term structure to defense high liquidity risk. However, in the practice of Chinese enterprises, the aggressive investment and financing strategies of "short-term lending and long-term investment" often exist. Because there is no repayment pressure on equity funds, the level of "short-term lending and long-term investment" of enterprises depends largely on the arrangement of corporate credit term

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structure. From the perspective of information asymmetry and agency cost, banks as credit providers are more inclined to issue short-term loans to strengthen risk control (Bharath et al., 2008; Armstrong et al., 2010; Custodio et al., 2013; Sun et al. 2005); However, based on transaction cost and pecking order theory, short-term debt costs are relatively low, and high-quality companies have the ability to bear the liquidity risk pressure of short-term debt funds, and thereby pass positive signals to the outside world (Flannery, 1986; Goyal And Wang, 2013; Fang, 2010). At the same time, multiple negotiations on short-term debt have also helped to improve the debt contract (Roberts, 2015) and reduce corporate debt financing costs (Custodio et al., 2013). It can be seen that "short-term lending and long-term investment" may be the sub-optimal choices made by enterprises under the financial suppression environment, or may be initiative actions taken by the enterprises to reduce the cost of debt financing transactions.

On the one hand, in China, banks are the dominant financial institution and the most important financing channel for enterprises. However, China's financial market has severe financial repression problem due to institutional reasons. From the perspective of banks, they are more willing to provide short-term credit to company in order to control credit risk and credit assessment pressure. First of all, short-term credit can reduce the reverse selection behavior of enterprises and eliminate the competition of credit resources for some high-risk projects. Secondly, short-term credit can strengthen supervision for investment projects and control corporate moral hazard problem, through multiple credit contract negotiations and the pressure of repaying principal and interest. In addition, short-term credit can also provide banks with greater flexibility to cope with regulatory pressures on credit issuance and recycling. From the perspective of enterprises, credit discrimination is still a common topic that cannot be bypassed by the credit market. In China's non-competitive financial markets, state-owned enterprises have implicit guarantee problems, and their credit availability is better. However, private enterprises are often discriminated against in different degrees in credit availability, at a disadvantage in the bargaining of the credit contract, so their dependence on short-term loans will be stronger. Therefore, in China, investment activities often have difficulty obtaining long-term credit with the same term, and can only rely partly on the continuous rollover of short-term credit to support long-term investment activities, that is, "short-term lending and long-term investment".

On the other hand, due to the problem of credit discrimination in China, state-owned enterprises have a strong advantage in credit availability. In the period of monetary policy easing, liquidity is relatively abundant, and banks will relax supervision in the issuance of loans. Therefore, the assessment of short-term loans is weakened, and the restrictions on the use of short-term loans for long-term investment purposes do not work, thus aggravate the maturity mismatch of investment and financing.

Therefore, the maturity mismatch of investment and financing may not only reduce the cost of financing transactions, but also increase the liquidity risk, which has a negative effect on the company's performance. China's regulatory authorities have noticed the serious maturity mismatch of investment and financing problem and started to deleverage since 2016. One of the goals of the deleveraging policy is to solve this problem. But what is the reason for the maturity mismatch between investment and financing in Chinese enterprises? Is tightening monetary policy conducive to reducing the maturity mismatch of investment and financing? In the past, the research on the structure of fund maturity focused more on the financing perspective, but did not deeply consider the term structure matching relationship between the investment and financing. This paper will try

to supplement this problem and analyze whether the radical financing method of "short-term lending and long-term investment" is a concrete manifestation of financing constraints under credit discrimination in China, and what role does monetary policy and bank supervision play in it? This study tries to answer these questions.

This study first constructs the sensitivity of investment to change of short-term loans to measure the degree of maturity mismatch of investment and financing. It finds that there are widespread maturity mismatch of investment and financing problems in Chinese enterprises. Enterprises rely on retained earnings and short-term loans for long-term investment. The dependence on long-term loans is relatively weak. Secondly, this paper finds that during the period of monetary policy easing, the maturity mismatch of investment and financing in state-owned enterprises is more serious than that in private enterprises. On the contrary, during the period of monetary policy tightening, the mismatch in private enterprises is more serious than that in state-owned enterprises. Thirdly, we specifically analyze the impact mechanism of monetary policy on the maturity mismatch of investment and financing. We find that when the monetary policy is easing, the bank liquidity is sufficient, the financing constraints faced by enterprises are not very obvious, and the supervision effect of short-term loans is only significant in private enterprises. The supervision is in absence in the state-owned enterprises, so the maturity mismatching of investment and financing in state-owned enterprises will be more serious. In the period of monetary policy tightening, private enterprises are shrinking due to credit discrimination. The scale of long-term loans is significantly shrinking, and the availability of loans is declining, therefore, investment rely more on short-term loans, leading the maturity mismatch problems worse. However, because of shifting to safety, state-owned enterprises can obtain more credit resources during the period of monetary policy tightening, and the supervision role of banks on short-term loans will be strengthened. The use of short-term loans will be more compliant for short-term purposes. The allocation of credit resources is more efficient, the problem of maturity mismatches is effectively solved, and investment efficiency has also been significantly improved. Therefore, two vital problems in China's financial system are the non-neutral competition problems of state-owned enterprises and private enterprises, including problems of implicit guarantee and credit discrimination, and the supervision of banks on short-term loans during the period of monetary policy easing. The solution is to strengthen the supervision of banks on loans, especially short-term loans, and guide enterprises to use short-term loans to supplement short-term uses such as working capital, and eventually promote the credit allocation efficiency to truly solve the maturity mismatch between investment and financing that are harmful to enterprises and economy.

The remainder of the paper is organized as follows. Section 2 provides the literature review and hypothesis development. Section 3 discusses sample selections. Section 4 reports the empirical findings. Section 5 presents the results of the robustness tests; and Section 6 concludes.

