Hindawi
Mobile Information Systems
Volume 2022, Article ID 6417530, 10 pages
https://doi.org/10.1155/2022/6417530

Research Article

Government Subsidy, External Financing, and Capacity for Scientific and Technological Innovation of Culture Industry from the Life Cycle Perspective

Tingting Ren and Xu Zhong

Economics & Management Experimental Center, Northeastern University at Qinhuangdao, Qinhuangdao 066000, Hebei, China

Correspondence should be addressed to Tingting Ren; rentingting@neuq.edu.cn

Received 9 May 2022; Revised 28 June 2022; Accepted 17 July 2022; Published 13 August 2022

Academic Editor: Imran Shafique Ansari

The surging development of modern information technologies such as cloud computing and blockchain has stirred up a revolution in the culture industry. In order to further integrate culture with technology, local governments continuously inject subsidies into the culture industry. With listed companies in the Chinese culture industry as the samples, we innovatively combine the life cycle, with technological innovation input and output. This study indicates that government subsidy can remarkably boost the input and output of technological innovation in the culture industry, which delivers a signaling effect to enhance the external financing of listed companies in the culture industry; during the process when government subsidy affects technological innovation activities in the culture industry, equity financing performs better in intermediate effect than bank loans; in the culture industry, government subsidy has a stronger impact on the technological innovation input of growing listed companies and the technological innovation output of advanced listed companies; for growing enterprises in the culture industry, equity financing delivers a strong mediating effect between government subsidy and scientific and technological innovation capacity.

1. Introduction

The rapid development of modern information technologies such as cloud computing, big data, blockchain, artificial intelligence, 5G, and the Internet of Things has brought technical support for the innovation and development of the culture industry. Since 2020, the Covid-19 pandemic has hit the offline culture industry severely, but it also brings challenges and opportunities for the integration of culture and technology. In order to build a great country with culture, better guide and support the technological innovation of the culture industry and promote the deep integration of culture and technology, governments at all levels continue to provide subsidies to the culture industry. That policy works as a support for the technological innovation of the culture industry. In this context, the main contribution of this study is to take the listed companies in the Chinese culture industry as samples. From the perspective of micro-enterprises, it verifies the effect of government subsidy on the capital investment, personnel input, and innovation output of scientific and technological innovation in the culture industry. Combining with characteristics of "Creativity-highlighted" and "High Risks," this study verifies the mechanism of government subsidy on the input and output of scientific and technological innovation of listed companies in the culture industry. Based on the life cycle theory, it proves the effect of government subsidy on the technological innovation capacity of listed companies with different life cycles, as well as the intermediate effect of equity financing. The conclusions are conducive to rationally evaluating the economic consequences of government subsidy, providing a theoretical basis for the government to develop policies supporting culture and other related industries in the future.

2. Theoretical Analysis and Research Hypothesis

2.1. Government Subsidy, External Financing, and Capacity for Scientific and Technological Innovation in the Culture Industry. The academic community has not reached a consensus on the impact of government subsidy on the scientific and technological innovation activities of enterprises. Many scholars deem that government subsidy helps to promote the R&D investment of enterprises. Feldman and Kelley [1] found that government agencies with high authority over science and technology will help increase enterprises' R&D investment while injecting subsidies into them. Chen et al. [2] took listed companies in the manufacturing and service sectors as samples and found that government subsidy is conducive to stimulating open innovation activities of enterprises. Li and Zhang [3] believed that government funding can promote enterprises to improve R&D intensity to a certain extent. However, some scholars believed that there is an inverted U-shaped relationship between government subsidy and corporate R&D investment [4], and even a crowding out effect [5, 6]. This study believes that government subsidy has not achieved the desired effect on corporate R&D, which does not mean that government subsidy does not function well. It is recommended to explore the mechanism of government subsidy on corporate R&D and maximize its effect through the good design of government subsidy terms.

Domestic scholars' research on culture industry government subsidy is mostly aimed at corporate performance, and less concerned about scientific and technological innovation capacities. However, "cultural scientific and technological innovation," as the integration of cultural creativity and scientific and technological innovation, is a crucial engine for the development of China's culture industry [7, 8]. The innovation of the cultural industry in this study includes both the input and output of innovation. The effect of government subsidy on cultural enterprises can be divided into two aspects. One is to produce book profits by directly making up for the study losses of cultural enterprises. Such government subsidy is equivalent to "blood transfusion" for cultural enterprises but fails to effectively improve their profitability. The other is to encourage scientific and technological innovation through government subsidy, boosting the "hematopoietic" ability of cultural enterprises themselves. On April 23 of 2019, the Ministry of Culture and Tourism issued the "Implementation Plan for the Integration and Innovation of Public Digital Culture Project" to promote the integration and innovation of digital culture projects. In August of 2019, the Ministry of Science and Technology, together with the other five ministries, released Guiding Opinions on Promoting the Further Integration of Culture and Technology. It can be seen that the governments hope to fully stimulate the innovation enthusiasm of cultural enterprises through policy guidance, enhance the core competitiveness of cultural enterprises, and give full play to the "competence effect" of government subsidy.

