Interest Rate Liberalization, Commercial Credit, and Investment Efficiency

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Abstract: This study investigates how interest rate liberalization influences investment efficiency through commercial credit. The interest rate liberalization process is measured by two indexes: the expert scoring index and the interest rate liberalization contribution assignment index. This study uses a sample of Shanghai and Shenzhen A-share non-financial listed companies for the period of 2003 to 2017 and builds a model to measure the impact of interest rate liberalization on commercial credit and investment efficiency, as well as the intermediation effect of commercial credit. The empirical results show that interest rate liberalization can improve the efficiency of enterprise investment and the use of commercial credit, and at the same time verifies the intermediary role of commercial credit. That is, interest rate liberalization can improve investment efficiency through business credit. The conclusion does not change with the robustness test.

1. Introduction

Interest rate reflects the price of loan capital. Controlling the interest rate causes it to deviate from the normal market equilibrium level and affects the allocation of funds, which will impact companies' investment decisions. China proposed interest rate liberalization as early as 1993, but the process was largely completed only by 2015. Since then, a great deal of research has emerged, but many studies focus on the impact on commercial banks, while only a few take the perspective of ordinary enterprises. Ordinary enterprises are the demand side of credit funds. Since the interest rate liberalization, commercial banks can set interest rates according to the actual operating conditions; that is, charge higher loan interest for enterprises with higher levels of risk, resulting in a change in the company's financing situation. In this case, both bank credit and commercial credit will be affected, such that enterprise investment efficiency will also vary.

Commercial credit is common in a firm's daily operations. As a kind of debt providing liquidity for enterprises, it is in widespread use globally. China's financial market development is behind that of developed countries, and there is a discrimination in the allocation of credit resources. Many enterprises are assessed by banks as high-risk companies and are unable to obtain sufficient bank loans. For these enterprises, commercial credit is an indispensable resource, and they increase their available capital by taking up suppliers' funds. Commercial credit plays a positive and special governance role that is independent of bank credit, and can affect the investment efficiency of an enterprise. After the interest rate liberalization, the credit resources of enterprises underwent new changes. This study examines the changes in the utilization of commercial credit.

Investment efficiency is important to the development of enterprises. However, enterprises always have problems with underinvestment and overinvestment. Existing studies conduct less research on how interest rate liberalization affects the investment efficiency of businesses. Therefore, this study explores whether firms' investment efficiency will improve with the development of interest rate liberalization, and the reasons for the impact. Interest rate liberalization is a change in the macro environment, and the path through which it acts on the investment efficiency of micro-enterprises is a topic worth exploring. In this analysis, this study first discusses firms' financing situations, sets commercial credit as an intermediary variable, and analyzes whether interest rate liberalization will affect the enterprise's commercial credit financing and

subsequently affect investment efficiency.

2. Literature Review and Research Hypotheses

2.1. Interest rate liberalization and commercial credit

In related research, the first two studies on interest rate liberalization were by McKinnon[1] and Shaw[2]. They put forward the theories of financial suppression and financial deepening, respectively, and concluded that the interest rate control and exchange rate control policies implemented in developing countries inhibited the development of financial markets and thus affected its economic growth. Galindo et al.,[3] taking developing countries as the research object, found that financial marketization could improve the efficiency of investment capital allocation. Li Xinze and Chen Yan[4] found that financial friction can affect the efficiency of capital elements through several paths, including credit constraints, information asymmetry, and so on. Commercial credit is an indispensable liability that plays an important role in the day-to-day operations of an enterprise. However, there is little research on how commercial credit as informal finance will change after the marketization of interest rates. Wu et al.[5] studied the relationship between commercial credit and cash holdings in the context of financial deepening, and found that financial deepening can help ease the financing constraints of enterprises and enhance the role of commercial credit as a short-term financial instrument. Formal financial instruments, such as bank loans, which serve as liabilities like commercial credit, received more attention. Chen Yanbin et al.[6] found that the introduction of interest rate liberalization will lead to higher loan interest rates, which will cause a decline in the scale of investment. Ji Yang et al.[7] stated that the financing costs of the formal market will rise after the marketization of interest rates, and the financing costs of the informal market will fall.

