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The Effects of Financing Channels on Enterprise Innovation and Life Cycle in Chinese A-Share Listed Companies: An Empirical Analysis

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Abstract: This paper offers an empirical analysis of the effects of financing channels on innovation and the regulatory effect of the enterprise life cycle based on data published from 2008 to 2017 on publicly traded companies in China. The results show that government subsidies, tax preferences, self-owned funds, and equity financing have significant positive incentives for enterprise innovation, and the incentive intensity is gradually weakened while bank loans will hinder enterprise innovation. The impacts of various financing channels on enterprise innovation vary with the different stages of the enterprise life cycle, and the overall performance is weakened with the advancement of the life cycle. According to the grouping research of property rights, it is found that the impacts of various financing channels on the innovation of non-state-owned enterprises are more significant than those of state-owned enterprises. Further research finds that the influence of each financing channel on enterprise innovation is U-shaped or inverted U-shaped, indicating that there is a moderate range of each financing channel. This study is of great significance to fully understand the impacts of various financing channels on enterprise innovation and the regulatory role of the enterprise life cycle and to optimize the allocation of innovation resources.

Keywords: financing channel; enterprise innovation; life cycle; financial subsidy; tax preference; self-owned funds

1. Introduction

Innovation is the primary driving force for enterprise development. It is becoming a global social and society activity [1] and a path to survival and growth [2]. Innovation also carries the costs of long period high investment and risk and low information transparency. This limits the level of innovation and R&D in most enterprises [3]. Sustained capital investment [4] requires enthusiasm to stimulate innovation. Various countries have enacted funding policies to encourage enterprise innovation. This exogenous source of financing has been made available in addition to government subsidies, tax benefits, bank loans, equity financing, and crowdfunding. These approaches encourage endogenous financing by means of the enterprises' own funds. Previous studies have focused on the impact of single or partial financing channels on enterprise innovation [5–8] rather than a more

holistic investigation of the impact of exogenous and endogenous financing channels on enterprise innovation [9]. The life cycle is another important characteristic of enterprises [8,10]. It affects the size, growth patterns, cash flow, financing ability, and enterprise objectives. Innovation needs and intensity vary depending on the stages of the life cycle. It is assumed that there is heterogeneity in the influence of each financing channel on enterprise innovation behavior in different life cycle stages.

The purpose of this paper is to identify which stage of each financing channel will play the biggest role in enterprise innovation, to achieve the best effect of each financing channel on enterprise innovation. This paper presents an empirical analysis on the impact of each financing channel on innovation input intensity and innovation output to comprehensively investigate the impact of various financing channels on enterprise innovation and the moderating effect of different life cycle stages based on the data of Chinese listed companies from 2008 to 2017. China, unlike many neighboring countries, was not subject to total colonial rule. This historical effect has had an impact on the country's contemporary mix of a unique environment, rich culture, and a strong and stable government [11], and this article is of great significance to understand the innovation of Chinese enterprises. This contributes to a unique study that may be of interest to readers based in other countries. In this study, the research seeks to investigate the following issues: (1) The influence direction and significance of different financing channels on enterprise innovation are not consistent; government subsidy, tax concessions, own funds, and equity financing can significantly enhance the innovation intensity and innovation output of enterprises; and the innovation incentive effect of government subsidy comes first, tax concessions second, own funds third, equity financing is the weakest, and bank loans significantly inhibit enterprise innovation; (2) The incentive effect of each financing channel to enterprise innovation varies in the different enterprise life cycle, and it is gradually weakened with the progress of the life cycle; (3) According to the research grouped by the nature of holding property rights, it is found that the incentive effect or inhibition effect of each financing channel on the non-state-owned holding enterprise is stronger than that on the state-owned holding enterprise. The empirical research hypotheses are itemized and discussed throughout the text, and their analysis is carried out and described in the methodology section.

The research contributions of this paper are reflected in the following three aspects. First, it comprehensively examines the influence of various channels of internal and external financing on enterprise innovation and avoids the deficiency of only examining single financing channels. This paper examines the impact of the five most important financing channels, such as government subsidies, tax concessions, bank loans, equity financing, and self-owned funds on innovation intensity and output of enterprises. Through comprehensive investigation, the degree of influence of various financing channels on enterprise innovation can be visualized. It avoids the deficiency that we can only observe the effect of one financing channel.

Second, it deepens the understanding of the adjustment effect of the enterprise life cycle on financing channels and enterprise innovation. The influence of financing channels on enterprise innovation may vary according to the life cycle of the enterprise, and observing the regulatory effect of enterprise life cycle on the impact of each financing channel on enterprise innovation can more clearly grasp the key stage of the role of each financing channel. This paper finds that the influence of various financing channels on enterprise innovation is weakened with the progress of the enterprise life cycle, which indicates that more sufficient financial support should be provided for enterprise innovation in the early stages. This result is conducive to optimizing the allocation of innovative resources and can maximize incentives for enterprises to carry out innovative activities.

Third, the influence of the financing channel on enterprise innovation is studied from the perspective of the non-linear effect. The existing literature assumes that financing channels show a linear relationship with enterprise innovation, but this paper finds that, for both the overall sample and the sample of different life cycle stages, the influence of each financing channel on enterprise innovation shows a non-linear relationship of U or inverted U, which indicates that the influence of each financing channel on enterprise innovation has a moderate range. Therefore, promoting enterprise innovation

is not only to increase capital input but also to carry out scientific and reasonable capital support, otherwise, even a large amount of capital input may hinder enterprise innovation. The theoretical analysis and hypotheses are presented in the following section.

2. Theoretical Analysis and Hypotheses

2.1. Financing Channels and Enterprise Innovation

Innovation is a high-risk enterprise activity, which requires large and sustainable long-term capital investment. It is highly uncertain whether investment in innovation can bring revenue. It requires a long time with the stages of innovation transformation, market development, and promotion to produce the revenue. Consequently, enterprise innovation often faces serious financing constraints. The financing sources for enterprise innovation include exogenous financing and endogenous financing. Given the positive externality of innovation and its extreme importance to social progress, governments are constantly introducing policies to ease financing constraints and stimulate enterprise innovation. Thus, the importance of exogenous financing to enterprise innovation is gradually increasing and has become an important source of enterprise innovation funds [12]. According to the different main bodies of capital supply, exogenous financing mainly includes government subsidy, tax preference, and bank loans. Crowdfunding has become one of the popular funding channels among enterprises and entrepreneurs for raising funds to finance new projects [13] using internet platforms. It is an efficient and low cost means of providing new financing ideas for innovation [14]. Crowdfunding can be equity based, where investors seek to maximize their financial returns through gaining shares and profits of the enterprises. It can be loan-based, where investors seek to maximize financial returns while mitigating the risk of default; it can be reward-based, where the implementation of the project results in certain intangible rewards; and it can be donor-based, where no monetary benefits are gained by donors [15]. Crowdfunding projects have significant (although often exaggerated) impacts on the success of financing [16]. The Chinese crowdfunding market is the largest in the world, with the number and size of platforms used by local enterprises increasing rapidly [17]. Crowdfunding has significant potential for small enterprises; this paper focuses on the relatively large-scale A-listed companies in China that rely on other traditional channels of funding. Whereas endogenous financing refers to an enterprise's own funds, the mechanism of different financing channels on enterprise innovation is different.

2.1.1. Government Subsidies and Enterprise Innovation

Government subsidy is one of the fiscal policy tools used to solve the market failure of innovative capital allocation in enterprises [18]. Enterprises can obtain government subsidies only if their innovative projects are evaluated by an expert group. Hence, government subsidies have a signal display effect, which is a certification effect [19–21]. This can alleviate the problem of information asymmetry between enterprises and financial institutions [22], which is conducive to raising funds for enterprise innovation. Government subsidies are mostly ex-ante incentives, and the incentive effect of R&D in the early stage of enterprise is more obvious. At the same time, it was pointed out that the acquisition cost of government subsidies is low compared with other channels [23]. The non-reimbursable nature of government subsidies can stimulate the innovation enthusiasm of enterprises by directly sharing the cost and risk of enterprise innovation, or by increasing the profits of enterprises through government subsidies, easing the financial constraints of R&D department investment.

There are two opinions regarding the influence of government subsidies on enterprise innovation, such as the support effect and the squeeze effect. The support effect suggests that government subsidies have significant positive effects on both R&D inputs and innovation outputs [24–26]. Previously, it was found that among the numerous financing channels, government subsidies mostly stimulate enterprise innovation [27,28]. The squeeze effect suggests that government subsidies will squeeze out enterprise R&D investment [29,30]. Besides, it was also reported that the number of enterprises innovation outputs

increased but the quality of innovation did not improve in enterprises after obtaining government subsidies from government support funds [31]. However, in general, the support effect is dominant in the previous literature. The purpose of government subsidy for enterprise innovation is to solve potential market failure under market-oriented resource allocation. As long as there are good projects, enterprises can get government subsidies after evaluation. Accordingly, government subsidies can reduce the cost and transfer the risk of enterprise innovation. At the same time, it can better encourage enterprises to increase R&D investment and stimulate the enthusiasm of enterprise innovation.

