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Retraction

Retracted: An Empirical Study on the Influence Mechanism of High-Level Universities on Local Enterprise Innovation under the Background of Machine Learning

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] H. Zhu and T. Feng, "An Empirical Study on the Influence Mechanism of High-Level Universities on Local Enterprise Innovation under the Background of Machine Learning," *International Transactions on Electrical Energy Systems*, vol. 2022, Article ID 8032864, 13 pages, 2022.

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Research Article

An Empirical Study on the Influence Mechanism of High-Level Universities on Local Enterprise Innovation under the Background of Machine Learning

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As the cradle of scientific research institutions and the cultivation of innovative talents, high-level universities are of certain theoretical and practical significance to investigate the impact of high-level universities on the innovation of local enterprises under the realistic background of the revival of machine learning. This paper takes A-share listed enterprises in Shanghai and Shenzhen stock markets from 2013 to 2019 as samples, and empirically examines the relationship between high-level universities and local enterprise innovation from the perspective of "double first-class" universities. The study found that high-level universities have a significant role in promoting the innovation of local enterprises, and a series of robustness tests have also confirmed the conclusions of this paper. Mechanism analysis shows that high-level universities promote local enterprise innovation mainly by promoting human capital output and school-enterprise cooperation. Heterogeneity analysis shows that executive gender, government intervention, and differences in regional development levels have significant heterogeneity effects. This paper has obvious policy implications: China should guide high-level universities to cultivate high-quality talents, cultivate positive school-enterprise cooperation, promote the sharing of innovative resources, and promote the high-quality development of the real economy.

1. Introduction

In recent decades, machine learning has started a renaissance and is widely used in various fields such as data mining and finance [1–3]. The availability and breadth of big data have increased the breadth and depth of knowledge sources [4], which has provided great help for high-level university teaching and research. In the context of machine learning, this paper conducts research on the relationship between high-level universities and local enterprise innovation. Innovation is crucial to the survival and development of enterprises [5, 6]. Innovation is not only the core driving force of enterprise competition but also a solid foundation for promoting the sustainable development of enterprises. It can effectively promote the sound evolution of the real economy and promote economic growth on the whole [7]. Therefore, discussing how to effectively improve the innovation level of local enterprises has always been a theoretical and practical proposition that scholars focus on research.

In practice, the level of enterprise innovation is on the road of exploring the frontier of science and technology, characterized by high investment, long cycle, high risk, and greater possibility of failure [8, 9]. Enterprises are always looking for a way to reduce the pressure on corporate R&D and reduce the risk of failure. To establish a good cooperative relationship with colleges and universities is the best choice for enterprises to maximize their relative benefits and minimize their costs. As the "power source" of knowledge output and innovation, the contribution of high-level universities to enterprise innovation cannot be ignored [10, 11]. High-level universities are the mainstay of basic and applied research and an important driving force for innovation [12, 13]. Since the implementation of the strategy of "rejuvenating the country through science and education," the

scientific research achievements of universities have been continuously put into the industry, and the connection between universities and the development of the real economy has become closer. The Institute of Advanced Technology of UTC China is a good example. According to the reports disclosed on the official website, since 2016, the Institute of Advanced Technology of UTC China has continued to promote cooperation with enterprises, building 25 joint laboratories, including Alibaba, Wanxin Media, Guoxuan High-tech, etc. In view of the increasing transformation of scientific and technological achievements, Science and technology policies such as the Administrative Measures for the Transformation of scientific and technological Achievements were promulgated in 2021. This is to improve the management level of scientific research results, so as to better serve the innovation of local enterprises.

At the policy level, the 13th Five-Year Plan puts forward relevant suggestions on "deeply implementing the innovation-driven development strategy": "Promote the construction of high-level universities and research institutes with distinctive characteristics, encourage enterprises to carry out basic frontier innovation research, and attach importance to disruptive technological innovation." This is a new idea and countermeasure proposed for building an innovative country. It aims to continuously promote the innovation-driven development strategy, improve the teaching and research level and innovation ability of universities, make a number of universities and a number of disciplines reach or approach the world-class level, and promote the integration of industry and education and school-enterprise cooperation. Under this policy background, on September 21, 2017, the Ministry of Education announced the key list of building world-class universities and first-class disciplines (hereinafter referred to as "double First-class"), including 42 first-class universities and 95 first-class discipline construction universities, aiming to serve the needs of economic and social development and national strategic needs. There is no doubt that policy support at the government level will help promote and guide high-level universities to serve local enterprise innovation and achieve collaborative innovation [14, 15]. However, whether policy expectations can be met is a question to be tested. In view of the urgency and importance of enterprise innovation-driven development, do high-level universities have a positive role in promoting local enterprise innovation? If the answer is yes, then what is the way to influence it? What is the effect of their relationship?

In order to answer the above questions, this paper takes A-share listed enterprises in Shanghai and Shenzhen from 2013 to 2019 as the research sample, selects "double first-class" universities as a representative perspective, and empirically examines the innovation relationship between high-level universities and local enterprises. At the same time, we further examine the transmission path of the impact of high-level universities on local enterprise innovation from the perspective of human capital and university-enterprise cooperation. We also discuss the heterogeneous effects of the differences of executive gender, government intervention, and regional development levels. The study found that high-level universities have a significant role in promoting innovation of local enterprises, and a series of robustness tests have also confirmed the conclusions of this paper. Mechanism analysis shows that high-level universities promote local enterprise innovation mainly by promoting human capital output and school-enterprise cooperation. Heterogeneity analysis shows that executive gender, government intervention, and differences in regional development levels have significant heterogeneity effects.

