The Impact of Using Short-term Lending for Long-term Investment on Firms' Investment in Innovation

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Abstract. The prerequisite to ensure the smooth implementation of corporate innovation activities is the availability of sufficient funds. As a form of investment and financing, using short-term lending for long-term investment can provide financial support and relieve financing constraints, but it increases debt repayment pressure and the risk of sustained business operations. Existing literature on the impact of using short-term lending for long-term investment on corporate innovation activities is not yet conclusive. Based on the panel data of Chinese A-share listed companies from 2010 to 2021, this paper empirically tests the impact of using short-term lending for long-term investment on innovation investment by using fixed effects model and mediation effects model. The results show that using short-term lending for long-term investment has a significant inhibitory effect on innovation investment, and financial distress plays a mediating effect, i.e., using short-term lending for long-term investment will increase the risk of financial distress, and then inhibit corporate innovation investment. Heterogeneity tests show that the above results mainly exist in non-Big 4 audited enterprises, non-state-owned enterprises and enterprises located in regions with high quality economic resources. The relevant authorities should strengthen the market financing environment and formulate differentiated policies to encourage enterprises to invest in innovative activities. Enterprises should fulfil their social responsibilities, abide by professional ethics, enhance their independent R&D capabilities and break through technological barriers. Banks and other financial institutions should assess the solvency of enterprises before signing contracts.

Keywords: Using Short-term Lending for Long-term Investment; Innovation Inputs; Fixed Effects Model; Mediation Effects Model.

1. Introduction

The report of the 20th Party Congress clearly pointed out that innovation is the first motive force. China's development has already stepped into a new era, is moving steadily towards the comprehensive construction of socialist modernization power. In this key node, innovation to enhance China's independent research and development capabilities, to support the rapid development of China's economy has an important strategic and practical significance. Generally speaking, the prerequisite for ensuring the smooth implementation of innovative activities is that enterprises have sufficient funds0. Due to the high cost of external financing and the existence of information asymmetry in the capital market, enterprises will give priority to investing internal financing in innovation activities[2]. However, the uncertainty and externality of innovation make enterprises not only bear the huge risks brought by technological innovation, but also face the serious free-riding behavior of their competitors. The mismatch between income and expenditure makes enterprises not only rely on internal financing, but also need external financing to make up for the capital needs. Based on the pecking order financing theory, compared with equity financing, enterprises are more inclined to choose debt financing. And the development of China's financial market lags behind, financing is limited. Therefore, for enterprises with insufficient internal financing, loans are the main source of R&D investment funds.

In China, the phenomenon of using short-term loans for long-term investment activities is widespread. As economic development enters the new normal and economic policy uncertainty increases, the debt maturity structure also shows a downward adjustment trend[3]. As a financing method, whether using short-term lending for long-term investment can encourage enterprises to invest funds in innovation activities has not been determined in academia. On the one hand, short-

term credit has low interest rates and high liquidity, which flexibly meets the financial needs of enterprises' investment activities and eases the financing constraints of enterprises, promoting enterprises' innovative input. On the other hand, based on the maturity matching theory, matching debt maturity with asset maturity will increase the debt agency cost and liquidity risk.[4] Even if the enterprise has enough funds, it is still prudent to invest them in such high-risk projects as innovation activities. Therefore, it is interesting to explore whether short-term lending and long-term investment can promote firms' innovation investment.

Based on the perspective of innovation input, this paper will take the empirical data of non-financial listed companies as samples to elaborate the mechanism of the impact of using short-term lending for long-term investment behaviour on the innovation activities of enterprises, and empirically test the impact of using short-term lending for long-term investment on the innovation input of enterprises. It aims to provide new ideas for stimulating enterprise innovation.

2. Literature Review

High leverage and using short-term lending for long-term investment are the two core debt problems faced by enterprises. In China, the current research on corporate innovation focuses on the impact of capital structure on corporate innovation, the research conclusions have gradually matured and believes that leverage and corporate innovation are in an "inverted U-shape", Wang Yuzhe (2019)[5] used Chinese listed companies as samples to conduct empirical research, and showed that there was an inverted U-shaped relationship between corporate leverage ratio and innovation investment and innovation output, while the impact on innovation risk was U-shaped, and found that the optimal leverage ratio was 43.01%. Li Gaoya et al. (2021)[6] believed that for enterprises, there is an optimal range of leverage ratio, but too low leverage ratio will inhibit corporate innovation, and the policy of continuous deleveraging cannot always promote corporate innovation.