Commercial credit and bank loans are closely related to the important financing methods enterprises use. Some scholars proposed that commercial credit has a secondary configuration role, and others introduced the substitution effect of commercial credit and bank loans. Biais and Gollier[8] showed that the information asymmetry between banks and enterprises will affect access to the credit resources of corporate banks, and enterprises that have no relationship with banks will use more commercial credit, and cash-flowing enterprises will provide more commercial credit. Petersen and Rajan[9] found that when some businesses do not have access to bank credit resources, they use more commercial credit. Suppliers have more information about their customers than banks do and are willing to provide commercial credit. Lu Zhengfei and Yang Deming[10] put forward two theories for why commercial credit is widespread in China. One is the alternative financing theory, which holds that some companies are so constrained by financing that they cannot get enough money from banks, so they fill the funding gap by using the supplier's funds and delaying payments. The other is the buyer's market theory, which holds that suppliers are willing to provide commercial credit to customers who have a higher market position and better credit evaluation in order to increase sales.

During the period of interest rate control, because the interest rate ceiling is regulated, banks have no way to charge higher loan rates for high-risk companies. With the release of the upper and lower limits of deposit and loan interest rates, businesses that originally obtained loans at lower interest rates because of the loan ceiling are facing an increase in loan rates. When the capital cost of formal finance, represented by bank loans, increases, commercial credit is served as a lower-cost financing method for enterprises, leading to increased demand for informal financial funds. Therefore, this paper expects that the interest rate liberalization will lead to an increase in the interest rate of loans, so that enterprises use more commercial credit, according to which the first hypothesis of this paper is presented:

H1: Interest rate liberalization will increase use of commercial credit by enterprises.

2.2. Intermediation effect of commercial credit

Commercial credit comes from the business demand or financing needs of enterprises, which can

affect investment efficiency. Fisman and Love[11] found that in areas with more developed financial markets, commercial credit can fill the funding gap, and companies that use more commercial credit show higher growth rates. Aktas et al.[12] showed that commercial credit can mitigate information asymmetry and its use has a positive effect on business value. Zhang Yichun and others[13] pointed out that commercial credit has a significant governance effect on investment efficiency, while bank deposits and corporate bonds have no significant effect on governance. Similarly, Deng Xiangrong and Zhang Jiaming's[14] research showed that commercial credit can improve the efficiency of a company's investment, and bank credit and internal financing can reduce the efficiency of the company's investment. Liu Weiping and Guan Jingyi[15] found that commercial credit has a governance effect on underinvestment and overinvestment. Liu Huan[16] found that commercial credit can improve the investment efficiency of enterprises, and that this effect becomes more significant among enterprises in lower market positions.

Commercial credit arises from the daily business process of the enterprise. A supplier often has a deeper understanding of the enterprise and can better and more quickly grasp the business risk, which mitigates information asymmetry. At the same time, suppliers can deal with defaults by no longer supplying the customer, and so on. Suppliers can be more binding on the enterprise, which encourages the company to actively return accounts payable. Commercial credit has a shorter repayment period, and in order to be able to make payments in a timely manner, businesses will reduce unnecessary investment and curb overinvestment. When banks allocate loan resources, they will account for factors such as corporate risk. Some enterprises cannot get loans even if they pay higher loan interest rates. When these enterprises encounter good investment opportunities but cannot rely on their own funds to invest because suppliers know more about the enterprise's projects than banks do, commercial credit can help enterprises and reduce underinvestment. Combined with the previous subsection, this study proposes that interest rate liberalization affects the financing decision-making of enterprises, such that enterprises increase the use of commercial credit, and thus improve the efficiency of investment. Based on this discussion, the second hypothesis is presented below.

H2: Commercial credit has an intermediation effect in the relationship between interest rate liberalization and investment efficiency.

3. Research Design and Sample Selection

3.1. Research indicator setting

3.1.1. Interest rate liberalization indicators

To better reflect the overall progress of interest rate liberalization, some scholars proposed an index of the interest rate liberalization process calculated using multiple indicators to replace the use of virtual variables, including expert scoring indicators and contribution evaluation indicators.