The contribution of this article may be as follows: Firstly, under the realistic background of machine learning and the active construction of "double first-class" universities, it is representative and practical to systematically examine the impact of high-level universities on the innovation of local enterprises from the representative perspective of "double first-class" universities. Secondly, from the perspective of human capital and university-enterprise cooperation, we expand the transmission path of high-level universities to boost the innovation of local enterprises, which provides theoretical evidence for relevant research. Thirdly, the empirical results of heterogeneity analysis provide corresponding evidence support, which is beneficial to put forward new empirical evidence and policy reference for high-level universities to more effectively serve the real economy innovation.

The follow-up arrangement of the structure of this paper is as follows: the second part is the literature review, the third part is the theoretical analysis and research hypothesis, the fourth part is the research design, the fifth part is the empirical analysis, and the sixth part is the discussion and conclusion.

2. Literature Review

The literature shows that universities have a positive role in promoting regional innovation and innovation in the enterprise [12, 13, 16-17]; Wang and Xu,2018; [13]. University influence research in promoting local enterprise innovation has always been the focus of academic circles. The existing literature focuses on high-quality human capital output [19, 20], university research investment and innovation [16, 17, 21], and the research contributions of university teachers [22–24].

First, high-quality human capital output. Human capital directly or indirectly promotes enterprise innovation [19], and a reduction in human capital supply reduces enterprise innovation [20], which is evident in emerging markets [25]. Education is a powerful guarantee to promote the quality of human capital. The more human capital stock, the easier to absorb advanced national technologies and then promote enterprise development and economic growth [26]. University education can improve the quality and ability of human capital and increase the supply of human capital to promote enterprise innovation [19, 20]. Che and Zhang [27] believe that human capital through university education will improve technology adoption and production efficiency, thus driving enterprise innovation. Based on the policy events of domestic education enrollment expansion, Li et al. [28] found that human capital promoted the quantity and quality of enterprise innovation, and university education played a very important role in this process.

Second, university scientific research investment and innovation. Jaffe [21] studied the relationship between university R&D and innovation, and innovatively introduced the university R&D investment variable in the model. It was found that the more university R&D investment, the more R&D investment and patent output of local enterprises, that is, the university R&D investment has a positive role in promoting the innovation of local enterprises. Audretsch and Feldman [16] with knowledge production function model found that university R&D investment activities can significantly promote regional innovation and promote regional economic growth to some extent. Heaton et al. [29] cited Stanford University, MIT, and University of California, Berkeley show that universities play an important role in promoting innovation ecosystems in cooperation with local businesses. Yang et al. [15] reached a similar conclusion through empirical research. In the relevant research of Chinese industrial enterprises, the concentrated investment of university R&D funds has a great role in promoting the innovation of local enterprises, which is more obvious in the eastern and central regions of China [29]. This is because university technology can bring new technologies and new products to enterprises, help local enterprises to enhance their core competitiveness, occupy new market advantages, and obtain certain excess profits, which means that university-enterprise cooperation helps to transform scientific research results into real productivity, and is an effective path to promote local enterprise innovation and development and enhance enterprise value [17, 30]. Yi and Long [39] found that, for every 1% increase in university R&D investment, the R&D output of listed enterprises in close province increased by about 2%.

Third, the scientific research contribution of university teachers. Most of the MIT faculty are business-oriented, favor and pursue a diverse working environment, committed to commercializing research results and achieving a "win-win" between enterprise innovation and personal income [22]. Markman et al. [23] found through empirical research that university teachers' participation in the patent licensing process can accelerate the innovation process and accelerate the commercialization time of innovation results. Based on the literature of domestic listed enterprises as samples, Xu and Li [31] found a significant positive relationship between academician (candidate) independent directors and enterprise innovation. As "bridge scientists," academician independent directors can effectively promote the industry-university-research cooperation and technological innovation of enterprises.

The above literature generally focuses on universities and innovation, but there are still shortcomings. Firstly, there is no literature in the existing research to pay attention to the impact of policy support for building high-level universities such as "double first-class" universities on the innovation of local enterprises. Secondly, the research has not been carried out from the dual dimensions of combining quantity and quality of innovation input and output, which has certain limitations. Starting from these two points, based on the representative perspective of "double first-class" universities, this paper studies from the dual dimensions of quantity of innovation input and quality of innovation output, discusses the influence of high-level universities on the innovation of local enterprises, and tests the influence of heterogeneity.

3. Theoretical Analysis and Hypothesis Development

New economic growth theory holds that knowledge is the driver of economic growth [32]. Universities are an important source of knowledge production, processing, and innovation output, and are important to driving innovation and economic growth [30, 33]. In addition to undertaking the teaching and scientific research functions, high-level universities also assume the function of serving the local economic development. High-level universities are the main body leading enterprises in innovation. It is the trend to promote universities to open up scientific research infrastructure and innovation resources, and improve the efficiency of transforming scientific research achievements into real productivity. Firstly, high-level universities have excellent human capital. On the one hand, teachers have made outstanding contributions to technological innovation [22–24], and intellectual output can realize the sharing of scientific research results and innovation resources. On the other hand, universities are the cradle of cultivating high-quality talents [34]. The inflow of high-quality talents can inject fresh impetus into the innovation and development of enterprises, improve the cognitive decision-making ability of the whole enterprise, thus promoting enterprise innovation [19, 20]. Secondly, university-enterprise cooperation between high-level universities and local enterprises can help accelerate knowledge spillover and achievement transformation [30, 35]. Knowledge spillover in high-level universities is a manifestation of technology spillover, and universities contribute to knowledge generation and transfer [10, 21, 30], which helps to promote local enterprise innovation. Thus, we put forward the following hypothesis:

Hypothesis 1. Ceteris paribus, high-level universities have significantly promoted innovation in local enterprises.

Specifically, this paper expounds the transmission path of high-level universities and local enterprise innovation from the perspective of human capital and university-enterprise cooperation.