The impact of government subsidy on the technological innovation capacity of cultural enterprises can be divided into direct impact and indirect impact. First, government subsidy can directly alleviate the financing constraints of cultural enterprises, supplementing the innovation funds of enterprises, and sharing innovation risks with enterprises. These risks refer to innovation failures as well as yield risks arising from the positive externalities of innovation activities. Thus, it reduces the R&D costs of cultural enterprises to stimulate the innovation vitality of cultural enterprises, opening up the "last mile" toward the integration of culture and technology, and enhancing the capacity of independent innovation of cultural enterprises.

Second, government subsidy has a signaling effect. Meuleman and De Maeseneire [9] pointed out that government subsidies can send positive signals to the outside world, making market investors confident in the innovation activities of enterprises. Domestic scholars Wang and Li [10] took listed companies in strategic emerging industries as research samples and found that government intervention has obvious signaling effects in the process of corporate innovation. The signaling mechanism of government subsidy for the culture industry is inseparable from the culture industry's features of "Creativity-highlighted" and "High Risks": (1) The culture industry's nature of "Creativity-highlighted" makes it highly dependent on innovation and creativity, with intellectual costs much higher than material costs. "Creativity-highlighted" means "Assets-neglected," that is, intangible assets are superior to tangible assets. Under the existing evaluation system, it is still difficult to assess intangible assets. Therefore, creditors such as financial institutions prefer to evaluate tangible assets. Cultural enterprises have fewer tangible assets and more intangible assets in the asset portfolio. Thus, the lacking of the "collateral" preferred by financial institutions constitutes the common financing constraints in the culture industry [11, 12]. In 2019, the average asset-liability ratio of listed companies in the culture industry was only 36.13%, which was much lower than that of traditional industries, indicating that cultural enterprises suffered more financing constraints and lacked innovation funds compared with traditional industries. Under these circumstances, technological innovation would struggle. At this time, government subsidy can fully act as a bridge between cultural enterprises and financial institutions, by recognizing the values of intangible assets of cultural enterprises and reducing the evaluation costs and risks of financial institutions. Therefore, investments from creditors such as financial institutions will be attracted to increase the debt financing of cultural enterprises. (2) The scientific and technological innovation activities themselves present high risks and positive externalities. Incorporated with industrial characteristics of "High Risks," scientific and technological innovation risks of the culture industry are significantly higher than those of traditional industries. At this time, government subsidy can alleviate the problem of information asymmetry between potential equity holders such as venture capital institutions and cultural enterprises, thereby reducing the former's investment risk. In order to obtain government subsidy, cultural enterprises need to provide government sectors with concerned project information for them to better grasp the

innovation capabilities of enterprises. Government sectors strictly and authoritatively implement evaluation of cultural enterprise projects, and cultural enterprises receiving subsidies tend to have more innovation capacities. Zang [13] found that government subsidy has a positive effect on the intangible assets of listed cultural companies.

To sum up, government subsidy can not only directly supplement the innovation funds and stimulate the vitality of scientific and technological innovation of cultural enterprises, but also can enhance external investors' confidence in the scientific and technological innovation activities of cultural enterprises through the signaling effect. To a certain extent, it will guide the investment direction of external investors. When the signaling transmitted by government subsidy is received by external investors, it will attract social capital into the culture industry to help cultural enterprises to obtain external financing. Furthermore, their financing constraints are mitigated and companies' scientific and technological innovation capabilities are enhanced.

Based on the above analysis, the following assumptions are made:

H1: government subsidy can effectively increase the technological innovation input of cultural enterprises

H2: government subsidy can effectively enhance the technological innovation output of cultural enterprises

H3: the signaling effect of government subsidy can facilitate cultural enterprises' borrowings from the banks

H4: the signaling effect of government subsidy can promote equity financing of cultural enterprises

H5: external financing plays a significant intermediary effect between government subsidy and cultural enterprises' scientific and technological innovation input (scientific and technological innovation output), that is, government subsidy has a positive effect on cultural enterprises' scientific and technological innovation input (scientific and technological innovation output) through external financing

2.2. Analysis in the Perspective of Life Cycle. First of all, cultural enterprises at different stages of the life cycle are equipped with varying innovation advantages. The growing enterprises are in a stage of rapid development, focusing on developing new products and expanding business scale to increase market share. Raising main business revenue is their top priority. Therefore, growing enterprises have more enthusiasm for innovation than mature enterprises and government subsidies can promote the R&D investment of the former enterprises. Compared with counterparts in the growth period, enterprises in the mature period are in a relatively stable stage, and their management models and organizational structures are mature with more definite innovation plans. Government subsidy can positively affect the innovation output of mature cultural enterprises empowered with advanced innovation capacities and technologies. Chen et al. [2] found that the impact of government subsidy on enterprise innovation performance is affected by the life cycle stages of the enterprises.

