

Research Article

Enterprise Financing Mode and Technological Innovation Behavior Selection: An Empirical Analysis Based on the Data of the World Bank's Survey of Chinese Private Enterprises

Entao Zhu ^{1,2}, Qiming Zhang,² and Lan Sun³

¹*Binjiang College, Nanjing University of Information Science & Technology, Wuxi, Jiangsu 214105, China*

²*School of Business, Nanjing University of Information Science & Technology, Nanjing, Jiangsu 210044, China*

³*Tianjin Institute of Science of Sciences, Tianjin 300011, China*

Correspondence should be addressed to Entao Zhu; entaozhu@163.com

Received 18 August 2020; Revised 14 December 2020; Accepted 20 February 2021; Published 16 March 2021

Academic Editor: Lifei Chen

Copyright © 2021 Entao Zhu et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In China, private enterprises are becoming more and more important subjects of technological innovation, however (at the same time) financing difficulties of private enterprises are also ubiquitous. The research on the impact of financing methods on technological innovation behavior of private enterprises is conducive for the government to launch more targeted financing support policies. I men private enterprises are becoming the mainbody of technological innovation, but the difficulties in financing is especially heavy in China. Based on the data of the World Bank survey on China's enterprises in 2012, this paper studies the impact of different financing methods on technological innovation behavior of private enterprises. The results show that (1) internal financing can promote the technological innovation behavior of enterprises better than external financing can do and (2) among the various forms of external financing, bank loans have the most significant impact on the technological innovation behavior of private enterprises, followed by commercial credit.

1. Foreword

As the main force of the national economy, private enterprises are facing the rapid changes of economic and social environment at home and abroad, as well as increasing survival pressures. Therefore, it is imperative for them to innovate for economic growth. Innovation requires a large amount of capital investment, so the Chinese government has issued a series of policy documents on improving the business environment for private enterprises to support them to broaden financing channels, such as the medium-term lending facility (MLF) [1] created for private enterprises and the policy mix of “three arrows” [2] (the first arrow is credit support, the second arrow is bond financing support instrument for private enterprises, and the third arrow is equity financing support instrument for private enterprises). How to enhance the technological innovation capability of

enterprises with the help of the power of capital is the key for China's private enterprises to win in the increasingly fierce market competition.

The impact of corporate financing on innovation has always been a hot academic topic for scholars at home and abroad. In terms of the relationship between financing and innovation, many research studies focus on the impact of aspects such as financing constraints [3, 4], financing scale [5], and capital structure [6] on innovation, while few research studies are conducted from the perspective of financing methods. In terms of measurement of innovation, the research perspective focuses on investment into innovation [7, 8] and innovation performance [9]; and there are not many research studies on technological innovation behavior of enterprises. In terms of the relationship between financing methods and technological innovation behavior of enterprises, the existing literature mainly studies the impact

of single financing methods [10, 11] on innovation behavior of enterprises under different influencing factors (such as tax, agency problems, control, industry factors, and so on) or the impact of multiple financing methods on the performance [12, 13]. There are few research studies on the direction and intensity of the impact of different financing methods on innovation behavior.

Based on the data of the World Bank's survey on China's enterprises in 2012, this paper studies the impact of different financing methods on technological innovation behavior of private enterprises. The conclusion of this paper not only enriches the theory of the relationship between financing and innovation but also helps enterprises to understand the internal relationship between different financing methods and innovation. This is beneficial for Chinese private enterprises to take better advantage of financing methods to improve their innovation capability and have their core competitiveness. The conclusion herein provides a strong theoretical reference for the government to improve the capital market and promote the innovation of private enterprises.

2. Literature Review and Research Hypotheses

According to the description in Guidance to Innovation by Loch [14], technological innovation behavior is divided into product innovation and process innovation. Product innovation refers to the introduction of goods or services that are brand-new or significantly improved in property or usage. Product innovation can create new applications or integrate existing applications on the basis of new technologies and services. Process innovation refers to the application of production methods that are novel or significantly improved, including major applications in technology, equipment, and software.

The following is the influence of internal financing and external financing on the technological innovation behavior of enterprises. According to the pecking order theory [15], compared with external financing, internal financing originates from the internal capital of the enterprises, with lower financing costs. When faced with financing decisions, private enterprises will come to internal financing for the first source of capital. According to Himmelerg and Peterson (1994), when the US SMEs suffer severely from financing constraints, internal capital is the main source of financing for them to carry out innovation activities. According to Hall [16], technology companies are more inclined to internal financing in countries where the exit mechanism is not perfect. Chinese researchers Tang and Wu [17] conducted an empirical analysis on the R&D investment by China's listed companies. They found that there is information mismatch between enterprises and the surrounding as well as market failure due to the special nature of R&D investment, so it is difficult for enterprises to obtain external financial support and enterprises have to rely on the internal capital. Ju [18] analyzed the impact of internal and external financing channels on technological innovation of enterprises based on the data of the listed companies between 2007 and 2010 and found that the technological innovation

investment of the enterprises is mainly from the internal financing. Moreover, internal financing of the enterprises made bigger contribution to innovation activities than external financing. The enterprises need to input a lot of capital in research and development at the early stage, and the income is uncertain, and the enterprises regard the innovation R&D as confidential activities, which leads to information asymmetry and other problems in the financing for the R&D activities, resulting in the external financing of the enterprises being subjected to certain financing constraints. In addition, the innovation R&D cycle of enterprises is large with long-term capital investment, and the R&D process needs uninterrupted funds. Financing can ease the financing constraints of the enterprises to promote the innovation of the enterprises. However, due to the characteristics of small and medium-sized private enterprises, such as weak capital, small scale, and few fixed assets, private enterprises are facing the problems of "difficult external financing" and "expensive external financing." Therefore, this paper puts forward the following hypotheses.

