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Credit Expansion, Free Cash Flow and Enterprise Investment: An Empirical Study Based on Listed Companies in China

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Abstract

By using the data of 936 listed companies from 2009 to 2014 in China, we use GMM method to empirically investigate whether credit expansion and free cash flow connect with the investment in enterprises. We decompose the ineffective investment into over-investment and insufficient-investment by drawing up Richardson's over-investment measurement method. The empirical results find that credit expansion and free cash flow promote corporate new investment and over-investment, which is also confirmed by the robustness test.

Keywords: credit expansion, free cash flow, investment behavior, over investment, over capacity

1. Introduction

Recent years, over-capacity is becoming a crucial problem influencing China's economy. A certain degree of over-capacity is an inevitable cyclical phenomenon in a market economy. However, if over-capacity cannot be under control, it may also harm the real economy, reduce efficiency of resources allocation, distort the economic structure, and damage intrinsic long-term growth potential. The main direct reason of over-capacity in China is over-investment and repeated construction of fixed assets (Han et al., 2011).

After reform and opening, China has over-invested in heavy industry and other capital-intensive industries for many years. How to suppress the repeated construction and over-investment has been the focus of China's economic policy for a long time. Especially the fiscal and monetary easing policy induced in 2008 caused a further aggravation of the excess capacity problem, which is more prominent in the steel, electrolytic aluminum, cement, nonferrous metals, flat glass and other high energy consumption industry.

Since banking industry is still dominating Chinese financial system, it is important to study how the credit factor affects over-investment. Raising money from banks is still the main financial channel to Chinese enterprises. RMB loans took a high proportion of the total financing in the whole society, and keep rising in recent years. In 2014, 59.5% of the total financing in the whole society is RMB loans, which reached a new level at 73.6% in 2015 (Figure 1).

Credit funds continue to flow into over-capacity industry and enterprises because of the intervention from Chinese government. The intervention leads to non-optimal allocation of financial resources. The problems above deteriorate over-capacity and over-investment problems, and cause a squeeze effect of investment in the growing industry and emerging industries. As a result, the industrial structure tends to be imbalanced, the economic system and financial stability also suffer from this problem.

This paper studies two issues by using the data of listed companies in Shanghai and Shenzhen Exchange from 2009 to 2014 in China. The first one is how the corporate credit expansion and free cash flow affect the new investment in enterprises, and the other one is how the corporate credit expansion and free cash flow affect the over-investment in enterprises. First, we review the investment behavior literatures which study the relationship

between corporate credit expansion, free cash flow and investment of enterprises, and make 5 relevant hypotheses. Second, we establish static and dynamic panel econometric model, and use GMM method to study the static and dynamic characteristics of new investment behavior (divergence or convergence). Third, we use Richardson's method to measure the degree of over-investment in enterprises, and have a further study on how the credit expansion and free cash flow affect the over-investment in enterprise.

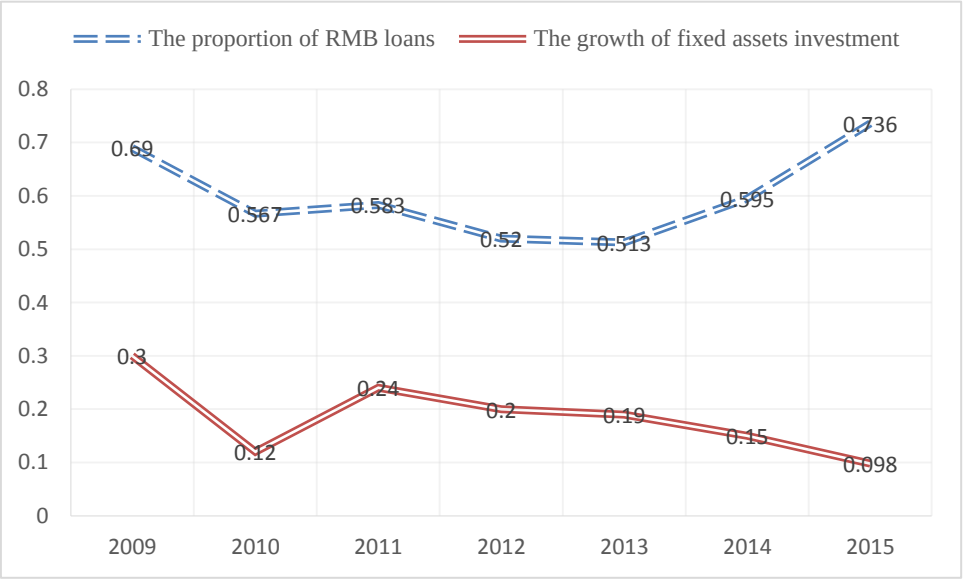

Figure 1. The proportion of RMB loans and the growth of fixed assets investment

The remainder of the article is structured as follows. Section 2 is the literature review and hypothesis building; Section 3 presents the data source and data description; Section 4 presents the static and dynamic new investment econometric model design and GMM empirical results; Section 5 presents the Richardson's over-investment measurement model and empirical results; Section 6 presents a variety of the robustness tests, and Section 7 concludes.