Hypothesis 1. *Government subsidies will encourage enterprises to increase innovation intensity and increase innovation output.*

2.1.2. Tax Preference and Enterprise Innovation

Tax preference is another important fiscal policy tool to stimulate enterprise innovation, and it is also an important means to internalize the externality of innovation activities [32]. Tax preference is a subsequent incentive measure that can take various forms, such as reducing the tax rate, tax amount, and tax return, with the aim of reducing innovation costs. By reducing R&D costs and tax burden, enterprises can get more innovation income, which can stimulate them to increase R&D investment [33]. It was found that tax preference has significant incentive effects on enterprise innovation intensity [34]. Through a comparative analysis of the incentive effects of government subsidies and tax preferences on enterprise innovation, Oliviero [35] found that these two financing channels can encourage enterprises to increase R&D investment, but the incentive effect of tax preferences is stronger. Moreover, when considering the difference in enterprises' property rights, Wang et al. [36] pointed out that the innovation incentive effect of non-state-owned enterprises is better than that of state-owned enterprises. Tax preference reduces the cost and increases the benefits of innovation by internalizing externality and solves the problem of the positive externality of enterprise innovation. Tax preference means that the more innovation output and innovation value an enterprise has, the greater the revenue of tax preference it can enjoy. Tax preference not only stimulates the enterprise to increase innovation input but also increases the innovation output.

Hypothesis 2. *Tax preference can encourage enterprises to increase innovation intensity and output.*

2.1.3. Bank Loans and Enterprise Innovation

Bank loans are the main source of debt financing [37] and can effectively alleviate the financial difficulties faced by enterprises. Yet it is not an effective financing means for enterprise innovation. Enterprise innovation is a long-term venture capital activity, and bank loans prefer low-risk ones. The risk of innovation is high and the uncertainty of income is great, while bank loans focus on the determined interest income to avoid risks. That is why the loan return of the bank does not match the cost of the risk [38]. Therefore, banks are not interested in such high-risk activities as enterprise innovation and therefore are unwilling to provide financial support for them. Innovation requires long-term, sustainable, and stable capital investment [39], while bank loans are usually short-term. Thus, there is a mismatch between the terms of bank loans and the demand for innovative capital. Bank loans usually need to provide valuable assets as collateral, especially for some technology companies and start-up companies. On one hand, enterprise innovation needs high investment, on the other hand, there is a lack of fixed assets, hence it is difficult to obtain financial support from bank loans. Even if the bank participates in enterprise innovation, it is often in the stage of innovation transformation rather than the early stage of R&D, because this stage can bring a more stable cash flow and the enterprises in this stage have more assets that can be used as loan collateral, which can ensure the safety of bank funds. Scholars have come to a more consistent conclusion that bank loans are not conducive to enterprise innovation. For instance [40], bank loans have no significant contribution to

enterprise technological innovation. Similarly [41], debt financing will hinder enterprise innovation and aggravate the continuous innovation dilemma of enterprises [38].

Hypothesis 3. *Bank loans are not conducive to enterprises to increase innovation input and enhance innovation output.*

2.1.4. Equity Finance and Enterprise Innovation

In the developed capital market, equity financing is an important tool for enterprise innovation [42]. Equity issuance can promote R&D input and innovation output [43] but nevertheless, at the present stage in China, equity financing is a beneficial yet limited financing source for enterprise innovation. The reason why it is beneficial is that equity financing needs to be fully open to the public. This can help alleviate the information asymmetry between innovators and investors and promote enterprise innovation. At the same time, compared with bank financing, the shareholders who pursue high returns are willing to bear corresponding higher risks, that is, higher return of investors is consistent with the higher risk incentives they undertake [44]. Thus, if there is a need for innovative financing, equity investors will have the willingness to invest, yet rational investors will also avoid higher risk innovative projects. Yenchu's study [45] provided evidence that venture capital is an important form of equity financing. However, venture capital is usually used in the commercialization stage of enterprise innovation, which is relatively late. Compared with other financing means, the stability of equity determines that the innovator does not have to pay back the principal and interest and can provide long-term and stable financial support [25]. Nonetheless, currently, in China's capital market, equity financing still faces relatively strict regulations, not being a flexible financing tool. Consequently, equity financing has a beneficial but limited role in enterprise innovation.

Hypothesis 4. *Equity financing is conducive to enhancing the innovation intensity and output of enterprises.*

2.1.5. Self-Owned Funds and Enterprise Innovation

According to the Pecking Order Theory [46], internal financing is more important than external financing for enterprise innovation and can promote related innovation activities [47]. On the one hand, start-up enterprises in particular, due to the lack of fixed asset mortgage, find it difficult to obtain the support of bank loans and other funds. On the other hand, because of the high uncertainty of innovation, they also find it difficult to obtain sufficient equity financing and government subsidies. Even if tax preference can be obtained, they are often only a subsequent incentive measure. Therefore, Brown et al. [48] and Zhang [49] found that self-owned capital serves as the main source of enterprise innovation. At the same time, the enterprise itself is more certain about the ability of its research team and prospects of its R&D projects, thus it is more willing to invest its internal funds into innovation activities. Compared with other financing means, it is more stable and not easily affected by the macro environment. Zhong et al. [50] reported that, in the face of tighter monetary policy, enterprise innovation is more dependent on internal capital.

Hypothesis 5. *Self-owned funds will be beneficial to innovation R&D input and innovation output.*

2.2. The Influence of the Life Cycle on the Relationship between Financing Channel and Enterprise Innovation

Enterprises have different development goals, levels of risk, innovation incentives, willingness, ability, capital, and performance targets in different life cycle stages [8]. Tax preferences enjoyed by enterprises will vary with different life cycle stages [51], and financing sources will have different incentive effects in different stages. In the early stage, a capital constraint is the biggest problem faced by enterprise innovation due to the serious problem of information asymmetry [52]. Chen et al. [8] found that government subsidies can stimulate the development innovation activities of manufacturing

and service enterprises in the growing period, as well as the exploration innovation activities of manufacturing enterprises in the mature period. In contrast, Tong et al. [53] reported that government subsidies significantly stimulate the technological innovation of mature enterprises but have little impact on the growing and declining period. It was also found that government subsidies have a more significant impact on non-state-owned enterprises. Chen et al. [8] found that tax preferences stimulate technological innovation in the mature manufacturing industry. Zhou et al. [54] suggested that government subsidies and tax preference have significant relationships with innovation performance but their roles in growing and declining enterprises are weakened. Bank loans focus more on stable returns and risk avoidance and are not involved in innovation and R&D in the early stage. With the growth of enterprises, their funds grow from small to large scale, which helps alleviate the difficulty of innovation financing. The severity of information asymmetry and the difficulty of equity financing varies with different life cycles.

Hypothesis 6. *The incentive effects of different financing channels on enterprise innovation vary with distinct stages of the enterprise life cycle.*

2.3. The Relationship between Financing Channels and Enterprise Innovation with Different Nature of Holding Property Rights

Enterprises with different properties of holding property rights have significant differences in policy treatment, capital sources, operation, and management. Therefore, different financing channels will have different influences on the innovation of enterprises with different properties of holding property rights. The financing structure of enterprises with different property rights has a differentiated impact on enterprise innovation [55]. Wang et al. [33] posited that non-state-owned enterprises will be more sensitive to tax preferential policies because they face greater financing constraints. It was also suggested that, because of differences in resource endowment and organizational management ability, compared with state-owned enterprises, government subsidies have a significantly greater incentive effect on the innovation of non-state-owned enterprises [56]. Dai and Cheng [57] found that, in a sample of non-state-owned enterprises, the promotion of high technology industry innovation intensity from government subsidy is bigger. Jia and Ma [58] found that the incentive effect of R&D tax incentives for the non-state-owned enterprises is superior to state-owned enterprises compared with non-state-owned holding companies, while the technology innovation performance of state-owned enterprises is higher input and lower output [9].

Hypothesis 7. *Different financing channels have different influences on the innovation of enterprises with different nature of holding property rights.*

3. Research Design

3.1. Data Sources and Data Processing

The study is based on Chinese A-share listed companies. Publicly listed companies began to disclose R&D investment and patent data in 2007, but the data for that year were not complete. Therefore this study is based on data from 2008 onwards. The latest patent data available in the CSMAR database is from 2017, so the sample time interval selected in this paper is from 2008 to 2017. The data were obtained from the CSMAR database, and 23,728 annual sample observations were collected after omitting incomplete data samples.

3.2. Stage Division of Enterprise Life Cycle

There are several ways to divide the enterprise life cycle stages. Dickinson [59] divided the life cycle of an enterprise into the initial stage, growth stage, maturity stage, turbulence stage, and decline stage according to different directions of cash flow from operating activities, investment activities,

and financing activities. This division method has been widely recognized by scholars. Based on Dickinson's classification method and the specific practices of Xie and Wang [60], this study divides the enterprise life cycle into three stages; growth stage, maturity stage, and decline stage. The specific basis of the division is shown in Table 1. In Table 1, "+" indicates that the net cash flow is positive, and "-" indicates that the net cash flow is negative.