Hypothesis 1. Compared with external financing, internal financing can better promote the technological innovation in enterprises.

There are many external financing methods for private enterprises, including bank loans, commercial credit, equity financing, and loans from nonbank financial intermediaries, which will have different significant impacts on the technological innovation behavior of private enterprises.

The following is about bank loans, commercial credit, and technological innovation behavior of enterprises. Based on the empirical data of Interstate Bank of Minnesota, Amore shows that deregulation of banking regulation helps to promote and foster enterprise innovation. According to Yu [19], bank credit can effectively promote the technological innovation behavior of enterprises. According to Li and Liu [20], bank credit has a significant positive impact on enterprise innovation, and the state ownership system will inhibit enterprise innovation, and the positive impact of bank credit on enterprises will gradually weaken with the increase of state ownership ratio. Luo [4] studied small and medium-sized private enterprises, finding that the tax-exemption effect of bank loan interest will increase the value of enterprises and increase their cash freedom, to ease them of financing constraints and promote the technological innovation of private enterprises. Commercial credit is a kind of short-term and informal debt financing method which is found everywhere in private enterprises. China is now in its transition period of economic development, where unsound capital market and strict supervision over bond financing and equity financing exist. Banks discriminate against private enterprises with high risks and few assets in the approval of bank loans and are less willing to lend money to them. According to Amiti and Weinstein [20], commercial credit is such kind of behavior that enterprises buy goods on credit delay payment and occupy the funds that could have been possessed by other enterprises. Commercial credit, as an alternative financing method to bank loans, is found throughout China. At this time, with the decrease of money

supply, it is more difficult for enterprises to obtain bank loans, and enterprises have to turn to alternative financing methods [21, 22]. Sun et al. [23] verified through the industrial data in China that commercial credit is an effective financing channel for enterprises. They believed that for SMEs, when the financing costs from formal sectors increase, commercial credit can help financing more and better promote innovation of enterprises based on the analysis of investment perspective. Zhang and Zhang [24] took the nonfinancial companies in the SME board and GEM board of the SSE and SZSE between 2007 and 2015 as samples, finding that commercial credit plays a significant role in promoting the R&D investment of listed companies, and the positive correlation between commercial credit and R&D investment is not restricted by the nature of property rights and monetary policies. This paper holds that, compared with bank loan financing, commercial credit can be perfectly used as a short-term alternative financing method, which can promote the technological innovation behavior of enterprises. However, due to its small amount of funds and unsustainability, commercial credit may not promote the technological innovation behavior of private enterprises as much as banks can do. Therefore, this paper puts forward the following hypotheses.

- (i) Hypothesis 2a: bank loans and commercial credit combined play a positive role in promoting the technological innovation behavior of private enterprises.
- (ii) Hypothesis 2b: bank loans have the most significant impact on the technological innovation behavior of private enterprises, followed by commercial credit.

The research hypotheses of this paper are summarized in Table 1.

3. Research Model and Data Description

3.1. Source of Data and Selection of Research Variables. This paper adopts the data from the World Bank survey on China's enterprises from October 2012 to February 2013. The data cover 11 manufacturing industries and 7 service industries and include the basic characteristics (industry, city, age, and ownership attribute), infrastructure, innovation and technology, competition, labor force, business performance, and business environment of 2,700 enterprises in 25 cities. In order to obtain unbiased estimation of overall enterprise data and avoid excessive concentration of sample data on specific enterprises, industries, and regions, the World Bank adopted strict hierarchical screening to improve the accuracy and representativeness of sample data. In the selection of the samples, this paper follows the following logic: (1) in the following, we classify the industries of the enterprises based on Question A4 of the questionnaire and only select the sample data of 2,700 private enterprises; (2) according to Question A7 of the questionnaire, we delete the enterprises whose branches and production bases cannot make decisions independently; (3) according to Question A4 of the questionnaire, we delete the data of nonmanufacturing enterprises; (4) according to Questions CNo2,

CNo14, and K3 of the questionnaire, we delete the missing values. A total of 7,956 pieces of data from 2,700 enterprises are selected, involving 17 industries including food manufacturing, textile manufacturing, and clothing manufacturing.

3.2. Model Design. To study the impact of financing methods on the technological innovation behavior of private enterprises, we adopt the following linear model for data regression:

$$y_i = \beta_0 + \beta_1 \text{fin_method}_i + \beta_2 \text{controls}_i + \gamma_i + \varepsilon_i, \quad (1)$$

where y_i denotes the selection of innovation behavior of the enterprise; fin_method_i denotes the financing method of the enterprise i ; controls_i denote the control variable; γ_i denotes the industry effect; and ε_i denotes the random error term.

3.3. Variable Setting. Table 2 lists the choice of explained variables and data sources. The explained variable is enterprises' technological innovation behavior. According to Oslo Manual, technological innovation is divided into product innovation and process innovation, and combined with questionnaire of the World Bank and enterprise innovation characteristics, we divide the specific innovation behavior of CNO.14 in the questionnaire into product innovation and process innovation. Product innovation refers to the introduction of goods or services that are brand-new or significantly improved in property or usage. It is pointed out in the *Oslo Manual Guidelines for Collecting and Interpreting Innovation Data* that product innovation includes both the introduction of new goods and services and significant improvements in the performance characteristics of existing goods and services. Therefore, this paper will describe product innovation by answering two questions related to CNo14e: have new products and services been developed in the past three years; and CNo14f: have new products been added to the existing products in the past three years? Process innovation refers to the application of production methods that are new or significantly improved. It is pointed out in the *Oslo Manual* that the purpose of process innovation is to reduce unit production or delivery cost, improve quality, and deliver new or significantly improved products. Therefore, this paper will describe process innovation by answering the following questions: Were new products and technologies introduced (CNo14a)? Was a new quality control process introduced (CNo14b)? Was a new management program introduced (CNo14c)? Have measures been taken to reduce the production costs (CNo14g)? Have measures been taken to improve the production elasticity (CNo14h)? The N/A values (N/A) and the "Don't know" answers in the questionnaires are removed. We assign the positive answer of the enterprises with 1 and the negative answer with 0, so we can construct the variables by using binary selection.