2. Literature Review and Hypotheses

2.1 Credit Expansion and Investment Behavior

In terms of the perspective of macroeconomic policy, credit policy as a special monetary policy is becoming an important tool for economic governance and macroeconomic regulation in developing countries or countries in transition, since the market economy system are not matured. At present, China's various institutional factors in credit policy lead to inefficient allocation of credit resources. The over-capacity is mainly derived from the institutional distortions of credit resources allocation and the excess liquidity of banks, which provides operational space for this distortion. On the other hand, in the credit crunch time, the distorted credit allocation is more serious in China. State-owned enterprises will get more funds comparing to private enterprises with high productivity. Credit tightening policy can reduce over-investment in private enterprises, but the state-owned enterprises did not get control. Xu and Chen (2009) constructed a dynamic stochastic general equilibrium model including the banking sector. The model shows that the bank loans could explain the over-investment to a certain degree, but the main reason of economic fluctuation are the external financing of enterprises' over-depending on the credit loans and the intervention from the government. He (2006) analyzed the credit supply and credit behavior in the framework of multilevel principal-agent. His research pointed out that the coexistence of excess credit supply and credit rationing is the reason why banks providing the excess credit to certain enterprises and leading to over-investment of enterprises.

In terms of the perspective of business environment, government intervention has become an important variable of enterprises' decision-making. The Chinese local government offers a variety of preferential policies, including low-cost for buying land, financial subsidies, tax exemption et cetera. Moreover, some local government in China even guarantees for the injection of loans for enterprises or subsidies for the enterprises' lost. These policies will induce banks' mismatch of credit resources, and distort the normal investment activities. Zhang et al

(2011) found bank loans which have political connection are more likely to lead to over-investment. Sun et al (2005) analyzed the relationship between the marketization and the maturity structure of the enterprises' loan. And found that under the un-perfect judicial system environment, government intervention reduces the expected cost of the borrower's default. In areas with low marketization degree, long-term borrowing got an invisible guarantee by the intimate connection between enterprises and the government. Not only the credit resources, but also the corporate investment and other decision-making behavior can also be subject to government intervention. Fang (2007) studied the relationship between credit expansion and institutional environment. The study found that state-owned enterprises are inclined to have low information cost and low default risk because of the government intervention. Therefore, bank loans to these enterprises are usually with a large amount and a long maturity. Tan and Zhou (2015) used China's provincial panel data from 1978 to 2008 to study the relationship of secretary of the provincial Party Committee and the governor with the credit investment and fixed asset investment. Research shows that there is an inverted U-shaped relationship between provincial credit availability and fixed asset investment during the term of office. The credit availability keeps enhancing during the first half term of office because of the economic growth pressures, as well as the engine function of investment. However, in the second half of the term of office, the credit availability is likely to decrease because of officials' myopia and internal competition. Luo and Zhang (2015) studied the impact of real estate investment on the efficiency of resource allocation in the manufacturing sector in the circumstance of credit expansion. They found that state-owned enterprises acquire credit funds at low cost and invest heavily in real estate, resulting in the ineffective allocation. Based on the above analysis, we have the following assumptions.

Hypothesis 1: Credit expansion in enterprises will promote new investment.

Hypothesis 2: Credit expansion in enterprises will lead to excessive investment.

Zhao (2012) studied the relationship between financial development, credit funds and over-investment based on the data of China's manufacturing listed companies from 2004 to 2007. He found that the more long-term loans, the more overinvestment in enterprise. And in the absence of creditor governance, financial deepening will result in more excess capacity and excessive investment. However, Zhao (2012) did not study how the short-term loans affect investment. Chen et al. (2009) studied the inefficiency of investment on China's listed companies. The study pointed out that the inefficient degree shown U-shape in change with the proportion of short-term debt, the company displays excessive investment tendencies when facing high risk project. Based on the above analysis, we had the third assumption.

Hypothesis 3: Short-term borrowings, like long-term borrowings also promote enterprises new investment.

2.2 Free Cash Flow and Enterprise Investment Behavior

Modigliani and Miller (1958) in their classic paper point out that without company income tax, the company's capital structure has nothing to do with the company's market value. If two companies have the same risk but capital structure is different, their values are equal. This theory provides a new starting point for the development of the capital structure theory. At the same time, strict assumptions on the theory assume that all the items inside the company have the same management risk, capital market is perfect, there is no transaction cost, etc.

But in reality, the capital market is not perfect, the enterprise is always faced with financing constraints, enterprises should make a choice in the internal financing and external financing. Endogenous financing mainly comes from the enterprise internal cash flow controlled by the insider, and its cost of capital relative to exogenous financing is lower. At the same time in external financing, the inner rules of bond financing can guarantee repayment of principal and interest, so investors can reduce the requirement of enterprise information, therefore the debt financing cost is also lower than equity financing costs.