Second, cultural enterprises in different life cycles face different levels of financing constraints. Enterprises in the growth stage lack capital strength and face unstable profitability. Meanwhile, there exist more potential risks in the aspects of operation, financial affairs, and innovation, which may lead to stringent financing constraints. Government subsidy acts as "the timely help" in two ways. First, they replenish in time the innovation funds of growing cultural enterprises. Second, they give full play to the signaling role, channeling social capital to the growing cultural enterprises which initially refuse to do so for fear of risks. Therefore, it greatly improves these enterprises' scientific and technological innovation capabilities. Mature enterprises feature stable profitability, abundant self-owned funds, and smooth external financing channels. Therefore, the financing constraints faced by mature enterprises are the least [14, 15], and the signaling effect of government subsidy is weak. Based on the above analysis, the following research hypotheses are proposed:

H6a: government subsidy has a stronger role in promoting the input in technological innovation of cultural enterprises in the growth stage than those in the mature stage

H6b: government subsidy has a stronger role in promoting the technological innovation output of cultural enterprises in the mature stage than those in the growing stage

H7: the intermediate effect of external financing in the process of government subsidy promoting the scientific and technological innovation of cultural enterprises in the growth stage is stronger than that of cultural enterprises in the mature stage

3. Research Design

3.1. Sample Selection and Data Sources. Based on the Classification of Culture and Related Industries (2018) issued by the China Bureau of Statistics in May 2018, according to the main business types of listed companies, the paper finally obtains 1,092 pieces of data from 182 companies in China's cultural industry from 2014 to 2019 as research samples (balanced panel data). ST companies and companies with missing data are excluded. The data mainly comes from the CSMAR database, the WIND database, the website of the China National Intellectual Property Administration, and the China Research Data Service Platform. In order to eliminate the influence of extreme values, this study conducts a 2% Winsorize treatment on all continuous variables in the regression analysis.

3.2. Variable Selection and Definition

3.2.1. Explained Variable. Most of the literature on scientific and technological innovation only discussed innovation input or innovation output, did not fully examine enterprises' scientific and technological innovation panorama, and did not discover the weakness of scientific and technological innovation. The scientific and technological innovation capability of cultural enterprises depends not only on the input of technological innovation but also on its

output. First of all, innovation activities are both capital- and labor-intensive activities. For traditional industries, capital investment is the major part of scientific and technological innovation input, whereas for cultural enterprises focusing on intellectual capital, human resources are particularly important. Therefore, this study selects R&D expenditure (RDE), R&D intensity (R&D), and R&D ability (RDA) to measure the scientific and technological innovation input of cultural enterprises. Second, Guan et al. [16] believed that innovation output mainly refers to the market performance of new products, including new product sales revenue, market share, and other related indicators. However, these indicators not only depend on the scientific and technological innovation capability of cultural enterprises, but also on the status quo of the entire culture industry and the marketing capabilities of each cultural enterprise. Therefore, they are not the optimal indicators for measuring innovation output. The patent is a concrete manifestation of the results of R&D innovation, and a key indicator to measure innovation output [17, 18]. The number of patents includes the patent application quantity and patent authorization quantity. Since the number of patent authorization is dependent on patent review institutions, it suffers great uncertainty and time lag. Domestic scholars usually use patent application quantity to measure the output of scientific and technological innovation. Patent application quantity (PAQ) is thus selected to measure the scientific and technological innovation output of cultural enterprises.

3.2.2. Explanatory Variables. This study uses government subsidy (Sub) as an explanatory variable. The latest Accounting Standards for Business Enterprises clearly define government subsidy as monetary or nonmonetary assets obtained by an enterprise from the government for free. At present, the government subsidy data of listed companies in the culture industry is disclosed in the notes accompanying the annual financial statements.

3.2.3. Mediating and Control Variables. In order to verify the mechanism of government subsidy on the technological innovation capability of cultural enterprises, this study uses external financing as the mediating variable, mainly referring to bank loans (Bank) and equity financing (Equity). Bank loans (Bank) reflect that enterprises obtain funds from banks or other financial institutions, and equity financing (Equity) reflects that enterprises use equity transactions to increase capital from the stock market.

The size of the enterprise (Size), the age of the enterprise (Age), and the nature of ownership (Own) will all have an impact on the amount of government subsidy the enterprise receives as well as the input and output of scientific and technological innovation. Therefore, the above factors are set as control variables. Industry and year dummy variables are used as control variables. The detailed variable description is shown in Table 1.

3.3. Model Design. To validate the relationship between government subsidy and technological innovation input/technological innovation output, the study establishes

$$\frac{R\ DE_{i,t}}{R\&D_{i,t}/R\ DA_{i,t}/PAQ_{i,t}} = \beta 0 + \beta_1 \mathrm{Sub}_{i,t} + \beta_2 \mathrm{Size}_{i,t} + \beta_3 \mathrm{Age}_{i,t} + \beta_4 \mathrm{Own}_{i,t} + \sum \mathrm{year} + \sum \mathrm{industry} + \varepsilon_{i,t}. \tag{1}$$

Models (2) and (3) are built on the basis of model (1) to test the mediating effect of external financing on the relationship between government subsidy and cultural enterprises' technological innovation capacities.

$$\frac{\mathrm{Bank}_{i,t}}{\mathrm{Equity}_{i,t}} = \beta 0 + \beta_5 \mathrm{Sub}_{i,t} + \beta_6 \mathrm{Size}_{i,t} + \beta_7 \mathrm{Age}_{i,t} + \beta_8 \mathrm{Own}_{i,t} + \sum \mathrm{year} + \sum \mathrm{industry} + \varepsilon_{i,t}, \tag{2}$$

$$\frac{RDE_{i,t}}{R\&D_{i,t}/RDA_{i,t}/PAQ_{i,t}} = \beta 0 + \beta_9 \mathrm{Sub}_{i,t} + \frac{\gamma \mathrm{Bank}_{i,t}}{\gamma \mathrm{Equity}_{i,t}} + \beta_{10} \mathrm{Size}_{i,t} + \beta_{11} \mathrm{Age}_{i,t} + \beta_{12} \mathrm{Own}_{i,t} + \sum \mathrm{year} + \sum \mathrm{industry} + \varepsilon_{i,t}. \tag{3}$$