Table 3 shows the choice of explanatory variables and data sources. The explanatory variable is financing methods. From the data sources of research on innovation behavior

TABLE 1

Hypotheses	Contents
Hypothesis 1	Compared with external financing, internal financing can better promote the technological innovation behavior of enterprises
Hypothesis 2a	Bank loans and commercial credit play a positive role in promoting the technological innovation behavior of private enterprises
Hypothesis 2b	Bank loans have the most significant impact on the technological innovation behavior of private enterprises, followed by commercial credit

TABLE 2: Explained variables.

	Variable dimension	Variables	Description of variables	Questions in the questionnaire	Assignments to answer
Technological innovation behavior	Product innovation	Developing new products	Developing new products or services	CNo14e	“Yes” = 1; “No” = 0
		Add a new characteristic	Add a new characteristic to existing products	CNo14f	“Yes” = 1; “No” = 0
		Technology/equipment improvement	Introducing new technology and equipment	CNo14a	“Yes” = 1; “No” = 0
		Control improvement	Introducing a new quality control process	CNo14b	“Yes” = 1; “No” = 0
	Process innovation	Management program	Introducing a new management program	CNo14c	“Yes” = 1; “No” = 0
		Reducing cost		CNo14g	“Yes” = 1; “No” = 0
		Production elasticity	Taking measures to increase production elasticity	CNo14h	“Yes” = 1; “No” = 0

TABLE 3: Explanatory variable.

Variable dimension	Variables	Description of variables	Questions in the questionnaire	Assignments to answer
Internal financing	Internal financing	Enterprise’s own capital	k3a	Raw data
	Bank loans	Loans obtained by enterprises from banks	k3bc	Raw data
	Commercial credit	Lending activities between enterprises in the form of commodities	k3f	Raw data
	Nonbank loans	Loans obtained by enterprises from financial institutions other than banks	k3e	Raw data
External financing	Other loans: informal financing	Funds obtained from relatives and friends or usuries/loans obtained by enterprises from financial institutions other than banks	k3hd/k3e	Raw data
	Equity financing	Shareholders of an enterprise are willing to transfer part of their shareholding and introduce new shareholders by means of capital increase	b1	”Sole proprietorship enterprise” = 0 “joint-stock enterprise”/ “partnership enterprise”/ “Other” = 1

and financing, it is difficult to find a more reasonable index to measure the financing status of private enterprises, and usually some indirect alternative variables are necessary. Therefore, there are few literatures on financing sources of private enterprises in China at present. In 2012, the World Bank carried out a questionnaire survey on the financing methods and the degree of financing constraints of Chinese private enterprises. The corresponding question and answer to this data in the questionnaire is K3 (over financial year 2011, please estimate the proportion of this working capital that was financed from each of the following sources). In this paper, the financing methods of enterprises are mainly divided into internal financing and external financing.

- (1) *Internal Financing*. The capital for internal financing mainly comes from the internal funds as well as the retained earnings accumulated by enterprises. Internal financing is enterprise’s own capital. In the questionnaire, the World Bank uses the proportion of funds from the internal financing in the total working capital of the enterprise as a measure indicator, and its code is k3a.
- (2) External financing generally refers to an enterprise obtaining funds from sources outside the enterprise.
 - (i) Bank loans refer to loans obtained by enterprises from banks. Bank loans play an important role

in the daily economic activities of enterprises. Banks have the capability of value discovery and regulatory functions. As formal financing institutions, banks can provide enterprises with external financing opportunities, choosing to grant loans to and supervising well-run enterprises and good projects, so as to optimize the allocation of credit capital. According to manufacturing data in the 2012 World Bank-China Enterprise Survey, this indicator is measured by the proportion of bank loans to total working capital, and the corresponding code is k3bc.

- (ii) Financing from nonbank financial intermediaries refers to the financial support obtained from nonbank financial intermediaries (trust companies, enterprise group finance companies, financial leasing companies, etc. approved by the CBRC). According to the data of manufacturing sector in 2012 in the World Bank - China - Enterprise Survey, it is expressed by the proportion of funds from nonbank financial intermediaries (including microfinance institutions, credit cooperatives, credit associations, or financial companies), and the corresponding code is k3e.
- (iii) Commercial credit is a common short-term debt financing method for private enterprises and mainly found in supply chain credit, featuring low default cost, no collateral, and flexible maturity. Commercial credit mainly occurs in the trading of commodities, which is generally represented by accounts payable financing, commercial paper financing, advance receipt financing, and so on. According to the data of manufacturing sector in 2012 in the World Bank - China - Enterprise Survey, it is expressed by the proportion of credit purchase from suppliers and advance payment from customers in working capital, and its code is k3f.
- (iv) Other financing mainly comes from borrowings from relatives and friends or usuries. According to the data of manufacturing sector in 2012 in the World Bank - China - Enterprise Survey, it is expressed by the proportion of funds from other financing (money lenders, relatives, and friends) to working capital, and the corresponding code is k3hd.
- (v) Equity financing refers to the fact that the shareholders of an enterprise are willing to give up part of their shareholding and introduce new shareholders by means of capital increase. This indicator is not directly expressed in the data of manufacturing sector in 2012 in the World Bank - China - Enterprise Survey. From the perspective of ownership characteristics, the questionnaire involves wholly owned enterprises, joint-stock enterprises, limited partnerships, and partnership enterprises. Only

joint-stock enterprises and limited partnership enterprises are regarded as enterprises with equity financing demands, whereupon this paper attempts to describe the equity financing of enterprises by constructing virtual variables through the ownership of enterprises; the sole proprietorship enterprise is assigned as "0," and the joint-stock enterprise/partnership enterprise/limited partnership enterprise is assigned as "1."