2 Literature review and hypothesis development
2.1 Maturity mismatch of investment and financing
The theory of asset-liability maturity matching was first proposed by Morris (1976), who argued that matching the maturity of corporate assets and liabilities would reduce the risk that the cash flow generated by the assets would not be sufficient to repay the principal and interest. Myers (1977) demonstrated the necessity of term matching from the perspective of agency cost, and considered that term matching is a solution to overcome debt overhang problem. Hart and Moore (1994) draw

conclusions from the perspective of debt contract: When the cash flow generated by the project becomes faster, the debt maturity becomes shorter; when the depreciation rate of the encumbered assets is lower, the debt maturity becomes longer. Their study further proved that the duration of assets and liabilities should match.

The maturity mismatch of investment and financing mainly refers to the use of short-term funds to support long-term investment activities. This mismatch arrangement can provide liquidity support for corporate investment and ease financing constraints (Campello et al., 2011); The pressure on corporate debt repayment has been further amplified and the risk of continuing rollover has increased (Diamond, 1991; Acharya et al., 2011). Specifically, commercial credit has always been regarded as one of the main means for Chinese companies to cope with financial repression (Wang, 2014), and has become an alternative financing method for enterprises in tight monetary conditions (Rao and Jiang, 2013); In addition, under China's bank-led financial system (Allen et al., 2005), bank credit provides major financing support for business operations and plays an important role in economic growth (Ayyagari et al., 2010).

However, China's financial market has serious structural problems. Specifically, the financial market dominated by commercial banks is the main financing channel for enterprises, and the structural problems faced by commercial banks are particularly prominent. In terms of the external policy environment, the changing monetary policy and the underestimation of long-term and short-term spreads make commercial banks reluctant to issue long-term loans to enterprises. Fan and Titman (2012), Bai et al. (2016) found that the weaker the institutional environment stability of a country and the less perfect the legal system, the higher the dependence of enterprises on short-term bank loans, in other words, the lower the willingness for banks to supply long-term loans, based on empirical comparisons of cross-country samples. Bai et al. (2018) established a more complex LMI index to measure the mismatch between market liquidity of commercial bank assets and financing liquidity of liabilities. The study found that the liquidity premium between long-term loans and short-term loans is not enough to compensate for the risks in the debt side. In the meanwhile, combined with the current situation of China's commercial banks, the sale of wealth management products in recent years has greatly reduced long-term deposit savings. This further weakens the ability of commercial banks to provide long-term loans, making enterprises more dependent on short-term loan financing. Orman and Koksal (2017) believed that under the environment of developed financial market and perfect system construction, enterprises will adjust their debt structure independently according to the principle of matching the maturity of assets and liabilities. However, the willingness and ability of China's commercial banks to supply long-term funds are not strong, which makes the allocation of debt maturity more likely to be a passive acceptance rather than an active decision. Constrained by China's financial regulation, weak investor protection, and low information transparency, banks have low willingness to provide long-term loans due to risk considerations, often providing short-term credit to control corporate default risk (Fan et al., 2012; Custodio et al., 2013; Xiao and Liao, 2008). Companies can only rely on short-term credit to support long-term investment, but this radical investment and financing mismatch may aggravate the company's operating risk, having a negative effect on the company's performance, restricting the stability of the regional financial system and the sustainability of economic growth. We put forth the following hypotheses:

Hypothesis 1: The maturity mismatch of investment and financing is widespread. Long-term investment depends on short-term loans rather than long-term loans.

2.2 Monetory policy and maturity mismatch

The problem of maturity mismatch of investment and financing should be considered at least in two aspects. From the perspective of financing side, Based on research in the US capital market, Kahl et al. (2015) found that companies use short-term commercial paper to support investment in the initial stage of capital expenditure, and then issue long-term bonds, with the aim of reducing the cost of financing transactions. This behavior occurs more frequently in higher credit quality, indicating that the "short-term lending and long-term investment" strategy is the result of independent decision-making by the enterprise based on its own characteristics and has a positive effect on the company's performance. However, in China, the financial repression is severe, the financing channels are limited, and the legal protection is imperfect. The "short-term lending and long-term investment" is more likely to be an alternative financing method than the initiative choice of enterprises to reduce the cost of financing transactions. Therefore, considering China's financial environment, the "short-term lending and long-term investment" behavior of enterprises may depend on the financing constraints of the enterprise itself.

From the perspective of the investment side, for China's financial system, the bank, as a fund provider, faces lower competitive pressures, and it pays more attention to evaluate indicators concerned by the regulatory agencies and bank headquarters, such as saving storage and credit distribution and recycling, than the performance indicators. When monetary policy is easing, liquidity is sufficient, financing constraints are low, and supervision over the issuance of loans is even lower. It is easier for enterprises to use short-term loans for long-term purposes, and the level of "short-term lending and long-term investment" is higher. When monetary policy is tightening, banks are more focused on the pressure of assessment indicators such as capital adequacy ratio and LTV. On the one hand, banks are more willing to use short-term credit to reduce agency risk for credit risk control. On the other hand, banks will strengthen the supervision of loans, especially short-term loans issued during the liquidty shortage period, thus reducing the maturity mismatch of investment and financing.

Therefore, tightening monetary policy will have two effects at the same time. On the one hand, it will reduce the availability of loans and increase the dependence of enterprises on short-term loans. On the other hand, it will strengthen supervision over the use of short-term loans. Combining the above two channels, we believe that the role of supervision is dominant in state-owned enterprises, and in the private enterprises, the role of financing constraints dominates, because of the existence of credit discrimination. On the basis of the foregoing discussion, we propose:

Hypothesis 2: During the period of monetary policy easing, the maturity mismatch of investment and financing in state-owned enterprises is higher than that in private enterprises. During the period of monetary policy tightening, the maturity mismatch of investment and financing in private enterprises is higher than that in state-owned enterprises.