The human capital perspective. Human capital is the potential driving force to promote the development of the region and even the whole society and economy, and talent competition has also become the contemporary theme. Human capital has a certain externality and has a certain impact on enterprise innovation [27, 28]. The key knowledge required for innovation comes from the contribution of human capital [25]. Human resources are the first resource for development. The essence of university education lies in cultivating talents and conveying high-quality human resources for the society. High-level universities have two important human capital: teachers and students. On the one hand, teachers working in high-level universities usually have a high level of scientific research, with fruitful results and excellent continuous creativity in scientific research. At

the same time, high-level universities continue to introduce high-level talents at home and abroad, set up and train targeted scientific research teams, and establish a solid foundation for accelerating the commercialization of achievements and serving the real economy. Therefore, the full-time teachers and their teams in high-level universities have made important contributions at the scientific research and innovation level [22–24], and the intellectual output realizes the rapid transformation of scientific research achievements and the sharing of innovation resources. On the other hand, high-level universities, as the cradle of scientific research institutions and high-level talent training, have high-quality school-running conditions and sound talent training modes, such as first-class teachers and a perfect integrated training system of "undergraduate, master and doctoral programs." Whether from the perspective of software or hardware, this provides high quality and objective conditions for cultivating high quality, high level, and other "three high" talents. After "three high" talents join local enterprises, with their professional knowledge level and excellent scientific research and technology level, they inject fresh vitality into enterprise innovation and development, and provide guarantee for enterprise cognitive decision-making and technological development, so as to promote enterprise innovation and performance improvement [19, 20, 27]. Under the fierce market competition, enterprises invest in different forms of human capital to promote independent technological innovation, which is of far more long-term value than relying on external acquisitions [25]. Thus, we put forward the following hypothesis:

Hypothesis 2. Ceteris paribus, high-level universities have significantly promoted local enterprise innovation through the human capital path.

The school-enterprise cooperation perspective. Firstly, school-enterprise cooperation is a common demand of both parties [36]. From the perspective of enterprises, R&D activities are uncertain and at high risk. Increasing market competition should also face rising R&D costs. Enterprises should not only accelerate independent technological innovation but also seek external innovation support [37]. From the perspective of universities, high-level universities are the main subjects responsible for promoting innovation and development. Through cooperation with enterprises, they provide technological innovation services and innovation resource sharing for enterprises [21]. While accelerating the commercialization of scientific research results, it also obtains financing, and also provides quality guarantee for the development of school running and the continuity of scientific research activities [34]. In addition, university-enterprise cooperation provides the possibility to provide a practical teaching platform, helps universities improve the talent training system combining theory with practice, have targeted training for high-level talents needed by local enterprises, and exchange needed goods [38].

Secondly, the innovation effect of direct cooperation between high-level universities and local enterprises is more obvious. Knowledge spillover from high-level universities is limited to a certain geographic distance [39–41]. As the geographical distance increases, as will the cost of knowledge transfer. This is because the same regional culture provides better cooperative communication and better social relations, which helps to enhance mutual loyalty and trust [42, 43]. At the same time, the high frequency of face-to-face communication helps enterprises to understand and apply the hidden knowledge behind forward-looking technologies to improve productivity and innovation performance [42, 44]. Therefore, the gathering of R&D resources of surrounding high-level universities will bring more opportunities and possibilities for local enterprises to innovate.

Finally, high-level universities are an important link to maintain cooperative innovation. From the perspective of strategic development, high-level universities are important links between scientific research institutions and enterprises. They have jointly established advanced scientific research bases or scientific research incubation centers. This provides a shared and cooperative platform for the transformation of scientific and technological research achievements into actual productivity. Thus, we put forward the following hypothesis:

Hypothesis 3. Ceteris paribus, high-level universities have significantly promoted the innovation of local enterprises through the university-enterprise cooperation path.

4. Research Design

4.1. Sample Selection and Data Sources. In this paper, A-share listed enterprises in Shanghai and Shenzhen from 2013 to 2019 were selected as the initial research sample. We screened the data according to the following principles: (1) Excluding listed companies in financial and insurance industries; (2) excluding ST and *ST companies to eliminate the impact of abnormal fluctuations of special samples; and (3) excluding missing samples with relevant data to obtain 11,941 samples. At the same time, in order to eliminate the effect of extreme values, this paper treats the variables at the 1% level (Winsorize). The data processing uses Stata15.1 software, and the data come from CSMAR database.

4.2. Variable Definitions. The explained variable is enterprise innovation (RD/Grants). Enterprise innovation behavior includes enterprise innovation input and innovation output [45]. Therefore, this paper comprehensively considers enterprise innovation from the perspectives of R&D input and patent output. On the one hand, using the practice of Aghion et al. [46], the proportion of R&D investment (RD) is selected as the index to measure enterprise innovation investment. On the other hand, based on the practice of Hall and Harhoff [47], the number of patent granted plus 1 natural logarithm (Grants) is selected as a measure of enterprise innovation output.

The explanatory variable was a high-level university (University). China has vast land and abundant resources, and has differences in running schools, handling styles, and norms of conduct. There are century-old schools with long running and profound deposits, and rising stars in recent years. The influence of universities on local enterprises is similar to that of Confucian culture. Chen et al. [48]; Gu

[49]; Cheng et al. [50]; Xu and Li [24] measure the influence of Confucian culture by the number of Confucian schools. This paper draws on the above research to measure Confucian culture, selects regional-level indicators, and uses the number of "double first-class" universities (University) within 200 kilometers of the registered location of listed companies as the index to measure the influence of high-level universities (we check the list of "double top" universities and "985" and "211" engineering universities. Among them, 81.43% of the list of "double first-class" universities are "985" or "211" universities, indicating that the selection of "double first-class" universities is representative to measure high-level universities.). The advantages of choosing this measurement are that: First, using the data at the spatial distance level, we can exclude the inaccessibility of the individual- and company-level data and the subjective interference of the questionnaire survey, and effectively eliminate the errors. Second, the homogeneity of the environment will reduce the difficulty of communication between cooperation and communication within a certain region, and may better reflect the cooperative relationship between schools and enterprises. The specific steps are as follows: First, the longitude (Lon_i) and latitude (Lat_i) coordinates are obtained based on Baidu Map, then the longitude (Lon_j) and latitude (Lat_j) coordinates of the listed company are obtained through the CSMAR database, and then the distance between the "double first-class" university and the listed company is calculated according to the following formula.