However, the above studies ignore the impact of debt maturity matching situation on firms' innovation, especially the debt maturity mismatch problem. In recent years, with the improvement of the capital market system, operational and financial information has become more transparent. Observation of the current situation of enterprises in China can be found that the phenomenon that short-term loans support long-term investment exists in large quantities. Ma Hong et al. (2018)[7] used the fixed effect model and the mediating effect model to empirically test that using short-term loans for long-term investment inhibits the accumulation of enterprise innovation ability and weaken the sensitivity between innovation and enterprise growth. Up to now, the relevant domestic term mismatch problem research mostly focused on the theoretical analysis, it is using domestic empirical data demonstrate the influencing factors of term mismatch and duration mismatch economic consequences, few through empirical test the impact of using short-term lending for long-term investment on innovation inputs.

Compared with domestic, foreign research on using short-term lending for long-term investment and enterprise innovation started early and is more abundant. Since Morris first proposed the maturity matching theory in 1976, Western scholars have further elaborated the importance of the maturity matching theory from different perspectives such as agency cost, contract theory and tax theory. These scholars point out that when the debt maturity is smaller than the investment maturity, the investment may not have sufficient cash flow to repay the maturing debt, which amplifies the debt servicing pressure and intensifies the business risk. However, some scholars hold the opposite view, believing that compared with long-term debt, short-term debt has a lower cost, which can effectively alleviate the financing constraints in long-term investment of enterprises and reduce the cost. Through the above analysis, it can be found that the conclusions of foreign studies on the maturity mismatch problem are not consistent, and it is meaningful and important to argue the effect of using short-term lending for long-term investment on corporate innovation.

The innovation of this paper is mainly reflected in the following three aspects: firstly, there are few domestic studies on debt maturity mismatch and corporate innovation, and they focus on

theoretical analysis rather than empirical analysis. Not only that, the impact of debt maturity mismatches on innovation activities has not yet been conclusive. Based on this, using the panel data of A-share non-financial listed companies from 2010 to 2021, this paper explores the impact of using short-term lending for long-term investment on corporate innovation input by constructing an OLS model, which is innovative in terms of research content. Secondly, the existing literature lacks the intrinsic mechanism of the impact of short-term lending and long-term investment from the perspective of innovation input, based on which, this paper explores the intermediary role played by financial distress through the establishment of intermediary effect model, which can help to understand the intrinsic mechanism of the impact of using short-term lending for long-term investment on the decision-making behaviour of enterprises' innovation activities. Thirdly, in order to comprehensively explore the effect of using short-term lending for long-term investment on corporate innovation investment, this paper adds the heterogeneity analysis of three factors, including audit quality, nature of property rights and geographic location. It aims to broaden the research on the heterogeneity analysis of using short-term loans for long-term investment and innovation inputs.

3. Rationale and Research Hypothesis

3.1 Using Short-term Lending for Long-term Investment and Innovation Inputs

There have been two views in the academic community about the impact of using short-term lending for long-term investment on the innovation capacity of enterprises.

On the one hand, innovation is characterised by high risk, uncertainty and externality, enterprises generally treat their innovations as commercial secrets, making it difficult for external investors to obtain relevant information and making investment risk higher. Although short-term credit raises the financial risk of enterprises compared with long-term credit, principal-agent theory suggests that it can force managers to make accurate R&D investment decisions, effectively supervise self-interested behaviour of managers, and reduce the potential moral hazard of innovative behaviour. The agency cost problem can be mitigated[8]. In addition, based on the market background of information asymmetry, using short-term lending for long-term investment also reflects the enterprise's ability to bear the high liquidity risk of short-term borrowing, sending a positive signal to the market about the enterprise's expectations[9]. The hypothesis of this paper is as follows:

H1a: Other things being equal, using short-term lending for long-term investment can promote firms' innovation inputs.