Table 4 lists the selection of control variables and their data sources. Control variables are divided into two dimensions: enterprise level and external environment of enterprises. The enterprise level is described by the size, informatization degree, age, export status of the enterprise, and international certification. Employees are an important part of enterprises, and the total number of employees will reflect the size of an enterprise to a certain extent. For the size, enterprise in different sizes will have different development paces and available resources. According to Tang Yuejun et al. [25], large-sized enterprises are easier to obtain resources and get monopolized. According to Yang et al. [26], the advantage can help enterprises to develop new products and improve their existing products. This paper describes size as the natural logarithm of the number of employees through the Question L1. For degree of informatization, the higher the development of information technology and the utilization rate of computer by employees are, the easier the information exchange between the enterprises and their surroundings will be. This will be more conducive for enterprises to take market opportunities, stimulate the employees' motivation to innovate, and improve the innovation level of enterprises. This paper describes it as the logarithm of the Question CNo.8 "the proportion of employees working with computer." According to Rao and Chen [27], the informatization skills of employees can promote the innovation of enterprises. For the enterprise's age, since the older enterprise meant earlier entry into the industry, the mature enterprises have more resources and innovation power and have stronger market impact on the industry than the young enterprises. This paper describes it as the difference between the year of establishment of the company and 2012 in Question b5. For enterprises, international quality certification is conducive to standardize the innovation process, improve the reputation of products in the hearts of consumers, and enhance the market competitiveness, so as to promote the innovative behavior of enterprises. The external environment of an enterprise is described by its industry characteristics and market environment. In terms of industry characteristics, according to the OECD industrial technology intensity standards, the enterprises involved in this paper are classified into four categories: high-tech, medium-to-high-tech, low-to-medium-tech, and low-tech industries, and they are assigned with values through dummy variables. In terms of market environment, the innovation behavior of enterprises is not only related to their own factors but also affected by the market environment. Another control variable is market

TABLE 4: Control variable.

Variable dimension	Variables	Description of variables	Questions in the questionnaire	Assignments to answer
Enterprise level	Size	Workforce size	L1	Natural logarithm of “number of employees”
	Degree of informatization	Knowledge intensity	CNo.8	Logarithm of the “proportion of employees using computers for work”
	Age	Business years	b5	2012: year of establishment of the enterprise
	Export status of the enterprise	Exports or not	d3a	Export = 1; no export = 0
External environment of enterprises	International certification	International quality certification	B8	Yes = 1; no = 0
	Industry characteristic	Industry dummy variable	A4	There are four industries according to OECD industrial technology intensity standards, and three dummy variables are set
	Market environment	The relationship between local government and market, product market development degree, and factor market development degree		Regional marketization index of Fan Gang

environment. With better operating environment, enterprises would have more resources and would meet less obstacles in the operation. The market environment faced by enterprises is so complex and changeable that is difficult to describe it exactly. The marketization index was put forward by Wang et al. [28]. The study comprehensively compares the marketization process of various provinces, autonomous regions and municipalities from different aspects. So, this paper adopts the marketization index put forward by Wang et al. [28] to describe market environment.

4. Empirical Analysis

4.1. Descriptive Statistics Variables. Through the descriptive statistical analysis of the research variables, this paper makes a preliminary analysis and overall grasp of the research variables. Table 5 shows that the proportion of private enterprises choosing internal financing to obtain funds is the largest. In the external financing, the proportion of choosing bank loans as financing channel is the largest, which is far greater than that of choosing other external financing methods.

4.2. Analysis of Empirical Results. Table 6 reports the regression results of internal financing and external financing on the technological innovation behavior of private enterprises. It can be seen from the table that both the internal financing and the external financing have a positive influence on the technological innovation behavior of private enterprises, indicating that both internal financing and external financing can significantly promote the technological innovation behavior of private enterprises. From the perspective of regression coefficient, the regression coefficient of the internal financing is far greater than that of the external financing, which indicates that the promotion effect

of internal financing on the technological innovation behavior of private enterprises is greater than that of external financing. This verifies Hypothesis 1. From the perspective of control variables, there is a significant positive correlation between company size and product innovation and process innovation of the enterprises. The enterprise involved in export business will significantly inhibit its product innovation. The possible reason is that China’s exports are still at the low end of the value chain, and many of them are exported through OEM, lacking core technologies. The enterprises are satisfied with the meager profits and are unwilling to take any risk to carry out product innovation. International certification is beneficial to significantly promoting product innovation and process innovation of the enterprises. International certification standardizes the process of innovation. In other words, it improves the process innovation of the enterprises, helps the enterprises to win the public trust, and makes them more confident to carry out product innovation with sufficient conditions. The degree of informatization shows not very significant influence on the technological innovation of the enterprises, and the possible reason is that most of the enterprises used as the sample data in this paper are small and medium-sized enterprises which do not have much high tech, but there is no obvious relationship between the number of computers used and the technological innovation behavior of the private enterprises.