An Hui and Zhang Fang[17] carefully collated the progress of China's interest rate liberalization, and calculated the progress of marketization. This study uses their results to measure marketization. From another point of view, Wang Shujun and Peng Jiangang[18] calculated China's benefits according to expert ratings of 12 indicators to create a marketization index. This study will use both methods in the study.

3.1.2. Investment efficiency indicators

When measuring the efficiency of an enterprise's investment, this study examines the efficiency of the firm's investment in long-term assets. The following models are set up based on Richardson's model, and according to Zhang Huili's model:

$$\text{Invest}_{i,t} = \alpha_0 + \alpha_1 \text{Invest}_{i,t-1} + \alpha_2 \text{Lev}_{i,t-1} + \alpha_3 \text{Size}_{i,t-1} + \alpha_4 \text{Ret}_{i,t-1} + \alpha_5 \text{Growth}_{i,t-1} + \alpha_6 \text{Cash}_{i,t-1} + \alpha_7 \text{Age}_{i,t} + \alpha_i \Sigma \text{Industry} + \alpha_j \Sigma \text{Year} + \varepsilon_{i,t} \text{Style (1)}$$

The explained variable is the scale of investment (($\text{Invest}_{i,t}$) for the current period, measured by dividing the cash for fixed assets, intangible assets, and other long-term assets by the total assets.

The explanatory variables include the scale of the previous period ($Invest_{i,t-1}$), the level of liabilities in the previous period ($Lev_{i,t-1}$), the size of the company in the previous period ($Size_{i,t-1}$), the return on the stock of the previous period ($Ret_{i,t-1}$)), the growth rate of the previous period's operating income ($Growth_{i,t-1}$) , the previous cash holding level ($Cash_{i,t-1}$)), and the company's age ($Age_{i,t}$). Table 1, the variable definition description Table, summarizes the specific calculations for each indicator. Industry and annual effects are controlled in the regression.

This model represents the company's normal investment scale estimate using the company's actual investment scale minus the estimated value. The residual size reflects the enterprise's non-efficient investment. A residual value greater than zero indicates that the company has excessive investment, and less than zero indicates that the company has insufficient investment. The residual value can be expressed as the enterprise's non-efficient investment.

3.1.3. Index of commercial credit

Drawing on Lu Zhengfei and Yang Deming[10], commercial credit is measured by the sum of accounts payable, notes payable, and pre-receivables of the enterprise divided by total assets to eliminate the scale effect.

3.2. Research sample

This study uses a sample of Shanghai and Shenzhen A-share listed companies for 2003-2017 in consideration of the RMB OPEN LOAN INTEREST RATE CAP 2004 August. To improve the ability to interpret the data, the sample excludes the following cases at the time of data collection: (1) listed financial companies, (3) sepcial treatment and *special treatment firms, (4) firms with missing financial data, and (5) the sample was winsorized at the first 1% and last 99% to avoid the effects of extreme values on the regression results. The final sample includes 25,775 observations.

3.3. Research model

This study investigates whether commercial credit has an intermediation effect in the relationship between interest rate liberalization and investment efficiency, and proposes an intermediate effect test procedure model designed following Wen Zhonglin and others (2004). The premise of the intermediation effect is that interest rate liberalization can affect investment efficiency. This study selects control variables based on the settings of studies by Liu Huan[16] and Yang Zheng[20] and adds them to interest rate liberalization and investment efficiency in the regression. Table 1 describes the measurements of the control variables (variable definition Table). This study controls the industry effects to build the following regression model:

$$Abste_{i,t} = \alpha_0 + \alpha_1 Intlib_{i,t} + \alpha_2 Lev_{i,t} + \alpha_3 Size_{i,t} + \alpha_4 Power_{i,t} + \alpha_5 Soe_{i,t} + \alpha_6 Cfo_{i,t} + \alpha_i \Sigma Industry + \varepsilon_{i,t} \ type(2)$$