On the other hand, the maturity matching theory suggests that the maturity structure of financing should be matched with the structure of investment use, so that R&D projects with long payback periods should be supported by long-term credit funds. If enterprises use short-term credit funds excessively in innovation investment, when short-term liabilities have been or will be due, innovation investment with longer payback period often has not yet generated enough cash flow to repay the debt, which leads to the break of capital chain[10]. Moreover, compared with using long term credit for long term investment, using short term credit for long term investment makes enterprises sign contracts with banks and other financial institutions frequently, which not only increases the cost of transactions between enterprises and financial institutions, but also makes enterprises bear the pressure of regular debt repayment and interest payment, forcing them to invest a lot of energy in solving the problem of capital liquidity, resulting in insufficient long term capital investment in R&D activities. The This leads to the hypothesis of this paper:

H1b: Other things being equal, using short-term lending for long-term investment can discourage firms from investing in innovation.

3.2 Mediating Effects of Financial Distress

Financial distress is a situation where a company is unable to repay its debts as they fall due or where the company's profitability continues to decline or even incurs losses[11] . Restricted by the shortage of funds, it reduces the amount of corporate innovation investment. In addition, based on the

principal-agent theory, managers in financial distress are often threatened by shareholders, creditors and other stakeholders, prompting managers to choose a conservative strategy. And potential investors are less willing to provide investment and financing to enterprises in financial distress, which further limits the material basis for enterprises to carry out R&D innovation[12].

Based on the above analyses, financial distress and using short-term lending for long-term investment are also closely linked, and one viewpoint holds that using short-term loans for long-term investment provides liquidity support for enterprise investment to a certain extent, alleviates the financing constraints faced by enterprises, and enables enterprises to get out of financial distress. Another view is that using short-term lending for long-term investment is more likely to cause enterprises to renew short-term loans at a higher financing cost, which is more to meet the needs of the enterprise's capital turnover than actual investment and R&D and innovation activities, resulting in enterprises falling into financial difficulties[13]. Therefore, the hypothesis of this paper is proposed:

H2: Other things being equal, financial distress mediates the effect between using short-term lending for long-term investment and firms' innovation inputs.

4. Research Design

4.1 Selection of Variables

4.1.1 Explained Variables

Firm Innovation Inputs. This paper uses the amount of R&D investment to measure. As there are large differences in the amount of R&D capital investment of enterprises under different operating scale. Therefore, in order to exclude the influence of the business scale of enterprises on R&D capital investment, drawing on Yin Meiqun (2018)[14] , using the amount of R&D investment as a proportion of operating revenue to measure innovation investment.

4.1.2 Explanatory Variables

Using Short-term Lending for Long-term Investments. It means the maturity structure mismatch problem between debt and assets. When the long-term debt of a firm is significantly lower than its long-term assets, it needs to continuously roll over short-term debt to support long-term investment. This paper draws on Liu Xiaoguang and Liu Yuanchun(2019)[13] approach, using short-term lending for long-term investment (SFLI) = (short-term liabilities/total liabilities) - (short-term assets/total assets). This indicator is a stock indicator and is suitable for additional examination of its impact on financial distress.

4.1.3 Mediating Variables

Financial Distress. Using short-term lending for long-term investments is prone to corporate liquidity risk, which in turn adversely affects debt risk. This paper draws on Jiang Fuxiu et al. (2009)[15], chosing the Z index as a comprehensive indicator of financial distress. The smaller the value of Zscore, the greater the risk of financial distress of the enterprise.

4.1.4 Control Variables

Combined with studies on firms' innovation inputs, in Wang Yuzhe et al. (2019)[5], Yan Ruosen et al. (2020)[16], Yuanhui Li and Yiming Xu (2021)[17], this paper selects return on total assets, gearing ratio, operating income growth rate, enterprise size, fixed asset ratio, capital expenditure, board size, equity checks and balances, total asset turnover, government subsidies, industry dummy variables and annual dummy variables as control variables.

Table 1. Definition of variables

Name	Code	Formula
Explained Variables:		
innovative inputs	R&D	Amount of R&D investment/revenue
Explanatory Variable:		
Using short-term lending for long-term investment	SFLI	(Short-term liabilities/total liabilities) - (Short-term assets/total assets)
Intermediary Variable:		
financial difficulty	Zscore	1.2*Working Capital/Total Assets + 1.4*Retained Income/Total Assets + 3.3*Earnings Before Interest and Taxes/Total Assets + 0.6*Market Value of Outstanding Stocks/Total Liabilities + 0.999*Operating Income/Total Assets
Control Variable:		
return on total assets	ROA	Net profit/total assets
asset-liability ratio	LEV	Total liabilities/total assets
Revenue growth rate	GROWTH	Revenue growth rate
Enterprise size	Size	Ln (total assets + 1)
Fixed asset ratio	PPE	Fixed assets/total assets
capital expenditure	CAPEX	Cash paid by enterprises for the purchase and construction of fixed, intangible and other long-term assets/total assets
Board size	BOD	Ln (number of board members + 1)
Shareholding checks and balances	EBD	Proportion of shares held by the 2nd-5th largest shareholders / proportion of shares held by the 1st largest shareholder
Total asset turnover	ATO	Operating income/total assets
government grant	SUB	Amount of government subsidies/operating income
Industry dummy variables	Industry	Based on the 2012 Guidelines for Industry Classification of Listed Companies issued by the SFC, there are 19 types of industry after deducting the financial industry, 18 industry dummy variables are generated
time dummy variable	Year	2010 to 2021, generating 11 yearly dummy variables