$$\begin{aligned} C &= \sin(\mathrm{Lat}_i) * \sin(\mathrm{Lat}_j) + \cos(\mathrm{Lat}_i) * \cos(\mathrm{Lon}_i) \\ &\quad * \cos(\mathrm{Lat}_j) * \cos(\mathrm{Lon}_j), \\ &\quad + \cos(\mathrm{Lat}_i) * \sin(\mathrm{Lon}_i) * \cos(\mathrm{Lat}_j) * \sin(\mathrm{Lon}_j), \\ \mathrm{Dis} &= R * \arccos(C). \end{aligned} \tag{1}$$

Specifically, for the equatorial radius, the value is 6371.004 km. According to the calculated distance (Dis), we calculate the number of "double first-class" universities (University) within the range of 200 kilometers of the registered location of a listed company. The larger the index, the stronger the impact the listed company is affected by the "double first-class" universities.

There are two main mediation variables: (1) Human capital (HumanC) is measured by the proportion of the number of senior executives in the total number of executives of listed companies; (2) School-enterprise cooperation (SchoolE) is measured by the proportion of senior executives with university background in the total number of executives.

This paper further controls other variables that may affect business innovation, including capital intensity (KL), enterprise size (Size), asset-liability ratio (Lev), return on equity (Roe), growth (Growth), management ownership (Manage), cash flow (CF), overseas business revenue (Overseas), and industry and annual virtual variables, as defined in Table 1.

4.3. Model Setting. To test Hypothesis 1, a fixed-effect model is designed for empirical testing:

$$RD \text{ or } \mathrm{Grants}_{i,t} = \alpha_0 + \alpha_1 \mathrm{University}_{i,t} + \alpha_2 \mathrm{Controls}_{i,t} + \varepsilon_{i,t}. \tag{2}$$

In order to test Hypothesis 2 and Hypothesis 3 and better identify the transmission path of the innovation boost effect of high-level universities on local enterprises, this paper uses the intermediary effect test method of Baron and Kenny [51]; Wen et al. [52] to establish the following path model:

$$\begin{aligned} RD \text{ or } \mathrm{Grants}_{i,t} &= \alpha_0 + \alpha_1 \mathrm{University}_{i,t} + \alpha_2 \mathrm{Controls}_{i,t} + \varepsilon_{i,t}, \\ \mathrm{Mediator}_{i,t} &= \alpha_0 + \alpha_1 \mathrm{University}_{i,t} + \alpha_2 \mathrm{Controls}_{i,t} + \varepsilon_{i,t}, \\ RD \text{ or } \mathrm{Grants}_{i,t} &= \alpha_0 + \alpha_1 \mathrm{University}_{i,t} + \alpha_2 \mathrm{Mediator}_{i,t} \\ &\quad + \alpha_3 \mathrm{Controls}_{i,t} + \varepsilon_{i,t}. \end{aligned} \tag{3}$$

Where, $\mathrm{Mediator}_{i,t}$ is the mediating variable.

5. Empirical Analysis

5.1. Descriptive Statistics. Table 2 is the results of the descriptive statistical analysis of the main variables. The mean value of enterprise innovation investment (RD) was 4.523%, minimum value of 0.040%, median value of 3.560%, maximum value of 25.410%, and standard deviation of 4.389. The mean of enterprise innovation output (Grants) was 2.060, a minimum of 0, a median of 2.079, a maximum of 9.503, and a standard deviation of 1.778. This shows that there are significant differences in the innovation level of enterprises in the sample companies. The mean value of high-level universities (University) is 13.019, the minimum value is 0, the median value is 5, the maximum value is 40, and the standard deviation is 13.188, which indicates that there are significant differences in the number of high-level universities around the sample companies, and the number of high-level universities around half of the sample companies is 5 or less. The average human capital (HumanC) is 0.346, the minimum value is 0, the median value is 0.348, the maximum value is 0.955, and the standard deviation is 0.221, indicating that the proportion of senior executives with high educated background is generally low. From the maximum and minimum values, the human capital between listed companies varies greatly. The average value of school-enterprise cooperation (SchoolE) is 0.113, the minimum is 0, the median value is 0.100, the maximum is 0.882, and the standard deviation is 0.091, indicating that the proportion of executives with college background is generally low, the possibility of university-enterprise cooperation is low, and the difference between listed companies is large. The performance of the control variables coincided with our expectations.

Table 1: Definition of variables.

Type	Name	Description
Explained variable	RD	R&D investment/operating income ∗ 100%
	Grants	Add 1 to the number of patents granted to take the natural logarithm
Explanatory variable	University	The number of "double first-class" universities within 200 kilometers of the enterprise's registered address
Mediating variable	HumanC	Number of highly educated executives/total number of executives
	SchoolE	Number of senior executives with background in universities/total number of senior executives
Control variable	KL	Net fixed assets/(number of employees ∗ 10000)
	Size	Natural logarithm of total assets
	Lev	Total liabilities/total assets
	Roe	Net profit/net assets
	Growth	(Current year's operating income − previous year's operating income)/previous year's operating income
	Manage	Number of shares held by management/total shares
	CF	(Cash + held-for-trading financial assets)/total assets
	Overseas	Overseas business income/operating income
	Industry	Virtual variable
	Year	Virtual variable

Table 2: Descriptive statistics.