When companies face external financing constraints, endogenous funds (free cash flow) become sources of funds. The creditor's financing becomes the second best choice. Due to the high cost of equity financing in external financing, so it is the final Financing choice of enterprises.

The free cash flow hypothesis was proposed by Jensen (1986), which pointed out the basic relationship between free cash flow, corporate investment, and business management. Free cash flow is an important internal financing source for business investment and shows more freedom relative to external claims. Free cash flow's proper use was determined by the managers as well as the distribution policy of corporate profits and dividend. Free cash flow hypothesis assumes that business managers have private interests, so they would like to expand scale of enterprises through enlarging investment proportion in order to increase business income and other performance indicators.

Fazzari et al. (1988) work within the Q theory of investment, and examine the importance of a financing

hierarchy created by capital-market imperfections. Using panel data on individual manufacturing firms, they compare the investment behavior of rapidly growing firms that exhaust all of their internal finance with that of mature firms paying dividends. They find that Q values remain very high for significant periods of time for firms paying no dividends, relative to those for mature firms. They also find that investment is more sensitive to cash flow. Chirinko and Sehaller (1995) choose Canada companies from 1973 to 1986 as research samples to study this issue. And their results also support the research conclusion.

Chen et al. (2015) studied the impact of free cash flow and corporate governance on over-investment using the data of 865 Chinese listed companies. Huang and Shen (2009) adopted the data of 206 listed companies in China from 1997 to 2004 to study the inefficient investment situation of free cash flow. They both found that the investment of listed companies were highly sensitive to cash flow.

Since the existence of moral hazard of managers, it is possible for them to use free cash flow to overinvest to fulfill their self-interest. Yang and Li (2013) studied the relationship between executive control, free cash flow and corporate investment, and they found that executive control is positively related to the scale of investment. Xu and Zhang (2009) examined the relationship between free cash flow and inefficient investment in the capital market and found that the more free cash flow in an enterprise, the more likely the agency problem exists, and the more likely the managers are to abuse free cash flow, which may lead to over-investment. Financial reform, well corporate governance and institutional environment can effectively reduce over-investment caused by free cash flow. The implement of cash dividend policy or state-owned enterprises bonus policy could also make a drastic reduction. Based on the analysis of free cash flow, we make the following assumptions.

Hypothesis 4: Free cash flow will stimulate new investment in enterprise.

Hypothesis 5: Free cash flow will cause over-investment in enterprise.

3. Data sources and Data Description

Our samples are listed companies in Shanghai and Shenzhen Exchange from 2009 to 2014, and they were downloaded from the WIND database. The samples were treated as follows: (1) Exclude listed companies with incomplete data; (2) Remove the ST shares; (3) Eliminate enterprises in financial industry. According to the characteristics of enterprise, they are divided into state-owned enterprises and private enterprises. State-owned enterprises include central government state-owned enterprises and local government state-owned enterprises, while private enterprises include public enterprises, collective enterprises, private enterprises, foreign-funded enterprises and other enterprises. Industry classification follows industry classification of China Securities Regulatory Commission. Table 1 is statistical description of the data.

Table 1. Statistical description

Variable	Mean	Std. Dev.	Min	Max	Observations
Inv	0.0480234	0.2316595	-11.52454	0.5453079	N = 5616
Loan	0.3373801	0.2383047	0	2.419859	N = 5616
L_loan	0.0758384	0.1223467	0	0.8907025	N = 5616
S_loan	0.2615417	0.2091196	0	2.419859	N = 5616
Fcf	0.0153523	0.108347	-4.477617	0.8792226	N = 5616
Growth	18.52259	181.1555	-99.6779	10706.56	N = 5616
Roa	6.70935	17.49185	-97.5715	1061.563	N = 5616
Size	21.79508	1.275403	17.04874	26.75123	N = 5616
Lev	49.524	47.92961	0.708	1371.142	N = 5616

4. Credit Expansion, Free Cash Flow and New Investment

4.1 Econometric Model Design

Our paper analyzes the relationship between credit expansion, free cash flow and enterprise investment. So, we build a static and dynamic panel econometric model including lagged dependent variables and use GMM method to estimate the parameters. The length of time for this study is 6 years, which is a relative short time for the institutional environment changes, therefore, we can assume that institutional environment has not changed significantly in this period, and its impact on enterprise investment can be eliminated.