4.2 Data Sources

Since there are many missing values before 2010, this paper selects the panel data of all China's A-share non-financial listed companies from 2010 to 2021 and treats the data as follows: Delete companies that have undergone special treatment such as ST and *ST; Deleted financial listed companies due to different financial structures; Delete missing data values; In order to reduce the influence of variable outliers on the research conclusions, the relevant continuous variables in the model are winsorized at the level of 1% and 99%. Finally, 26,223 observation sample data are obtained, among which the data of listed companies come from the CSMAR database.

According to the descriptive statistics of the sample variables in Table 2, the mean value of R&D is 0.049, which indicates that the amount of R&D investment accounts for a relatively low proportion of operating income. The mean value of SFLI is 0.062, the minimum value is -0.547, and the maximum value is 0.625, which indicates that most of the enterprises have the behaviour of short loan and long investment. The mean value of Zscore is 5.218, which is much lower than the optimal value of 36.192, indicating that Zscore varies greatly among enterprises and the financial situation is generally poorer, and the level of financial distress faced by enterprises is generally higher.

Table 2. Results of descriptive statistics

Variant	Size	Avg	sd	min	P25	median	P75	max
R&D	26,223	0.049	0.048	0.000	0.021	0.037	0.057	0.281
SFLI	26,223	0.062	0.257	-0.547	-0.116	0.055	0.253	0.625
Zscore	26,223	5.218	5.783	-0.160	2.018	3.395	5.996	36.192
ROA	26,223	0.040	0.066	-0.295	0.017	0.042	0.072	0.201
LEV	26,223	0.395	0.201	0.048	0.232	0.383	0.541	0.893
GROWTH	26,223	0.313	0.687	-0.635	-0.018	0.137	0.409	4.287
Size	26,223	22.100	1.266	19.978	21.180	21.896	22.802	26.138
PPE	26,223	0.202	0.143	0.004	0.091	0.174	0.283	0.642
CAPEX	26,223	0.051	0.046	0.001	0.017	0.037	0.071	0.224
BOD	26,223	2.371	0.227	1.792	2.303	2.303	2.485	2.944
EBD	26,223	0.785	0.621	0.036	0.306	0.627	1.109	2.895
ATO	26,223	0.608	0.375	0.103	0.368	0.527	0.741	2.332
SUB	26,223	0.006	0.013	0.000	0.000	0.001	0.007	0.080

4.3 Modelling

In order to test the impact of using short-term lending for long-term investment on the level of corporate innovation, this paper constructs a regression test model:

$$R\&D_{i,t} = \alpha_0 + \alpha_1 SFLI_{i,t} + \alpha_2 Control_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (1)$$

In model (1), when the regression coefficient α_1 is significantly positive, H1a is tested, indicating that using short-term lending for long-term investment can promote enterprise innovation investment; when the regression coefficient α_2 is significantly positive, H1b is tested, indicating that using short-term lending for long-term investment can inhibit enterprise innovation input.

$$Zscore_{i,t} = \beta_0 + \beta_1 SFLI_{i,t} + \beta_2 Control_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (2)$$

$$R\&D_{i,t} = \gamma_0 + \gamma_1 SFLI_{i,t} + \gamma_2 Zscore_{i,t} + \gamma_3 Control_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (3)$$

Referring to Wen Zhonglin and Ye Baojuan (2014)[18] , the mediation effect test method establishes model (2) and (3), in which the financial distress proxy variable (Zscore) is the mediating variable, testing the mediating transmission mechanism of using short-term lending for long-term investment and corporate innovation.