In order to study the impact of interest rate liberalization on commercial credit, the following model replaces type (2) with commercial credit to obtain equation (3):

$$TC_{i,t} = \beta_0 + \beta_1 Intlib_{i,t} + \beta_2 Lev_{i,t} + \beta_3 Size_{i,t} + \beta_4 Power_{i,t} + \beta_5 Soe_{i,t} + \beta_6 Cfo_{i,t} + \beta_i \Sigma Industry + \varepsilon_{i,t} Type (3)$$

In order to test the intermediation effect of commercial credit, commercial credit is added to equation (2) to obtain formula (4):

$$Abste_{i,t} = \gamma_0 + \gamma_1 Intlib_{i,t} + \gamma_2 TC_{i,t} + \gamma_3 Lev_{i,t} + \gamma_4 Size_{i,t} + \gamma_5 Power_{i,t} + \gamma_6 Soe_{i,t} + \gamma_7 Cfo_{i,t} + \gamma_i \Sigma Industry + \varepsilon_{i,t} Type (4)$$

In order to test the intermediation effect of commercial credit in the relationship between interest rate liberalization and investment efficiency, it is necessary to examine several important factors in the model. Figure 1 illustrates the specific process.

This study holds that interest rate liberalization can improve investment efficiency and α_1 is expected to be significantly negative. According to assumption 1, interest rate liberalization can promote the improvement of commercial credit, which means that β_1 is expected to be significantly positive. According assumption 2, interest rate liberalization improves investment

efficiency through commercial credit, and γ_2 is expected to be significantly negative, but it is not possible to determine whether it is a full or partial intermediation effect, and the expected coefficient γ_1 may be significantly negative or not significant.

The measurements of the variables are discussed above and in Table 1 below.

Table 1 Descriptions and definitions of the variables

	Variable name	Symbol	Variable definition
Explained variables	Scale of investment	Invest	(cash paid for fixed assets, intangible assets, and other long-term assets) / Total assets
	Non-efficient investments	Abste	The absolute value of the residuals calculated; overinvested when the residuals are 0, and when the residuals are under-invested at the time of the residuals.
Explaining variables	Interest rate liberalization expert scoring index	Intlib1	Interest rate liberalization index calculated according to expert scoring mechanism
	Interest Rate Market-oriented Contribution Assignment Indicator	Intlib2	Interest rate liberalization index calculated according to contribution assignment mechanism
	Business credit	TC	(Accounts payable, notes payable, and pre-receivables) / Total assets
Control variables	Level of liability	Lev	Total liabilities/total assets
	Size of the company	Size	Logarithm of total assets
	Return on stocks	Rand	Annual return on individual stocks considering cash dividend reinvestment
	Revenue growth rate	Growth	Annual growth in operating income
	Cash holding levels	Cash	Cash and cash equivalents/total assets at the end of the period
	Company founding time	Age	Logarithm of the years of company establishment
	Two jobs in one	Power	Equal to 1 when the Chairperson and general manager are the same person, and 0 otherwise
	The nature of ownership	Soe	Equity nature; state-owned enterprises take 1, non-state-owned enterprises take 0
	Operating cash flow	Cfo	Operating Cash Flow/Total Assets
	Industry Virtual Variables	Industry	Equal to 1 for an industry, and 0 otherwise
	Annual Virtual Variable	Year	Equal to 1 for the year, and 0 otherwise

4. Empirical Results

4.1. Descriptive statistical results

The non-efficient investment variable Abste is generated according to formula (1). Table 2 summarizes the descriptive statistics of the related variables, with four decimal places in the results.

Table 2 Descriptive Statistics for the Model Variables

Variable name	Sample size	Average	Standard deviation	Median	Min	Maximum
Intlib1	25775	0.7668	0.1818	0.7457	0.4468	0.9901
Intlib2	25775	85.1042	8.0893	82.5300	66.7900	94.6800
Invest	25775	0.0553	0.0534	0.0392	0.0002	0.2569
Abste	25775	0.0273	0.0282	0.0188	0.0004	0.1516
TC	25775	0.1627	0.1205	0.1327	0.0054	0.5590
Lev	25775	0.4573	0.2046	0.4623	0.0533	0.9043
Size	25775	21.9139	1.2393	21.7484	19.5330	25.7681
Power	25775	0.1958	0.3968	0.0000	0.0000	1.0000
Soe	25775	0.5066	0.5000	1.0000	0.0000	1.0000