Table 1. Enterprise cash flow characteristics and life cycle stage division.

Net Cash Flow	Growth Stage		Mature Stage			Decline Stage	
	Initial Stage	Growth Stage	Mature Stage	Turbulence Stage	Turbulence Stage	Turbulence Stage	Decline Stage
Operating cash flow	–	+	+	–	+	+	–
Investment cash flow	–	–	–	–	+	+	+
Financing cash flow	+	+	–	–	+	–	–

3.3. Model Design

In order to test the impact of various financing channels on enterprise innovation, this study develops a regression model, as shown in Model (1):

$$Innovation = \alpha_0 + \alpha_1 Finance + \alpha_2 Roa + \alpha_3 AT + \alpha_4 Size + \alpha_5 Age + \alpha_6 Soe + \alpha_7 Growth + \sum Year + \sum Ind + \varepsilon \quad (1)$$

To test the moderating effect of the enterprise life cycle on the influence of various financing channels on enterprise innovation, the study applies regression models based on the study of Liang et al. [61], which are shown below as Model (2) and Model (3):

$$Innovation = \alpha_0 + \alpha_1 Finance + \alpha_2 Elife + \alpha_3 Finance \times Elife + \alpha_4 Roa + \alpha_5 AT + \alpha_6 Size + \alpha_7 Age + \alpha_8 Soe + \alpha_9 Growth + \sum Year + \sum Ind + \varepsilon \quad (2)$$

$$Innovation = \alpha_0 + \alpha_1 Finance + \alpha_2 Finance \times Elife2 + \alpha_3 Finance \times Elife3 + \alpha_4 Elife2 + \alpha_5 Elife3 + \alpha_6 Roa + \alpha_7 AT + \alpha_8 Size + \alpha_9 Age + \alpha_{10} Soe + \alpha_{11} Growth + \sum Year + \sum Ind + \varepsilon \quad (3)$$

3.3.1. Dependent Variables

Innovation intensity and innovation output were selected as dependent variables to comprehensively test the impact of financing channels on enterprise innovation. Innovation intensity (*RD*) can reflect the willingness of enterprises to engage in innovation, which is measured by the proportion of R&D expenditure in total revenue. Li and Zheng [31] found that, to obtain government subsidies, the enterprises actively improve innovation output, yet the quality of innovation does not significantly increase. To examine the influence of various financing channels for substantive innovation, this study chooses the natural logarithm of invention patents authorized number (*Igrant*), reflecting the innovation quality most used to measure innovation output.

3.3.2. Explanatory Variables

In order to comprehensively investigate the impact of various financing channels on enterprise innovation, five key explanatory variables (*Finance*) are selected to measure the financial support of each financing channel on enterprise innovation. Following Ju [62] and Li et al. [28], the study uses the proportion of government subsidies in the initial total assets to measure subsidies variables (*Gov*), the proportion of received tax rebates in the initial total assets to measure the tax preference variable

(*Tax*), the proportion of cash received from borrowed money in the initial total assets to measure bank loans variable (*Loan*), the proportion of cash received from equity investment in the initial total assets to measure equity financing variable (*Equity*), and the proportion of initial cash and cash equivalent balance in the initial total assets to measure the self-owned capital variable (*Own*). According to the results of the enterprise life cycle stage shown in Table 1, *Elife* in Model (2) is assigned, which is: (1) when the enterprise is in a growth stage; (2) when it is in the maturity stage; and 3) when it is in the decline stage. In Model (3), *Elife2* is a dummy variable, which is '1' when the enterprise is in the mature period, and otherwise is '0'. *Elife3* is also a dummy variable, which is '1' when the enterprise is in recession, or '0' if it is not.

3.3.3. Control Variables

Based on existing literature, the ratio of total asset turnover rate (*AT*) and the proportion of operating income in annual average assets were controlled during the research. Return on total assets (*ROA*), the ratio of net profit of the year to total assets at the end of the period. Growth of operating income (*Growth*), the growth rate of operating income of the current year over the previous year; *age* of the company (*Age*), the natural logarithm of the years of company establishment; enterprise-scale (*Size*), the natural log of the total assets at the end of the year; property right nature (*Control*), a dummy variable is '1' when the enterprise is state-controlled, '0' if not; year (*Year*), and industry (*Ind*) dummy variables are also controlled. To avoid the influence of outliers on regression results, continuous variables were winsorized (1%, 99%) during regression. Stata 16.0. was employed to perform the analysis.

4. Empirical Research

4.1. Descriptive Analysis of Variables

Table 2 reports the results of a descriptive statistical analysis of variables. The descriptive statistical results of enterprise innovation variables show that the mean value of innovation intensity of sample enterprises is 2.63%, the minimum value is 0, the maximum value is 21.19%, and the standard deviation is 0.0379, indicating that there are significant differences in innovation intensity of different enterprises. The maximum value of invention patents authorized number is 4.1897, the median value is 0, and the standard deviation is higher than the mean value, which also indicates that there are significant differences in invention patents authorized number among different enterprises. The statistical results of financing channels of enterprises innovation show that the mean value, maximum value, and standard deviation of government subsidies are 0.055%, 4.74%, and 0.078%, indicating that there are significant differences in the level of government subsidies for different enterprises. The maximum value of tax incentives is 7.15%, and the minimum value is 0. The maximum value of the bank loan is 82.51%, and the minimum value is 0. The maximum value of equity financing is 61.56%, and the minimum value is 0. The maximum value of self-owned funds is 66.81%, and the minimum value is 0.065%. The above statistical results show that there are significant differences in the financing ability of different enterprises through various financing channels. Descriptive analysis results for other variables are also reported in Table 2.

Table 2. Descriptive analysis of variables.

Variables	N	Mean	Std. Dev.	p50	Min	Max
<i>RD</i>	23,728	0.0263	0.0379	0.0105	0.0000	0.2119
<i>Igrant</i>	23,728	0.6533	0.9795	0.0000	0.0000	4.1897
<i>Gov</i>	23,728	0.0055	0.0078	0.0028	0.0000	0.0474
<i>Loan</i>	23,728	0.1834	0.1817	0.1409	0.0000	0.8251
<i>Tax</i>	23,728	0.0058	0.0120	0.0007	0.0000	0.0715
<i>Equity</i>	23,728	0.0499	0.1209	0.0000	0.0000	0.6156
<i>Own</i>	23,728	0.1542	0.1343	0.1117	0.0065	0.6681
<i>AT</i>	23,728	0.6663	0.4679	0.5588	0.0503	2.6456
<i>Roa</i>	23,728	0.0441	0.0624	0.0398	−0.1982	0.2363
<i>Growth</i>	23,728	0.2018	0.5866	0.0910	−0.6171	4.3304
<i>Age</i>	23,728	2.7060	0.3949	2.7726	1.3863	3.3673
<i>Size</i>	23,728	21.9219	1.3121	21.7689	19.1466	25.8755
<i>Control</i>	23,728	0.3800	0.4854	0.0000	0.0000	1.0000

4.2. Correlation Analysis of Major Variables

Table 3 shows the Pearson correlation between major variables. The results show that government subsidies, tax preference, equity financing, and self-owned funds are significantly positively correlated with innovation intensity at the 1% level. In addition to their own funds, the above variables are significantly positively correlated with the invention patents authorized at the level of 5% or 1%. The above results show that these financing channels have significant incentive effects on innovation intensity and innovation output. However, the variable of bank loans is significantly negatively correlated with enterprise innovation intensity and invention patents authorized number at the 1% level, indicating that the increase of bank loans will hinder enterprise innovation. According to Table 3, correlation coefficients of all variables are lower than 0.31, and the variance inflation factor (VIF) of all variables during regression is within 3, indicating that there is no serious multicollinearity among variables.

4.3. Regression Analysis

4.3.1. The Impact of Financing Channels on Enterprise Innovation

Table 4 presents the regression results of financing channels on the full sample of enterprise innovation and by the life cycle stage. Columns (1)–(4) show the regression results of financing channels on innovation intensity. Column (1) shows that when conducting full sample regression, government subsidies, tax preference, equity financing, and self-owned funds are significantly positively correlated with innovation intensity at the 1% level, indicating that the above financing channels will significantly stimulate enterprises to enhance investment in innovation, actively engaging in innovation R&D. However, bank loans are significantly negatively correlated with innovation intensity at a 1% level, which means that more bank loans will hinder enterprise innovation activities. Columns (2)–(4) present the influence of various financing channels on innovation intensity according to the stage of the enterprise life cycle. The results show that the relationship of innovation intensity in the maturity stage and equity financing is not significant, and the other results are highly consistent with Column (1). By observing the regression coefficient of each financing channel on different life cycle stages and innovation intensity, it can be seen that government subsidies, tax preference, and self-owned funds have the best incentive effect on the innovation intensity in the growth period, followed by the maturity period, while the incentive effect on the innovation intensity in the recession period is the weakest. By comparing and analyzing the incentive effect of various financing channels from Column (1) to Column (4) on enterprise innovation intensity is expressed as: Government Subsidy -> Tax Preference -> Self-owned Capital -> Equity Financing.