Var	*N*	Mean	Std.	Min	Median	Max
RD	11941	4.523	4.389	0.040	3.560	25.410
Grants	11941	2.060	1.778	0	2.079	9.503
University	11941	13.019	13.188	0	5	40
HumanC	11941	0.346	0.221	0	0.348	0.955
SchoolE	11941	0.113	0.091	0	0.100	0.882
KL	11941	45.915	62.625	0.972	27.462	491.935
Size	11941	22.139	1.234	19.714	21.974	26.438
Lev	11941	0.402	0.196	0.054	0.390	0.922
Roe	11941	0.057	0.118	-0.641	0.064	0.302
Growth	11941	0.201	0.439	-0.562	0.125	3.216
Manage	11941	0.164	0.208	0.000	0.032	0.699
CF	11941	0.177	0.119	0.015	0.146	0.619
Overseas	11941	0.126	0.207	0.000	0.008	0.898

Table 3: Benchmark regression results.

	(1) RD	(2) Grants
University	0.017***	0.004***
	(6.88)	(3.44)
KL	−0.001**	−0.004***
	(−2.05)	(−15.44)
Size	−0.215***	0.698***
	(−5.93)	(44.86)
Lev	−4.403***	−0.200**
	(−19.90)	(−2.15)
Roe	−2.891***	1.087***
	(−9.56)	(7.41)
Growth	−0.304***	−0.131***
	(−3.96)	(−4.17)
Manage	1.411***	0.335***
	(8.08)	(4.54)
CF	3.604***	−0.142
	(11.96)	(−1.13)
Overseas	0.455***	0.388***
	(2.83)	(5.73)
_Cons	8.060***	−13.987***
	(9.94)	(−40.56)
Industry	Control	Control
Year	Control	Control
R^2	0.074	0.352
N	11941	11941

Note: ***, **, and *, indicate the significance levels of 1%, 5%, and 10%, respectively, with *t* values in parentheses.

5.2. Benchmark Regression. Table 3 is the regression result of the relationship between high-level universities and enterprise innovation. The results listed in (1) in Table 3 show that, when the explained variable is enterprise innovation input (RD), the regression coefficient of high-level universities (University) is 0.017 and at the 1% statistical level. According to the results of column (2), when the dependent variable is enterprise innovation output (Grants), the regression coefficient of high-level university (University) is 0.004, and it is significant at the statistical level of 1%. The synthesis of the above results shows that high-level universities boost the innovation of local enterprises and verify the theoretical assumptions, both from the perspective of innovation input and from the perspective of innovation output.

5.3. Intermediation Path. Table 4 is the transmission path test result based on the perspective of human capital and university-enterprise cooperation. For Path A test results, please refer to Table 3. Column (1) in Table 4 shows the test results of Path B. It can be seen from the results that the regression coefficient of high-level universities (University) is positive and significant at the 5% statistical level, which means that high-level universities effectively promote the output of high-quality human capital. Column (2) and (3) are the test results of Path C. The results showed that the regression coefficients of the high-level universities (University) and human capital (HumanC) were both positive and significant at the 1% statistical level. According to the methods of Baron and Kenny [51]; Wen and Ye [52]; the overall results confirm that the impact of high-level universities on enterprise innovation has some intermediary effect in the path of human capital, and the corresponding

Table 4: The intermediary path results.

	(1) HumanC	(2) RD	(3) Grants	(4) SchoolE	(5) RD	(6) Grants
University	0.000**	0.016***	0.003***	0.000*	0.017***	0.003***
	(2.55)	(6.55)	(3.16)	(1.84)	(6.79)	(3.27)
HumanC		2.467***	0.619***			
		(16.57)	(9.82)			
SchoolE					2.034***	1.100***
					(5.65)	(7.30)
KL	−0.000***	−0.001	−0.004***	0.000	−0.001**	−0.004***
	(−4.42)	(−1.29)	(−15.09)	(−0.64)	(−2.02)	(−15.46)
Size	0.024***	−0.275***	0.684***	0.007***	−0.229***	0.691***
	(10.11)	(−7.63)	(43.97)	(7.16)	(−6.29)	(44.44)
Lev	−0.077***	−4.213***	−0.152	−0.021***	−4.361***	−0.176*
	(−5.74)	(−19.23)	(−1.63)	(−3.68)	(−19.72)	(−1.89)
Roe	−0.012	−2.862***	1.080***	0.004	−2.899***	1.095***
	(−0.63)	(−9.57)	(7.41)	(0.57)	(−9.60)	(7.49)
Growth	0.017***	−0.345***	−0.139***	−0.002	−0.301***	−0.128***
	(3.51)	(−4.54)	(−4.45)	(−0.95)	(−3.92)	(−4.08)
Manage	0.041***	1.309***	0.297***	−0.004	1.418***	0.335***
	(4.29)	(7.57)	(4.04)	(−0.85)	(8.13)	(4.54)
CF	0.102***	3.354***	−0.212*	0.011	3.581***	−0.156
	(5.72)	(11.24)	(−1.69)	(1.50)	(11.90)	(−1.24)
Overseas	0.027***	0.387**	0.371***	−0.013***	0.481***	0.402***
	(2.95)	(2.43)	(5.51)	(−3.14)	(2.99)	(5.94)
_Cons	−0.240***	8.652***	−13.847***	−0.040**	8.142***	−13.947***
	(−4.53)	(10.78)	(−40.35)	(−1.96)	(10.05)	(−40.57)
Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
R^2	0.215	0.078	0.354	0.090	0.075	0.353
N	11941	11941	11941	11941	11941	11941

Note: ***, **, and *, indicate the significance levels of 1%, 5%, and 10%, respectively, with t values in parentheses.

intermediary effect size is 5.84% (innovation input) and 6.98% (innovation output), respectively. Meanwhile, the sobel test result was significant. Therefore, high-level universities promote enterprise innovation through high-quality human capital export, Hypothesis 2 holds.

