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Research on the impact of financing maturity mismatch on corporation innovation

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ABSTRACT: *Innovation is an important guarantee to achieve sustainable and efficient economic development, and is also an inherent need for corporations to achieve development themselves. Innovation requires corresponding financial support, but in the Chinese context financial market resources are not allocated according to the principle of efficiency, and the phenomenon of financing maturity mismatch is widespread, which can increase the financial and operational risks of corporations. This paper examines the impact of maturity mismatch on corporate innovation based on data from Chinese listed companies from 2008-2018. The study shows that the maturity mismatch has a dampening effect on innovation.*

KEY WORD: *Financing maturity mismatch；Innovation； Financial technology level；Rule of law environment*

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I. INTRODUCTION

Corporate innovation is a key driver of China's sustained economic growth and a source of long-term development for corporations. The capital market has the function of capital allocation. It provides a platform for both investment and financing activities of corporations, and corporations cannot carry out innovation activities without capital market. The capital market provides external financing channels for corporations' innovative activities, which require stable sources of funds due to their long cycle. The development of financial technology and the improvement of the rule of law environment play an important role in improving the capital market and promoting innovation. Innovation is the cornerstone to stimulate the vitality of the market economy, which is of great significance in the context of today's times.

In 1976, Morris first proposed the finance theory of maturity matching. According to the maturity matching theory, long-term credit funds should be used to meet innovation, an investment activity with long-term asset needs. However, contrary to this, the maturity mismatch problem of using short-term credit funds to support corporate innovation has existed in China in recent years and inhibiting the willingness of companies to innovate. This paper attempts to analyze the impact of maturity mismatch on the innovation behavior of corporations from the perspective of investment and financing, which has not been studied in depth.

This paper attempts to make corresponding additional contributions in the following aspects: first, to verify the existence of adverse effects of maturity mismatch on firms' innovation, and to add empirical evidence on the microeconomic consequences of the impact of maturity mismatch on innovation behavior; second, to construct a moderating effect model to analyze the moderating effect of the level of financial technology and the rule of law environment on the relationship between maturity mismatch and firms' innovation, and to broaden the research on the impact of maturity mismatch in terms of external environment; third, we examine the heterogeneity of the impact of maturity mismatch on firms' innovation from the perspective of property rights differences.

II. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

(i) Maturity mismatch of financing and corporate innovation

Term matching theory points out that the innovation behavior with longer term should be mainly supported by long-term capital. However, due to the imperfect development of China's capital market, banks occupy a dominant position and often become the suppliers of credit funds. According to the information asymmetry theory, there is information asymmetry between financial market and corporations, which further leads to adverse selection and moral hazard. The information asymmetry problem between corporations' innovation compared to general activities and financial market is more serious, and corporations face external financing dilemma when they carry out innovation. When banks and other financial institutions enter into credit contracts with corporations, they prefer to provide short-term credit for risk control reasons, which can easily lead to short-term debt maturity, while the cash flow from innovation activities is not enough to support the debt service.Firms will be more cautious or even reject high-risk innovation inputs. Based on the above analysis, the following hypothese is proposed.

H1:The financing maturity mismatch has an inhibitory effect on corporate innovation.

(ii) Level of financial technology, maturity mismatch and corporation innovation

The improvement of the level of financial technology makes the external financing channels universal, lowers the financing threshold, and reduces the cost of innovation. The development of financial technology has the functions of mutual matching of investment and financing needs and information transfer: on the one hand, the improvement of the level of financial technology provides better financial support for corporation innovation through the mechanism of mutual matching of venture capital and financing needs; on the other hand, the information transfer mechanism can reduce the information asymmetry between investment parties, make the financial market grasp more information about corporation innovation, effectively evaluate the value of innovation, better realize the matching of resources and on the other hand, the information transmission mechanism can reduce the information asymmetry between the two sides of investment, so that the financial market can grasp more information about corporation innovation, effectively evaluate the value of innovation, better match resources with innovative projects, and improve the efficiency of capital allocation.

H2:The level of financial technology can alleviate the inhibiting effect of financing maturity mismatch on corporate innovation.