Table 3. Correlation analysis of major variables.

Variable	<i>RD</i>	<i>Igrant</i>	<i>Gov</i>	<i>Loan</i>	<i>Tax</i>	<i>Equity</i>	<i>Own</i>	<i>AT</i>	<i>ROA</i>	<i>Growth</i>	<i>Age</i>	<i>Size</i>
<i>Igrant</i>	0.240 ***											
<i>Gov</i>	0.119 ***	0.053 ***										
<i>Loan</i>	−0.175 ***	−0.024 ***	−0.008									
<i>Tax</i>	0.077 ***	0.096 ***	0.097 ***	0.061 ***								
<i>Equity</i>	0.110 ***	0.014 **	0.015 **	−0.121 ***	0.004							
<i>Own</i>	0.129 ***	0.006	0.018 ***	−0.167 ***	0.034 ***	−0.102 ***						
<i>AT</i>	−0.146 ***	0.022 ***	−0.008	0.177 ***	0.169 ***	−0.003	−0.016 **					
<i>ROA</i>	0.022 ***	0.018 ***	0.028 ***	−0.085 ***	0.003	0.067 ***	0.140 ***	0.046 ***				
<i>Growth</i>	−0.004	−0.005	0.001	−0.004	0.000	−0.003	−0.003	0.000	0.000			
<i>Age</i>	−0.129 ***	−0.059 ***	−0.037 ***	0.047 ***	−0.045 ***	−0.181 ***	−0.088 ***	−0.025 ***	−0.034 ***	0.010		
<i>Size</i>	−0.156 ***	0.198 ***	−0.109 ***	0.201 ***	−0.073 ***	−0.135 ***	−0.185 ***	0.036 ***	−0.015 **	−0.001	0.139 ***	
<i>Control</i>	−0.218 ***	−0.058 ***	−0.014 **	0.094 ***	−0.043 ***	−0.171 ***	−0.060 ***	0.041 ***	−0.042 ***	0.007	0.149 ***	0.308 ***

Note: *, **, *** respectively represents significance at the level of 10%, 5%, and 1%.

Table 4. The impact of financing channels on enterprise innovation.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Samples	Growth Stage	Mature Stage	Decline Stage	All Samples	Growth Stage	Mature Stage	Decline Stage
	RD	RD	RD	RD	Igrant	Igrant	Igrant	Igrant
<i>Gov</i>	0.7034 *** (27.98)	0.8611 *** (22.91)	0.5747 *** (15.94)	0.4712 *** (4.90)	10.1341 *** (13.30)	12.5370 *** (10.66)	8.4219 *** (7.72)	9.0848 *** (4.06)
<i>Loan</i>	−0.0084 *** (−7.02)	−0.0096 *** (−5.63)	−0.0089 *** (−4.77)	−0.0149 *** (−3.33)	−0.3140 *** (−8.70)	−0.3015 *** (−5.63)	−0.3513 *** (−6.21)	−0.2381 ** (−2.29)
<i>Tax</i>	0.2400 *** (14.96)	0.2813 *** (11.75)	0.2125 *** (9.13)	0.1642 *** (2.77)	6.1265 *** (12.60)	7.3481 *** (9.81)	5.3238 *** (7.56)	4.1594 *** (3.02)
<i>Equity</i>	0.0200 *** (11.80)	0.0174 *** (8.64)	−0.0060 (−0.57)	0.0265 ** (2.05)	−0.0696 (−1.35)	−0.1679 *** (−2.67)	−0.2713 (−0.85)	−0.0464 (−0.15)
<i>Own</i>	0.0365 *** (22.57)	0.0387 *** (13.33)	0.0359 *** (16.74)	0.0122 * (1.86)	0.1715 *** (3.50)	0.1774 * (1.96)	0.1950 *** (3.01)	0.4160 *** (2.74)
<i>AT</i>	−0.0145 *** (−31.46)	−0.0149 *** (−22.73)	−0.0148 *** (−21.24)	−0.0072 *** (−4.00)	0.0244 * (1.75)	0.0347 * (1.69)	0.0192 (0.91)	−0.0289 (−0.69)
<i>Roa</i>	0.0178 *** (5.27)	0.0192 *** (3.67)	0.0256 *** (5.22)	−0.0354 *** (−3.25)	0.2795 *** (2.74)	0.4486 *** (2.74)	0.1640 (1.10)	−0.2515 (−0.99)
<i>Growth</i>	−0.0006 * (−1.82)	−0.0008 * (−1.83)	−0.0006 (−1.02)	−0.0019 ** (−1.96)	−0.0441 *** (−4.52)	−0.0604 *** (−4.53)	−0.0302 * (−1.76)	−0.0230 (−1.00)
<i>Age</i>	−0.0132 *** (−24.71)	−0.0107 *** (−14.89)	−0.0142 *** (−16.83)	−0.0205 *** (−8.19)	−0.1926 *** (−11.93)	−0.1506 *** (−6.70)	−0.2201 *** (−8.62)	−0.4020 *** (−6.92)
<i>Size</i>	−0.0010 *** (−5.78)	−0.0010 *** (−4.15)	−0.0017 *** (−6.54)	0.0013 * (1.90)	0.2160 *** (42.36)	0.2032 *** (27.55)	0.2408 *** (30.42)	0.1292 *** (7.90)
<i>Control</i>	−0.0045 *** (−10.45)	−0.0037 *** (−5.88)	−0.0046 *** (−7.20)	−0.0038 ** (−2.33)	−0.0448 *** (−3.43)	−0.0481 ** (−2.45)	−0.0425 ** (−2.19)	−0.0086 (−0.22)
<i>ind</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0460 *** (11.26)	0.0397 *** (6.87)	0.0652 *** (10.38)	0.0179 (1.04)	−4.2220 *** (−34.09)	−4.0614 *** (−22.49)	−4.6950 *** (−24.71)	−1.6977 *** (−4.23)
N	23,728	11,815	10,512	1401	23,728	11,815	10,512	1401
Adj-R2	0.4442	0.4487	0.4583	0.3298	0.2351	0.2242	0.2423	0.2513
F	513.5138	260.9251	241.3806	20.1386	198.0677	93.2712	91.8581	14.0497

Note: *, **, *** respectively represent significance at the level of 10%, 5%, and 1%. T value (below) is presented below each.

Columns (5)–(8) in Table 4 show the influence of various financing channels on the innovation output of enterprises. Column (5) is the full sample regression, and Columns (6)–(8) show a phased regression according to the different enterprise life cycles. The regression results of Column (5) show that government subsidies, tax preferences, and self-owned funds are significantly positively correlated with invention patents authorized number at the 1% level, while equity financing is not significantly negatively correlated with innovation output, and bank loans are significantly negatively correlated with innovation output at the 1% level. The regression results by life cycle stage also show that government subsidy, tax preference, and self-owned funds are significantly positively correlated with innovation output, equity financing is only negatively correlated with innovation output in the growth stage, and a bank loan is negatively correlated with innovation output at each stage. The changing trend of the influence coefficient of each financing channel on innovation output is not the same, the influence of government subsidies on innovation output changes from high to low and then increase, and the influence of tax preferences on innovation output has been gradually reduced. On the contrary, with the development of the life cycle, the positive impact of self-owned funds on innovation output is stronger and stronger, which illustrates that there is heterogeneity in the impact of various financing channels on innovation output among different life cycle stages. Comparing the regression

coefficient of each financing channel on innovation output, we can see that it is consistent with its influence on innovation intensity.

Through the above regression results, it can be found that government subsidies, tax preferences, and self-owned funds have a significant incentive effect on innovation intensity and innovation output, equity financing has an unstable impact on enterprise innovation, and bank loans significantly hinder enterprise innovation. From the incentive effect of enterprise innovation analysis, the effect of government subsidy is the best, the effect of tax preference is second, and the effect of self-owned funds is the weakest. The incentive effect of government subsidies on enterprise innovation is the best among all financing channels, and the effect of exogenous financing is better than internal financing; this conclusion agrees with Li et al. [28]. From the perspective of enterprise innovation effects in each life cycle stage, the influence of various financing channels on innovation intensity and innovation output is different. The regression results of the control variables show that the total asset turnover (*AT*) and enterprise-scale (*Size*) is not conducive to enterprise innovation intensity increases, but it is conducive to innovation output increases; the higher the *AT* is, the bigger the enterprise innovation intensity and innovation output will be, and company *Age*, *Growth*, and state-controlled enterprises hinder the innovation behavior of enterprises.