In this study, the stepwise regression and the Bootstrap methods are used to validate the mediation effect. If β_1 in model (1) is significant, then the tests of models (2) and (3) are performed. If β_5 in model (2) and γ in model (3) are both significant, then according to the significance of β_9 in model (3), it is to confirm whether it is a complete mediating effect or a partial mediating effect. If β_9 is not significant, it is a complete mediating effect. If β_9 is significant, it is a partial mediating effect, and the ratio of the mediating effect is $\gamma \times \beta_5/\beta_1$. If the test results of β_5 in model (2) or γ in model (3) are not significant, the Bootstrap method is used to conduct product of the coefficients approach (Wen et al.) [19, 20].

4. The Empirical Test

4.1. Descriptive Statistical Analysis and Correlation Analysis. Table 2 is a descriptive statistical analysis of the main variables. According to Table 2, it can be seen that there is a big gap in scientific and technological innovation input among listed companies in China's culture industry, whether it is in the aspect of R&D expense, R&D intensity, or R&D ability. In terms of scientific and technological innovation output, the maximum value of patent application quantity is 7.653, and the minimum value is 0. The standard deviation is small compared to the input of technological innovation, indicating that the average difference in innovation output is small. From 2014 to 2019, the government subsidy received by cultural enterprises increased year by year, but the growth rate gradually slowed down. This showed that the governments' investment in cultural enterprises was going up with

Table 1: Variable specification table.

Variable category	Variable code	Variable name	Variable definition
Explained variable	RDE	R&D expense	Natural logarithm of R&D expense
	R&D	R&D intensity	Proportion of R&D expense in operation revenue
	RDA	R&D ability	Proportion of postgraduates and doctors
	PAQ	Patent application quantity	Natural logarithm of patent application quantity of the company in the current year
Explanatory variable	Sub	Government subsidy	Natural logarithm of government subsidy
Mediating variable	Bank	Bank loans	Natural logarithm of the sum of short-term and long-term loans
	Equity	Equity financing	Natural logarithm of the sum of paid-in capital and capital reserve
Control variable	Size	Company size	Natural logarithm of operating revenue
	Age	Company age	(Year of sample data-year of establishment)+1
	Own	Nature of ownership	1 for state-owned enterprise, 0 for nonstate-owned enterprise
	year	Year	Year dummy variable
	Industry	Industry	Industry dummy variable

Table 2: Descriptive statistical table of main variables.

Variable	Name	Obs	Mean value	Standard deviation	Minimum	Maximum	Variables	Year	Mean value
RDE	R&D expense	1 092	12.957	7.747	0.000	21.658		2014	13.464
R&D	R&D intensity	1 092	4.258	6.485	0.000	57.490		2015	14.596
RDA	R&D ability	1 092	3.579	5.647	0.000	47.670		2016	15.368
PAQ	Patent application quantity	1 092	1.220	1.522	0.000	7.653	Sub	2017	15.937
Sub	Government subsidy	1 092	15.205	3.573	0.000	20.759		2018	15.970
Bank	Bank loans	1 092	13.183	9.101	0.000	25.097		2019	15.896
Equity	Equity financing	1 092	20.770	1.211	16.009	23.606			

Table 3: Relevance table of main variables.

	RDE	R&D	RDA	PAQ	Sub	Bank	Equity
RDE	1						
R&D	0.455***	1					
RDA	0.051*	0.101***	1				
PAQ	0.368***	0.073**	−0.054*	1			
Sub	0.389***	0.073**	0.116***	0.252***	1		
Bank	0.105***	−0.204***	−0.087***	0.155***	0.229***	1	
Equity	0.302***	−0.002	0.210***	0.315***	0.480***	0.319***	1

Note. The symbols ***, **, and * indicate significance at the statistical levels of 1%, 5%, and 10%, respectively.

increasing rationality and they began to highlight the effects of subsidy to achieve an effective allocation of resources. The maximum value of equity financing of listed companies in the culture industry is 23.606, the minimum value is 16.009, and the average value is 20.770. At the same time, the maximum value of bank loans is 25.097, the minimum value is 0, and the average value is 13.183. It is obvious that cultural enterprises vary a lot in the aspect of bank loans rather than equity financing. The main source of funds for most cultural enterprises is equity financing, and there are still difficulties in bank loans due to the industrial characteristics of "Creativity-highlighted" and "Assets-neglected."

Table 3 is the relevance table of main variables. It can be seen from Table 3 that government subsidy has a significant positive correlation with R&D expense, R&D intensity, R&D ability, patent application quantity, bank loans, and equity financing. There is a significant positive correlation between R&D expense, R&D intensity, and the patent application quantity. Equity financing has a positive correlation with R&D expense, R&D intensity, R&D ability, and patent application quantity. The interaction effects between variables should be further validated.