Table 7 further explores the impact of different financing channels on enterprises’ investment in innovation. First of all, the regression coefficient of bank loans is significantly positive, and the regression coefficient of commercial credit is also significantly positive, which indicates that bank loans and commercial credit play positive roles in promoting technological innovation behavior in private enterprises, supporting Hypothesis 2a. Secondly, from the perspective of significance, bank loans and

TABLE 5: Descriptive statistics of variables.

Variable	Obs	Mean	Standard deviation	Min	Max
Product innovation	2,700	0.3759259	0.4844508	0	1
Process innovation	2,700	0.5348148	0.4988788	0	1
Internal financing	2,646	88.70295	20.75148	0	100
External financing	2626	11.10368	19.80966	0	100
Bank loans	2,639	6.902994	14.86481	0	100
Commercial credit	2,639	3.011747	10.18581	0	100
Nonbank loans	2,636	0.7640364	5.597547	0	100
Equity financing	2,700	0.5196296	0.4997071	0	1
Other loans: informal	2,635	0.6425047	4.18984	0	4.61512
Size	2,699	235.7362	1120.516	4	30,000
Degree of informatization	1,657	11.17924	1.887501	2	19
Export status of the enterprise	2,698	0.7601927	0.4270449	0	1
International certification	2,681	0.61768	0.4860448	0	1
Age	2,627	12.72021	7.911288	0	125

TABLE 6: Regression of financing methods to technological innovation behavior of private enterprises.

	Product innovation	Process innovation
Internal financing	0.580*** (3.24)	0.577*** (3.13)
External financing	0.0158*** (3.88)	0.0208*** (4.38)
Size	0.131*** (4.12)	0.233*** (4.86)
Age	-0.00796* (-1.89)	0.00405 (0.60)
Export status of the enterprise	-0.353*** (-4.30)	-0.243** (-2.12)
Degree of informatization	-0.0758 (-1.42)	-0.00549 (-0.08)
International certification	0.255*** (2.91)	0.680*** (6.22)
Industry characteristic	Yes	Yes
Market environment	Yes	Yes
N	1606	1468

Note. *, **, and *** indicate it is statistically significant at the levels of 1%, 5%, and 10%, respectively. Market environment refers to the fixed effect of the city; industry characteristic refers to the fixed effect of the industry. They are same as below and therefore will not be repeated in this paper.

commercial credit are more significant than other external financing methods in stimulating technological innovation behaviors of private enterprises. From the value of regression coefficient, the proportions of product innovation and process innovation will increase by 0.16 and 0.119, respectively, for one standard deviation of bank loans increased. The proportions of product innovation and process innovation will increase by 0.088 and 0.117, respectively, for one standard deviation of commercial credit increased. It indicates that the impact of bank loans on the technological innovation behavior of private enterprises is greater than that of commercial credit, which verifies Hypothesis 2b. In addition, the loans from nonbank financial intermediaries play a significant role in promoting the process innovation of private enterprises. However, equity financing and other informal financing have no

TABLE 7: Specific financing methods and technological innovation of enterprises.

	Product innovation	Process innovation
Internal financing	0.348*** (2.90)	0.363* (2.50)
Bank loans	0.160*** (4.68)	0.119*** (2.69)
Nonbank loans	0.0293 (0.41)	0.368*** (2.95)
Commercial credit	0.0883** (2.08)	0.117*** (3.90)
Equity financing	-0.0357 (-0.45)	0.115 (1.05)
Other loans: informal financing	0.0186 (0.25)	-0.0714 (-0.79)
Size	0.133*** (4.19)	0.231*** (4.84)
Age	-0.00795* (-1.89)	0.00412 (0.61)
Export status of the enterprise	-0.356*** (-4.34)	-0.238** (-2.08)
International certification	0.240*** (2.76)	0.685*** (6.31)
Industry characteristic	YES	YES
Market environment	YES	YES
N	1608	1470

Note. *, **, and *** indicate it is statistically significant at the levels of 1%, 5%, and 10%, respectively.

significant impact on the technological innovation behavior of enterprises.

Table 8 reports the independent impact of different external financing methods on the choice of technological innovation behavior of enterprises. From the perspective of bank loans, column (1) and column (2) show that bank loans can significantly promote the product innovation behavior of the enterprises and significantly promote the process innovation behavior of the enterprises. Combined with the description of statistical analysis, we can see that bank loans account for a large proportion in the choice of external financing channels. Therefore, bank loan is an ideal

TABLE 8: External financing method and technological innovation of enterprises.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Product	Process	Product	Process	Product	Process	Product	Process	Product	Process
Bank loans	0.118*** (3.96)	0.133*** (3.04)								
Commercial credit			0.0629 (1.61)	0.217*** (3.95)						
Nonbank loans					-0.0393 (-0.60)	0.260** (2.37)				
Equity financing							-0.0583	0.151		
Other loans: informal financing									0.149 (1.40)	0.0198 (0.21)
Size	0.114*** (3.55)	0.224*** (4.33)	0.137*** (4.35)	0.257*** (5.01)	0.140*** (4.45)	0.256*** (5.03)	0.138*** (4.39)	0.244*** (4.88)	0.556*** (4.92)	0.255*** (5.00)
Age	-0.0783 (-1.03)	0.179 (1.64)	-0.0949 (-1.25)	0.173 (1.58)	-0.0930 (-1.22)	0.158 (1.46)	-0.0790 (-1.05)	0.149 (1.40)	0.575*** (5.11)	0.166 (1.53)
Export status of the enterprise	-0.297*** (-3.57)	-0.137 (-1.14)	-0.323*** (-3.91)	-0.153 (-1.26)	-0.344*** (-4.15)	-0.154 (-1.29)	-0.346*** (-4.25)	-0.166 (-1.42)	0.124 (0.48)	-0.151 (-1.26)
International certification	0.212** (2.41)	0.631*** (5.51)	0.222** (2.53)	0.652*** (5.66)	0.196** (2.22)	0.631*** (5.52)	0.223** (2.55)	0.575*** (5.11)	0.525** (2.23)	0.623*** (5.47)
Degree of informatization	0.440* (1.85)	-0.267 (-0.78)	0.552** (2.33)	-0.131 (-0.39)	0.549** (2.32)	-0.119 (-0.35)	0.547** (2.35)	-0.236 (-0.72)	0.300 (0.44)	-0.130 (-0.39)
Industry characteristic	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Market environment	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	1,554	1,268	1,555	1,268	1,552	1,267	1,590	1,303	296	1,266