4.1.1 Static Panel Model

In order to investigate the influence of corporate credit expansion and free cash flow on new investment in

enterprise, we use new investment as the explained variable, set credit amount and the free cash flow in enterprise as main explanatory variables, set operating income growth rate, the scale of assets and the return on assets as the control variables. And then we build two static panel econometric models as following:

$$Inv_{i,t+1} = \alpha_0 + \alpha_1 Loan_{i,t} + \alpha_2 Fcf_{i,t} + \alpha_3 Growth_{i,t} + \alpha_4 Size_{i,t} + \alpha_5 Roa_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (1)$$

$$Inv_{i,t+1} = \alpha_0 + \alpha_1 L\_Loan_{i,t} + \alpha_2 S\_Loan_{i,t} + \alpha_3 Fcf_{i,t} + \alpha_4 Growth_{i,t} + \alpha_5 Size_{i,t} + \alpha_6 Roa_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (2)$$

The main explanatory variables in equation (1) are the total loans and free cash flow in enterprise. This model analyzes the impact of the total loans and cash flow on investment in enterprises. The main explanatory variables in equation (2) are the long-term loans, short-term loans and free cash flow in enterprise. This model not only analyzes the impact of free cash flow on the investment of the enterprises, but also the effect of the term structure of loan in enterprises.

$Inv_{i,t+1}$ represents the new investment in enterprises i at time t+1, which equals the cash paying for fixed assets, intangible assets and other long-term assets plus the net cash recovered from disposal of fixed assets, intangible assets and other long-term assets, then divided by the total capital at the end of the year. The new investment is determined by operating indicators and available loans in the previous year; $Loan_{i,t}$ stands for credit amount in enterprises i at time t, which calculated by loans (including both long-term loans and short-term loans) in the Balance Sheet divided by total asset at the end of the year, it measures the external financing capacity of enterprises. In equation (2), $L\_Loan_{i,t}$ stands for long-term loan, $S\_Loan_{i,t}$ stands for short-term loan. $Growth_{i,t}$ stands for the growth capacity indicator of the enterprise i at time t, which is measured by annual operating revenue growth rate. $Fcf_{i,t}$ stands for corporate free cash flow, which equals to the net cash flow from operating activities minus depreciation (including depreciation of fixed assets, depletion of oil and gas assets, depletion of productive biological assets) and amortization of intangible assets, and then divided by the total assets at the end of the year; $Size_{i,t}$ stands for the scale of enterprise i at time t, which is measured by the natural logarithm of total assets; $Roa_{i,t}$ is the total return on assets of enterprise i at time t; α_0 represents the constant term. Since the impact of macroeconomic change on all enterprises is homogeneous, we set Year as the annual dummy variable to consider macroeconomic factors and set Industry as the industry dummy variable to consider the business investment difference in different industries, error term is represented by $\varepsilon_{i,t}$.

4.1.2 Dynamic Panel Model

The explanatory variables of Equation (1) and (2) only include business indicators that are closely related to investment decisions and do not include a large number of invisible factors that have a significant impact on corporate investment. These factors include variables of corporate governance, such as the scale and membership background of the board of directors, marketization degree of professional managers and etc., as well as institutional environment variables, such as the method and degree of government intervention, the difference of regional marketization degree and differences in regional financial development. These invisible factors are involved in determining new investment and could be fully considered by inducing the lagged investment in enterprise.

Therefore, in order to solve the omitted variables problem, we build a dynamic panel econometric model based on Equation (1) and (2) by adding the lagged investment in enterprises. Compared with the static panel data model, Equation (3) not only help us to solve the omitted variables problem, but also help us to further study the convergence or divergence characteristics of investment behavior in enterprises.

If the coefficient of lagged investment is significantly negative, it means that there is a convergence (more investment in the last period and less investment in the next period) of investment in different periods. If the coefficient of lagged investment is significantly positive, it means that the previous investment has a positive impact on the next phase of investment and the investment will growth incrementally. We call this divergence of investment in enterprise.

$$Inv_{i,t+1} = \beta_0 + \beta_1 Loan_{i,t} + \beta_2 Fcf_{i,t} + \beta_3 Growth_{i,t} + \beta_4 Size_{i,t} + \beta_5 Roa_{i,t} + \beta_6 Inv_{i,t} + \sum Year + \sum Industry + \mu_{i,t} \quad (3)$$

β_0 is a constant term; $Inv_{i,t}$ is the lagged investment of enterprises i of explained variable $Inv_{i,t+1}$. $Loan_{i,t}$, $Growth_{i,t}$, $Fcf_{i,t}$, $Size_{i,t}$ and $Roa_{i,t}$ are the same as those in Equation (1).

4.2 Endogenous Problem

The corporate investment will bring cash flow, and fixed assets from investment could be more suitable for

obtaining bank loans. So the increase of cash flow and enterprise credit will further lead to more investment. The interaction relation between enterprise investment, credit and free cash flow will leads to the existence of endogenous problem in Equation (1), (2) and (3). Although fixed effect can solve the problem of individual heterogeneity (missing variables), but they cannot eliminate the endogeneity caused by reverse causality. So we use lagged variables instrumental variable to eliminate endogenous problems caused by reverse causality.