In the case of β_1 and γ_2 significantly, if γ_1 is significant and decreases, it indicates that there is a partial mediation effect of financial distress between short-term lending and long-term investment and firms' innovation inputs; if γ_1 not significant, it indicates that there is a full mediation effect of financial distress between short-term lending and long-term investment and firms' innovation inputs. The above results then use the sobel test to prove that if there is a mediation effect, H2 holds.

When β_1 and γ_2 are not significant in at least one case, tested by the Bootstrap method, H_0 :$\beta_1 \times \gamma_2 = 0$, if H_0 is rejected, the above steps are repeated, and if H_0 is accepted, it means that the mediating effect does not exist and H2 is not valid.

5. Empirical Findings

Table 3 and Table 4 show the regression results of using short-term lending for long-term investment, financial distress and corporate innovation investment. Before the test, in order to test the influence of explanatory variables on explained variables more scientifically and accurately, this paper carried out the Hausman test, in which the P-value of models (1) (2) and (3) are less than 0.05, so that the fixed effect model can be established. In this paper, stata16.0 is used to regression analysis of sample data.

5.1 Impact of Using Short-term Lending for Long-term Investment on Innovation Inputs

Table 3 shows the regression results of Model (1). Column (1) is listed as the regression results without adding any control variables and without fixing any effects, and it is found that R^2 is 0.021, with a low degree of goodness of fit, and the coefficient of SFLI is -0.027, which is significant at the 1% level, indicating that using short lending for long investment has an inhibitory effect on corporate innovation. Column (2) is listed as adding control variables and not fixing any effects, and it is found that R^2 is 0.239, with an enhanced goodness-of-fit, and the coefficient of SFLI is -0.004, which is significant at the 1% level. Column (3) presents the regression results with the addition of control variables and fixes time industry effects, which R^2 is 0.374, with a good model fit. The coefficient of SFLI is -0.005, significant at the 1% level, indicating that the lower the degree of using short lending for long investment, the more innovation inputs of enterprises. It means using short loan for long investment has a significant inhibitory effect on innovation inputs of enterprises. Columns (1) (2) (3) of R^2 are significantly enhanced, indicating that the goodness of fit is gradually enhanced. H1b is considered to be established.

Table 3. Results of empirical tests

variant	(1) R&D	(2) R&D	(3) R&D
SFLI	-0.027***(-23.924)	-0.004***(-3.675)	-0.005***(-4.894)
ROA		-0.083***(-18.341)	-0.069***(-16.554)
LEV		-0.048***(-26.720)	-0.036***(-21.044)
GROWTH		0.004***(10.014)	0.003***(7.965)
Size		-0.002***(-7.705)	-0.001***(-5.133)
PPE		-0.067***(-32.615)	-0.050***(-24.759)
CAPEX		0.064***(10.655)	0.073***(13.225)
BOD		-0.006***(-5.349)	-0.003***(-2.802)
EBD		0.007***(16.513)	0.004***(10.832)
ATO		-0.025***(-34.069)	-0.025***(-34.417)
SUB		0.410***(20.120)	0.629***(30.176)
intercept term	0.050***(167.409)	0.146***(26.255)	0.072***(12.306)
Industry	No	No	Yes
year	No	No	Yes
N	26223	26223	26223
R^2	0.021	0.239	0.374

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

5.2 The Mediating Effect of Financial Distress

In Table 4, column (1) presents the results of the regression of using short loan for long investment on financial distress, and column (2) presents the results of the regression with the addition of the financial distress proxy variable (Zscore) to the main regression test. In column (1), the coefficient of SFLI is -2.298, which is significant at the 1% level, indicating that an increase in the level of SFLI significantly increases the degree of firms' financial distress. In column (2), the coefficient of Zscore is 0.001, which is significant at the 1% level, indicating that a decrease in the level of financial distress promotes firms' investment in innovation. While the coefficient of SFLI is -0.002, significant at the 10% level, and its coefficient size in absolute value and significance are lower than the results of the main regression test. According to the mediation effect procedure of Wen Zhonglin and Ye Baojuan (2014), it can be concluded that the mediation effect of financial distress exists, which is manifested as a partial mediation effect. In order to enhance the robustness of the results, this paper also conducts the Sobel test, as shown in Table 5, which indicates that the mediation effect of financial distress exists, and H2 is established.