Column (4) in Table 4 shows the test results of Path B. It can be seen from the results that the regression coefficient of high-level universities (University) is positive and significant at the statistical level of 10%, which means that there is more school-enterprise cooperation between high-level universities and local enterprises. Column (5) and (6) are the test results of Path C, which show that the regression coefficients of high-level universities (University) and university-enterprise cooperation (SchoolE) are both positive and significant at the statistical level of 1%. According to Baron and Kenny [51]; Wen and Ye [52]; the overall results confirm that the impact of high-level universities on enterprise innovation has some intermediary effects in the path of school-enterprise cooperation, and the corresponding intermediary effect size is 1.38% (innovation investment) and 3.56% (innovation output), respectively. Meanwhile, the sobel test result was significant. Therefore, when high-level universities promote enterprise innovation by establishing school-enterprise cooperation, Hypothesis 3 is established.

5.4. Robustness Test. To ensure the robustness of the results, we test the robustness from the following four aspects. Firstly, the endogenous test. As the Ministry of Education is the administrative department of universities across China, it has a key impact on the determination of "double first-class" universities and "double first-class" disciplines, but it is not directly related to the innovation of local enterprises. Therefore, in this paper, the reverse chemical index (University) of the geographical distance between the registered place of listed companies and the Ministry of Education was selected as the tool variable (IV) for the endogenous test. Column (1) in Table 5 is the regression result of the first stage, showing that the coefficient of the instrumental variable is 8.108 and is significant at the 1% statistical level, indicating that this is not a weak instrumental variable. Column (2) and (3) are the regression results of the second stage, and the coefficients of University are 0.021 and 0.003, respectively, and they are positive and significant. The results are consistent with the above article and support the above conclusion.

Secondly, the change is measured by the explanatory variables. We choose the ratio of R&D expenditure (Spend) as the variable to measure enterprise innovation input and take natural logarithmic number (Apply) as the variable to measure enterprise innovation output. Finally, the changed interpreted

Table 5: Endogenous test: regression results of instrumental variables.

	(1) University	(2) RD	(2) Grants
IV	8.108***		
	(95.80)		
University		0.021***	0.003*
		(5.63)	(1.77)
KL	−0.002*	−0.001**	−0.004***
	(−0.95)	(−2.10)	(−15.41)
Size	0.076	−0.219***	0.699***
	(0.80)	(−6.02)	(44.76)
Lev	−1.721***	−4.385***	−0.204**
	(−2.87)	(−19.78)	(−2.18)
Roe	3.631***	−2.899***	1.087***
	(4.46)	(−9.58)	(7.41)
Growth	0.014	−0.305***	−0.131***
	(0.07)	(−3.97)	(−4.16)
Manage	2.594***	1.400***	0.338***
	(5.52)	(8.01)	(4.56)
CF	1.719**	3.585***	−0.137
	(2.17)	(11.89)	(−1.09)
Overseas	2.270***	0.452***	0.389***
	(5.18)	(2.81)	(5.74)
_Cons	74.612***	8.126***	−14.002***
	(31.77)	(5.55)	(−40.52)
Industry	Control	Control	Control
Year	Control	Control	Control
N	11941	11941	11941

Note: ***, **, and *, indicate the significance levels of 1%, 5%, and 10%, respectively, with *t* values in parentheses.

variables were replaced into the regression for empirical testing. The changed interpreted variables were replaced into the regression and the results were robust, as shown in Table 6 (1) –(2). Thirdly, change the measure of explanatory variables. In this paper, the number of double first-class disciplines (Subject) within 200 kilometers of the registered location of listed companies is selected as the alternative explanatory variable and re-substituted into the regression test. The coefficients of the number of double first-class disciplines (Subject) were 0.004 and 0.001, respectively, which were significant at the 1% statistical level, indicating that the statistical results are robust, as shown in Table 6 (3)–(4). Fourthly, the pre-2017 samples were excluded. The impact of samples before 2017 was not excluded in the previous article. Such samples are excluded here and tested for robustness test. The results are still reliable, as shown in Table 6 (5)–(6).

6. Further Test: Heterogeneity Analysis

In the further examination, we mainly considered the possible heterogeneity analysis of executive gender, government intervention, and the level of regional development.

Firstly, the female executive perspective. High-level universities promote enterprise innovation and are influenced by their internal attributes [11]. From the perspective of executive cognition, their cognitive level differences can affect organizational decision-making [53, 54]. Compared with male executives, female executives' soft and cautious attitude makes them tend to avoid risks and pursue a stable development environment, which may inhibit innovation activities with high uncertainty. This paper measures the proportion of female executives (Female) in the team of executives to study the heterogeneous effects of female executives. The regression coefficient of Table 7 (1) is 0.023 and significant at the 1% statistical level. The regression coefficient of interaction term (University ∗ Female) is −0.030, but not significant, meaning that the difference in the proportion of female executives in the team has no significant impact on enterprise innovation input. It means that the difference in the proportion of female executives in the team has no significant impact on corporate innovation investment. The regression coefficient of column (2) middle universities (University) is 0.014, and the interaction term (University ∗ Female) is 0.053, and it is significant at the 1% statistical level. It means that female executives will inhibit the positive promotion effect of high-level universities on enterprise innovation output. This is mainly because female executives tend to avoid risk and are more cautious about innovative decisions related to uncertain and high-risk research and development activities.

Secondly, the perspective of government intervention. The government plays an important role in guiding local enterprises to innovate. On the one hand, the government, as an intermediary, guides school-enterprise cooperation to provide them with cooperation platforms and other conveniences. On the other hand, the government guides the school scientific research talents to serve the local economy and provide policy guidance. In general, the tripartite cooperation between "government, university and enterprises" helps to promote the positive effect of high-level universities on enterprise innovation [14, 15], and government intervention is expected to have a regulatory effect. Therefore, the government intervention index of Wang et al. [55] was used for empirical test. The regression coefficients of columns (3) and (4) middle and high level universities (University) are 0.093 and 0.027, respectively, and the regression coefficients of interaction terms (University ∗ Gov) are –0.011 and –0.003, and the above results were significant at the 1% statistical level. This means that the higher the government intervention, higher-level universities (University) have a more significant positive effect on enterprise innovation (RD/Grants). This shows that the tripartite cooperation between "government, university and enterprise" is of positive significance and is conducive for promoting high-level universities to serve the local economic development.

