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The Impact of Sustainable Input on Regional Innovation Performance: Moderating Effects of Policy Support and Cultural Value

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Abstract: Innovation, an internal drive promoting regional sustainable economic development, has received great attention around the world. The goal of this paper is to explore the relationship between sustainable input and regional innovation performance under the moderating effects of policy support and cultural value in various regions in China. This paper uses Schwartz's cultural dimensions and data from 31 Chinese provinces (2006–2018) to empirically examine the relationships of interest. Based on the 403 total samples, the results reveal that innovation input has a significantly positive impact on regional innovation performance, and policy support positively moderates the relationship between regional innovation input and innovation performance. Further, with regard to cultural values, embeddedness (vs. autonomy) negatively moderates the relationship between sustainable input and innovation performance, while egalitarianism (vs. hierarchy) and mastery (vs. harmony) positively moderate this relationship. We discuss the implications of our findings for policy.

Keywords: innovation input; policy support; cultural value; regional innovation performance

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1. Introduction

Innovation, as an important driving force for sustainable economic development, has become a powerful force in enhancing comprehensive national strength for all countries around the world [1]. For an emerging market, the role of innovation is more prominent. Especially in China, relying on innovative activities to promote sustainable development and competitiveness has become the fundamental essence in order to build "innovation China". Since the 18th national congress of the Communist Party of China, remarkable achievements have been made in implementing innovation-driven development strategies. From the perspective of the country, the innovation environment is continuously optimized, innovation input has been increasing, and innovation output has grown rapidly. The construction of an innovative country is not separable from the improvement of regional innovation performance. According to the *China Regional Innovation Capacity Evaluation Report 2021*, a multicentric regional innovation system has been basically formed, but the gap in regional innovation performance between the north and the south is relatively large. The main reason lies in the lack of innovation input in some northern regions. From an academic perspective, many scholars study the impact factors on regional innovation performance besides innovation input, e.g., intra- and inter-regional localization of knowledge [2], regions' innovation network size [3], quality of industry-university-research cooperation [4], and urban and regional visions [5]. However, it cannot be ignored that institutional factors play an important role. Based on institutional theory, institutions generally refer to the rule of the game in a society [6]. The institutional factors include formal institutions and informal ones. Formal institutions refer to the laws and regulations that determine the dynamics of an industry, which mainly include political rules, economic laws, property rights, and other related policies, and informal institutions mainly involve the set of values, beliefs, and knowledge that characterize the behaviour of a specific population [7]. Compared to the studies of policy support in raising regional innovation performance [8], studies about the role of cultural values are very few [9], even if some studies discuss the effect of cultural values on innovation in enterprises [10]. In fact, the diversity of Chinese geography, ethnicity, and dialects determine the diversity of regional culture value [11], making the research on the impact of regional culture more significant. Therefore, how the relationship between innovation input and regional innovation performance develops when involving policy support and cultural value is an important issue. However, few studies explore regional innovation performance from the perspective of the interaction among innovation input, policy support and cultural value, making related research one-sided. Therefore, the goal of this article is to explore the relationship between sustainable input and regional innovation performance under the moderating effects of policy support and cultural value based on the data of 31 provinces from 2006 to 2018 in China. The results provide a theoretical reference for promoting sustainable regional innovation.

2. Theoretical Basis and Research Hypothesis

2.1. InstitutionalTtheory

This study adopts institutional theory to explain the role of policy support and cultural value between innovation input and regional innovation performance. According to North's definition, institutions are related to humanly devised constraints that shape human interaction [12]. Thus, taken broadly, institutions consist of economic, legal and cultural aspects which independently and jointly affect market transaction mechanisms and the business environment [13]. Many studies have found that certain institutional systems are key factors to firms' or regional competitiveness, especially in emerging and developing economies [14,15]. However, most of them focus on the direct effect of institutional factors, and few consider their indirect effect in the process of enhancing regional innovation performance under a certain innovation input. Taking a cue from extant works in the regional innovation literature [16–18], this study adopts policy support and cultural value as relevant external conditions in order to explore their roles in the relationship between sustainable input on regional innovation performance.