Table 4. Mediated effects test

variant	(1) Zscore	(2) R&D
SFLI	-2.298***(-18.453)	-0.002*(-1.845)
Zscore		0.001***(27.233)
ROA	9.599***(19.772)	-0.083***(-19.966)
LEV	-13.997***(-71.058)	-0.016***(-8.589)
GROWTH	-0.309***(-7.293)	0.003***(9.295)
Size	-0.336***(-11.901)	-0.001***(-3.193)
PPE	-0.614***(-2.609)	-0.049***(-24.665)
CAPEX	-3.570***(-5.525)	0.078***(14.332)
BOD	0.385***(3.030)	-0.004***(-3.351)
EBD	-0.060(-1.332)	0.004***(11.208)
ATO	0.375***(4.497)	-0.025***(-35.643)
SUB	21.841***(9.004)	0.597***(29.039)
intercept term	17.492***(25.662)	0.047***(8.060)
Industry	Yes	Yes
year	Yes	Yes
N	26223	26,223
R^2	0.420	0.391

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

Table 5. Sobel test results

intermediary variable	indirect effect			direct effect	N
	a_1	β_2	$a_1 \times \beta_2$	β_1	
Zscore	-2.334***(-18.756)	0.002***(26.878)	-0.004***(-15.381)	-0.001(-0.608)	26223

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with Z-values in parentheses.

5.3 Heterogeneity Analysis

The inhibitory effect of using short-term lending for long-term investment on firms' investment in innovation may vary due to the large differences in audit quality, nature of property rights and the external market environment of the economic regions in which the firms are located. Therefore, this paper groups the samples according to the audit quality, the nature of property rights and the economic region respectively. For example, the sample is divided into Big 4 and non-Big 4 audit firms according to audit quality, the sample is divided into state-owned and non-state-owned firms according to the nature of property rights, the sample is divided into the four regions of East, Central, West and Northeast according to the economic region

5.3.1 Impact of Audit Quality

The results by audit quality grouping are shown in Table 6. In column (1), the coefficient of SFLI is -0.005 and it is not significant, indicating that for Big 4 audit firms, SFLI cannot affect firms' innovation inputs, and it also cannot change firms' innovation inputs by affecting firms' risk of financial distress. In column (2), the coefficient of SFLI is -0.005, which is significant at the 1% level, suggesting that the inhibitory effect of SFLI is more significant for non-Big 4 audit firms compared to Big 4 audit firms. It may be due to the fact that Big 4 audit firms are more concerned about the high audit risk conveyed by short loans and long investments in audited units. Luo Hong et al. (2019)[19] argue that compared to non-Big 4, International Big 4 pay more attention to the high audit risk transmitted by using short loan for long investment of the audited companies. As a result, Big 4 audited firms have a lower degree of using short-loan for long investment, which has a relatively less constraining effect on innovation investment.

Table 6. Analysis of audit quality heterogeneity

variant	(1) Big Four Audit R&D	(2) Non-Big 4 audits R&D
SFLI	-0.005(-0.925)	-0.005***(-4.562)
Control	Yes	Yes
intercept term	0.087***(3.303)	0.080***(12.637)
Industry	Yes	Yes
year	Yes	Yes
N	1,376	24,847
R^2	0.507	0.369

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

5.3.2 Impact of the Nature of Property Rights

The test results grouped by the nature of property rights are shown in Table 7. In column (1), the coefficient of SFLI is -0.005, and in column (2), the coefficient of SFLI is -0.006, which are both significant at the 1% level, showing that compared with the state-owned enterprises and non-state-owned enterprises short and lend long shots for inhibitory effect is more significant in innovation. The main reason for this is that long-term credit increases the uncertainty of creditors about loan recovery and increases the risk of creditors, Liu Yunguo et al. (2010)[20] argue that state-owned enterprises (SOEs) have a "government relationship" and the government acts as an "implicit guarantor", which makes SOEs' loans highly credible and banks and other financial institutions less constrained by their debts, so SOEs generally use long-term credit to support long-term investment activities, instead of short-term credit. Therefore, compared with non-SOEs, SOEs generally use long-term credit to support long-term investment activities. According to Table 7, the difference in coefficients between groups is significant at the 10% level, indicating that the heterogeneity in the nature of property rights is significant and the above argument is correct.