4.2. Full-Sampled Regression Analysis of Panel Data. *F* test and Hausman test are conducted on model (1) and model (2) by using the software Stata14.0. According to the test results, a fixed effect model should be selected. The regression results are shown in Table 4. Government subsidy is significantly positively correlated with R&D expense, R&D intensity, and patent application quantity at the level of 1%, indicating that government subsidy has promoted cultural enterprises to invest more in R&D funds, and effectively improved output capacity arising from the scientific and technological innovation of cultural enterprises. Although there is a positive correlation between government subsidy and R&D ability, it is not significant. This may be because, on the one hand, cultural enterprises pay more attention to capital investment

Table 4: Regression results of full-sampled models (1) and (2).

Name of variables	RDE	R&D	RDA	PAQ	Bank	Equity
Sub	0.573*** (0.000)	0.214*** (0.000)	0.019 (0.680)	0.040*** (0.000)	0.239*** (0.008)	0.041*** (0.000)
Size	0.565*** (0.004)	−1.151*** (0.000)	0.334** (0.027)	0.330*** (0.000)	2.010*** (0.000)	0.476*** (0.000)
Age	0.012 (0.740)	−0.024 (0.450)	−0.036 (0.257)	0.014** (0.049)	0.325*** (0.000)	0.029*** (0.000)
Own	−2.326*** (0.000)	−0.806* (0.065)	1.980*** (0.000)	−0.415*** (0.000)	−2.222*** (0.001)	0.026 (0.688)
Year	Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control	Control
Modified R^2	0.456 3	0.360 7	0.252 1	0.295 1	0.303 2	0.631 7

Note. (1) The symbols ***, **, and * indicate significance at the statistical level of 1%, 5%, and 10%, respectively. (2) The values in brackets are the test values of P.

Table 5: Regression results of full-sampled model (3).

Name of variables	Bank as mediating variable			Equity as mediating variable		
	RDE	R&D	PAQ	RDE	R&D	PAQ
Sub	0.571*** (0.000)	0.231*** (0.000)	0.040*** (0.000)	0.545*** (0.000)	0.181*** (0.000)	0.028*** (0.002)
Bank	0.007 (0.764)	−0.070 (0.124)	−0.003 (0.539)			
Equity				0.684** (0.010)	0.795*** (0.000)	0.279*** (0.000)
Size	0.551*** (0.006)	−1.011*** (0.000)	0.337*** (0.000)	0.240 (0.296)	−1.530*** (0.000)	0.197*** (0.000)
Age	0.009 (0.794)	−0.001 (0.969)	0.015** (0.046)	−0.009 (0.806)	−0.047 (0.122)	0.005 (0.445)
Own	−2.309*** (0.000)	−0.961** (0.030)	−0.422*** (0.000)	−2.343*** (0.000)	−0.827* (0.056)	−0.422*** (0.000)
Year	Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control	Control
Modified R^2	0.456 3	0.368 4	0.295 4	0.460 3	0.369 8	0.313 2

Note. (1) The symbols ***, **, and * indicate significance at the statistical level of 1%, 5%, and 10%, respectively. (2) The values in brackets are the test values of P.

Table 6: Further results with the bootstrap method.

Name of variables	RDE	R&D	RDA	PAQ
Normal-based (95% conf. interval)	(−0.016 0.008)	(−0.002 0.003)	(−0.037 0.001)	(−0.002 0.003)

Note. ank is the mediating variable.

in R&D than to high-quality personnel investment, which is the improvement of R&D ability. On the other hand, professional and versatile talents in China's culture industry are scarce. In developed countries, the proportion of employees in cultural and creative industries is generally high, and they are concentrated in the field of cultural creativity. In China, the proportion of talents in this field is relatively low, and mostly skilled-orientated. Government subsidy, in view of the features of "Creativity-highlighted" and "High Risks" in the culture industry, is significantly positively correlated with bank loans and equity financing and has played a better role in signaling. It better addresses the issue of assessing the intangible assets of cultural enterprises and the inability to evaluate the risks of innovation activities due to information asymmetry, promoting debt financing and equity financing of cultural enterprises, and easing the financing constraints of cultural enterprises. Hypotheses 3 and 4 are verified.

The F test and Hausman test were performed on model (3), and the fixed effect model should be selected according to the regression results. The regression results are shown in Table 5. In model (3), there is a significant positive correlation between equity financing, R&D expense, R&D intensity, and patent application quantity at the level of 1%, and government subsidy is also significantly positively correlated with R&D expense, R&D intensity, and patent application quantity at the level of 1%. The regression coefficient is lower than that in model (1) with the fitted value of R^2 going up, which shows that after adding equity financing, the explanatory power of the entire model is significantly improved, and equity financing plays a partial mediating effect in the signaling process of government subsidy to the technological innovation input and output of cultural enterprises. With the step-by-step regression method, the intermediate effect of bank loans has not been identified, and Bootstrap needs to be used for further testing. The test results are shown in Table 6. It concludes that bank loans deliver no intermediary effect when government subsidy promotes the research and development of cultural enterprises in China. Together with Table 5, it can be seen that equity financing plays a more direct role than bank loans when government subsidy affects the R&D of cultural enterprises. Although the signaling effect of government subsidy has increased bank loans of cultural enterprises, the overall scale of bank loans is still low and they vary a lot among enterprises. Low-scale bank loans cannot fully satisfy the funds needed for cultural enterprises' R&D and innovation. At the same time, government subsidy has a good guiding effect on equity financing, especially on venture capital of cultural enterprises. Equity financing is still the main source of funds for cultural enterprises. Under the guidance of government subsidy, the financing difficulties have been alleviated, and the input and output of scientific and technological innovation of cultural enterprises have been effectively stimulated.