Next, we specifically analyze the role of these two channels. Economic theory points out that the impact of monetary policy on the economic system mainly work through the currency channel and credit channel. The former is mainly reflected in interest rates (Hicks, 1937), and the latter is mainly reflected in bank credit (Bernanke and Blinder, 1988; Bernanke and Blinder, 1992), both of which affect the company's financing environment. In China, due to interest rate regulation, we mainly

focus on the credit channel. The impact of easing monetary policy on the financing constraints of private enterprises is mainly reflected in two aspects: on the one hand, easing monetary policy is conducive to private enterprises to obtain credit rationing. Previous literature shows that Chinese financial institutions discriminate against private enterprises in credit rationing (Allen et al., 2005; Brandt and Li, 2003; Ye et al., 2009). Credit resources are allocated to state-owned enterprises, and private enterprises can only obtain surplus resources. When monetary policy tends to tighten, the total amount of credit rationing resources is reduced, and private enterprises are less likely to obtain credit resources. When monetary policy is more relaxed, due to the increase in credit resources that banks can allocate, after meeting the needs of state-owned enterprises, they can allocate the remaining credit resources to private enterprises, thus alleviating the financing constraints of private enterprises. Therefore, based on the above analysis, in the period of tight monetary policy, private enterprises face greater financing constraints, while state-owned enterprises have greater credit advantages during the tightening monetary policy period. We propose the following assumptions:

Hypothesis 3: Monetary policy tightening will lead to stronger financing constraints for private enterprises, but will allow more credit resources to fly to state-owned enterprises.

It is believed that debt maturity structure can also serve as an effective disciplining device. Many theories have proved that short-maturity debt can reduce the agency conflicts between managers and shareholders (Hart and Moore, 1995, 1998; Shleifer and Vishny, 1997). The firm needs to roll over the debt when it mature, subjecting managers to more frequent monitoring by the capital market. Banks have access to more private information, their monitoring should be more effective and thus can further help reduce managerial agency costs (James, 1987; Lummer and McConnell, 1989; Rauh and Sufi, 2010). In addition, corporate investment behavior is subject to various supervisions of banks. As a provider of funds, banks can guarantee the timely payment of interest after the issuance of loans and full recovery of capital at maturity, reducing the bad debt rate, and it is bound to audit the targeting enterprise before the loan is issued and closely track and supervise the use of their fundings after lending. Short-term loans, because of their short duration, have more inspections of distribution and rollover, and there is more supervision.

And what's more, money supply had an impact on the company's performance, and the two were significantly positively correlated. It can be seen that monetary policy can affect company performance. During the period of monetary policy tightening, the scale of bank credit was severely restricted, and the uncertainty of future business performance of the company increased, and the possibility of declining performance increased. At this time, faced with the increase in default risk of the borrowing enterprise, and once the contract is breached, the possibility of bank penalties increases, and the bank is bound to increase the control over the loan risk. Short-term loans have a supervisory role and can reduce the maturity mismatch of investment and financing. We believe that private enterprises will be subject to short-term loans supervision because of their relatively large credit risks, and their use of funds will be more constrained. But for state-owned enterprises, this kind of supervision is often not implemented in the period of monetary policy easing, and monetary tightening is conducive to banks to play their supervisory role. This leads to our fourth main hypothesis.:

Hypothesis 4: Credit discrimination leads to the supervision of short-term loans is effective for

private enterprises. But the supervision for state-owned enterprises only works during the period of monetary policy tightening.

3 Sample selection and empirical methodology
3.1. Sample construction
We draw our initial sample of China's A-share listed firms over the 2003–2018 period from CSMAR database. Monetary policy and money supply data come from the People's Bank of China website. We use annual data to eliminate seasonality of investment and other financial data. Following prior literature, we exclude firms in financial industry, firms that have zero sales or total assets, ST firms and firms that have missing data. To minimize the effects of outliers, we winsorize main variables at the 1st and 99th percentiles. Table 1 shows the annual and ownership distribution of the sample. It can be found that the number of state-owned enterprises has grown slowly, while the number of private enterprises has grown rapidly.

Table 1 Distribution of observations by year and property

Year	SOE	Percentage	Private Enterprises	Percentage
2003	702	2.28%	444	1.44%
2004	744	2.41%	456	1.48%
2005	779	2.53%	481	1.56%
2006	768	2.49%	477	1.55%
2007	784	2.54%	500	1.62%
2008	835	2.71%	599	1.94%
2009	840	2.72%	642	2.08%
2010	859	2.78%	767	2.49%
2011	898	2.91%	1,071	3.47%
2012	919	2.98%	1,302	4.22%
2013	937	3.04%	1,403	4.55%
2014	920	2.98%	1,400	4.54%
2015	912	2.96%	1,485	4.81%
2016	940	3.05%	1,696	5.50%
2017	962	3.12%	1,939	6.29%
2018	1,021	3.31%	2,362	7.66%
Total	**13820**	**44.81%**	**17024**	**55.19%**

Notes: This table present the distribution for the main sample of 30,844 firm-years included in CSMAR database during the period 2003-2018.

3.2. Variable construction
3.2.1 How to measure the maturity mismatch of investment and financing
This study investigates the maturity mismatch of investment and financing in Chinese enterprises. We use the sensitivity of investment to change of short-term loans to measure the mismatch. We use cash paid for the purchase and construction of fixed assets, intangible assets and other long-term assets less net cash recovered from disposal of fixed assets, intangible assets and other long-term assets (*Investment*) to measure investment. And we use the short-term loans and long-term loans data in the balance sheet to calculate the change of the loans.

3.2.2 Loan term structure

Firstly, in order to better measure the dependence of investment on loans, we construct the flow data of loans by subtracting the balance of the loan a year earlier from the current balance of loan. We use the ratio of the change in short-term borrowings to the total assets ($\Delta stdebt$) to measure the change of short-term loan. We use the ratio of the change in long-term borrowings ($\Delta ltdebt$) to the total assets to measure the change of long-term loan.