Note. *, **, and *** indicate it is statistically significant at the levels of 1%, 5%, and 10%, respectively.

financing method for private enterprises. Column (3) and column (4) report the impact of commercial credit on the technological innovation of the enterprises. It shows that the commercial credit from enterprises can significantly promote the process innovation, as part of the technological innovation of the enterprises, but it showed no significant effect in promoting the product innovation. The most possible reason is that financing from commercial credit usually acts as temporary financing method or is not chosen by enterprises, since it is small in amount that cannot meet the needs of input in production innovation. In particular, overdue repayment of commercial credit will bring a lot of negative effects to enterprises and even affect the future financing from commercial credit. Therefore, it is difficult for commercial credit to play a positive role in the product innovation in the technological innovation of enterprises. Column (5) and column (6) report the impact of loans from nonbank financial intermediaries on the technological innovation of the enterprises. It can be found that loans from nonbank financial intermediaries can significantly promote the process innovation, a part of the technological innovation behavior of the enterprises. It can be seen from columns (7)–(10) that equity financing and other informal financing have no significant impact on the technological innovation behavior of the private enterprises.

4.3. *Robustness Test.* To ensure the robustness of the empirical results, this paper adopts the following methods.

- (1) Adopting the method of substitution variables: the above regression is conducted through the

financing mode of working capital financing, and there is a question in the questionnaire of the World Bank that also includes the data information related to the financing method, which describes the financing source of the enterprises when making fixed asset investment. Therefore, this paper adopts this variable to replace the variable financing structure and conducts empirical tests. The substitution variables are represented by internal financing-1 and external financing-1, respectively. The results are shown in Table 9. Table 9 shows that external financing plays a significant role in promoting the technological innovation behavior of enterprises. The effect of internal financing on the technological innovation behavior of private enterprises is not significant, but it does not reject the original hypothesis. The possible reason is that the purchase of fixed assets generally involves a large amount of expenditure; therefore, enterprises tend to choose to obtain the funds from external parties. The internal capital of an enterprise is not only required to cover the R&D investment but also maintain the enterprise in operation, so there is high opportunity cost.

- (2) Considering the impact of the year of establishment of enterprises: generally speaking, the longer a company has been in the industry, the more mature it is. Mature enterprises have more resources and higher industry influence than young enterprises. In this paper, the sample enterprises are classified into two groups depending on the average year of establishment of enterprises (the average years of

TABLE 9: Stability test.

	Substitution variable		Budding enterprise		Mature enterprise		SME		Large-scale enterprise	
	Product	Process	Product	Process	Product	Process	Product	Process	Product	Process
Internal financing-1	0.116 (0.81)	0.118 (0.58)								
External financing-1	0.00885* (1.94)	0.0140* (1.92)								
Internal financing			0.589*** (2.90)	0.650*** (3.08)	0.482 (1.15)	0.294 (0.75)	0.649** (2.40)	1.048*** (3.28)	0.616** (2.44)	1.867 (1.12)
External financing			0.0152*** (3.10)	0.0227*** (3.85)	0.0165** (2.01)	0.0189** (2.11)	0.0182*** (3.31)	0.0323*** (4.74)	0.0178*** (2.72)	-0.0190 (-0.74)
Age							-0.00370 (-0.57)	0.0121 (1.34)	-0.00607 (-1.07)	0.00540 (0.47)
Size	0.146*** (3.00)	0.220** (2.51)	0.129*** (2.99)	0.187*** (3.05)	0.133*** (2.94)	0.310*** (4.02)				
Export status of the enterprise	-0.271** (-2.47)	-0.00198 (-0.01)	-0.414*** (-3.82)	-0.173 (-1.19)	-0.303** (-2.35)	-0.382* (-1.92)	-0.466*** (-4.53)	-0.300** (-2.22)	-0.519***** (-3.53)	-0.376* (-1.67)
International certification	0.282** (2.27)	0.713*** (4.08)	0.301*** (2.72)	0.782*** (5.74)	0.233* (1.72)	0.630*** (3.46)	0.324*** (3.38)	0.814*** (6.98)	0.450** (2.56)	0.985*** (3.85)
Industry characteristic	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Market environment	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	846	631	956	875	659	500	1,083	1,001	505	302

Note. *, **, and *** indicate it is statistically significant at the levels of 1%, 5%, and 10%, respectively.

establishment of the sample enterprises is 12.07) for regression. If the year of establishment of an enterprise is smaller than the average year of establishment, it is defined as the growing enterprise. Otherwise, it is defined as mature enterprise. The results of regression are shown in Table 9. The regression results show that both internal and external financing can significantly promote the technological innovation behavior of growing enterprises, verifying the hypotheses in this paper. External financing has a significant positive role in promoting the technological innovation behavior of mature private enterprises. Although internal financing is not playing a significant role, it does not reject the original hypothesis, which may be due to the fact that mature enterprises have more external resources than growing enterprises and do not rely much on internal financing. It can be seen from the regression coefficient that internal financing can better promote the technological innovation behavior of private enterprises.