Table 7: Cash portfolio of cultural enterprises in the growth and maturity period.

Activity type	Life cycle					
	Growth period			Maturity period		
Operating activities	−	+	+	−	+	+
Investment activities	−	−	−	−	+	+
Financing activities	+	+	−	−	+	−

Table 8: Regression results of models (1) and (2) in the growth period.

Name of variables	RDE	R&D	PAQ	Bank	Equity
Sub	0.633*** (0.000)	0.255*** (0.001)	0.045* (0.053)	0.304*** (0.009)	0.056*** (0.000)
Size	0.464 (0.115)	−0.926*** (0.000)	0.386*** (0.000)	1.857*** (0.000)	0.478*** (0.000)
Age	−0.080 (0.157)	−0.106** (0.017)	−0.001 (0.952)	0.338*** (0.000)	0.020*** (0.007)
Own	−1.704** (0.044)	−1.508** (0.022)	−0.215 (0.279)	−1.348 (0.178)	0.139 (0.199)
Year	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control
Modified R^2	0.392 3	0.312 0	0.321 4	0.268 1	0.579 7

Note. (1) The symbols***, **, and*indicate significance at the statistical level of 1%, 5%, and 10%, respectively. (2) The values in brackets are the test values of *P*.

Table 9: Regression results of models (1) and (2) in the maturity period.

Name of variables	RDE	R&D	PAQ	Bank	Equity
Sub	0.543*** (0.000)	0.192** (0.016)	0.048*** (0.006)	0.311*** (0.008)	0.046*** (0.000)
Size	0.671** (0.016)	−1.414*** (0.016)	0.271*** (0.000)	1.635*** (0.000)	0.463*** (0.000)
Age	0.063 (0.147)	0.027 (0.509)	0.026*** (0.004)	0.334*** (0.000)	0.034*** (0.000)
Own	−3.227*** (0.000)	−0.687 (0.297)	−0.504*** (0.001)	−2.074** (0.032)	0.031 (0.722)
Year	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control
Modified R^2	0.481 7	0.343 1	0.239 2	0.282 3	0.652 2

Note. (1) The symbols***, **,and* indicate significance at the statistical level of 1%, 5%, and 10%, respectively. (2) The values in brackets are the test values of *P*.

Table 10: Regression results of model (3).

Name of variables	Growth period			Maturity period		
	RDE	R&D	PAQ	RDE	R&D	PAQ
Sub	0.575*** (0.000)	0.206*** (0.008)	0.030 (0.205)	0.529*** (0.000)	0.150* (0.062)	0.038** (0.033)
Equity	1.039** (0.005)	0.870*** (0.003)	0.270*** (0.002)	0.319 (0.346)	0.919*** (0.004)	0.233*** (0.001)
Size	−0.032 (0.925)	−1.341*** (0.000)	0.257*** (0.001)	0.523 (0.101)	−1.840*** (0.000)	0.163** (0.014)
Age	−0.100* (0.077)	−0.123*** (0.005)	−0.006 (0.648)	0.052 (0.246)	−0.004 (0.928)	0.019** (0.047)
Own	−1.849** (0.028)	−1.630** (0.013)	−0.253 (0.200)	−3.237*** (0.000)	−0.716 (0.274)	−0.511*** (0.000)
Year	Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control	Control
Modified R^2	0.401 7	0.324 6	0.334 6	0.481 6	0.351 7	0.253 0

Note. (1) The symbols ***, **, and * indicate significance at the statistical level of 1%, 5%, and 10%, respectively. (2) The values in brackets are the test values of *P*.

4.3. Regression Analysis Based on Life Cycle. Dickinson [21] divides the firm life cycle into five stages based on the cash portfolio, namely the initial stage, the growth stage, the mature stage, the turbulent stage, and the recession stage. Considering China's requirements for listed companies, cultural enterprises which pass the review and get listed have generally passed the initial stage. For enterprises in the recession period, this study draws on the practices of Chen et al. [2] and Li and Tan [22], the initial period and the growth period are combined into the growth period, and the samples with similar characteristics of the mature period and the turbulent period are classified as the mature period. See Table 7 for details.

In the promotion of scientific and technological innovation of cultural enterprises by government subsidy, to verify that the intermediary effect of external financing is affected by the enterprise's life cycle, the insignificant variables are excluded based on the regression results of the full samples. Regression analysis is carried out on the samples of cultural enterprises in the growth and mature periods respectively. The results are shown in Tables 8–10. By comparing Tables 8 and 9, it concludes that the influence coefficient of government subsidy on R&D expense and R&D intensity of cultural enterprises in the growth stage is greater than that of the mature cultural enterprises ($0.633 > 0.543$, $0.255 > 0.192$), which shows that the cultural

Table 11: The intermediate effect of equity financing.