Secondly, for the stock data, when we study the total amount of loans, we pay attention to the scale relative to the assets, so we use the total assets to standardize them and construct *Loan*. When we study the term structure of long-term loans and short-term loans, we pay more attention to their proportion of liabilities, that is, the structure of loans rather than the total amount, so we use the total amount of liabilities to standardize them and construct *ST* and *LT*.

3.2.3 Monetary policy

In order to measure the impact of monetary policy on the maturity mismatch of investment and financing, we need to construct the monetary policy variable (*MP*). With regard to the difference between monetary policy tightening and easing, the academic research have different definitions. Money supply and interest rates are the general tools of monetary policy. China has gradually shifted from quantitative regulation to price-based regulation. Money supply and interest rate indicators sometimes give us the opposite signs. Therefore, we combine the money supply and interest rate indicators, based on the previous studies, to establish a dummy variable of monetary policy, which solves the problem of inconsistent continuous indicators. We define 2004, 2005, 2007, 2008, 2011, 2014, 2017, 2018 as tightening monetary policy years and *MP* is equal to 1, other years as easing monetary policy years and *MP* is equal to 0.

3.2.4. Control variables

Consistent with previous literature, we consider several firm-specific variables as determinants of investment. Net operating cash flow *(CFO)*, and corporate free cash flow (*FCF*), derived from financial statements controlling the impact of corporate cash flow; company size (*Size*), expressed as the natural logarithm of the total asset size of the enterprise; leverage ratio (*Lev*), expressed as the ratio of total liability to total assets, in order to control the impact of different capital structures on the dependent variables; Tobin Q value (*Tobinq*), controlling the impact of the growth capacity of the enterprise; Current ratio (*Current*), defined as the ratio of current assets to current liabilities, controlling the impact of different working capital policy.

3.2.5 Descriptive statistics

Table 2 contains the descriptive statistics of our main variables. The mean value of *Investment* is 0.0502, revealing the amount of investment is 5% of the total assets for an average firm. The mean value of $\Delta stdebt, \Delta ltdebt \ and \ \Delta loan$ is positive. On average, the amount of corporate short-term and long-term loans are on the rise. The mean value of *MP* and *SOE* is around 0.5, indicating that the number of state-owned enterprises and private enterprises is equivalent, and the number of tightening monetary policy periods and the number of easing monetary policy periods is equivalent, which makes our research more credible.

Table 2 Summary Statistics

VARIABLES	Obs.	Mean	Sd	Min	Max
Investment	30,844	0.0502	0.0736	-7.705	0.642
Δstdebt	30,844	0.0191	0.0807	-0.192	0.360
Δltdebt	30,844	0.0117	0.0629	-0.137	0.350
Δloan	30,844	0.0311	0.1113	-0.218	0.565
MP	30,844	0.511	0.500	0	1
SOE	30,844	0.448	0.497	0	1
Size	30,844	21.92	1.306	12.31	28.52
Lev	30,844	0.486	4.997	0.00708	877.3
CFO	30,844	0.0439	0.0832	-1.938	1.127
FCF	30,844	-0.0743	12.95	-2,275	12.12
ROA	30,844	0.0363	0.0769	-1.859	1.007
ROE	30,844	0.0428	0.690	-75.89	33.83
Tobinq	30,844	2.144	12.62	0.0272	2,124
Current	30,844	2.268	3.717	0.00120	204.7

4. Empirical results

This section contains the results of multivariate analyses, as well as additional tests that we conduct to gain a more thorough understanding of the relation between the monetary policy and the maturity mismatch of investment and financing.

4.1 Financing for investment: long-term debt or short-term debt

We first study the source of funds for long-term investment in enterprises. We note that investment is flow data, and loans are stock data, so in order to better measure the dependence of long-term investment on short-term financing, this paper draws on the "investment-current liabilities" sensitivity method constructed by Mclean and Zhao (2014). Using the change in debt and the flow of investment standardized with total assets as research variables, we build a sensitivity model of investment to change of loans to verify the maturity mismatch between investment and financing in China's enterprises. We establish the following model:

$$Investment_{i,t} = \beta_0 + \beta_1 \Delta stdebt_{i,t} + \beta_2 \Delta ltdebt_{i,t} + \beta_3 ROA_{i,t} + \beta_4 CFO_{i,t} + \beta_5 FCF_{i,t}$$
$$+ \beta_6 Lev_{i,t} + \beta_7 Size_{i,t} + \beta_8 Current_{i,t} + \beta_9 tobinq_{i,t} + fixed\ effect + \varepsilon_{i,t}$$

(1)

We use *Investment* as the dependent variable, and then add $\Delta stdebt$, $\Delta ltdebt$ and *ROA* to the explanatory variables. We focus on the sign and significance of the coefficients β_1, β_2, and β_2, ie the sensitivity of investment to change of short-term loans, sensitivity of investment to change of long-term loans, and sensitivity of investment to retained earnings. If the sensitivity of investment to change of short-term loans is significantly positive, it indicates that corporate investment is dependent on new-issued short-term loans. According to the previous analysis, Chinese enterprises generally have financing constraints. Investment mainly depends on bank loans, especially short-term loans. At the same time, according to pecking order theory, internal financing is also an important source of funds for corporate investment. Therefore, the estimated coefficient β_1 and β_3 should be significant, while β_2 should not be significantly.

The regression results are shown in Table 3. The regression results show that the regression

coefficient of $\Delta stdebt$ is significantly positive at the level of 1%, while the coefficient of $\Delta ltdebt$ is not significant, indicating that there is a positive correlation between the change of short-term loans and long-term investment, while the change of long-term debt is not significantly related with investment. It indicates that corporate investment is more dependent on short-term loans rather than long-term loans, consistent with Hypothesis 1. The reason for this phenomenon is that the financing availability of Chinese enterprises to obtain long-term loans is limited, so many company-year observations have no change in long-term loans, while the investment is fluctuating due to some frequent and small projects.