4.3.2. Financing Channels, Life Cycle, and Enterprise Innovation

Table 5 shows the moderating effect of the enterprise life cycle on the impact of financing channels on enterprise innovation. Columns (1) and (3) of Table 5 show the interaction term of financing channels and enterprise life cycle variables. The results show that the regression coefficients of the interaction term of government subsidies and the life cycle and the interaction term of tax preferences and the life cycle in the 1% significance level are negative, which shows that, with the advancement of the enterprise life cycle, the incentive effect of government subsidies and tax preferences on enterprise innovation intensity and output will gradually weaken. There are no significant regression coefficients of the interaction of other financing channels with the life cycle, which shows that the impact of these financing channels on enterprise innovation does not show a significant trend with the advancement of the enterprise life cycle. In Column (2) and Column (3), the life cycle was further divided into the mature and decline periods, and join the interaction term of various financing channels with *Elife2* and *Elife3*. Regression results show that the regression coefficient of each interaction term of government subsidies and tax preferences are significantly negative, and once again shows that, along with the advancement of the life cycle, the incentive intensity of government subsidies and tax preferences for enterprise innovation gradually reduce. There are no significant regression coefficients of the interaction of other channels and life cycle.

4.3.3. Group Study according to the Nature of Holding Property Right

Table 6 reports the influence of financing channels on enterprise innovation according to the nature of holding property rights of listed companies. The dependent variable in Panel A of Table 6 is enterprise innovation intensity. Columns (1) and (2) are the grouping study of all the samples; the results show that government subsidies, tax preferences, equity financing, and self-owned funds are significantly positively related to enterprise R&D intensity. While the bank loan is significantly negatively related to the enterprise's R&D intensity, and the incentive intensity of government subsidies is greater than tax preferences, and the impact intensity of both is greater than several other financing channels. Columns (3)–(8) are a group study based on the life cycle stage. It can be found that the influences of various financing channels on enterprise innovation in the growth and maturity stages are the same as in the whole sample. The explained variable of panel B is innovation output, and the influence of various financing channels on innovation behavior is the same as that of Panel A. By comparing the influences of various financing channels on the innovation behaviors of enterprises with different natures of holding property rights, it is found that the incentive effects of various financing channels on non-state-owned holding enterprises are higher than those on state-owned

holding enterprises, while the inhibiting effects of bank loans on non-state-owned holding enterprises are stronger.

Table 5. Financing channels, life cycle, and enterprise innovation.

Variables	(1) <i>RD</i>	(2) <i>RD</i>	(3) <i>Igrant</i>	(4) <i>Igrant</i>
<i>Gov</i>	1.0419 *** (14.92)	0.8435 *** (22.55)	17.4650 *** (8.24)	13.3244 *** (11.73)
<i>Gov</i> × <i>Elife</i>	−0.2084 *** (−5.24)		−4.5081 *** (−3.74)	
<i>Loan</i>	−0.0115 *** (−3.75)	−0.0098 *** (−5.84)	−0.3478 *** (−3.75)	−0.3338 *** (−6.58)
<i>Loan</i> × <i>Elife</i>	0.0011 (0.60)		0.0116 (0.22)	
<i>Tax</i>	0.3244 *** (7.31)	0.2804 *** (11.70)	9.9179 *** (7.37)	7.6372 *** (10.49)
<i>Tax</i> × <i>Elife</i>	−0.0504 ** (−2.00)		−2.3041 *** (−3.02)	
<i>Equity</i>	0.0160 ** (2.55)	0.0153 *** (7.90)	−0.1307 (−0.69)	−0.1347 ** (−2.30)
<i>Equity</i> × <i>Elife</i>	−0.0010 (−0.19)		−0.0077 (−0.05)	
<i>Own</i>	0.0412 *** (7.95)	0.0351 *** (12.28)	0.1242 (0.79)	0.1909 ** (2.20)
<i>Own</i> × <i>Elife</i>	−0.0021 (−0.74)		0.0345 (0.41)	
<i>Elife</i>	−0.0014 ** (−2.01)		−0.0034 (−0.16)	
<i>Gov</i> × <i>Elife2</i>		−0.2278 *** (−4.54)		−5.5616 *** (−3.65)
<i>Gov</i> × <i>Elife3</i>		−0.3862 *** (−3.87)		−6.8139 ** (−2.25)
<i>Loan</i> × <i>Elife2</i>		−0.0010 (−0.42)		0.0137 (0.19)
<i>Loan</i> × <i>Elife3</i>		0.0062 (1.44)		−0.0004 (−0.00)
<i>Tax</i> × <i>Elife2</i>		−0.0667 ** (−2.05)		−2.3899 ** (−2.41)
<i>Tax</i> × <i>Elife3</i>		−0.0778 (−1.27)		−4.3189 ** (−2.33)
<i>Equity</i> × <i>Elife2</i>		−0.0183 * (−1.73)		−0.0937 (−0.29)
<i>Equity</i> × <i>Elife3</i>		0.0101 (0.78)		0.0578 (0.15)
<i>Own</i> × <i>Elife2</i>		0.0053 (1.59)		−0.0301 (−0.29)
<i>Own</i> × <i>Elife3</i>		−0.0245 *** (−3.52)		0.2232 (1.06)
<i>Elife2</i>		−0.0017 * (−1.84)		0.0151 (0.53)
<i>Elife3</i>		−0.0018 (−1.07)		−0.0371 (−0.74)
<i>AT</i>	−0.0144 *** (−31.36)	−0.0143 *** (−31.11)	0.0258 * (1.85)	0.0247 * (1.77)
<i>ROA</i>	0.0174 *** (5.18)	0.0165 *** (4.90)	0.2695 *** (2.64)	0.2730 *** (2.66)
<i>Growth</i>	−0.0007 ** (−2.31)	−0.0007 ** (−2.24)	−0.0460 *** (−4.70)	−0.0456 *** (−4.66)
<i>Age</i>	−0.0128 *** (−23.99)	−0.0127 *** (−23.81)	−0.1889 *** (−11.66)	−0.1898 *** (−11.71)
<i>Size</i>	−0.0011 *** (−6.51)	−0.0011 *** (−6.62)	0.2147 *** (41.79)	0.2148 *** (41.71)
<i>Control</i>	−0.0043 *** (−10.05)	−0.0043 *** (−9.97)	−0.0425 *** (−3.25)	−0.0432 *** (−3.30)
Constant	0.0503 *** (11.49)	0.0493 *** (11.79)	−4.1989 *** (−31.60)	−4.2075 *** (−33.17)
N	23,728	23,728	23,728	23,728
Adj-R2	0.4466	0.4473	0.2361	0.2360
F	446.3481	392.8089	171.5307	150.5811

Note: *, **, *** respectively represents significance at the level of 10%, 5%, and 1%.

Table 6. Financing channel, nature of holding property right, and enterprise innovation.