For the short-time dynamic panels with large N and small T, Arellano and Bond (1991) proposed a differential GMM method that used lagged variables to make GMM estimation. The differential GMM method solved the problem of both endogeneity and individual heterogeneity, and can get a better consistent estimation result. The consistency of the differential GMM estimation depends on the validity of the selected moment condition, which depends on the validity of the instrumental variable. Usually, we use Sargan statistics to examine the validity. The original assumption of Sargan test is "the instrumental variable or moment condition is valid", under this assumption, the Sargan statistics is subject to the chi-square distribution of the degree of freedom r-k, where r is the rank of the instrumental variable and k is the number of parameters to be estimated.

4.3 Empirical Results

Hausman test is used and confirms that Equation (1) and (2) are suitable to be estimated by fixed effect. The Hausman test results for Equation (1) and (2 are presented in Appendix A. Table 2 reports the full regression results of the GMM estimation. Column 1 reports the regression results of Equation (1) focusing the effects of total loans (including both short-term loans and long-term loans) and free cash flow on new investment in enterprises. Column 2 reports the regression results of Equation (2) focusing the effects of long-term loans, short-term loans and free cash flow on new investment. Column 3 reports the regression results of Equation (3) emphasizing the dynamic behavior of investment. We also use the systematic GMM to estimate Equation (3). The results of systematic GMM are similar with differential GMM estimation. The coefficient of Loan and Fcf are both positive significantly. Since the P value of Sargan statistics is 0.0000, less than 5%, it is better to use the differential GMM. More details can be seen in Appendix B.

In column 1, we found that the total credit and free cash flow have a significant positive impact on firm's new investment, and the coefficients are 0.0768 and 0.997 respectively. However, the growth rate of corporate earnings is not significant, and the coefficient of enterprises' return on assets is significant negative, which indicates that corporate performance indicators such as enterprise revenue and return are not an important factor for enterprise manager's investment decision making. In view of China's financial system which is dominated by bank financing, these finding indicates that the credit amount and free cash flow can promote the enterprises to invest more. The positive effects of corporate credit expansion and free cash flow on firms' new investment help us to confirm Hypothesis 1 and Hypothesis 4.

Table 2. New investment model

	Equation (1)	Equation (2)	Equation (3)
Loan	0.0768***		0.150**
	(0.0157)		(0.0638)
L_Loan		0.112***	
		(0.0253)	
S_Loan		0.0390**	
		(0.0169)	
Fcf	0.997***	0.991***	1.167***
	(0.0204)	(0.0204)	(0.453)
Growth	9.06e-05***	9.05e-05***	8.38e-05***
	(1.10e-05)	(1.10e-05)	(1.65e-05)
Size	0.0293***	0.0302***	0.00103
	(0.00576)	(0.00575)	(0.0175)
Roa	-0.00910***	-0.00913***	-0.00858***
	(0.000120)	(0.000120)	(0.00125)
Constant	-0.578***	-0.578***	0.0217
	(0.122)	(0.123)	(0.384)
Inv.L1			0.26**
			(0.0117)
Observations	5,616	5,616	3,744
Number of id	936	936	936
R square	0.654	0.654	

Sargan Test	11.73
	(0.229)
AR(1)	2.43
AR(2)	1.88

Note. (1) Robust standard errors are calculated in brackets; *, **, *** means significant at 10%, 5%, 1% level respectively. (2) Brackets in Sargan statistics is the P value, Sargan statistics is subject to the chi-square distribution. The AR statistics follows the standard normal distribution.

In column 2, the coefficient of short-term loan is positive significant, which indicates that enterprises use the short-term loan to finance the long-run investment. Why does this happen? It's probably because that the state-owned enterprises can get the cyclical loans and use the new loans to repay the old one. On the other hand, the private enterprises are harder to obtain long-term loans, so the private enterprises' short-term loans are often used for long-run investments. This finding proves Hypothesis 5.

In column 3, the coefficient of the lagged investment is positive significant (0.26), which means that if the investment of the previous year increases by one unit, the next investment will increase by 26% because of the investment inertia. And the coefficient of the total credit and free cash flow are respectively 0.150 and 1.167, both significantly. The finding above not only confirmed Hypothesis 1 and Hypothesis 4, but also that investment inertia has a dramatic influence on the investment next year. Large positive investment inertia coefficient also probably indicates that the enterprise may have excessive investment behavior. Over-investment in enterprises will be further studied in section 5.

5. Credit Expansion, Free Cash Flow and Over-Investment

5.1 The Over-Investment Measurement

According to the empirical results of Equation (3), we know that enterprise investment behavior has divergent characteristics (it means that the previous investment has a positive impact on the next phase of investment and the investment will grow incrementally). In order to investigate over-investment behavior, Richardson (2006) established an over-investment measurement method about inefficient investment. A large number of researches on over-investment draw up extensively his method to measure the inefficient investment behavior of individual firm by using regression residuals.