2.2. The Measure of Regional Innovation Performance

With the deepening of research innovation and the development of innovation theory, innovation has gradually evolved into a complex concept [19]. The typical feature of innovation is dynamic diversity over time and space. This type of dynamic diversity not only runs through a certain department but also clusters into the regional level. Therefore, the research of regional innovation has gradually become the focus of academia.

With regards to the concept of regional innovation performance, it has been controversial in academia worldwide, and there are some differences in the measurement of regional innovation performance. By combing domestic and foreign literature, most studies use the following three methods to measure and define the concept of regional innovation performance. The first method tends to build a comprehensive indicator evaluation system. Hagedoorn and Cloodt [20] constructed a comprehensive index evaluation system, which involves input and output indicators of R&D and then forms factor scores as innovation performance. Acs et al. [21] used a single indicator, patents, to measure regional innovation performance. However, the application of patents to the market is still uncertain, limiting this type of measurement. Therefore, some researchers have introduced the sales revenue of new products to measure regional innovation performance to reflect the applicability of innovation [22]. The second method focuses on using the efficiency assessment of regional innovation systems to measure regional innovation performance. Some scholars introduce innovation input and output and use the efficiency of the innovation system to represent regional innovation performance [23]. Additionally, some scholars measure regional innovation performance through stochastic frontier function [24], especially those of data envelopment analysis [25]. The third method calculates the total factor productivity within the framework of the production function to reflect regional innovation ability, thereby measuring regional innovation performance [26]. This paper argues that regional innovation performance equals the output value achieved by the market mechanism through the integration of innovation resources in innovation activities among the various entities within the regional innovation system and adopts a multi-indicator evaluation method to measure regional innovation performance.

2.3. Regional Innovation Input and Innovation Performance

Many studies argue that there is a significantly positive relationship between regional innovation input and innovation performance. Regional innovation subjects can use innovation resources, including human resources, intellectual resources, and R&D funds, as input elements. Based on these input elements, regional innovation subjects can make full use of their endowment advantages to achieve synergistic interaction, thereby optimizing innovation resource allocation [27,28]. Relying on the powerful resource absorption capacity, the innovation subjects transform the input of innovation resources into innovation output, thus achieving high regional innovation performance [29]. Meanwhile, the spillover effect of external knowledge appears through the introduction of external technology, thereby improving the capabilities of regional innovation performance [30]. Obviously, whether the internal research and development of innovative products and technologies, external high-quality industry-university-research cooperation, which plays the role of an innovation network, or the introduction of external technology will show a positive relationship between regional innovation input and innovation performance. Therefore, this paper proposes the following hypothesis:

Hypothesis 1. *Regional innovation input has a positive and significant effect on innovation performance. The greater the innovation input, the higher the regional innovation performance.*

2.4. Moderating Effect of Policy Support for Innovation

Traditional institutional economics theory argues that individual behavior is subject to the constraints of institutional environments. Individuals and organizations choose to abide by the norm of the institutional environment to maintain their status and legitimacy [31]. The institutional environment includes formal and informal institutions, where formal institutions involve policies, economic rules, and contracts [32]. Policy support, as a key factor in the institutional environment, plays a leading role in the formation of regional innovation performance. Innovative activities, which contribute to the overall progress of society, often reduce the enthusiasm for individual innovation due to lower returns. Therefore, the government has to provide funding and tax incentives to promote the implementation of research and development activities [4]. Meanwhile, governmental subsidies for R&D activities can alleviate the financial pressure of R&D in enterprises, thus stimulating enterprises to undertake innovation activities [33]. Above all, policy support creates cooperation among regional innovation subjects (enterprises, universities, and research institutions) [34], giving full play to the synergies of innovation. Obviously, policy support is conducive to the formation of regional innovation performance.