Name of variables	Growth period			Maturity period		
	RDE	R&D	PAQ	RDE	R&D	PAQ
Total effect	0.633	0.206	0.045	0.543	0.192	0.048
Mediating effect	0.056*1.039	0.056*0.870	0.056*0.270	Insignificant mediating effect	0.046*0.919	0.046*0.233
Ratio	9.19%	23.65%	Full mediating effect	—	22.01%	22.33%

Note. Equity is the mediating variable.

enterprises in the growth stage tend to increase investment in scientific and technological innovation so as to strengthen their featured product and expand production and operation scale. Government subsidies will solve the fund shortage faced by the growing enterprises and help them to speed up investment in scientific and technological innovation. The influence coefficient of government subsidy on the patent application quantity for cultural enterprises in the growth stage is smaller than that of the cultural enterprises in the mature stage ($0.045 < 0.048$). The mature enterprises build themselves with bright development prospects, clear innovation goals as well as advanced innovative technology, and they can produce more scientific and technological innovation output with government subsidy.

With reference to Wen and Ye [20], the relative size of the intermediary effect is calculated by the ratio of the intermediary effect to the total effect. The specific calculation and results are shown in Table 11. It can be seen from the table that the signaling impact imposed by equity financing on government subsidy and corporate technological innovation is significantly different in cultural enterprises at growth and mature stages. In the cultural enterprises in the growth stage, the ratios of the mediating effect for R&D expense and R&D intensity are 9.19% and 23.65%, respectively. Equity financing acts as a full mediator for patent application quantity. For mature cultural enterprises, the mediation effect is not identified for R&D expense. And the ratios of the intermediary effect for R&D intensity and patent application quantity are 22.01% and 22.33% respectively. It can be seen that the intermediary effect of equity financing in the process of government subsidy promoting the research and development of growing cultural enterprises is stronger than that of cultural enterprises in the mature stage. It further confirms that the growing cultural enterprises face more severe financing constraints and rely heavily on equity financing, which verifies Hypothesis 7.

4.4. Robustness Test. In order to ensure the accuracy of the empirical results, this study adopts substitution variables and sample grouping methods to conduct robustness tests and replaces the measure of government subsidy with the ratio of government subsidy to operating income. It divides the samples into two groups of state-owned and nonstate-owned cultural enterprises to carry out the regression analysis of models (1)–(3), showing that there is no substantial difference between the results and the previous conclusions.

5. Research Conclusions and Recommendations

5.1. Research Conclusions. In the context of innovative development of culture industry integration, based on the current situation of the Chinese culture industry, this study analyzed the macroscopic aspect of government subsidy together with the microscopic aspect of technological innovation capacities of cultural enterprises. It uses the data of listed companies in the culture industry from 2014 to 2019 to validate the effect and mechanism of government subsidy on technological innovation input and output of cultural enterprises. The study finds that: (1) government subsidy has a significant incentive effect on innovation capital investment and technological innovation output of cultural enterprises in China. (2) Government subsidy does not have an ideal effect on the R&D capabilities of cultural enterprise personnel. (3) The signaling effect of government subsidy is obvious, effectively increasing the scale of bank loans and equity financing of cultural enterprises, and alleviating their financing constraints. (4) Equity financing acts as a part mediator when government subsidy affects the R&D of cultural enterprises, while the intermediary effect of bank loans is not detected. (5) The incentive effect of government subsidy on scientific and technological innovation input of growing enterprises is stronger than that of mature ones. Government subsidy stimulates mature enterprises better to produce scientific and technological innovation output than the growing ones. (6) The intermediate effect of equity financing in promoting the R&D of cultural enterprises in the growth stage is greater than that of enterprises in the mature stage.

5.2. Countermeasures and Suggestions. Based on the above research results, some suggestions are put forward for the Chinese government sectors and cultural enterprises: (1) policies of government subsidy for cultural enterprises should be continuously implemented to expand the coverage of beneficiaries. In 2020, the culture industry suffered the attack of the Covid-19 epidemic and got stuck in the predicament of operation and financing. It is desperate for cultural companies to explore development through innovation. Government subsidy can not only directly supplement innovation funds, but also establish demonstration effects through signaling theory. It helps attract sidelined private capital to enter the culture industry, thus broadening the financing channels of cultural enterprises and supporting the investment in scientific and technological innovation of cultural enterprises. With the above support, these companies will be inspired to create more innovative

achievements in the integration of culture and technology. (2) It is necessary to establish a training mechanism for innovative talents in the culture industry to cultivate original high-end cultural and creative talents. At present, people employed in Chinese cultural and creative industries are much fewer than those in developed countries, and most of them are emulation-based and technical talents. There is a lack of original high-end cultural and creative talents. Human capital is the key element in the innovation activities of cultural enterprises, so it plays an increasingly key role in innovation. Therefore, on the one hand, it is required to innovate the talent training mechanism and continuously improve the overall quality of cultural and creative personnel. On the other hand, by optimizing the design of the government subsidy system, cultural enterprises are encouraged and guided to increase input in high-level R&D personnel and continuously spur their R&D capabilities, thereby improving innovation efficiency and turning the new opportunities brought by science and technology into the driving force for the development of the culture industry. (3) It is suggested to strengthen the signaling effect of government subsidy on bank loans. According to this study, government subsidy has effectively promoted the increase of bank loans to cultural enterprises. Due to the low overall scale, bank loans have not produced an intermediary effect on the scientific and technological innovation capabilities of cultural enterprises. This does not mean that bank loans are inessential, but that we should explore a new path for the integrated development of the culture industry and the financial industry. Thus, it can better address the difficulty of evaluating the intangible assets of cultural enterprises and use government subsidy policies to channel bank loans to cultural enterprises. The signaling mechanism of governments toward financial institutions should be given full play, as well as the intermediary effect of debt financing on the technological innovation capabilities of cultural enterprises. (4) Different government subsidy systems should be developed according to the life cycle stages of cultural enterprises. Cultural enterprises in the growth stage have strong innovative impetus but lack innovation funds and technology. Therefore, their innovation efficiency is lower than that of mature companies. Mature cultural enterprises face fewer financing constraints but lack innovative motivation. According to the characteristics of cultural enterprises with different life cycles, relevant government subsidy systems should be introduced to improve the overall innovation efficiency of the culture industry and provide strong support for high-quality cultural supply.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