Richardson (2006) calculates the scale of reasonable investment expenditure by using the regression Equation (4) which contains the enterprise's operating indicators. He argues that the positive residual of Equation (4) means excess investment and negative residual means insufficient investment. The degree of inefficient investment in the enterprises is represented by the difference between the actual investment expenditure and the reasonable investment. This paper measures the level of over-investment using the same approach like Richardson (2006).

$$Inv_{i,t+1} = \gamma_0 + \gamma_1 Lev_{i,t} + \gamma_2 Cash_{i,t} + \gamma_3 Growth_{i,t} + \gamma_4 Size_{i,t} + \gamma_5 Roa_{i,t} + \gamma_6 Age_{i,t} + \gamma_7 Inv_{i,t} + \sum Year + \sum Industry + \zeta_{i,t+1} \quad (4)$$

where $Lev_{i,t}$ is the asset-liability ratio of the enterprise, represented by the total liabilities to the total assets; $Cash_{i,t}$ is the cash ratio, calculated by total cash to the total assets. $Inv_{i,t}$ stands for the previous investment, γ_7 measures the intertemporal inertial effects of investment; Year is the year dummy variable; Industry is the industry dummy variable; $\zeta_{i,t+1}$ is the error term, we use it to represents the indicator of the over-investment or insufficient investment.

According to the positive and negative residuals, we filter out those enterprises with over-investment. The over-investment enterprises account for 40% of the full sample. In over-investment enterprises, state-owned enterprises account for 56.2%, central government enterprises state-owned enterprises account for 20.3%, local government state-owned enterprises account for 35.9%, and private enterprises account for 43.8%.

5.2 Over-Investment and Empirical Results

In this section, we study how the credit expansion and free cash flow affect the over-investment. The residual of Equation (4) represents enterprises' inefficient investment behavior, which can be divided into over-investment and insufficient investment. This paper only focuses on the over-investment behavior of enterprises, so we build a static panel econometric model the same as Richardson (2006) to study this issue:

$$Overinv_{i,t+1} = \rho_0 + \rho_1 Loan_{i,t} + \rho_2 Fcf_{i,t} + \rho_4 Size_{i,t} + \rho_5 Roa_{i,t} + \sum Year + \sum Industry + \delta_{i,t+1} \quad (5)$$

Where $Overinv_{i,t+1}$ stands for the over-investment in enterprise i at time t; $Loan_{i,t}$, $Fcf_{i,t}$, $Size_{i,t}$ and $Roa_{i,t}$ are

the same as those in Equation (1); $\delta_{i,t+1}$ is the error term. The regression results of the over-investment model are shown in Table 3 below.

Table 3, Regression result of Equation (5)

	Equation (5)
Loan	0.1630***
	(0.00976)
Fcf	0.7197*
	(0.0119)
Size	0.0307
	(0.00314)
Roa	0.0187***
	(0.00600)
Constant	-0.0408
	(0.0668)
Observations	4,059
Number of id	1,176
R-squared	0.670

Note. The estimated results in the brackets are robust standard error; *, **, *** means significant at 10%, 5%, 1% level respectively.

It can be seen clearly that credit expansion has a significant positive effect on over-investment, which verify Hypothesis 2. In recent years, excess production capacity in China is prominent. Our empirical results demonstrate that the credit expansion in enterprises is an important reason for the over-capacity in Chinese economy. In order to resolve excess capacity problem, monetary policy and credit policy is needed to strictly be controlled to prevent credit funds further flowing into excess capacity industries.

The impact of corporate free cash flow on over-investment is also significantly positive, which verifies Hypothesis 5. Free cash flow is an important source of internal financing. The abuse of free cash flow caused by the imperfect external intervention and internal corporate governance, will also create over-investment. Enterprises should improve the governance of manager, board of directors and supervisors, and ameliorate information disclosure mechanism in company to prevent the over-investment.

6. Robustness Test

6.1 Group Sample by Enterprise Attributes

In China, governments usually intervene enterprises because of the private interests of officer and public interest. There is a strong incentive of intervention for both central government and local governments. The close connection between the government and state-owned enterprises cause the latter suffer more administrative intervention compared to the private company. In addition, if the private company in the area creates high contribution in GDP or employs lots workers, the company will undertake the intervention or preferential policies from local governments.

We first separate the sample into 3 parts according to whether it is central government state-owned enterprises, local government state-own enterprises or private enterprises. And then we estimate Equation (1) and Equation (3) for each subsample. The regression results are shown in Table 4.

For Equation (1), Table 4 shows that all the coefficient of credit expansion and free cash flow in three types of firms are positive significant. With regard to Equation (3), only the coefficient of credit expansion in central state-own enterprises subsample and free cash flow in private enterprises subsample are not significant. Sargan statistics for Equation (3) is also used to examine whether the lagged variables are valid instrumental variables. As you can see, the Sargan statistics indicates that our lagged variables are valid. These results demonstrate that the regression results in Table 1 are robust.