Cfo	25775	0.0449	0.0755	0.0447	-0.1961	0.2520

It can be seen from the descriptive statistics that Intlib1 is measured as 1 in full marketization, while Intlib2 is measured as 100 if the marketization is completed. There is a slight gap between the level of interest rate liberalization, as measured by Intlib1 in 2017 in terms of the annual market-oriented level of 0.9901, which is close to the level of full marketization, while Intlib2 measured by the 2017 annual market-oriented level is 94.68, which means that there is also some room for improvement. The difference is mainly due to the different weights given to the indicators. The average value of Abste is 0.0273 and the maximum value is 0.1516, which indicates serious problems with inefficient investment in China. The average TC of 0.1627 indicates that the proportion of commercial credit to total assets is 16.27%. The minimum is 0.0054 and no result equals 0. More than 20,000 sample firms use commercial credit in the daily operations of their enterprises, indicating that commercial credit has been widely used in China. The descriptive statistical results of the above variables are distributed reasonably.

4.2. Variable correlation test

The following Table shows the correlation between the explanatory variable, the interpreted variable, and the control variable with the Spearman test result in the upper right corner and the Pearson test result in the lower left corner, reported with four decimal places.

Table 3 Variable Correlation Analysis

Variable	Abste	Intlib1	Intlib2	TC	Lev	Size	Power	Soe	Cfo
Abste	1	-0.1976	-0.2026	-0.1470	-0.1235	-0.1429	0.0180	-0.0164	0.0744
Intlib1	-0.1768	1	0.9629	-0.0054	-0.1396	0.2793	0.1724	-0.2636	-0.0628
Intlib2	-0.1732	0.9735	1	-0.0104	-0.1310	0.2586	0.1583	-0.2469	-0.0478
TC	-0.1383	-0.0110	-0.0100	1	0.4727	0.1793	-0.0384	0.0906	-0.0620
Lev	-0.0841	-0.1285	-0.1172	0.4877	1	0.3866	-0.1446	0.2551	-0.1458
Size	-0.1171	0.2635	0.2468	0.1941	0.3886	1	-0.1041	0.2268	0.0445
Power	0.0210	0.1675	0.1579	-0.0462	-0.1436	-0.1045	1	-0.2811	-0.0317
Soe	-0.0237	-0.2577	-0.2442	0.1069	0.2549	0.2418	-0.2811	1	0.0585
Cfo	0.0832	-0.0497	-0.0426	-0.0255	-0.1549	0.0437	-0.0323	0.0581	1

As can be seen from the correlation analysis Table, Intlib1 and Abste are negatively correlated and Intlib2 and Abste also show a negative correlation, indicating that with the progress of interest rate liberalization, the non-efficient investment among enterprises is decreasing; that is, interest rate liberalization promotes the investment efficiency of enterprises. Intlib1, Intlib2, and TC have a negative correlation. Thus, the results for hypothesis 2 are different and require further observation through a regression. TC and Abste are negatively correlated, indicating the existence of commercial credit governance, and that it helps to improve enterprise investment efficiency. Yet whether the mediation effect exists, and if this effect is full or intermediary also requires exploration using an empirical test to examine the significance of the coefficients. The high correlation between the two interest rate liberalization variables indicates that although the two calculation methods are considered from different angles, the results are more consistent and there is no abnormality in the correlation between the variables. The model variables are set reasonably.

4.3. Regression results and analysis

4.3.1. The return of interest rate liberalization and investment efficiency

Using the regression in formula (2), in order to better verify the effect of interest rate liberalization on investment efficiency, in addition to testing the full sample, the sample was divided into underinvestment and excessive investment groups for the regression. The results are shown in Table 4 below, in which the Table regression coefficients retain four decimal places.