(iii) Rule of law environment, maturity mismatch and corporate innovation

According to the theory of incomplete contract, the formulation of a standardized and formal contract can clarify the rights and responsibilities of both parties and avoid disputes, but the difference of contract duration leads to the difference of its implementation cost. The longer the term, the cost of monitoring creditors will increase and the risk of default suffered will also increase, so the contract enforcement of long-term debt has a certain dependence on the external performance mechanism——the rule of law environment. With the improvement of the rule of law environment, on the one hand, the efficiency of contract enforcement will be improved, and by increasing the default cost of corporations, the subjective default of long-term debt can be curbed to a certain extent, and banks and other institutions will pay more attention to corporations' own innovative projects and their development potential in the process of deciding loan maturity, on the other hand, the improvement of the rule of law environment can also play a role in alleviating the trust problem caused by information asymmetry.In conclusion, improving the rule of law environment can also alleviate the trust problem caused by information asymmetry, establish a trust relationship between the supply and demand of funds, and promote a better match between innovative projects and funds.

H3:The improvement of the rule of law environment can alleviate the inhibiting effect of financing maturity mismatch on corporate innovation.

Table 1 Definition and description of variables

Variable name	Variable symbol	Variable declaration
Corporate innovation	Innov	Uses R&D investment intensity (R&D investment/operating revenue) as an indicator of corporate innovation.
Financing maturity mismatch	Mis_la	Cash outlay for investing activities such as purchase and construction of fixed assets-(increase in long-term borrowing for the period + increase in equity for the period + net cash flow from operating activities+ cash inflow from sale of fixed assets).
Level of Financial Technology	Fintech	The Digital Financial Inclusion Index compiled by the Center for Internet Finance Research of Peking University is a digital financial inclusion index system constructed from three dimensions: the breadth of coverage,depth of use and digitization of digital financial services. It measures the degree of fintech development at the provincial and city level (not accounting for Hong Kong, Macao and Taiwan in China) in China (Guo,Feng et al.,2016; Xie,Xunli et al.,2018). In this paper,it is used as a proxy variable for the level of financial technology.
Rule of law environment	Lawa	Score of rule of law environment by province in China, data from Wang Xiaolu, Fan Gang et al. China Marketization Index Report by Province (2018).
Corporation size	Size	Ln number of employees of the corporation.
Corporate leverage	Lever	Asset-liability ratio.
Corporation age	Age	Age of the firm Years of listing.
Return on assets	ROA	Net profit/total assets.
The positions of chairman and manager overlap	Dual	If the positions of chairman and manager overlap, the overlap is 1, and the other positions are 0.
The nature of the corporation	State	The value of state-owned corporations is 1, and the value of others is 0.
Number of executive shareholdings	Manager share	The number of holdings held by executives in the company.
Shareholding ratio of controlling shareholders	Topshar e	Ratio of the largest shareholder.
Board size	Borad	Log_{10} number of board members。
Ratio of independent directors the proportion of independent directors	Indepen dent	Director Ratio Independent The number of independent directors as a percentage of the total number of board of directors.

III. RESEARCH DESIGN

(i) Empirical model

First, to analyze the impact of financing maturity mismatch on firm innovation, we construct a proxy variable for the degree of maturity mismatch at the firm level (Mis_la) by drawing on the measure of funding gap used in the paper by Kai Zhong, Xiao Ke Cheng and Wei Hua Zhang (2016) and design the following model (1) for analysis.

$$Innov=\alpha+\beta_1 Mis\_la +Controls+\varepsilon \quad (1)$$

Among them, Innov is the proxy variable for corporate innovation, and drawing on Xuan Zhang (2017), the R&D investment intensity index (R&D investment/operating revenue) is used to measure corporate innovation behavior; Mis_la is the proxy variable for the degree of maturity mismatch at the firm level; Controls represents the control variables, and referring to the existing relevant studies on corporate innovation performance, this paper draws on the previous studies to select a number of firm characteristics variables related to innovation accumulation, including corporation size,corporate leverage,corporation age,return on assets,the positions of chairman and manager overlap,the nature of the corporation,number of executive shareholdings,shareholding ratio of controlling shareholders,board size,ratio of independent directors,the proportion of independent directors, while also controlling for industry and year effects, as measured by referring to Table 1.