Table 4. Equation (1) and Equation (3): subsample regression results by enterprises' attribute

	Equation (1)			Equation (3)		
	Central government state-owned enterprises	Local government state-owned enterprises	private enterprises	Central government state-owned enterprises	Local government state-owned enterprises	private enterprises
Loan	0.0730***	0.173***	0.0500*	0.0303	0.224***	0.0251**
	(0.0133)	(0.0268)	(0.0290)	(0.0241)	(0.0581)	(0.0123)
Fcf	0.0318*	1.318***	0.121***	0.0358*	1.854***	-0.300
	(0.0164)	(0.0239)	(0.0142)	(0.0196)	(0.324)	(0.206)
Growth	-1.55e-05	1.11e-05	4.92e-06	4.34e-05	2.05e-05	3.10e-06
	(2.93e-05)	(2.94e-05)	(3.46e-06)	(3.27e-05)	(7.77e-05)	(3.76e-06)
Size	0.00207	0.0230***	0.000911	-4.66e-05	-0.0196	0.00359
	(0.0033)	(0.0077)	(0.0057)	(0.0050)	(0.0356)	(0.0117)
Roa	0.00048***	-0.00989***	-0.00521***	-0.000139	-0.0126***	-0.00675**
	(0.00018)	(0.00035)	(0.0001)	(0.00016)	(0.0028)	(0.0032)
Constant	-0.00229	-0.476***	0.0560	0.0127	0.495	0.00801
	(0.0751)	(0.169)	(0.121)	(0.115)	(0.804)	(0.250)
Inv.L1				0.6361***	0.2987***	0.2279**
				0.0709	0.0610	0.0897
R Square	0.45	0.664	0.424			
Observations	1,698	3,252	4,498	1,132	2,168	2,999
Number of id	283	542	750	283	542	750
Sargan Test				8.60	5.68	3.82
				(0.475)	(0.771)	(0.923)
AR(1)				2.05	2.24	1.70
AR(2)				1.67	1.59	1.28

Note. (1) The estimated results in the brackets are robust standard error; *, **, *** means significant at 10%, 5%, 1% level respectively. (2) Brackets in Sargan test is the P value, Sargan test statistics is subject to the chi-square distribution. The AR test statistic follows the standard normal distribution.

6.2 Group Sample by the Dependence On Fixed Assets

Corporate investment mainly refers to the fixed asset investment and they are usually different according to the dependence on fixed assets in different industries. If enterprises with high dependence on fixed assets, the scale of investment will be larger and the cost of investment adjustment will be higher. In the industry with high dependence on fixed assets, over-investment in enterprises is more likely leads to excess capacity in the industry. Over-capacity is likely to emerge in ferrous metals, nonferrous metals, petrochemical coking, chemical Raw materials, non-metallic mineral products and other industries. In order to analyze the investment behavior of enterprises, it is necessary to separate the sample into high-fixed-asset-dependent industry and low fixed-asset-dependent industry. We first calculate the ratio of fixed assets over total assets in all enterprises, and then separate them into high-fixed-asset-dependent industry and low-fixed-asset-dependent industry according to the median of the proportion distribution.

Table 5 reports the subsample regression results of Equation (1) and Equation (3). For the industries with high dependence on fixed assets, the impact of enterprise credit and free cash flow on corporate new investment is consistent with the benchmark model, showing a significant positive impact. However, with respect to the industries with low dependence on fixed assets, the impact of credit on investment is not significant, while free cash flow has a significant negative impact on investment, which is not consistent with the benchmark model. But in both industries, the inertial influence of the new investment is significantly positive, which means the existence of potential over-investment in two kinds of industries.

Table 5. Equation (1) and Equation (3): high or low dependency on fixed assets

	Equation (1)		Equation (3)	
	High fixed asset dependent industry	Low fixed asset dependent industry	High fixed asset dependent industry	Low fixed asset dependent industry
Loan	0.119***	0.0228	0.146***	-0.0369
	(0.0265)	(0.0216)	(0.0542)	(0.0461)
Fcf	1.338***	-0.179***	1.895***	-0.381**
	(0.0244)	(0.0112)	(0.597)	(0.169)
Growth	-8.96e-06	6.04e-06**	-6.25e-05	4.05e-06
	(2.09e-05)	(2.76e-06)	(8.39e-05)	(4.26e-06)
Size	0.0104	0.00474	-0.0226	-0.00499
	(0.00663)	(0.00466)	(0.0284)	(0.0155)
Roa	-0.00149***	-0.00679***	-0.00186	-0.00837***
	(0.000166)	(9.26e-05)	(0.00205)	(0.00259)
Constant	-0.215	-0.0166	0.504	0.200
	(0.144)	(0.0998)	(0.638)	(0.347)
Inv.L1			0.2503392**	0.2592056**
			(0.0522)	(0.0760)
R Square	0.514	0.547		
Observations	3,887	5,564	2,591	3,708
Number of id	648	928	648	928
Sargan Test			21.44	7.41
			(0.212)	(0.594)
AR(1)			3.57	2.07
AR(2)			2.78	1.38

Note. (1) the estimated results in the brackets for the standard error; *, **, *** means significant at 10%, 5%, 1% level respectively. (2) Brackets in Sargan test is the P value, Sargan test statistics subject to the chi-square distribution. The AR test statistic follows the standard normal distribution.