Table 7. Analysis of heterogeneity in the nature of property rights

variant	(1) state-owned business R&D	(2) non-state enterprise R&D
SFLI	-0.005***(-2.926)	-0.006***(-4.289)
Control	Yes	Yes
intercept term	0.072***(8.531)	0.058***(7.023)
Industry	Yes	Yes
year	Yes	Yes
N	7,651	18,572
R^2	0.332	0.371
Difference in regression coefficients between groups	chi2(1)=2.94 Prob>chi2=[0.0864]	

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

5.3.3 Impact of Economic Regions

The test results by economic region are shown in Table 8. For the eastern and northeastern economic regions, the coefficients of SFLI are -0.005 and -0.015, which are significant at the 1% level, indicating that using short-term lending for long-term investment significantly inhibits innovation investment in the eastern and northeastern economic regions, and the northeastern economic region of inhibition effect is even stronger. For the central and western economic regions, the coefficients of SFLI are -0.004 and -0.005, respectively, which are not significant, indicating that using short-term lending for long-term investment in the central and western economic regions do

not have a significant effect on innovation input. The main reason may be that the innovation factor environment of enterprises in the eastern and northeastern regions is better.

Table 8. Analysis of regional heterogeneity

variant	(1) eastern part R&D	(2) Central Region R&D	(3) Western Region R&D	(4) North-eastern region R&D
SFLI	-0.005***(-3.508)	-0.004(-1.537)	-0.005(-1.562)	-0.015***(-3.898)
Control	Yes	Yes	Yes	Yes
intercept term	0.072***(9.646)	0.054***(3.674)	0.055***(3.614)	0.098***(4.030)
Industry	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
N	18,514	3,670	2,977	974
R^2	0.389	0.352	0.337	0.388

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

5.4 Robustness Checks

In order to verify the robustness of the above empirical results, this study conducted robustness checks.

5.4.1 Replacement of Core Variables

(1) Replacement of Explained Variables

Referring to Yuanhui Li and Yiming Xu (2021)[17] , this paper uses the natural logarithm of the number of patent applications plus 1 as a proxy for firms' innovation capability, and the results are shown in Table 9. In column (1), the coefficient of SFLI is -0.561, which is significant at the 1% level, indicating that using short-term lending for long-term investment has an inhibitory effect on firms' innovation. In column (2), the coefficient of SFLI is -2.628, which is significant at the 1% level, and in column (3), the coefficient of Zscore is -0.003, which is not significant. Referring to Wen Zhonglin and Yeh Baojuan (2014)[18], the mediating effect of financial distress is considered to exist and the results are robust by Bootstrap method.

Table 9. Robustness checks results

variant	(1) ln(PATENT+1)	(2) Zscore	(3) ln(PATENT+1)	(4) R&D	(5) Zscore	(6) R&D
SFLI	-0.561*** (-7.917)	-2.628*** (-7.787)	-0.569*** (-7.991)			
SFLI1				-0.011*** (-7.155)	-1.909*** (-10.562)	-0.008*** (-5.467)
Zscore			-0.003 (-1.106)			0.001*** (27.219)
Control	Yes	Yes	Yes	Yes	Yes	Yes
intercept term	-10.482*** (-25.583)	12.314*** (6.305)	-10.442*** (-25.382)	0.074*** (12.643)	17.983*** (26.259)	0.048*** (8.295)
Firm	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes
N	4,935	4,935	4,935	26,223	26,223	26,223
R^2	0.364	0.429	0.364	0.374	0.415	0.392
Bootstrap confidence interval		-0.006-0.003				

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

(2) Replacement of Explanatory Variables

Referring to Qiu Muqing and Bai Yunxia (2019)[21] approach, current assets and current liabilities are used instead of short-term assets and short-term liabilities in short loan and long investment (SFLI), which is calculated as SFLI1 = (current liabilities/total liabilities) - (current assets/total assets). The regression results are shown in Table 9. In column (4), the coefficient of SFLI1 is -0.011, which is significant at the 1% level, indicating that SFLI1 has an inhibitory effect on firms' innovation investment. In column (5), the coefficient of SFLI1 in column (5) is -1.909, which is significant at the 1% level, and in column (6), the coefficient of Zscore is 0.001, which is significant at the 1% level, and the coefficient of SFLI1 is -0.008, which is significant at the 1% level but is less significant than that in column (4), suggesting that the mediating risk of financial distress in the relationship between using short-term lending for long-term investment and firms' innovation investment effect is significantly present, which manifests itself as a partial mediation effect. This is also confirmed by the Sobel test results shown in Table 10. The results remain robust.