Thirdly, the perspective of regional development level differences. Differences in regional development levels lead to natural differences in the factor endowments obtained by different local enterprises [29]. Knowledge innovation and other resources provided by high-level universities are particularly important, which is more important for local enterprises with relatively backward regional development level [13]. This paper expects the heterogeneous effects of regional development-level differences. Therefore,

Table 6: Results of the robustness test.

	(1) Spend	(2) Apply	(1) RD	(2) Grants	(5) RD	(6) Grants
University	0.017***	0.003***			0.016***	0.003*
	(6.75)	(3.07)			(3.97)	(1.66)
Subject			0.004***	0.001***		
			(7.38)	(3.18)		
KL	−0.001*	−0.005***	−0.001**	−0.004***	−0.002**	−0.004***
	(−1.76)	(−15.01)	(−2.05)	(−15.43)	(−2.45)	(−8.67)
Size	−0.211***	0.743***	−0.219***	0.698***	−0.176***	0.747***
	(−5.72)	(45.33)	(−6.02)	(44.82)	(−3.22)	(25.63)
Lev	−4.515***	−0.261***	−4.392***	−0.201**	−4.312***	−0.005
	(−20.10)	(−2.66)	(−19.85)	(−2.15)	(−12.53)	(−0.03)
Roe	−3.010***	1.627***	−2.891**	1.088***	−3.157***	0.517*
	(−9.81)	(10.49)	(−9.56)	(7.42)	(−7.55)	(1.75)
Growth	−0.302***	−0.086***	−0.304***	−0.131***	−0.457***	−0.194***
	(−3.88)	(−2.59)	(−3.96)	(−4.17)	(−3.62)	(−3.16)
Manage	1.420***	0.412***	1.408***	0.336***	1.615***	0.488***
	(8.01)	(5.30)	(8.06)	(4.54)	(6.01)	(3.43)
CF	3.542***	−0.185	3.599***	−0.140	2.853***	−0.043
	(11.59)	(−1.40)	(11.95)	(−1.12)	(5.93)	(−0.17)
Overseas	0.455***	0.458***	0.447***	0.387***	0.769***	0.422***
	(2.78)	(6.42)	(2.78)	(5.71)	(3.08)	(3.18)
_Cons	8.051***	−14.656***	8.143***	−13.980***	7.815***	−26.89
	(9.78)	(−40.35)	(10.04)	(−40.51)	(6.10)	(−0.04)
Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
R^2	0.073	0.349	0.074	0.352	0.068	0.515
N	11941	11941	11941	11941	5280	5280

Note: ***, **, and *, indicate the significance levels of 1%, 5%, and 10%, respectively, with t values in parentheses.

Table 7: Results of the heterogeneity test.

	(1) RD	(2) Grants	(3) RD	(4) Grants	(5) RD	(6) Grants
University	0.023*** (4.66)	0.014*** (6.53)	0.093*** (7.06)	0.027*** (4.84)	0.014*** (5.00)	0.001 (1.11)
Female	0.232 (0.53)	0.261 (1.40)				
University ∗ Female	−0.030 (−1.33)	−0.053*** (−5.43)				
Gov			0.128*** (4.86)	0.104*** (9.42)		
University ∗ Gov			−0.011*** (−5.86)	−0.003*** (−4.34)		
Area					−0.197*** (−3.08)	−0.135*** (−5.02)
University ∗ Area					0.010* (1.66)	0.006** (2.42)
KL	−0.001** (−2.04)	−0.004*** (−15.43)	−0.001* (−1.70)	−0.004*** (−14.82)	−0.001* (−1.91)	−0.004*** (−15.24)
Size	−0.220*** (−6.00)	0.689*** (43.93)	−0.230*** (−6.34)	0.696*** (44.87)	−0.216*** (−5.95)	0.698*** (44.88)
Lev	−4.397*** (−19.86)	−0.190** (−2.04)	−4.368*** (−19.76)	−0.172* (−1.85)	−4.373*** (−19.74)	−0.175* (−1.87)
Roe	−2.888*** (−9.55)	1.099*** (7.51)	−2.876*** (−9.51)	1.006*** (6.89)	−2.930*** (−9.68)	1.042*** (7.11)
Growth	−0.303*** (−3.95)	−0.128*** (−4.08)	−0.316*** (−4.11)	−0.133*** (−4.24)	−0.305*** (−3.97)	−0.131*** (−4.16)
Manage	1.416*** (8.07)	0.352*** (4.74)	1.329*** (7.57)	0.263*** (3.56)	1.372*** (7.81)	0.309*** (4.17)
CF	3.607*** (11.97)	−0.128 (−1.02)	3.594*** (11.95)	−0.138 (−1.11)	3.640*** (12.07)	−0.115 (−0.91)
Overseas	0.457*** (2.84)	0.396*** (5.85)	0.399** (2.46)	0.295*** (4.34)	0.384** (2.36)	0.338*** (4.94)
_Cons	8.100*** (9.78)	−13.842*** (−39.37)	7.565*** (9.20)	−14.607*** (−41.89)	8.191*** (10.09)	−13.894*** (−40.29)
Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
R^2	0.074	0.353	0.075	0.354	0.074	0.353
N	11941	11941	11941	11941	11941	11941

Note: ***, **, and *, indicate the significance levels of 1%, 5%, and 10%, respectively, with t values in parentheses.

according to the standard of the division of eastern, central, and western regions by the National Bureau of Statistics, the regional development level (Area) variable is 0 in the eastern region, 1 in the central region, and 2 in the western region. The regression coefficients of columns (5) and (6) middle and high level universities (University) are 0.014 and 0.001, respectively, and the regression coefficients of interaction terms (University ∗ Gov) are 0.010 and 0.006, and all the above results are positively significant. It means that in areas with relatively backward regional development level, high-level universities (University) play a more significant role in promoting enterprise innovation (RD/Grants). Compared with "icing on the cake," the knowledge resource output provided by high-level universities for local enterprises with poor resources and backward economy is more like "timely help," and the effect of improving the innovation of local enterprises is remarkable.