Variables	Panel A							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Samples		Growth Stage		Mature Stage		Decline Stage	
	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises
	RD	RD	RD	RD	RD	RD	RD	RD
<i>Gov</i>	0.4040 *** (13.20)	0.9028 *** (25.37)	0.5610 *** (11.00)	1.0105 *** (20.24)	0.3032 *** (7.49)	0.7983 *** (14.67)	0.2237 * (1.90)	0.6658 *** (4.72)
<i>Loan</i>	−0.0043 *** (−2.96)	−0.0126 *** (−7.42)	−0.0059 *** (−2.66)	−0.0137 *** (−5.83)	−0.0059 *** (−2.76)	−0.0117 *** (−4.19)	−0.0079 (−1.45)	−0.0240 *** (−3.60)
<i>Tax</i>	0.1024 *** (4.83)	0.2941 *** (13.51)	0.1027 *** (2.79)	0.3315 *** (10.98)	0.1375 *** (4.84)	0.2429 *** (7.32)	−0.0054 (−0.08)	0.2948 *** (3.04)
<i>Equity</i>	0.0226 *** (6.86)	0.0201 *** (9.71)	0.0159 *** (4.19)	0.0177 *** (7.17)	−0.0039 (−0.25)	−0.0067 (−0.49)	0.0655 *** (3.92)	−0.0053 (−0.29)
<i>Own</i>	0.0154 *** (6.47)	0.0422 *** (20.07)	0.0115 ** (2.55)	0.0452 *** (12.40)	0.0172 *** (5.69)	0.0423 *** (14.66)	0.0071 (0.83)	0.0132 (1.45)
<i>AT</i>	−0.0075 *** (−13.64)	−0.0192 *** (−28.99)	−0.0072 *** (−8.72)	−0.0200 *** (−21.95)	−0.0084 *** (−10.61)	−0.0194 *** (−18.38)	−0.0048 ** (−2.08)	−0.0089 *** (−3.52)
<i>roa</i>	0.0266 *** (6.09)	0.0132 *** (2.87)	0.0353 *** (4.72)	0.0138 ** (2.03)	0.0316 *** (5.34)	0.0208 *** (2.94)	−0.0245 * (−1.70)	−0.0380 ** (−2.48)
<i>Growth</i>	−0.0005 (−1.14)	−0.0009 ** (−2.04)	−0.0011 ** (−1.98)	−0.0007 (−1.28)	−0.0001 (−0.13)	−0.0014 * (−1.69)	−0.0006 (−0.43)	−0.0027 ** (−2.06)
<i>Age</i>	−0.0104 *** (−12.96)	−0.0138 *** (−20.03)	−0.0087 *** (−7.42)	−0.0112 *** (−12.60)	−0.0117 *** (−10.11)	−0.0147 *** (−12.79)	−0.0075 * (−1.93)	−0.0250 *** (−7.62)
<i>Size</i>	−0.0009 *** (−4.57)	−0.0009 *** (−3.63)	−0.0007 ** (−2.35)	−0.0011 *** (−3.27)	−0.0015 *** (−5.47)	−0.0015 *** (−3.55)	0.0021 ** (2.39)	0.0012 (1.17)
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Ind</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0360 *** (6.97)	0.0456 *** (7.68)	0.0280 *** (3.62)	0.0430 *** (5.35)	0.0534 *** (7.17)	0.0614 *** (6.37)	−0.0314 (−1.45)	0.0340 (1.29)
N	9016	14,712	4037	7778	4406	6106	573	828
Adj-R2	0.3244	0.4519	0.3393	0.4470	0.3288	0.4714	0.2753	0.3538
F	124.6689	337.9350	60.2115	175.6114	62.6590	156.5228	7.5858	14.3182
Variables	Panel B							
	All the Samples		Growth Stage		Mature Stage		Decline Stage	
	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises
	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>
<i>Gov</i>	8.3200 *** (6.81)	11.2742 *** (11.50)	11.9544 *** (5.81)	12.8454 *** (8.88)	6.7168 *** (4.06)	9.8417 *** (6.73)	4.5321 (1.27)	11.9110 *** (4.08)
<i>Loan</i>	−0.1875 *** (−3.26)	−0.4002 *** (−8.55)	−0.1446 (−1.63)	−0.4069 *** (−5.99)	−0.1690 * (−1.95)	−0.4921 *** (−6.52)	−0.4169 ** (−2.52)	−0.1754 (−1.27)
<i>Tax</i>	4.7142 *** (5.57)	7.1087 *** (11.85)	5.2557 *** (3.54)	8.2696 *** (9.46)	5.6447 *** (4.86)	5.5981 *** (6.27)	−1.0812 (−0.54)	8.5529 *** (4.27)
<i>Equity</i>	0.0724 (0.55)	−0.0801 (−1.41)	0.1579 (1.03)	−0.2262 *** (−3.17)	−0.3647 (−0.58)	−0.2690 (−0.73)	−0.5431 (−1.07)	0.0964 (0.26)
<i>Own</i>	0.1402 (1.48)	0.1865 *** (3.22)	0.0704 (0.39)	0.2186 ** (2.07)	0.1473 (1.19)	0.2193 *** (2.83)	0.2832 (1.08)	0.4287 ** (2.27)
<i>AT</i>	0.0670 *** (3.07)	−0.0156 (−0.86)	0.0704 ** (2.12)	0.0045 (0.17)	0.0625 * (1.94)	−0.0240 (−0.85)	0.0905 (1.30)	−0.1056 ** (−2.01)
<i>ROA</i>	0.3424 ** (1.96)	0.3231 ** (2.54)	0.2945 (0.98)	0.5805 *** (2.95)	0.2982 (1.23)	0.1745 (0.92)	−0.0367 (−0.08)	−0.3349 (−1.06)
<i>Growth</i>	−0.0581 *** (−3.48)	−0.0381 *** (−3.17)	−0.0786 *** (−3.39)	−0.0554 *** (−3.38)	−0.0468 * (−1.67)	−0.0198 (−0.90)	0.0054 (0.12)	−0.0244 (−0.90)
<i>Age</i>	−0.1738 *** (−5.42)	−0.1976 *** (−10.45)	−0.1066 ** (−2.25)	−0.1654 *** (−6.40)	−0.2462 *** (−5.19)	−0.2064 *** (−6.70)	−0.1216 (−1.03)	−0.4867 *** (−7.17)

Table 6. Cont.

Variables	Panel A							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Samples		Growth Stage		Mature Stage		Decline Stage	
	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	Non-State-Owned Enterprises
	RD	RD	RD	RD	RD	RD	RD	RD
Size	0.2070 *** (26.68)	0.2199 *** (31.79)	0.1904 *** (16.32)	0.2110 *** (21.64)	0.2291 *** (19.80)	0.2464 *** (22.02)	0.1596 *** (6.13)	0.1100 *** (5.07)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−4.2819 *** (−20.81)	−4.1825 *** (−25.57)	−4.1449 *** (−13.27)	−4.0962 *** (−17.61)	−4.6325 *** (−15.21)	−4.6792 *** (−18.06)	−3.0036 *** (−4.58)	−1.0589 * (−1.94)
N	9016	14,712	4037	7778	4406	6106	573	828
Adj-R2	0.2630	0.2148	0.2402	0.2108	0.2844	0.2072	0.2170	0.2815
F	92.9185	112.7962	37.4620	58.7091	51.0083	46.5874	5.8051	10.5287

Note: *, **, *** respectively represents significance at the level of 10%, 5%, and 1%.

4.4. Robustness Test

4.4.1. Robustness Test of Explanatory Variables with a Lag Phase

The robustness of regression results are tested by lag phase. Due to the lag of innovation output, variables of various financing channels with a lag of one stage are adopted as explanatory variables, and the regression analysis above is carried out. The results are highly consistent.

4.4.2. Substitution of Enterprise Innovation Indicators

The robustness of regression is also tested in light of how the study uses *RD2* to replace *RD* and *Iapply* to replace *Igrant*. *RD2* is measured by the proportion of R&D expenditure in the total assets at the beginning, *Iapply* is expressed by the natural logarithm of “1+ number of invention patent applications”, and the regression with full sample and life cycle stages is carried out; the results are shown in Table 7. The results of the regression analysis are highly consistent with the previous results.

Table 7. Sensitivity test of the enterprise innovation index.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Samples	Growth Stage	Mature Stage	Decline Stage	All Samples	Growth Stage	Mature Stage	Decline Stage
	RD2	RD2	RD2	RD2	Iapply	Iapply	Iapply	Iapply
Gov	0.3426 *** (19.35)	0.3949 *** (19.75)	0.2909 *** (9.44)	0.2966 *** (4.44)	13.0218 *** (13.53)	16.4796 *** (11.01)	10.8818 *** (7.98)	8.6380 *** (3.16)
Loan	−0.0045 *** (−5.37)	−0.0040 *** (−4.37)	−0.0050 *** (−3.13)	−0.0100 *** (−3.21)	−0.3823 *** (−8.38)	−0.3973 *** (−5.83)	−0.4705 *** (−6.65)	−0.2410 * (−1.89)
Tax	0.2453 *** (21.71)	0.2749 *** (21.58)	0.2356 *** (11.84)	0.1421 *** (3.45)	6.4450 *** (10.49)	8.1773 *** (8.57)	5.4097 *** (6.14)	3.1708 * (1.88)
Equity	0.0004 (0.34)	−0.0003 (−0.24)	−0.0118 (−1.30)	0.0131 (1.46)	0.1777 *** (2.73)	−0.0497 (−0.62)	−0.3568 (−0.89)	0.2588 (0.70)
Own	0.0118 *** (10.36)	0.0135 *** (8.73)	0.0099 *** (5.40)	0.0072 (1.59)	0.4300 *** (6.94)	0.3194 *** (2.77)	0.5357 *** (6.61)	0.4917 *** (2.65)

Table 7. Cont.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Samples	Growth Stage	Mature Stage	Decline Stage	All Samples	Growth Stage	Mature Stage	Decline Stage
	RD2	RD2	RD2	RD2	Iapply	Iapply	Iapply	Iapply
AT	0.0033 *** (10.33)	0.0037 *** (10.72)	0.0028 *** (4.67)	0.0041 *** (3.29)	0.0738 *** (4.19)	0.0965 *** (3.69)	0.0633 ** (2.39)	−0.0075 (−0.15)
ROA	0.0231 *** (9.72)	0.0279 *** (10.04)	0.0241 *** (5.76)	−0.0123 (−1.63)	0.8361 *** (6.48)	1.1422 *** (5.48)	0.5913 *** (3.19)	−0.0518 (−0.17)
Growth	−0.0009 *** (−4.18)	−0.0012 *** (−5.34)	−0.0006 (−1.20)	−0.0011 (−1.53)	−0.0695 *** (−5.64)	−0.1053 *** (−6.21)	−0.0380 * (−1.76)	−0.0364 (−1.29)
Age	−0.0053 *** (−14.08)	−0.0043 *** (−11.33)	−0.0057 *** (−7.92)	−0.0064 *** (−3.68)	−0.2977 *** (−14.59)	−0.2353 *** (−8.23)	−0.3269 *** (−10.24)	−0.5148 *** (−7.24)
Size	−0.0007 *** (−6.19)	−0.0008 *** (−6.19)	−0.0010 *** (−4.39)	0.0000 (0.06)	0.2849 *** (44.22)	0.2723 *** (29.01)	0.3109 *** (31.42)	0.1466 *** (7.33)
Control	−0.0016 *** (−5.17)	−0.0011 *** (−3.34)	−0.0016 *** (−2.94)	−0.0016 (−1.37)	−0.0391 ** (−2.36)	−0.0487 * (−1.95)	−0.0303 (−1.25)	0.0793 * (1.70)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0191 *** (6.62)	0.0174 *** (5.65)	0.0254 *** (4.73)	0.0083 (0.69)	−5.3070 *** (−33.90)	−5.1367 *** (−22.34)	−5.8236 *** (−24.51)	−1.9652 *** (−4.00)
N	23,728	11,815	10,512	1401	23,728	11,815	10,512	1401
Adj-R2	0.2716	0.3910	0.2183	0.1578	0.2535	0.2417	0.2620	0.2392
F	240.0679	206.0389	80.3359	8.2840	218.7251	102.7717	101.8461	13.2263

Note: *, **, *** respectively represents significance at the level of 10%, 5%, and 1%.