6.3 Over-Investment and Enterprise Attributes

In order to examine the regression results of the over-investment model, the sample is divided into two subsamples: the state-owned enterprises and private enterprises. Table 6 shows the estimated results of the robustness test. It shows that the impact of credit expansion and free cash flow on over-investment is robust and that significantly positive relationships are established in both state-owned enterprises and private enterprises. The estimated result of robustness support Hypothesis 2 and Hypothesis 5. These results also indicates that not only government-controlled enterprises are likely to have over-investment, but also the private enterprises with concentrated ownership will also lead to the abuse of free cash flow.

Table 6. Robustness test of over-investment model

	State-owned Enterprises	Private Enterprises
Loan	0.09579**	0.107***
	(0.0084)	(0.0275)
Fcf	0.197***	0.147***
	(0.0194)	(0.0136)
Size	-0.0286***	0.0118**
	(0.00607)	(0.00592)
Roa	0.812***	0.485***
	(0.0276)	(0.00976)
Constant	0.698***	-0.184
	(0.128)	(0.119)
Observations	4,950	4,496
Number of id	825	750
R-squared	0.541	0.405

Note. The estimated results in the brackets are robust standard error; *, **, *** means significant at 10%, 5%, 1% level respectively.

7. Conclusions

In this paper, we study how the credit and cash flow connect with enterprises' new investment and over-investment. In the first part, we first use the fixed effect model to study the impact of credit expansion and free cash flow on the new investment. At the same time, we set up the dynamic panel model to study the dynamic characteristics of the new investment. The static and dynamic model both confirm that the credit expansion and free cash flow both have a significant positive impact on the new investment, and the dynamic behavior of the new investment is divergent. In the second part, we use Richardson's method to further study the impact of credit expansion and free cash flow on the over-investment, and find that credit expansion and free cash flow have a significant positive impact on over-investment.

Bank credit expansion plays an important role on the over-investment in enterprises. For the sake of solving the over-capacity problem in Chinese economy, Chinese government should deepen the economic reform, improve market economy system, and guide the loans to invest more in the emerging corporate. The improper use of free cash flow is an important reason for the over-investment too. In order to prevent the inefficient investment, enterprises should not only improve the governance of manager behaviors, board of directors and supervisors, but also ameliorate information disclosure mechanism in company.

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Appendix A

Hausman test for fixed effect or random effect

Table A1. Hausman test for Equation (1)

	FE	RE	Difference	S.E.
Loan	.0958297	.0769441	.0188856	.0129379
Fcf	.9928661	1.047455	-.0545893	.0105217
Growth	.0095966	.0087799	.0008167	.0004254
Size	.0099472	.0042552	.005692	.004326
Roa	-.0090416	-.0085645	-.0004771	.0000569
_cons	-.1574646	-.0309232	-.1265414	.0943215
chi2(6)	82.06		Prob>chi2	0.0000

Note. Ho: difference in coefficients not systematic. We can reject the Ho since he P vale is 0.0000 and accept the fixed effect.

Table A2. Hausman test for Equation (2)

	FE	RE	Difference	S.E.
L_loan	.1601264	.1349903	.0251361	.0195727
S_loan	.0716183	.0587732	.0128451	.0143867
Fcf	.9910529	1.046997	-.0559438	.0105572
Growth	.0095952	.0086894	.0009057	.0004259
lnsize	.009647	.0029352	.0067118	.0043139
roa	-.0090497	-.0085626	-.000487	.0000571
_cons	-.149384	-.0017923	-.1475919	.0940629
chi2(7)	85.61		Prob>chi2	0.0000

Note. Ho: difference in coefficients not systematic. We can reject the Ho since he P vale is 0.0000 and accept the fixed effect.

Appendix B

Regression results of systematic GMM for Equation (3)

Table B. Regression results of systematic GMM for Equation (3)

	Equation (3)
Inv.L1	-0.0134
	(0.0263)
Loan	0.0837**
	(0.0420
Fcf	0.8038*
	(0.4736)
Growth	0.0060**
	(0.0027)
Size	-0.0188
	(0.0128)
Roa	-0.0060
	(0.0039)
_cons	0.4604
	(0.2868)
Observations	4680
Sargan Test	283.4589
	(0.0000)

Note. (1) Robust standard errors are calculated in brackets; *, **, *** means significant at 10%, 5%, 1% level respectively. (2) Brackets in Sargan statistics is the P value, Sargan statistics is subject to the chi-square distribution. Since the P value of Sargan statistics is 0.0000, less than 5%, it is better to use the differential GMM. (3)The results of systematic GMM are similar with differential GMM estimation. The coefficient of Loan and Fcf are both positive significantly.