Table 10. Results of Sobel's Test - Replacement of Explanatory Variables

intermediary variable	indirect effect			direct effect	N
	a_1	β_2	$a_1 \times \beta_2$	β_1	
Zscore	-1.624***(-8.944)	0.002***(27.003)	-0.002***(-8.490)	-0.003**(-1.539)	26223

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with Z-values in parentheses.

5.4.2 Endogeneity Test

Table 11. 2SLS least squares regression results

variant	2SLS Phase I (1) SFLI	2SLS Phase II (2) R&D	2SLS Phase I (3) SFLI	2SLS Phase II (4) Zscore	2SLS Phase I (5) SFLI	2SLS Phase II (6) R&D
SFLI		-0.007*** (-4.722)		-2.753*** (-15.990)		-0.004** (-2.363)
LSFLI	0.688*** (107.148)		0.688*** (107.148)		0.682*** (106.593)	
L2SFLI	0.095*** (15.167)		0.095*** (15.167)		0.094*** (15.077)	
Zscore					-0.003*** (-14.946)	0.001*** (15.053)
Control	Yes	Yes	Yes	Yes	Yes	Yes
intercept term	0.093*** (4.005)	0.094*** (15.655)	0.093*** (4.005)	23.086*** (30.393)	0.165*** (6.968)	0.064*** (10.384)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes
N	21,950	21,950	21,950	21,950	21,950	21,950
R^2	0.712	0.373	0.712	0.450	0.715	0.388
Value of instrumental variable F	1320.25		1320.25		1307.22	
Endogeneity test p-value	0.00		0.00		0.00	

***, **, * indicate significant at 1%, 5%, 10% level of significance, respectively, with T-values in parentheses.

The above regression results indicate that using short-term lending for long-term investment behaviours significantly inhibit corporate innovation inputs. But the increase of corporate innovation investment may lead to the increase of corporate long-term loans, thus reducing the degree of using short-term lending for long-term investment. There may be endogeneity problems caused by mutual

causality between each other. For this reason, this paper re-estimates the impact of using short-term lending for long-term investment on corporate innovation investment by two-stage least squares regression method (2SLS). Referring to Ma Hong et al. (2018)[7] , the lag 1 period and lag 2 period of short loans and long investments are selected as instrumental variables, and the test finds that the instrumental variables are correlated with SFLI, which are exogenous to firms' innovation inputs.The empirical results of the 2SLS test are in line with the previous empirical results, which indicate that the conclusions of this study are robust and reliable.

6. Conclusion

This paper adopts the data of China's A-share non-financial listed companies from 2010 to 2021, combines theoretical and empirical analyses, and draws the following conclusions: Firstly, using short-term lending for long-term investment will inhibit corporate innovation investment. Secondly, using short-term lending for long-term investment increases the risk of financial distress of firms, thus inhibiting firms' investment in innovation. Thirdly, there is a gap in the inhibitory effect of using short-term lending for long-term investment on corporate innovation investment among enterprises with different audit quality, property rights nature and economic regions. Non-Big 4 audited firms, non-state-owned firms, and firms located in the eastern and northeastern economic regions have a more significant inhibitory effect on innovation investment than Big 4 audited firms, state-owned firms, and firms located in the western and central economic regions.

Based on the above conclusions, the following relevant recommendations are put forward. For the government and relevant departments, firstly, the enterprise financing regulatory mechanism should be continuously improved to provide enterprises with a good financing environment, and continuously improve the scientific and rationality of investment and financing decision-making. Secondly, formulate different support policies according to the specific situation of enterprises, fully consider the audit situation of enterprises, the nature of property rights and economic regions, so as to stimulate enterprise innovation and complete high-quality development. For enterprises, firstly, they should choose financing modes scientifically and reasonably according to their own actual situation, so as to avoid financial difficulties. Secondly, they should actively fulfill their social responsibilities, disclose the sources and reasons of financing as much as possible, and provide high-quality accounting information for investors. Thirdly, they should strengthen the responsibility of talents to enhance the innovation and research and development ability. For banks and other financial institutions, before signing the debt relationship, they should pay attention to the solvency of the enterprise, reduce the degree of information asymmetry with the enterprise. While protecting their own interests, they can also promote the sustainable and healthy development of enterprises, thus improving the level of innovation to a certain extent.

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