4.4.3. Sample Period is Shortened to 2012–2017

The innovation data of listed companies in the CSMAR database has been published since 2007. However, Long and Lin [63] pointed out that the R&D data disclosure is incomplete before 2011. This is because some enterprises in which R&D data are not disclosed carried out R&D activities, thus the data underestimated the R&D spending of enterprises. According to their point of view, only since 2012 did the enterprise innovation data of CSMAR data becomes complete. Hence, the robustness test is based on the data of 2012–2017 (Table 8), and the regression results are highly consistent.

Table 8. Robustness tests with samples from 2012 to 2017.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All the Samples	Growth Stage	Mature Stage	Decline Stage	All the Samples	Growth Stage	Mature Stage	Decline Stage
	RD	RD	RD	RD	Igrant	Igrant	Igrant	Igrant
Gov	0.9061 *** (27.95)	1.1166 *** (23.32)	0.7367 *** (15.77)	0.5348 *** (4.20)	12.1662 *** (12.30)	14.8730 *** (9.92)	10.1667 *** (7.01)	10.9504 *** (3.84)
Loan	−0.0129 *** (−8.25)	−0.0140 *** (−6.30)	−0.0138 *** (−5.70)	−0.0230 *** (−3.71)	−0.3686 *** (−7.75)	−0.3317 *** (−4.76)	−0.4172 *** (−5.55)	−0.3997 *** (−2.88)
Tax	0.2994 *** (14.52)	0.3498 *** (11.44)	0.2605 *** (8.75)	0.2385 *** (2.92)	7.5575 *** (12.01)	7.8630 *** (8.21)	7.5081 *** (8.13)	5.9871 *** (3.27)
Equity	0.0129 *** (5.43)	0.0065 ** (2.31)	−0.0027 (−0.20)	0.0426 ** (2.50)	0.0132 (0.18)	−0.1258 (−1.43)	−0.0888 (−0.22)	0.2817 (0.74)
Own	0.0371 *** (17.76)	0.0450 *** (12.20)	0.0334 *** (12.20)	0.0174 * (1.82)	0.2556 *** (4.01)	0.2196 * (1.90)	0.3044 *** (3.59)	0.6209 *** (2.91)
AT	−0.0178 *** (−29.22)	−0.0186 *** (−21.23)	−0.0179 *** (−19.60)	−0.0091 *** (−3.65)	0.0420 ** (2.25)	0.0628 ** (2.28)	0.0302 (1.06)	−0.0127 (−0.23)
ROA	0.0068 (1.50)	0.0105 (1.54)	0.0190 *** (2.89)	−0.0666 *** (−4.11)	0.3184 ** (2.32)	0.4330 ** (2.02)	0.3109 (1.53)	−0.5816 (−1.60)

Table 8. Cont.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All the Samples	Growth Stage	Mature Stage	Decline Stage	All the Samples	Growth Stage	Mature Stage	Decline Stage
	RD	RD	RD	RD	Igrant	Igrant	Igrant	Igrant
Growth	−0.0011 *** (−2.67)	−0.0011 ** (−2.09)	−0.0019 ** (−2.53)	−0.0026 * (−1.85)	−0.0439 *** (−3.52)	−0.0619 *** (−3.79)	−0.0233 (−1.00)	−0.0203 (−0.63)
Age	−0.0126 *** (−18.18)	−0.0102 *** (−10.84)	−0.0129 *** (−12.09)	−0.0225 *** (−6.56)	−0.2587 *** (−12.21)	−0.2140 *** (−7.23)	−0.2786 *** (−8.40)	−0.5209 *** (−6.80)
Size	−0.0007 *** (−3.05)	−0.0005 * (−1.69)	−0.0016 *** (−4.94)	0.0016 * (1.66)	0.2391 *** (36.48)	0.2232 *** (23.29)	0.2664 *** (26.44)	0.1558 *** (7.41)
Control	−0.0051 *** (−9.04)	−0.0041 *** (−5.05)	−0.0048 *** (−5.84)	−0.0037 (−1.63)	−0.0322 * (−1.89)	−0.0428 * (−1.67)	−0.0223 (−0.88)	−0.0021 (−0.04)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0538 *** (10.07)	0.0411 *** (5.42)	0.0796 *** (9.85)	0.0346 (1.48)	−4.3625 *** (−26.75)	−4.1584 *** (−17.51)	−4.9299 *** (−19.65)	−1.5940 *** (−3.04)
N	16,652	8278	7413	961	16,652	8278	7413	961
Adj-R2	0.4369	0.4372	0.4613	0.3221	0.2286	0.2139	0.2370	0.2698
F	392.5190	201.9008	193.3609	15.7174	150.5519	71.3832	70.7660	12.4413

Note: *, **, *** respectively represents significance at the level of 10%, 5%, and 1%.

5. Test of the Non-Linear Relationship between Financing Channel and Enterprise Innovation

Mao and Xu [5] and Yu et al. [64] believed that only moderate government subsidies could promote enterprise R&D innovation, and excessive government subsidies might hinder innovation intensity due to rent-seeking and other factors. Dai and Cheng [57] also pointed out the non-linear relationship between government subsidies and enterprise innovation. Is there a moderate range in the impact of other funding channels on enterprise innovation in addition to government subsidies? Tax preferences policy has the same effect as government subsidies. The implementation of the tax preferences policy can increase corporate profits by reducing the tax rate, or, in the form of tax rebates, lowers R&D costs. Yet excessive tax preferences might reduce the enthusiasm of enterprise innovation because it brings increased profits. Because the goal of innovation is gaining profits, and tax preferences can also increase profits, as the preferential tax rate increases, its effect on enterprise innovation incentives may weaken and even hinder enterprise innovation. Similarly, the influence of other financing channels on enterprise innovation may also have a non-linear relationship. Based on this, the following hypothesis is proposed:

Hypothesis 8. *The influence of various financing channels on enterprise innovation is non-linear.*

To test this hypothesis, the square term of each financing channel variable is added to the regression model, as shown in Model (4):

$$\begin{aligned} \text{Innovation} = & \alpha_0 + \alpha_1 \text{Finance} + \alpha_2 \text{Finance}^2 + \alpha_3 \text{Roa} + \alpha_4 \text{At} + \alpha_5 \text{Size} + \\ & \alpha_6 \text{Age} + \alpha_7 \text{Soe} + \alpha_8 \text{Growth} + \sum \text{Year} + \sum \text{Ind} + \varepsilon \end{aligned} \quad (4)$$

Table 9 presents the results of the full sample and grouped studies according to different stages of the life cycle. Full sample regression results show that the quadratic term of government subsidies have a significantly negative correlation to both R&D strength and innovation output, indicating that government subsidies will encourage enterprise innovation, with increases at the beginning. However, the relationship is not linear and shows an inverted U-shaped relationship. The inflection point of the inverted U-shape is 3.10%. That is, when government subsidy is higher than the value, the incentive effect of it on enterprise innovation will weaken and even hinder enterprise innovation. The impact of

tax preferences on enterprise innovation is the same as that of government subsidies, and the inflection point of its impact on innovation intensity is 3.82%. The quadratic term of bank loans with R&D intensity and innovation output is significantly positively related, namely that bank loans have a U-shaped relationship with enterprise innovation strength. The inflection point was 47.01%, indicating that the increase of bank loan proportion will hinder enterprise innovation at first, but with the increase of bank loans, there will be a shift from hampering enterprise innovation to stimulating enterprises innovation. The quadratic term of equity financing and self-owned capital are significantly positively correlated with R&D intensity and negatively correlated with innovation output, indicating that the influences of these two financing channels on R&D input and innovation output are heterogeneous. The results of the life-cycle grouping study are consistent with the regression results of the entire sample. The above results indicate that there is a U-shaped or inverted U-shaped non-linear relationship between the influences of various financing channels on enterprise innovation. Thus, there is a moderate range of financing channels that is consistent with the viewpoints of Mao and Xu [5]. This provides a new view of the accurate understanding of the influences of financing channels on enterprise innovation.