- (3) Considering the impact of enterprise size: enterprises of different sizes have different development speeds and resources. According to Tang Yuejun et al. (2008), large-sized enterprises are easier to obtain resources and get monopolized. According to the World Bank's definition of the surveyed enterprises, an enterprise having less than 100 employees is defined as a small and medium-sized enterprise; an enterprise having more than 100 employees is defined as a large-sized enterprise in this paper. The regression results shown in Table 9 indicate that internal financing and external financing do not reject the original hypothesis, but their impact on the process innovation of

large-sized enterprises is not very significant. The possible reason is that large-sized enterprises have relatively mature and stable internal control process and they are more inclined to develop new products and new functions to promote their own development.

5. Conclusion and Discussion

In order to promote the technological innovation behavior of Chinese private enterprises, it is necessary to give an insight into the choices that private enterprises may have for innovative financing. To private enterprises, choosing an appropriate financing method and making good decisions on financing will help improve their innovation levels to form their core competitiveness and promote innovation throughout China. To the government, the paper provides the theoretical support for the policies that have been announced and is beneficial to make more targeted policies, which helps China's private enterprises have better access to innovation financing and promotes their innovation and development. This paper systematically reviews the literature that is based on the innovation theory and the pecking order theory and studies the relationship between the external financing methods and the technological innovation behavior of private enterprises based on the data from the survey of Chinese private enterprises by World Bank in 2012. The results are expressed as follows.

- (1) Both internal financing and external financing can significantly promote the technological innovation behavior of private enterprises, and compared with external financing, the main source of funds for the innovation activities of private enterprises from internal financing better promotes the technological innovation behavior of enterprises, which is consistent with the conclusion of most scholars [12, 29].

Investment in enterprise innovation needs long-term, uninterrupted input of a large amount of funds and is featured with highly uncertain returns. Based on the problem of asymmetric information, this paper further verifies the pecking order theory, and enterprises will give priority to internal financing channels.

- (2) Among different external financing methods, bank loan and commercial credit play a significant positive role in promoting the technological innovation behavior of private enterprises. Furthermore, bank loans have the most significant impact on the technological innovation behavior of private enterprises, followed by commercial credit. Bank loan is the main source of external financing for private enterprises, which can not only promote product innovation but also process innovation of enterprises. The targeted medium-term lending facility (TMLF), an instrument created by the PBOC for private enterprises, provides a long-term and stable source of funds for the innovation of private enterprises. This paper further provides theoretical support for this policy. Since this policy provides the driving force for enterprises with small amount of internal capital to innovate enterprises, it is conducive to the improvement of technological innovation among private enterprises in an all-around way, thus bringing about the development of innovation performance. In addition, the CBRC has issued policies and measures to encourage banking financial institutions to increase credit support for private enterprises, and blindly delaying or suspending loans is not allowed. Through the establishment of a law-based society and the improvement of the legal system, the interests of enterprises providing commercial credit can be effectively guaranteed. Let these enterprises organically combine bank loans and commercial credit, jointly promote the development of technological innovation behavior of private enterprises, and improve the innovation ability of private enterprises.

There are some deficiencies in this paper, and they should be further discussed in the future. First of all, there is deficiency of data. The data in this paper are from the survey by World Bank in 2012, but it is 2019 this year. The lack of the latest annual data may lead to the conclusion of lagging behind or inconsistent with the actual situation, which may weaken the research significance somehow. The data in this paper are merely the data of the fiscal year 2011, and they are not involved with a certain period or continuous years, which may lead to some deviations in results. Secondly, this paper only considers the impact of financing methods on technological innovation behavior, and it did not consider the different influences of different financing methods on technological innovation of enterprises, or it further focuses on the in-depth study of the impact of a specific financing method on technological innovation behavior and performance. In the future research, we will have a systematic and

comprehensive consideration of other factors that affect the financing methods and technological innovation behavior of enterprises to enrich and improve the existing research from the following aspects. (1) What is the mechanism of private enterprises' financing mode affecting enterprises' technological innovation behavior? (2) What are the mechanisms of other factors that affect the selection of technological innovation behavior of private enterprises? (3) How to promote the innovation behavior of private enterprises more effectively so as to improve their innovation capability?

Data Availability

The data used to support the findings of this study are available at <https://microdata.worldbank.org/index.php/catalog/1559/datafile/F1>.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This study was supported by the rolling support project "Monetary Policy to Stabilize Prices in the Economic Transition Period" (no. IRT_17R52) under the "Innovation Team Development Plan" of the Ministry of Education of the People's Republic of China, the Special Fund for Basic Scientific Research and Business Expenses of Central Universities (no. 010414380001), the general program "Research on Coordination of Monetary Policies and Capital Regulation under the Credit Transmission Channel" (no. 71673132) of the National Natural Science Foundation of China, the project "Research on the Transformation and Upgrading of China's Manufacturing Industry Based on the "Internet Plus"" (no. 71673145) of the National Natural Science Foundation of China, and the Research Project of Philosophy and Social Sciences in Universities of Jiangsu Province (2020SJA2287).