At the same time, the coefficient of ROA is also statistically significant. ROA is an indicator to measure the profit and the retained earnings of the enterprise. The result shows that the retained earnings are still an important source of funds for Chinese enterprises' investment, which is consistent with the pecking order theory. Therefore, the funding of investment comes more from retained earnings and new-issued short-term loans.

However, according to the principle of maturity matching, enterprises should use long-term funds to finance long-term investments, and the amount of investment should be independent of short-term debt changes. It can be seen that there is a widespread maturity mismatch between investment and financing in Chinese enterprises.

Table 3 Funding for investment

VARIABLES	(1) Investment	(2) Investment
$\Delta stdebt$		0.162***
		(0.00406)
$\Delta ltdebt$	0.000581	
	(0.00483)	
ROA	0.0512***	0.0201***
	(0.00472)	(0.00467)
CFO	0.0932***	0.136***
	(0.00409)	(0.00413)
FCF	-0.00912***	-0.0138***
	(0.000736)	(0.000727)
Lev	-0.0315***	-0.0437***
	(0.00190)	(0.00187)
$Size$	0.00492***	0.00474***
	(0.000301)	(0.000294)
$Current$	-0.00102***	-0.000943***
	(9.63e-05)	(9.39e-05)
$Tobinq$	-0.000362***	-0.000362***
	(9.54e-05)	(9.30e-05)
Constant	-0.0277***	-0.0266***
	(0.00638)	(0.00622)
Fixed effect	Industry Year Province	Industry Year Province
Observations	30,844	30,844
R-squared	0.432	0.460

4.2 Structural differences between state-owned enterprises and private enterprises

We are concerned about the impact of monetary policy on the maturity mismatch of investment and financing. In view of the credit discrimination phenomenon in China's credit market, state-owned enterprises and private enterprises have inherent differences in credit availability. Therefore, we believe that there will be structural differences of the maturity mismatch of investment and financing between state-owned enterprises and private enterprises. In addition, monetary policy plays different role. There may also be heterogeneity in the maturity mismatch behavior.

We respectively add the cross term of *MP* and $\Delta stdebt$ and the cross term of *SOE* and $\Delta stdebt$ to test these structural differences. The regression models are as follows:

$$
\begin{aligned}
Investment_{i,t} = \beta_0 &+ \beta_1 \Delta stdebt_{i,t} + \beta_2 SOE_{i,t} + \beta_3 \Delta stdebt_{i,t} \times SOE_{i,t} + \beta_4 ROA_{i,t} + \beta_5 CFO_{i,t} \\
&+ \beta_6 FCF_{i,t} + \beta_7 Lev_{i,t} + \beta_8 Size_{i,t} + \beta_9 Current_{i,t} + \beta_{10} tobinq_{i,t} \\
&+ fixed\ effect + \varepsilon_{i,t}
\end{aligned} \qquad (2)
$$

$$
\begin{aligned}
Investment_{i,t} = \beta_0 &+ \beta_1 \Delta stdebt_{i,t} + \beta_2 MP_t + \beta_3 \Delta stdebt_{i,t} \times MP_t + \beta_4 ROA_{i,t} + \beta_5 CFO_{i,t} \\
&+ \beta_6 FCF_{i,t} + \beta_7 Lev_{i,t} + \beta_8 Size_{i,t} + \beta_9 Current_{i,t} + \beta_{10} tobinq_{i,t} \\
&+ fixed\ effect + \varepsilon_{i,t}
\end{aligned} \qquad (3)
$$

The results are presented in Table 4, which is in line with our expectations. Panel A present results of regression (2) and Panel B present results of regression (3).During the period of monetary policy easing, the maturity mismatch of investment and financing in state-owned enterprises is significantly higher than that in private enterprises, and the tightening of monetary policy will significantly increase the maturity mismatch in private enterprises, but it will reduce the maturity mismatch in state-owned enterprises, and eventually lead the maturity mismatch in state-owned enterprises to be significantly lower than that in private enterprises during the period of monetary policy tightening.

Table 4 maturity mismatch and monetary policy

Panel A Period of monetary policy tightening and monetary policy easing			
	(1)	(2)	(3)
VARIABLES	All samples	Tightening monetary policy	Easing monetary policy
$\Delta stdebt$	0.163***	0.198***	0.137***
	(0.00528)	(0.00754)	（0.00735）
SOE	-0.00554***	-0.00535***	-0.00553***
	(0.0007)	(0.00097)	（0.00099）
$\Delta stdebt \times SOE$	-0.00833	-0.0118**	0.00518**
	(0.00773)	(0.00519)	(0.00236)
Constant	-0.0379***	-0.0173*	-0.0417***
	(0.00636)	（0.009）	（0.00895）
Control Var.	YES	YES	YES

	Industry Year Province	Industry Year Province	Industry Year Province
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	30,844	15,751	15,093
R-squared	0.461	0.194	0.605

Panel B   State-owned enterprises and private enterprises

VARIABLES	(1) All samples	(2) Private enterprises	(3) State-owned enterprises
$\Delta stdebt$	0.139***	0.141***	0.141***
	(0.0055)	(0.00738)	(0.00811)
MP	-0.0243***	-0.0205***	-0.0328***
	(0.0019)	(0.00293)	(0.00264)
$\Delta stdebt \times MP$	0.0165	0.0492***	-0.0387***
	(0.0167)	(0.0103)	(0.0112)
Constant	-0.0255***	-0.0266***	-0.0348***
	(0.00622)	(0.00991)	(0.00892)
Control Var.	YES	YES	YES
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	30,844	17,024	13,820
R-squared	0.461	0.578	0.208

Notes: This table presents the results of regressing Investment on the change of short-term loans and two cross term. In column (1), we use the whole samples and then divide the samples into two groups according to our regression set-up. The control variables are ROA, CFO, FCF, Size, Lev, Current and Tobinq. ***, ** ,* represent significance level of 1%, 5% and 10% respectively; and standard error is reported in parentheses.