Table 4 Interest Rate Liberalization and Investment Efficiency Regression Results

Abste	Non-efficient investments		Insufficient investment		Over-investment	
Intlib1	-0.0303***		-0.0260***		-0.0362***	
	(-21.92)		(-25.67)		(-14.29)	
Intlib2		-0.0007***		-0.0006***		-0.0008***
		(-22.39)		(-25.39)		(-14.07)
Lev	-0.0053***	-0.0046***	-0.0092***	-0.0085***	-0.0014	-0.0005
	(-4.17)	(-3.59)	(-10.21)	(-9.53)	(-0.53)	(-0.20)
Size	-0.0008***	-0.0010***	-0.0006***	-0.0008***	-0.0015***	-0.0017***
	(-3.08)	(-4.04)	(-3.55)	(-4.77)	(-3.32)	(-3.91)
Power	0.0020***	0.0019***	0.0009**	0.0008*	0.0027**	0.0026**
	(3.44)	(3.21)	(2.10)	(1.77)	(2.53)	(2.43)
Soe	-0.0038***	-0.0035***	-0.0025***	-0.0023***	-0.0045***	-0.0041***
	(-6.90)	(-6.46)	(-6.69)	(-6.22)	(-4.52)	(-4.14)
Cfo	0.0171***	0.0181***	-0.0080***	-0.0074***	0.0352***	0.0371***
	(6.38)	(6.73)	(-4.21)	(-3.88)	(6.05)	(6.40)
_cons	0.0726***	0.1089***	0.0625***	0.0940***	0.0996***	0.1418***
	(14.30)	(22.29)	(18.06)	(27.62)	(10.78)	(15.70)
Industry effects	Control	Control	Control	Control	Control	Control
Adj.R2	0.073	0.071	0.106	0.104	0.073	0.071
F	61.85	62.84	82.78	81.07	39.85	41.07
n	25775	25775	16044	16044	9731	9731

Note: The values in parentheses are the standard errors for robustness in cluster processing at the company level. The variables represent significance at the 10%, 5%, and 1% levels. The results shown in the Table below are the same as with this test, so the related discussion is not included here.

The results from the Table above show that after controlling for the industry effect, Intbli1 and Intlib2 have significantly negative results, which means that interest rate liberalization reduces non-efficient investment in enterprises, and the premise of the intermediation effect has been verified.

This study divides the sample into underinvestment and overinvestment to observe whether interest rate liberalization inhibits both types of non-efficient investments. From the total sample of 25,775 observations, 16,044 represent underinvestment and 9,731 represent overinvestment. Underinvestment was more common than overinvestment, and companies lacked capital, even with good investment projects. In this environment, commercial credit as a supplementary credit means provides insufficient mitigation. In the underinvestment sample, the negative correlation between the interest rate liberalization index and non-efficient investment is significant at the 1% level, indicating that interest rate liberalization can effectively alleviate the problem of underinvestment in enterprises. In the overinvestment sample, the negative correlation is still significant at 1%. The marketization of interest rates can improve the investment efficiency of enterprises, whether for underinvestment or overinvestment, and plays a positive role. In the regression results of both sets of samples, the direction of the other control variables was the same, except that the coefficient of Cfo was inconsistent. In the overinvestment sample, Cfo and non-efficient investments are positively correlated at the 1% level, which means that firms with higher cash flows are prone to overinvestment. The coefficient of Cfo is negative at the 1% level, the opposite of the overinvestment sample, suggesting that cash flows can alleviate underinvestment.

4.3.2. Interest rate liberalization and commercial credit regression results

Table 5 reports the regression results for formula (3).

Table 5 Interest Rate Liberalization and Commercial Credit Regression Results

	TC	
Intlib1	0.0265***	
	(3.88)	
Intlib2		0.0005***
		(3.57)
Lev	0.2783***	0.2771***
	(32.07)	(32.11)
Size	0.0026	0.0029*
	(1.52)	(1.78)
Power	0.0040	0.0042
	(1.32)	(1.40)
Soe	0.0121***	0.0116***
	(3.20)	(3.09)
Cfo	0.1379***	0.1364***
	(10.21)	(10.11)
_cons	-0.1126***	-0.1421***
	(-3.39)	(-4.69)
Industry effects	Control	Control
Adj.R2	0.353	0.352
F	84.96	85.07
n	25775	25775