Second, for the moderating effect of fintech level, we constructs model (2) for regression on the interaction term between financing term mismatch and fintech level in model (1).

$$Innov=\alpha+\beta_1 Mis\_la+\beta_2 Mis\_la*Fintech+\beta_3 Fintech+Controls+\varepsilon \quad (2)$$

where Fintech is derived from the Digital Financial Inclusion Index - compiled by the Digital Finance Research Center of Peking University, which measures the level of Fintech at the provincial and city levels in China; the other variables are as above.

Then, in order to test the moderating role of legal environment, this paper adds the interaction term of financing term mismatch and legal environment to model (1) and constructs model (3) for regression.

$$Innov=\alpha+\beta_1 Mis\_la+\beta_2 Mis\_la*Lawa+\beta_3 Lawa+Controls+\varepsilon \quad (3)$$

Where, Lawa is the proxy variable of rule of law environment, which is obtained from the rule of law environment score of China's sub-provinces in the China Sub-Provincial Marketization Index Report (2018) by Wang Xiaolu and Fan Gang et al. to measure the rule of law environment of each region; other variables are as above.

(ii) Sample selection

The research sample of this paper is selected from the listed companies in Shanghai and Shenzhen A-shares from 2008 to 2018, and the following data screening is carried out on the basis of this: (1) excluding the listed companies in finance and insurance; (2) excluding the companies in ST and *ST; (3) excluding the listed companies with missing information data; (4) to eliminate the influence of outliers, the continuous variables are subjected to the upper and lower 1% tail reduction. Financial data are obtained from CSMAR and Wind database.

IV. Empirical Results

(i)Financing maturity mismatch and firm innovation

To illustrate the inhibitory effect of financing maturity mismatch on firm innovation, this paper uses model (1) to conduct the corresponding regression analysis, and Table 2 demonstrates the relevant regression results. The results show that financing maturity mismatch is significantly and negatively related to corporate innovation, indicating that the existence of maturity mismatch phenomenon tends to reduce the financial investment in innovation in the process of resource allocation by firms, which has an inhibitory effect on corporate innovation, consistent with expectations, and hypothesis 1 is supported.

Table 2 Main effect and moderating effect results

	(1)	(2)	(3)
	Innov	Innov	Innov
Mis_la	-0.168***	-0.180***	0.042***
	(-3.556)	(-3.605)	(-3.575)
Mis_la*Fintech		0.319**	
		(2.185)	
Fintech		2.778***	
		(8.295)	
Mis_la*Lawa			0.010***
			(7.509)

Lawa			0.032***
			(12.249)
Size	-0.300***	-0.273***	0.294***
	(-5.107)	(-4.453)	(-7.271)
Lever	-4.297***	-4.365***	-0.880***
	(-24.837)	(-24.118)	(-11.554)
Age	-1.924***	-1.939***	-0.723***
	(-10.211)	(-9.764)	(-6.686)
ROA	-4.446***	-4.796***	1.826***
	(-8.390)	(-8.744)	(-7.607)
State	-0.128**	-0.088	-0.096***
	(-2.237)	(-1.476)	(-2.860)
Dual	0.063	0.050	-0.031
	(1.015)	(0.783)	(0.875)
Managershare	0.177***	0.174***	0.091***
	(8.254)	(7.855)	(8.268)
Topshare	-0.013***	-0.014***	-0.004***
	(-7.816)	(-8.069)	(-4.558)
Borad	0.064	-0.108	0.107
	(0.156)	(-0.235)	(0.518)
Independent	0.561	0.618	-0.494**
	(1.021)	(1.053)	(2.011)
_cons	7.672***	2.220***	2.417***
	(12.661)	(2.675)	(8.194)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
N	17224.000	16254.000	17224.000
F	.	.	.