4.3 Monetary policy and loan availability

In order to study the impact of tight monetary policy on the availability of corporate loans, we construct the following model:

$$Loan_{i,t} = \beta_0 + \beta_1 MP_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROA_{i,t} + \beta_5 CFO_{i,t} + \beta_6 FCF_{i,t} +$$
$$\beta_7 Growth_{i,t} + \beta_8 tobinq_{i,t} + \beta_9 LargestholderRate_{i,t} + fixed\ effect + \varepsilon_{i,t} \qquad (4)$$

We use *ST* and *LT* to replace the dependent variable and our focus is on the coefficient β_1 which measure the change in the term structure of the loan during the monetary policy tightening period. The results of the regression are presented in Table 5, it can be seen that from the perspective of total loans, the tightening of monetary policy has reduced the availability of loans for private enterprises. For state-owned enterprises, the total amount of loans has increased, because the state-owned enterprises have the expectation of "rigid redemption". Banks will transfer credit resources to state-owned enterprises with lower risks, making state-owned enterprises have more credit resources. Specific to the loan term structure, the increase in credit resources of state-owned enterprises is reflected in the obvious increase in short-term credit, while the reduction in credit resources of private enterprises is concentrated in the reduction of long-term credit. Therefore, if we look at the ratio of short-term loans and long-term loans, private enterprises and state-owned

enterprises both have a tendency to shorten the credit term structure under the tightening monetary policy. However, the reason for the shortening of the credit term structure of state-owned enterprises is the increase of short-term loans, while it's because of the reduction in long-term loans in private enterprises. Therefore, it can be seen that financing constraints and credit availability do have an important impact on the maturity mismatch of enterprises. There is indeed credit discrimination at the supply level in China's credit market.

Table 5 Monetary policy and Loan availability

Panel A Change of the total loans			
	(1)	(2)	(3)
VARIABLES	Loan	SOE	Private enterprises
MP	0.000308	0.00476**	-0.00398**
	(0.00132)	(0.00216)	(0.00160)
Control Var.	YES	YES	YES
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	27,407	12,420	14,987
R-squared	0.517	0.466	0.556
Panel B Change of the short-term loans			
	(1)	(2)	(3)
VARIABLES	ST	SOE	Private enterprises
MP	0.00274	0.00824**	-0.00476
	(0.00228)	(0.00323)	(0.00319)
Control Var.	YES	YES	YES
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	27,407	12,420	14,987
R-squared	0.178	0.192	0.180
Panel C Change of the long-term loans			
	(1)	(2)	(3)
VARIABLES	LT	SOE	Private enterprises
MP	-0.00454***	-0.00226	-0.00564***
	(0.00161)	(0.00275)	(0.00182)
Control Var.	YES	YES	YES
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	27,407	12,420	14,987
R-squared	0.160	0.159	0.141

Notes: This table presents the results of regressing loan term structure on the monetary policy. Panel A, B and C respectively use the total amount of loans, the short-term loans and long-term loans as independent variable. In column (1), we use the whole samples and then divide the samples into two groups: SOE and private enterprises. The control variables are ROA, CFO, FCF, Size, Lev, Growth, Tobinq and LargestholderRate. Because of the data missing of the new control variables (Growth,

4.4 Monetary policy and short-term loan supervision
4.4.1 Short-term loan and maturity mismatch
We first study the impact of short-term loans on the maturity mismatch of investment and financing. We add the squared term of short in the benchmark regression to establish the following model:

$$Investment_{i,t} = \beta_0 + \beta_1 \Delta stdebt_{i,t} + \beta_2 \Delta stdebt_{i,t}^2 + \beta_3 ROA_{i,t} + \beta_4 CFO_{i,t} + \beta_5 FCF_{i,t} + \beta_6 Lev_{i,t} + \beta_7 Size_{i,t} + \beta_8 Current_{i,t} + \beta_9 tobinq_{i,t} + fixed\ effect + \varepsilon_{i,t} \quad (5)$$

Among them, we focus on the coefficient signs and significance of β_2. If β_2 is negative, it means that with the increase of new-issued short-term loans, the maturity mismatch of investment and financing becomes weaker, which proves that short-term loans have certain supervisory effect on maturity mismatch.

Table 6 The impact of short-term loans on the mismatch

VARIABLES	SOE		Private Enterprises	
	Easing M.P.	Tightening M.P.	Easing M.P.	Tightening M.P.
$\Delta stdebt$	0.146***	0.228***	0.157***	0.232***
	(0.00708)	(0.0111)	(0.00983)	(0.0100)
$\Delta stdebt^2$	-0.0456	-0.242***	-0.114***	-0.201***
	(0.0305)	(0.0495)	(0.0410)	(0.0453)
ROA	0.0325***	0.07 64***	0.0359***	0.0816***
	(0.00779)	(0.0118)	(0.0101)	(0.00727)
CFO	0.128***	0.182***	0.106***	0.150***
	(0.00605)	(0.00892)	(0.00814)	(0.00734)
FCF	-0.0112***	-0.0515***	-0.0136***	-0.0864***
	(0.00106)	(0.00365)	(0.00143)	(0.00435)
Lev	-0.0359***	-0.00181	-0.0424***	-0.00866**
	(0.00273)	(0.00454)	(0.00371)	(0.00363)
Size	0.00192***	-0.000523	0.00104	-0.00142**
	(0.000396)	(0.000528)	(0.000649)	(0.000589)
Current	-0.000907***	-0.00274***	-0.000729***	-0.000346**
	(0.000142)	(0.000382)	(0.000157)	(0.000135)
Tobinq	-0.000785***	-0.00170***	-0.000673***	-0.00171***
	(0.000100)	(0.000477)	(0.000108)	(0.000257)
Constant	0.0200**	0.0666***	0.0376***	0.0717***
	(0.00846)	(0.0117)	(0.0137)	(0.0126)
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province	Industry Year Province
Observations	6,877	6,943	8,216	8,808
R-squared	0.177	0.180	0.710	0.173