The results above show that after controlling the industry effect, Intlib1 and business credit are positively correlated at the 1% level, which indicates a significant increase in business credit after interest rate liberalization. Intlib2 and commercial credit are positively correlated, verifying hypothesis 2 that interest rate liberalization promotes the use of commercial credit. The control variables Size and commercial credit are positively correlated, but not strongly significant. In the regression of Intlib2 and TC, the coefficient of Size is positive at the 10% level, indicating that large enterprises can obtain more commercial credit. The reason may be that large enterprises generally have a relatively strong market position, and small enterprises will provide large enterprises with commercial credit in order to maintain the relationship. Soe's coefficient is positive at the 1% level, indicating that state-owned enterprises have more commercial credit than non-state-owned enterprises do, and that state-owned enterprises have state credibility as an endorsement. Suppliers believe they can pay their bills on time and are willing to provide them with commercial credit. Cfo's coefficient is also significantly positive, indicating that companies with more cash flows have a strong ability to repay and can take up more commercial credit, which is consistent with the company characteristics of the other people's money strategy, as with WalMart, Suning Tesco, and other retail enterprises, which have higher cash flows and at the same time can also occupy more suppliers' commercial credit.

4.3.3. The intermediation effect of commercial credit in the relationship between interest rate liberalization and investment efficiency

Regression (4) aims to verify the intermediation effect of commercial credit. Table 6 displays the results.

Table 6 Intermediation Effects of Commercial Credit

Abste	Non-efficient investments		Insufficient investment		Over-investment	
Intlib1	-0.0297***		-0.0259***		-0.0343***	
	(-21.76)		(-25.67)		(-13.71)	
Intlib2		-0.0006***		-0.0006***		-0.0007***
		(-22.24)		(-25.38)		(-13.44)
TC	-0.0245***	-0.0248***	-0.0071***	-0.0074***	-0.0445***	-0.0448***
	(-11.20)	(-11.38)	(-4.69)	(-4.94)	(-10.14)	(-10.22)
Lev	0.0015	0.0023	-0.0072***	-0.0064***	0.0104***	0.0113***
	(1.02)	(1.62)	(-7.09)	(-6.38)	(3.52)	(3.85)
Size	-0.0007***	-0.0009***	-0.0006***	-0.0007***	-0.0015***	-0.0018***
	(-2.84)	(-3.76)	(-3.33)	(-4.51)	(-3.42)	(-3.99)
Power	0.0021***	0.0020***	0.0009**	0.0008*	0.0028***	0.0027**
	(3.65)	(3.42)	(2.20)	(1.88)	(2.62)	(2.53)
Soe	-0.0035***	-0.0032***	-0.0024***	-0.0022***	-0.0044***	-0.0040***
	(-6.52)	(-6.08)	(-6.40)	(-5.93)	(-4.51)	(-4.13)
Cfo	0.0204***	0.0215***	-0.0068***	-0.0062***	0.0406***	0.0425***
	(7.61)	(7.96)	(-3.56)	(-3.21)	(6.99)	(7.31)
_cons	0.0698***	0.1053***	0.0614***	0.0927***	0.0972***	0.1371***
	(13.80)	(21.54)	(17.65)	(27.14)	(10.60)	(15.21)
Industry effects	Control	Control	Control	Control	Control	Control
Adj.R2	0.080	0.079	0.107	0.106	0.084	0.083
F	62.99	63.98	79.06	77.52	39.10	39.20
n	25775	25775	16044	16044	9731	9731

As can be seen from the regression results in the Table above, the coefficient of TC is negative at the 1% level. Combined with the significantly positive coefficient of interest rate liberalization and commercial credit, commercial credit has an intermediation effect in the relationship between interest rate liberalization and investment efficiency. Hypothesis 3 is verified. The coefficients of Intlib1 and Intlib2 are added, and TC is still significantly negative, indicating that commercial credit has a partial intermediation effect, which means that interest rate liberalization can directly promote the improvement of investment efficiency, or other factors can play a role in the relationship between the interest rate liberalization and investment efficiency. After dividing the sample into underinvestment and overinvestment, the results did not change; the coefficients of Intlib1, Intlib2, and TC are still negative at the 1% level. The results show that after the interest rate liberalization, enterprises increased their use of commercial credit, and the use of commercial credit can improve investment efficiency, so commercial credit serve as an intermediary variable.