[1] M. P. Feldman and M. R. Kelley, "The ex ante assessment of knowledge spillovers: government R&D policy, economic incentives and private firm behavior," *Research Policy*, vol. 35, no. 10, pp. 1509–1521, 2006.

[2] H. Chen, Y. Zhang, and D. Liu, "Government subsidy, tax breaks and enterprise's innovation performance: an empirical study on different life cycle stages," *Nankai Business Review*, vol. 22, no. 03, pp. 187–200, 2019.

[3] W. Li and L. Zhang, "Research on entrepreneurial performance, government funding and R&D changes," *Proceedings of Business and Economic Studies*, no. 24, pp. 189–192, 2019.

[4] P. Song, "Research on the relevance between China's government R&D subsidy and enterprise innovation performance and R&D capability of enterprises," *Soft Science*, vol. 33, no. 05, pp. 65–70, 2019.

[5] B. E. Clausen, "Government documents librarianship: a guide for the Neo-Depository Era," *Government Information Quarterly*, vol. 26, no. 4, p. 614, 2009.

[6] X. Xiao and Y. Wang, "Government subsidy and enterprise decision of social capital investment—evidence from strategic emerging industries," *China Industrial Economics*, no. 09, pp. 148–160, 2014.

[7] Y. Xiang, "The Historical Evolution, Key Issues and Talent Requirements of the Integrated Development of Culture and Technology . Modern Communication," *Journal of Communication University of China)*, vol. 35, no. 01, pp. 55–57, 2013.

[8] M. Wang and C. Meng, "The Interactive mechanism of scientific and technological innovation and cultural consumption and its influence on the transformation and upgrading of cultural industry: an analysis based on supply-side reform," *Taxation and Economy*, no. 02, pp. 50–55, 2019.

[9] M. Meuleman and W. De Maeseneire, "Do R&D subsidies affect SMEs' access to external financing?" *Research Policy*, vol. 41, no. 3, pp. 580–591, 2012.

[10] M. Wang and X. Li, "Government Intervention, External Investment and Business Independent Innovation from the Signaling Perspective," *Shanghai Journal of Economics*, no. 02, pp. 9–16, 2017.

[11] Y. Pan, X. Meng, and M. Zhao, "The Research of the effect of financing constraints on investment efficiency of cultural creative enterprise," *China Soft Science*, no. 08, pp. 127–136, 2016.

[12] T. Hui, "Reasons and countermeasures for financing difficulties of small and medium-sized cultural enterprises," *Wuhan Finance*, no. 05, pp. 55–57, 2013.

[13] Z. Zang, "Government subsidy, capital nature and intangible assets of listed cultural enterprises," *Shanghai Finance*, no. 05, pp. 100–104, 2015.

[14] K. Lv and H. Sun, "The internal mechanism of the influence of government subsidy on enterprise innovation performance: research on new energy enterprises," *Science and Technology Management Research*, vol. 40, no. 06, pp. 54–62, 2020.

[15] H. Huang, S. Zhai, and J. Chen, "Corporate life cycle, financing methods and financing constraints—based on the moderating effect research of investor sentiment," *Journal of Financial Research*, no. 07, pp. 96–112, 2016.

[16] J. C. Guan, C. M. A. Yam, K. M. Mok, and N. Ma, "A study of the relationship between competitiveness and technological innovation capability based on DEA models," *European Journal of Operational Research*, vol. 170, no. 3, pp. 971–986, 2006.

[17] J. Hagedoorn and M. Cloodt, "Measuring innovative performance: is there an advantage in using multiple indicators?" *Research Policy*, vol. 32, no. 8, pp. 1365–1379, 2003.
[18] L. Fu and X. Li, "The signaling effect of government subsidy in the corporate innovation process: evidence from strategic emerging industries' listed companies," *Engineering System*, vol. 32, no. 11, pp. 50–58, 2014.
[19] Z. Wen, J. Hou, and L. Zhang, "A comparison of moderator and mediator and their applications," *Acta Psychology Sinica*, no. 02, pp. 268–274, 2005.
[20] Z. Wen and B. Ye, "Analyses of mediating effects: the development of methods and models," *Advances in Psychological Science*, vol. 22, no. 05, pp. 731–745, 2014.
[21] V. Dickinson, "Cash flow patterns as a proxy for firm life cycle," *The Accounting Review*, vol. 86, no. 6, pp. 1969–1994, 2011.
[22] Y. Li and M. Tan, "Accounting information transparency and firm value: retesting based on life cycle theory," *Accounting Research*, no. 10, pp. 27–33, 2019.