The regression results are presented in Table 6. For private enterprises, regardless of the easing or tightening of monetary policy, the coefficient β_2 is significantly negative, indicating that the supervision effect of short-term loans on the maturity mismatch of investment and financing has little to do with monetary policy. Because private enterprises are in a disadvantaged position in the credit market, banks will pay more attention to the business risks of enterprises and impose strict restrictions and supervision on the use of short-term loans. The supervision is strong whenever. For state-owned enterprises, during the period of monetary policy easing, because of the adequate liquidity, the supervision of short-term enterprises is weak, and the restriction of the use of funds is less powerful. While in the period of monetary policy tightening, the coefficient of the square term is significantly negative, indicating that the more short-term loans, the stronger the supervision, the weaker the maturity mismatch. Because state-owned enterprises get more short-term loans during the tightening period, it will strengthen the supervision of bank loans, which will reduce the maturity mismatch of investment and financing. Therefore, the more short-term loans, the greater the supervision of enterprises, but for state-owned enterprises, such supervision is only significant during the period of monetary policy tightening.

4.4.2 Credit resource allocation efficiency

In addition, we analyze the relationship between the credit resource allocation efficiency and monetary policy, the regression are as follows:

$$\Delta Loan_{i,t} = \beta_0 + \beta_1 ROE_{i,t} + \beta_2 MP_t + \beta_3 MP_t \times ROE_{i,t} + \beta_4 Size_t + \beta_5 Lev_{i,t} + \beta_6 CFO_{i,t} + \beta_7 FCF_{i,t} + \beta_8 Growth_{i,t} + \beta_9 Tobinq_{i,t} + \beta_{10} LargestholderRate_{i,t} + fixed\ effect + \varepsilon_{i,t}$$

$$(6)$$

The sensitivity of $\Delta Loan$ to ROE measures the allocation efficiency of credit resources, that is, whether credit resources are allocated according to the profitability or investment opportunities of enterprises. Under the assumption of short-term loan supervision, the bank will supervise the short-term loans issued beforehand, so companies with better profits or more investment opportunities will get more credit resources. From the results of the table 7, it can be seen that the tightening of monetary policy will only promote the mismatch of credit resources of state-owned enterprises, indicating that the supervision effect on banks only pl ays a role in the period of monetary policy tightening. The liquidity during the period of monetary policy easing is abundant, and the implicit guarantee of state-owned enterprises exists. Banks do not care about the profitability and investment opportunities of state-owned enterprises, providing them with short-term loans, but in the period of monetary policy tightening, the short-term liquidity will allow banks to strengthen pre-existing supervision to improve the efficiency of allocation of credit resources.

Table 7 Allocation efficiency of credit resources

VARIABLES	(1) All samples	(2) Private Enterprises	(3) SOE
ROE	0.149***	0.235**	0.0447**
	(0.0459)	(0.0924)	(0.0175)
MP	0.00704	0.0130	-0.000403

	(0.0112)	(0.0203)	(0.00475)
$ROE \times MP$	0.0222	-0.0379	0.0398*
	(0.0533)	(0.100)	(0.0242)
Lev	0.204***	0.270***	0.152***
	(0.0334)	(0.0601)	(0.0153)
Size	0.00861*	0.0244**	0.00348*
	(0.00478)	(0.00997)	(0.00184)
Growth	6.05e-05***	5.58e-05**	0.000681***
	(2.11e-05)	(2.81e-05)	(0.000102)
FCF	-0.238***	-0.289***	-0.126***
	(0.0425)	(0.0673)	(0.0221)
CFO	-0.446***	-0.463***	-0.384***
	(0.0691)	(0.121)	(0.0301)
Tobinq	0.000384	0.000417	0.000942
	(0.00160)	(0.00225)	(0.00148)
LargestHolderRate	-0.000370	-0.000144	0.000255*
	(0.000373)	(0.000723)	(0.000153)
Constant	-0.182*	-0.527**	-0.0973**
	(0.101)	(0.209)	(0.0403)
fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	27,407	14,987	12,420
R-squared	0.007	0.008	0.038

Notes: ***, ** ,* represent significance level of 1%, 5% and 10% respectively; and standard error is reported in parentheses.

4.4.3 Investment efficiency

Bank supervision of investment will have an impact on the investment efficiency. We use the following model to study the impact of monetary policy on corporate investment efficiency to reveal the bank's supervision of corporate investment behavior.

$$Investment_{i,t} = \beta_0 + \beta_1 ROE_{i,t} + \beta_2 MP_{i,t} + \beta_3 ROE_{i,t} \times MP_{i,t} + \beta_4 CFO_{i,t} + \beta_5 FCF_{i,t} + \beta_6 Lev_{i,t} + \beta_7 Size_{i,t} + \beta_8 Current_{i,t} + fixed\ effect + \varepsilon_{i,t} \quad (7)$$

The results are presented in Table 8. We found that the tightening monetary policy will increase the investment efficiency of state-owned enterprises, but reduce the investment efficiency of private enterprises. The reason is similar to the reason that affects the maturity mismatch of investment and financing. The tightening of financing channels plays a more important role in the impact of private enterprises, affecting the source of investment funds of private enterprises, thus reducing the investment efficiency of private enterprises. State-owned enterprises can obtain more credit resources because of the credit discrimination, and the strengthening of bank supervision is also conducive to further improving investment efficiency.