The above regression results verify the hypotheses of this study. Interest rate liberalization can increase use of commercial credit, and commercial credit has an intermediation effect in the relationship between interest rate liberalization and investment efficiency; that is, with the progress of interest rate liberalization, enterprises increase their use of commercial credit, which leads to improvements in enterprise investment efficiency.

5. Robustness Test

In order to verify the reliability of the regression results, this study also includes a robustness test, and the conclusions do not change significantly. Due to space limitations, the results are not provided here in detail, but briefly as follows.

5.1. Changing the index of interest rate liberalization process

Yang Zheng[20] set virtual variables to measure the process of interest rate liberalization, and set virtual variables at important periods during the process. According to this method, the selected loan ceiling liberalization is in 2004, and the lower limit of the annual loan rate liberalization in 2013 has two key points. This study sets up the Marketup and Marketdown variables to represent interest rate

liberalization. Replacing Intlib1 and Intlib2 with these two variables, the results show that both the liberalization of the loan interest rate ceiling and the lower limit of the loan rate have a catalytic effect on investment efficiency, and promotes commercial credit. There is a partial intermediation effect between the upper limit of loan interest rate and investment efficiency, as well as a partial intermediation effect between the lower limit of loan interest rate liberalization and investment efficiency, which is still in line with hypotheses 1 and 2.

5.2. Using a panel data regression

The regression above in this study is a simple OLS regression. In order to control the possible impact of firm-level differences, the robustness of the results are tested using the panel data regression method. The regression results show that interest rate liberalization improved enterprise investment efficiency, and can promote the use of commercial credit, which has the effect of improving investment efficiency. However, the effect of interest rate liberalization on investment efficiency is not fully absorbed, and commercial credit plays a partial role in the relationship between interest rate liberalization and investment efficiency, supporting the hypotheses of this study.

6. Conclusion

China is pushing forward with interest rate liberalization, which will affect the macro-financing environment, and investment efficiency is an indicator of micro-enterprises. How the changes in the macro-environment affect the operations and decision-making of individual companies is the focus of many scholars' research. This study posits that commercial credit acts as a bridge between interest rate liberalization and investment efficiency. Interest rate liberalization allows banks to make their own decisions on deposit loan prices, which will increase the loan interest rate. To control the cost of credit, enterprises will choose to use more commercial credit as a source of funds. As a liability, commercial credit has a unique governance role that can improve investment efficiency. Thus, it plays an intermediary role in the relationship between interest rate liberalization and investment efficiency. This study is based on a sample of Shanghai and Shenzhen A-Share listed companies from 2003 2017 to examine the impact of interest rate liberalization on investment efficiency and commercial credit, as well as the intermediation effect of commercial credit in the relationship between interest rate liberalization and investment efficiency. The empirical results show that interest rate liberalization can inhibit inefficient investment. As interest rate liberalization progresses, inefficient investment within enterprises decreases. Interest rate liberalization increases the use of commercial credit, which itself has an intermediation effect in the relationship between interest rate liberalization and investment efficiency; that is, after interest rate liberalization, the use of commercial credit increases, which in turn enhances the investment efficiency of enterprises. The further robustness tests do not change the results, indicating that the conclusions herein are reliable, and commercial credit plays a unique role.

The limitations of this study is that it uses a sample of listed companies for 2003-2017. This is a long time span covering large fluctuations in economic conditions, so other variables may affect the efficiency of investment that the model in this study does not capture, which could affect the model's explanatory power. Some scholars suggested that China's interest rate liberalization process includes not only the liberalization of price controls, but also changes in quantitative controls. However, the current rate of the marketization process indicators does not provide a sufficient quantitative measure of this part of the quantitative controls, so the measurement may be biased. This study verifies the partial intermediation effects of commercial credit, and shows that other factors play a role in the relationship between interest rate liberalization and investment efficiency.

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