(ii)Empirical Results and Analysis of Moderating Effects

To illustrate the moderating effects of the level of financial technology and the rule of law environment on the inhibition of corporate innovation by the maturity mismatch of financing, this paper uses model (2) and model (3) to conduct the corresponding regression analysis, and Table 2 shows the relevant regression results. Equation (2) in Table 2 shows the regression results of model (2) to analyze the relationship between the level of financial technology, maturity mismatch and corporate innovation. Among them, the regression coefficient of the cross product term (Mis_la*Fintech) of maturity mismatch and the level of Fintech is positive, indicating that the level of Fintech can mitigate the inhibitory effect of financing maturity mismatch on firm innovation, which is consistent with expectations and hypothesis 2 is supported. Equation (3) in Table 2 shows the regression results of model (3) to analyze the relationship between rule of law environment, maturity mismatch and firm innovation. Among them, the regression coefficient of the cross product term of maturity mismatch and rule of law environment (Mis_la*Lawa) is positive, indicating that the improvement of rule of law environment can alleviate the inhibitory effect of financing maturity mismatch on firm innovation, hypothesis 3 is supported.

(iii)Further analysis considering the nature of corporation property rights

Table 3 Differences in the nature of property rights

	State-owned corporations	Non-State Owned corporations
	Innov	Innov
Mis_la	-0.100*	-0.195***

	(-1.940)	(-2.618)
Size	-0.586***	-0.028
	(-8.144)	(-0.325)
Lever	-2.288***	-5.518***
	(-9.309)	(-23.189)
Age	-2.399***	-1.703***
	(-7.928)	(-7.006)
ROA	-1.563**	-5.770***
	(-2.070)	(-8.330)
State	0.000	0.000
	(.)	(.)
Dual	-0.128	0.147**
	(-1.423)	(1.983)
Managershare	0.318***	0.146***
	(4.033)	(6.453)
Topshare	-0.007***	-0.013***
	(-3.121)	(-5.688)
Borad	-0.751*	1.277*
	(-1.761)	(1.802)
Independent	-1.350**	2.230**
	(-2.202)	(2.501)
_cons	8.822***	4.214***
	(14.831)	(3.961)
Year	Yes	Yes
Industry	Yes	Yes
N	5876.000	11348.000
F	597.523	.

In China's market economy, the nature of corporation property rights has an extremely important position, and the nature of property rights reflects the nature of the actual controlling body of the corporation. China's capital market divides market players into two categories: state-owned corporations and non-state-owned corporations, and there are significant differences between the two types of corporations in terms of resource endowment and political background. In China's specific context, soes have a specific status in the market economy and have better financing conditions and channels than non-soes, while non-soes often face the problem of "financial discrimination", which puts them in a disadvantageous position in seeking financial support. We further analyze whether the impact of maturity mismatch on corporation innovation differs among corporations with different property rights by grouping property rights.

The empirical results are presented in Table 3. The results show that both soes and non-soes have an inhibitory effect of financing maturity mismatch on firm innovation, and there are differences between the two types of firms with different property rights, and the inhibitory effect of financing maturity mismatch on firm innovation is stronger in non-soes.

(iv) Robustness test

Table 4 Regression results of the replacement variable Innov

	(1)	(2)	(3)
	apply	apply	apply
Mis_la	-3.595*	-3.335	-3.900**
	(-1.798)	(-1.448)	(-1.968)
Mis_la*Fintech		8.867*	
		(1.760)	
Fintech		177.805***	

		(7.721)	
Mis_la*Lawa			0.261**
			(-0.996)
Lawa			3.029**
			(7.147)
State	4.843	7.289	7.218
	(0.822)	(1.145)	(1.227)
Dual	25.724***	27.599***	24.565**
	(2.660)	(2.659)	(2.549)
Managershare	-3.279**	-3.970**	-3.792**
	(-2.033)	(-2.292)	(-2.318)
Topshare	-0.242	-0.353**	-0.315*
	(-1.454)	(-1.968)	(-1.878)
Borad	125.821***	154.006***	127.041***
	(3.493)	(3.340)	(3.519)
Independent	207.803***	238.537***	215.984***
	(5.357)	(5.178)	(5.524)
_cons	-618.352***	-913.550***	-617.759***
	(-8.861)	(-8.778)	(-8.885)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
N	21338.000	19663.000	21338.000
F	.	.	.

In order to verify the reliability of the findings of this paper and make the above empirical results more robust, we use another measure of firm innovation - innovation output, replace the explanatory variable (Innov) with this measure, and regress it again to test the robustness of the above model.