Table 8 Monetary policy and Investment efficiency

	(1)	(2)	(3)

VARIABLES	All samples	Private Enterprises	SOE
MP	0.00146**	0.000562	0.00337***
	(0.000648)	(0.000884)	(0.000941)
ROE	0.00158***	0.00450***	0.00146**
	(0.000609)	(0.00151)	(0.000647)
MP × ROE	0.000431	-0.00288*	0.00302*
	(0.000965)	(0.00173)	(0.00158)
Lev	-0.0253***	-0.0311***	-0.00908***
	(0.00182)	(0.00246)	(0.00302)
Size	0.00277***	0.00291***	0.00196***
	(0.000269)	(0.000424)	(0.000356)
Current	-0.000957***	-0.000687***	-0.00326***
	(9.79e-05)	(0.000107)	(0.000282)
FCF	-0.00634***	-0.00859***	-0.0507***
	(0.000700)	(0.000949)	(0.00305)
CFO	0.113***	0.0966***	0.145***
	(0.00397)	(0.00525)	(0.00608)
Constant	-0.00151	-0.00642	0.0152*
	(0.00575)	(0.00893)	(0.00781)
Fixed effect	Industry Year Province	Industry Year Province	Industry Year Province
Observations	30,844	17,024	13,820
R-squared	0.406	0.534	0.112

Notes: ***, ** ,* represent significance level of 1%, 5% and 10% respectively; and standard error is reported in parentheses.

5 Robustness test

5.1. Exclude years with large macroeconomic fluctuations

The basic results of this paper should be based on a relatively stable economic background. If the macro economy is highly volatile, the investment and credit of the enterprise will be affected by more macro variables that are not related to monetary policy, such as the decline of exports. At the same time, some people think that China's economy has undergone a structural change in the past two decades. The economic structure before 2008 and the current economic structure are definitely different. Structural factors will affect the stability of the results. Therefore, in order to eliminate these interference factors, we choose the most recent data from 2012 to 2018, which are structural stable and have less economic fluctuations, to re-examine the main test of the article. We find that the results of the article will not be greatly affected.

5.2. The alternative role of corporate bonds and commercial credit

With the improvement of the capital market, China has allowed some large-scale and profitable companies to carry out corporate bond financing. Therefore, corporate bond financing can replace bank credit. At the same time, commercial credit has also proven to be an important alternative to corporate credit, especially during period of monetary policy tightening. In order to rule out the

impact of bond financing, we exclude the samples existence of bond financing. In order to eliminate the impact of commercial credit, we add commercial credit (payables, etc.) to short-term loans to build new short-term credit indicators, and re-examine the impact of monetary policy tightening on credit term structure and maturity mismatch. The results show that after excluding the companies existence of bond-paying sample and after the new short-term credit indicators are constructed, the monetary tightening still has the heterogeneity impact on private enterprises and state-owned enterprises, and the significance of our main conclusions is not affected.

5.3. Continuous monetary policy variables

When we construct monetary policy variables, we combine the money supply and interest rate indicators, construct a dummy variable of monetary policy, and solve the problem of variable inconsistency, but we still care about the continuous monetary policy variables. Since monetary policy transition to interest rate transmission mechanism has not been fully completed in China, money supply is still an important variable to measure monetary policy. Therefore, we use nominal GDP growth rate minus nominal money supply growth rate to measure the tightness of monetary policy. The tighter the monetary policy is, the larger this continuous variable will be. As a result, we find that the signs and significance of the previous results do not change.

6 Conclusion

Through theoretical analysis and empirical test, this paper studies the maturity mismatch of investment and financing in Chinese enterprises. The study finds that corporate investment relies on short-term loans rather than long-term loans, and the maturity mismatch of investment and financing is widespread. The tightening monetary policy plays two roles on the maturity mismatch problem, one is to intensify the financing constraints faced by enterprises, and the other is to strengthen the role of loan supervision. Because of the existence of credit discrimination, more credit resources fly to state-owned enterprises during period of monetary policy tightening and loan supervision is strengthened, so the problem of maturity mismatch of investment and financing is weakened. However, private enterprises face severe shortage in supply of short-term loans during the period of monetary policy tightening, so the role of financing constraints dominates, which makes the maturity mismatch of investment and financing intensified.

The results indicate that the reason for the maturity mismatch of investment and financing in Chinese enterprises lies in the credit discrimination problem and the lack of bank loan supervision in the period of monetary policy easing. In response to these questions, this paper proposes the following policy recommendations.

First, solve the problem of credit discrimination in private enterprises. It is a common phenomenon in which investment institutions compete for government and state-owned enterprise projects. This has led to the inability to achieve optimal configuration of credit resources. In particular, since the financial crisis in 2008, the leverage ratio of enterprises has shown a clear differentiation trend. The leverage ratio of non-state-owned enterprises has dropped significantly, while the leverage ratio of state-owned enterprises has been relatively stable and slightly increased. Therefore, breaking the implicit guarantee of the government, strengthening the bank's budget hard-constrained function, in order to make the credit risk truly and reasonably priced, is the most important way to resolve the maturity mismatch of investment and financing.

Second, strengthen macro-prudential supervision and curb bank procyclical behavior. As a financial

institution, banks have advantages in information and can solve some adverse selection and moral hazard problems. They have an important role in regulating the use of funds by enterprises. However, in the period of monetary easing, due to sufficient liquidity, the willingness to lend is strong, and the willingness to monitor is reduced. Therefore, it often leads to the lack of supervision of bank loans and it is necessary to improve the internal risk control mechanism of banks, strengthen macro-prudential supervision, curb excessive lending by banks during the period of monetary policy easing, and excessive contraction during the period of monetary policy tightening, and promote the smooth operation of the credit market and financial stability.

Finally, develop multi-level capital markets and alleviate the problem of maturity mismatch. Financial markets have insufficient long-term funds. The main financing method of local enterprises is bank credit. However, due to the limited space for long-term loan interest rates in China, the liquidity risk of banks is not well compensated, and the judicial protection of creditors is not perfect. Therefore, enterprises can only choose the wrong way to finance, that is, through the rollover of debts, increasing new debts and repaying old debts to maintain operations, thus accumulating serious problem of maturity mismatch. Therefore, it is necessary to develop a multi-level capital market, provide long-term funds for long-term investment through equity and bonds, and alleviate the structural debt problem of maturity mismatch.

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