7. Discussion and Conclusion

7.1. Discussion. Corporate innovation is a necessary condition for the sustainable growth of the real economy [7], which is a global consensus. At the same time, with the revival of machine learning, corporate innovation has reached a new level. For China, as a representative of emerging markets, it is of great practical significance to study the innovation problem of Chinese enterprises. Since the proposal of "rejuvenating the country through science and education" in 1995, the Chinese government has always been committed to the construction of high-level universities and the exploration of effective ways to guide universities to serve enterprise innovation, and has issued a series of relevant policies. The 13th Five-Year Plan proposes to "promote the construction of high-level universities and research institutes with distinctive features, encourage enterprises to carry

out basic frontier innovation research, and attach importance to disruptive technological innovation." Continuing the strategic thinking of the 13th Five-Year Plan, the 14th Five-Year Plan further proposes to "focus on integrating and upgrading a number of key generic technology platforms, supporting leading enterprises in the industry to jointly with institutions, research institutes and upstream and downstream enterprises in the industry to build a national industrial innovation center and undertake major national science and technology projects." In 2020, the CPC Central Committee and The State Council promulgated the Opinions on Building a Better System and Mechanism for Market Allocation of Factors. The policy calls for accelerating the development of the domestic technology factors market, focusing on promoting the transformation of scientific and technological achievements in universities and research institutes, and emphasizing the important role of intellectual property protection. These policies are aimed at promoting collaborative innovation between high-level universities and enterprises. In general, the core of enterprise innovation lies in the breakthrough of knowledge and technology. As the cradle of scientific research institutions and innovative talents, high-level universities have these resources and the ability to create knowledge and update cutting-edge technologies [12, 13]. The results of Section 5 show that high-level universities can help to drive local enterprise innovation, both in terms of the quantity of innovation input and the quality of innovation output. Furthermore, this paper discusses the role mechanism of high-level universities to promote local enterprise innovation, mainly manifested in the two paths of high-quality human capital export and university-enterprise cooperation. This is because the job of high-level universities is to cultivate talents and scientific research output, which are the core competitiveness urgently needed for enterprise innovation. This conclusion just confirms the correctness of the strategy of "putting science and technology and education in an important position in economic and social development" proposed by "rejuvenating the country through science and education."

Finally, considering executive gender, government intervention, and the heterogeneity impact of regional development level, we examined correlation in Section 6. This is because the effect of high-level universities in promoting enterprise innovation may be influenced both by the internal attributes of the enterprise [11] and restricted by the external environment of the enterprise. The empirical results proved that in the groups with low proportion of female executives, higher government intervention and poor level of regional development, high-level universities play a more significant role in promoting innovation in local enterprises. In general, female executives may be more cautious about corporate innovation, given their risk aversion characteristics. The government plays an important role in guiding high-level universities to establish cooperative relations, and helps to promote the positive role of high-level universities in enterprise innovation [14, 15]. Regional development differences lead to differences in the endowment conditions of enterprise innovation. Therefore, the "preferential help" of high-level universities is like "timely help," with better results. The above conclusions are in line with our expectations.

7.2. Conclusion. This paper takes A-share listed enterprises in Shanghai and Shenzhen from 2013 to 2019 as the research sample, selects "double first-class" universities as a representative perspective, and empirically examines the innovation relationship between high-level universities and local enterprises. At the same time, we further examine the transmission path of the impact of high-level universities on local enterprise innovation from the perspective of human capital and university-enterprise cooperation. We also discuss the heterogeneous effects of the differences of executive gender, government intervention, and regional development levels. The study found that high-level universities have a significant role in promoting innovation of local enterprises, and a series of robustness tests have also confirmed the conclusions of this paper. Mechanism analysis shows that high-level universities promote local enterprise innovation mainly by promoting human capital output and school-enterprise cooperation. Heterogeneity analysis shows that executive gender, government intervention, and differences in regional development levels have significant heterogeneity effects.

The research implications of this paper are as follows: Firstly, the empirical conclusion of the "double first-class" universities with typical representatives as the research objects shows that high-level universities have indeed boosted the innovation and development of local enterprises. The government should actively build high-level universities; guide the correct and healthy relationship between school and enterprise; introduce corresponding measures and means to build a tripartite cooperation platform between government, school, and enterprise enterprises; create good objective conditions for school-enterprise cooperation; and accelerate the transformation of scientific and technological achievements. Secondly, university teachers and researchers should actively respond to the call of the CPC Central Committee, while improving the level of teaching and scientific research, actively seek cooperation with local enterprises matching their majors, devote themselves to enterprise innovation, and make contributions to serving the local economic development. Thirdly, local enterprises should actively seek cooperation opportunities from high-level universities with abundant human resources and innovation resources to exchange needed goods and achieve synchronous development. The unbalanced regional development level leads to different factor endowment conditions of local enterprises. Local enterprises in backward areas should actively seek cooperation with high-level universities in order to achieve high-quality sustainable development.

This study provides a new perspective and empirical evidence for the study of the relationship between high-level university and local enterprise innovation, but there are still some limitations. Firstly, due to the data limitations, the research in this paper is limited to the impact of "double first-class" universities on local listed companies, and cannot cover

all enterprises. Secondly, there is no more appropriate variable to measure human capital and school-enterprise cooperation, and there are still some limitations in the research. Finally, there are many factors that high-level universities promote local enterprise innovation, and this paper only considers the heterogeneous effects of executive gender, government intervention, and differences in regional development levels.

Data Availability

The data of this paper can be obtained from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this work.

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