Table 5 Tobit estimation - Robustness test

	(1)	(2)	(3)
	Innov	Innov	Innov
Mis_la	-0.168***	-0.180***	-0.179***
	(-3.008)	(-3.127)	(-3.189)
Mis_la*Fintech		0.319*	
		(1.485)	
Fintech		2.778**	
		(7.716)	
Mis_la*Lawa			0.000*
			(0.038)
Lawa			0.036***
			(5.924)
State	-0.128**	-0.088	-0.083
	(-2.055)	(-1.362)	(-1.319)
Dual	0.063	0.050	0.048
	(0.998)	(0.768)	(0.749)
Managershare	0.177***	0.174***	0.172***
	(8.931)	(8.470)	(8.709)
Topshare	-0.013***	-0.014***	-0.014***
	(-7.359)	(-7.591)	(-7.758)
Borad	0.064	-0.108	0.083
	(0.182)	(-0.276)	(0.234)
Independent	0.561	0.618	0.635
	(1.074)	(1.117)	(1.218)
_cons	7.672**	2.220***	7.684**
	(2.380)	(2.591)	(2.386)
var(e.Innov)	10.069***	10.201***	10.047***
	(92.801)	(90.150)	(92.801)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
N	17224.000	16254.000	17224.000
F			

The regression analysis of the three models by replacing the innovation variables reveals that the direction of the coefficients of the interaction terms of maturity mismatch, maturity mismatch and the level of financial technology, and maturity mismatch and the rule of law environment are basically consistent with the above findings, and the results are significant and pass the robustness test. This indicates that the existence of maturity mismatch has an inhibitory effect on firms' innovation and hinders the improvement of firms' innovation, and this inhibitory effect can be alleviated by the improvement of the level of financial technology and the rule of law environment, which indicates that the empirical results of this paper are more robust.

To further ensure the reliability of the empirical results, Tobit's robustness test is conducted on the

sample. Table 5 presents the estimated results of tobit regression analysis. The regression results show that maturity mismatch is negatively related to corporate innovation and the results are significant, further verifying that corporate maturity mismatch has an inhibitory effect on corporate innovation activities to some extent. In addition, the coefficients of the interaction term mismatch and the level of financial technology, and the interaction term mismatch and the rule of law environment are in the same direction as the above findings, and the results are also significant. In general, the tobit test results are consistent with the previous results, indicating that the conclusions drawn from the above tests are robust and reliable.

IV. CONCLUSION

Having reliable financial support is an important guarantee for corporations to successfully carry out innovative activities. In recent years, although China has been increasing its investment in corporation innovation, there is still an obvious gap between China and developed countries. Considering the financial environment in China, maturity mismatches are common in the credit allocation process. The results of this study find that financing maturity mismatch has a significant inhibitory effect on corporate innovation, and the inhibitory effect of maturity mismatch on innovation behavior is stronger in non-state corporations.

The rapid development of information technology has promoted the mutual integration of finance and technology, which has given rise to new financial business models and has a greater impact on the financing behavior of corporations. In such a context, it is of necessary relevance to examine the impact of the level of financial technology in the process of term mismatching firms' innovation inhibition effect. The results of this study find that the level of regional financial technology mitigates the inhibitory effect of maturity mismatch on firms' innovation activities. The rule of law environment has a greater impact on the financial market and the way and also the development of financing channels. The improvement of the rule of law environment helps to build trust between investors and financiers in order to facilitate the effective combination of innovative activities and finance. When corporate financing needs develop, the rule of law environment also requires gradual improvement. The findings of this paper provide the following policy implications for promoting corporate innovation.

（1）Since maturity mismatches are prevalent in the process of innovation activities conducted by Chinese corporations, the reform process of China's financial market should be accelerated to broaden the external financing channels of corporations, improve the status of corporations in the contracting process, and reduce the financing costs of corporations to alleviate the constraints of maturity mismatches on corporation innovation.

（2）The development of financial technology helps corporations to carry out innovative activities, which in turn helps to promote the sustainable development of the real economy.

（3）Local governments improve the rule of law environment by improving the relevant laws and regulations, improving judicial and law enforcement efficiency, thus promoting corporations to carry out innovative activities and promoting the development of the real economy.

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