References

- [1] The State Council, "Notice of the general office of the state council on focusing on the concerns of enterprises and further promoting the implementation of policies for optimizing business environment," 2018, http://www.gov.cn/zhengce/content/2018-11/08/content_5338451.
- [2] Xinhua News Agency, *Making Good Use of the "Three Arrows" to Broaden the Financing Channels for Private Enterprises - Interview with Yi Gang, Governor of the People's Bank of China*, http://www.gov.cn/zhengce/2018-11/06/content_5337948.htm, 2018.
- [3] Mancusi and R. Davide, "Charity, and J. Cugnon. Unified description of fission in fusion and spallation reactions," *Physical Review*, vol. 82, no. 4, pp. 44610–0, 2010.
- [4] J. Luo, "Financing constraints, foreign direct investment and technological innovation of private enterprises," *Journal of Central University of Finance and Economics*, vol. 1, pp. 96–103, 2017.
- [5] F. Wang, S. Liu, and L. Xiao, "The impact of financing structure on technological innovation of high-tech

- enterprises: an Empirical Analysis Based on information technology enterprises,” *North China Finance*, vol. 8, 2017.
- [6] X. Zhang, G. Chen, G. Yang et al., “Does the ownership nature of enterprises affect the innovation performance of industry-university-research cooperation?” *Studies in Science of Science*, vol. 6, pp. 934–942, 2015.
- [7] Z. Hu and F. Ting, “Research on the impact of external financing structure on technological innovation of enterprises -- an empirical analysis based on the listed companies in information technology industry of China,” *Journal of Industrial Technological Economics*, vol. 37, no. 1, pp. 3–10, 2018.
- [8] V. Malhotra and P. Sasidharan, “Anaesthesia for decompen-sating cardiac function secondary to a rare large left ventricular tumour,” *European Journal of Anaesthesiology*, vol. 31, p. 69, 2014.
- [9] H. Li and S. Liu, “bank credit, ownership nature and enter-prise innovation,” *Studies in Science of Science*, vol. 33, no. 7, pp. 1089–1099, 2015.
- [10] Li Chong, C. Zhong, and Xu Xu, “Financing structure and enterprise technological innovation -- an empirical analysis based on the data of China’s listed companies,” *Shanghai Journal of Economics*, vol. 7, pp. 64–72, 2016.
- [11] J. Fu, “Tax evasion, commercial credit financing and enter-prise performance,” *Journal of Shanxi University of Finance and Economics*, vol. 2, pp. 87–98, 2017.
- [12] H. Li, Y. Tang, and J. Zuo, “Innovate with your own money or others’ money? - a research based on financing structure and corporate innovation of China’s listed companies,” *Journal of Financial Research*, vol. 2, pp. 170–183, 2013.
- [13] Z. Sun and L. Xiao, “Financing structure and enterprise independent innovation -- empirical evidence from A-share listed companies in China’s strategic emerging industries,” *Economic Theory and Business Management*, vol. V36, no. 3, pp. 45–58, 2016.
- [14] C. Bloch, “Assessing recent developments in innovation measurement: the third edition of the Oslo Manual,” *Science & Public Policy (SPP)*, vol. 34, no. 1, pp. 23–34, 2007.
- [15] S. C. Myers and N. S. Majluf, “Corporate financing and investment decisions when firms have information that investors do not have,” NBER Working Papers, 1984.
- [16] B. H. Hall and J. Lerner, *The Financing of R&D and Innovation*, UNU-MERIT Working Papers, 2009.
- [17] Q. Tang and C. Wu, “Research on enterprise internal and external R & D and innovation performance based on synergy effect,” *Journal of Management Science*, vol. 5, pp. 12–23, 2014.
- [18] Ju, “Xiaosheng. Financing sources and smoothing mechanism of innovation investment of China’s listed enterprises,” *The Journal of World Economy*, vol. 4, pp. 138–159, 2013.
- [19] L. Yu, *Research on the Impact of Financial Structure on Technological Innovation*, Southwest University, Chongqing, China, 2014.
- [20] M. Amiti and D. E. Weinstein, “Exports and financial shocks,” *The Quarterly Journal of Economics*, vol. 126, no. 4, pp. 1841–1877, 2011.
- [21] Z. Lu, J. Zhu, and Z. Fan, “Monetary tightening, credit discrimination and investor profit loss of private listed companies,” *Journal of Financial Research*, vol. 8, pp. 124–136, 2009.
- [22] M. Yu and H. Pan, “Financial development, commercial credit and product market competition,” *Management World*, vol. 8, 2010.
- [23] P. Sun, F. Li, and L. Gu, “Whether commercial credit can be an effective financing channel for enterprises -- an analysis based on the perspective of investment,” *China Economic Quarterly*, vol. 13, no. 4, pp. 1637–1652, 2014.
- [24] L. Zhang and F. Zhang, “Life cycle, executive compensation incentive and enterprise innovation investment -- empirical evidence from GEM listed companies,” *Journal of Zhongnan University of Economics and Law*, vol. 1, pp. 146–156, 2018.
- [25] T. Yuejun, L. Feishi, and C. Xinsheng, “Large shareholder balance, governance strategy and information disclosure: evidence from Chinese Listed Companies in 2003,” *Economics: Quarterly*, vol. 2, pp. 269–286, 2008.
- [26] M. Yang, W. Jiang, and L. Luo, “Evaluating collaborative innovation ability of school-enterprise cooperation,” *Open Journal of Business and Management*, vol. 3, no. 1, pp. 75–82, 2015.
- [27] Y. Rao and Y. Chen, “Enterprise informatization, knowledge sharing and enterprise performance,” *Finance and Trade Economics*, vol. 7, pp. 126–132, 2012.
- [28] X. Wang, G. Fan, and F. Li, “Business environment index for China’s provinces 2011,” CITIC press, Beijing, China, 2012.
- [29] X. Cao, “Financing constraints and enterprise R & D investment: an empirical study based on enterprise level data,” *Soft Science*, vol. 28, no. 12, 2014.