Table 9. The nonlinear relationship test between financing channel and enterprise innovation.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All the Samples	Growth Stage	Mature Stage	Decline Stage	All the Samples	Growth Stage	Mature Stage	Decline Stage
	<i>RD</i>	<i>RD</i>	<i>RD</i>	<i>RD</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>	<i>Igrant</i>
<i>Gov</i>	1.5182 *** (24.37)	1.4991 *** (16.86)	1.3605 *** (14.64)	1.9264 *** (7.45)	34.2003 *** (18.08)	34.2263 *** (12.28)	34.2318 *** (12.14)	34.1711 *** (5.65)
<i>Gov2</i>	−24.5031 *** (−15.31)	−20.4443 *** (−8.55)	−22.8429 *** (−9.86)	−39.2200 *** (−6.23)	-7.2×10^2 *** (−14.79)	-6.8×10^2 *** (−9.09)	-7.4×10^2 *** (−10.52)	-7.0×10^2 *** (−4.74)
<i>Tax</i>	0.7740 *** (18.73)	0.6803 *** (11.62)	0.8079 *** (13.14)	0.8898 *** (4.91)	18.9746 *** (15.12)	17.3207 *** (9.44)	19.4022 *** (10.40)	28.1099 *** (6.63)
<i>Tax2</i>	−10.1484 *** (−14.17)	−7.8975 *** (−7.49)	−10.9610 *** (−10.47)	−13.1436 *** (−4.58)	-2.5×10^2 *** (−11.37)	-2.0×10^2 *** (−6.03)	-2.6×10^2 *** (−8.31)	-4.2×10^2 *** (−6.23)
<i>Loan</i>	−0.0267 *** (−9.20)	−0.0296 *** (−6.87)	−0.0328 *** (−7.29)	−0.0391 *** (−3.59)	−0.5290 *** (−6.00)	−0.2474 * (−1.83)	−0.8076 *** (−5.91)	−0.9625 *** (−3.77)
<i>Loan2</i>	0.0284 *** (6.62)	0.0297 *** (4.90)	0.0384 *** (5.52)	0.0367 ** (2.36)	0.3193 ** (2.45)	−0.1004 (−0.53)	0.7676 *** (3.64)	1.0775 *** (2.97)
<i>Equity</i>	0.0075 (1.59)	−0.0084 (−1.61)	−0.0040 (−0.19)	0.0604 * (1.73)	0.4018 *** (2.82)	0.2501 (1.52)	−0.1078 (−0.17)	0.5412 (0.66)
<i>Equity2</i>	0.0209 ** (2.15)	0.0486 *** (4.69)	−0.0031 (−0.05)	−0.0892 (−1.21)	−1.1694 *** (−3.97)	−0.9430 *** (−2.91)	−0.2969 (−0.17)	−1.6497 (−0.95)
<i>Own</i>	0.0255 *** (5.91)	0.0419 *** (6.01)	0.0087 (1.43)	0.0694 *** (4.05)	0.4162 *** (3.18)	0.5064 ** (2.31)	0.3680 ** (1.98)	0.7086 * (1.77)
<i>Own2</i>	0.0128 * (1.76)	−0.0150 (−1.07)	0.0393 *** (4.05)	−0.1226 *** (−3.96)	−0.5799 *** (−2.62)	−0.7820 * (−1.78)	−0.4575 (−1.55)	−0.8350 (−1.15)
<i>AT</i>	−0.0141 *** (−30.69)	−0.0145 *** (−22.06)	−0.0142 *** (−20.36)	−0.0086 *** (−4.90)	0.0239 * (1.71)	0.0375 * (1.82)	0.0200 (0.94)	−0.0418 (−1.01)
<i>Roa</i>	0.0158 *** (4.72)	0.0167 *** (3.21)	0.0254 *** (5.22)	−0.0364 *** (−3.45)	0.2113 ** (2.08)	0.3368 ** (2.06)	0.1184 (0.80)	−0.2503 (−1.01)
<i>Growth</i>	−0.0005 (−1.62)	−0.0007 (−1.55)	−0.0007 (−1.25)	−0.0015 (−1.53)	−0.0433 *** (−4.47)	−0.0585 *** (−4.40)	−0.0293 * (−1.72)	−0.0164 (−0.73)
<i>Age</i>	−0.0127 *** (−24.10)	−0.0104 *** (−14.63)	−0.0135 *** (−16.16)	−0.0184 *** (−7.57)	−0.1794 *** (−11.19)	−0.1443 *** (−6.46)	−0.2021 *** (−7.98)	−0.3688 *** (−6.49)
<i>Size</i>	−0.0010 *** (−5.73)	−0.0009 *** (−3.64)	−0.0018 *** (−6.76)	0.0006 (0.86)	0.2129 *** (41.66)	0.2009 *** (27.18)	0.2393 *** (30.24)	0.1191 *** (7.17)
<i>Control</i>	−0.0042 *** (−9.77)	−0.0037 *** (−5.91)	−0.0039 *** (−6.09)	−0.0045 *** (−2.80)	−0.0364 *** (−2.80)	−0.0471 ** (−2.41)	−0.0266 (−1.38)	−0.0145 (−0.39)
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Ind</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0449 *** (11.06)	0.0374 *** (6.49)	0.0658 *** (10.54)	0.0232 (1.37)	−4.2589 *** (−34.50)	−4.1229 *** (−22.87)	−4.7696 *** (−25.18)	−1.5879 *** (−4.00)
N	23,728	11,815	10,512	1401	23,728	11,815	10,512	1401
Adj-R2	0.4564	0.4575	0.4719	0.3739	0.2485	0.2337	0.2575	0.2918
F	475.3704	238.1695	224.6335	21.3949	187.8237	86.7834	87.7958	15.0715

Note: *, **, *** respectively represents significance at the level of 10%, 5%, and 1%.

6. Conclusions and Limitations

This paper presents an empirical analysis of financing channels and their impact on enterprise innovation. The high-risk nature of enterprise activity is described, considering the uncertainty involved in producing revenue during transformative stages related to innovation, market development, and re-designed promotional campaigns. The potential of employing crowdfunding to bridge the risk-gap is suggested but at this point is beyond the scope of this study. Rather, government subsidies and their connection to innovation is explored in terms of corporate life cycle. The empirical analysis supports the importance of these traditional forms of government subsidies and shows that they are working to optimize the allocation of innovative resources and the promotion of enterprise innovation. These subsidies will effectively promote the smooth transformation of China's economy from medium-high speed development to high-quality development. Based on the data of A-share listed companies in China from 2008 to 2017, this study empirically tested the impact of internal and external financing channels on enterprise innovation and investigated the moderating effect of the enterprise life cycle.

It was found that there is heterogeneity in the influence of different financing channels on enterprise innovation. Among them, government subsidies, tax preferences, equity financing, and self-owned funds can significantly stimulate enterprise innovation, while bank loans can significantly inhibit enterprise innovation. At the same time, different financing channels have a different incentive intensity on enterprise innovation. The incentive effect of government subsidies, tax preferences, self-owned funds, and equity financing on enterprise innovation is gradually weakened, which proves that government subsidies and tax incentives are important tools to stimulate enterprise innovation. In addition, it was found that the life cycle has a moderating effect on the incentive effect of financing channels to innovation, and the incentive effect of financing channels represented by government subsidies and tax incentives weakens with the advance of the life cycle stages. Also, the incentive effect of various financing channels on enterprise innovation of listed companies with different property rights is heterogeneous, and its incentive effect or inhibiting effect on non-state-owned holding enterprises is stronger than that on state-owned holding enterprises. Finally, the study shows how the main financing channels have a non-linear relationship with enterprise innovation, and that the non-linear relationship was consistent in the entire sample for enterprises in the growth period and mature period. This indicates that each financing channel has moderate space, and excessive financing support hinders enterprise innovation.

Based on this research, the following countermeasures and suggestions are proposed. First, while continuing to give full play to the incentive effect of government subsidies, tax preferences, self-owned funds, and other tools of enterprise innovation, studies must be carried out on the reasons why equity financing and banks hinder enterprise innovation and see how it is possible to remove the factors that are not conducive to its play. Second, because different financing channels have different incentive effects on enterprise innovation, to stimulate enterprise innovation to the maximum extent, it is necessary to optimize the allocation of resources. Third, the function space of each financing channel should be studied to avoid insufficient fund support and excessive fund support. Fourth, it is important to study the influence of financing channels on the innovation behavior of enterprises in different life cycles, and strengthen the incentive effect of financing channels on innovation in different life cycles. Finally, attention should be paid to the innovation of non-state holding enterprises to further stimulate the innovative incentive effect of financing channels.

This study examined the effect of various sources of capital on enterprise innovation and tested the moderating effect of the enterprise life cycle. However, it is not completely free from certain limitations. First, this research found that each financing channel has a significant effect on enterprise innovation channels. Further research is needed to see if there is an interaction effect between the various channels, such as how the signal effect of government subsidies will affect other financing channels. Second, according to the property rights group study, it was found that, compared with state-owned enterprises, various financing channels have a more significant impact on the innovation

of non-state-owned enterprises, and both the mechanism of action and the transmission path need to be studied. Third, further research may find that the influence of various financing channels on enterprise innovation is U-shaped or inverted U-shaped, and the mechanism of action also needs to be studied in the future.

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