In addition to the direct effect, policy support also plays a moderating role. In fact, it can achieve higher levels of contextualization by investigating changes in the relationship between independent variables and dependent variables by adding higher-level characteristics [35]. Under higher policy support, the willingness of regional innovation subjects to invest in innovation resources is stronger, and the innovation network formed among innovation subjects is more intimate, thus making it easier to achieve higher regional innovation performance under a certain innovation input. On the contrary, under lower policy support, it is difficult for regional innovation subjects to enjoy additional treatment, and regional innovation performance cannot achieve the expected results even if a certain innovation input exists. Therefore, policy support for innovation can positively moderate the relationship between regional innovation input and innovation performance. Thus, this paper proposes the following hypothesis:

Hypothesis 2. *Policy support for innovation has positive and significant effects on regional innovation performance, and it also positively moderates the relationship between regional innovation input and innovation performance.*

2.5. Moderating Effects of Cultural Values

In general, culture refers to the basic assumptions, values, norms, and conventions shared by a group or society [36]. With the deepening of international trade and international management, the study of national culture has gradually become a focus of academia. Since the 1980s, scholars have engaged in three cultural theories to quantify the dimension of cultural value. Hofstede [37] divided culture value into four dimensions through survey data on national culture. Subsequently, based on research of Asian countries, Hofstede and Bond [38] used long-/short-term orientation as the fifth dimension of cultural value. The second type of research for national culture comes from the Global Leadership and Organizational Behavior Effectiveness (GLOBE), which formed nine cultural dimensions by investigating data from 62 countries [39]. However, the results have been controversial due to the flaws in the sample choice. The specific context requires that the measurement of cultural differences should have pertinence [40], so Schwartz's [41] seven-dimensional cultural value theory, based on psychological needs and motivation theory, which focuses more on the individual level and has a certain universality [36], has been gradually recognized by scholars [42]. Institutional theory argues that informal institutions, including social and cultural practices, have shown to have certain applicability in the field of innovation research [43]. Therefore, it is of great significance to study regional innovation input and innovation performance from a cultural perspective. Due to China's vast territory, geographical disparity, and diverse ethnic and dialectic features [44], its regional culture has certain diversity and differences. Therefore, Su et al. [45] considered it untimely to study Chinese cultural values from the national level. In view of this, this paper uses provincial data to study the relationship between regional innovation input and innovation performance in the context of Schwartz's cultural values. In fact, some scholars have directly adopted the data of cultural values from regional levels to study specific topics [36].

Schwartz's personal values include ten types: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity, and security [46]. Subsequently, Schwartz uses a multidimensional scaling procedure to examine the relationship among these values and further forms seven types of cultural values with three dimensions of opposite relations [41]: embeddedness and autonomy (intellectual autonomy and affective autonomy); egalitarianism and hierarchy; mastery and harmony. Although many scholars have discussed the influence of Hofstede's cultural values on national innovation, there is a great correlation between Schwartz's cultural values and Hofstede's cultural values [40]. Therefore, it provides theoretical support for the study of the relationship between regional innovation input and regional innovation performance in the context of Schwartz's cultural values through its relationship to Hofstede's cultural values.

Embeddedness and autonomy are used to describe the degree of individuals maintaining independence or embeddedness in a social group [36]. Intellectual autonomy emphasizes the autonomy of the individual in the social identity, and the individual is qualified to pursue the interest and desire for knowledge. Emotional autonomy emphasizes the individual's qualification to pursue the interests and desires of stimulation and hedonism [40]. On the one hand, in a society that advocates autonomy (similar to the individualism of Hofstede), individual freedom is more powerful, and people have more opportunities to touch new ideas [47]. On the other hand, in a society with a deeper degree of embeddedness (similar to the collectivism of Hofstede), the majority of individual contribution is attributed to the organization [48], reducing the individual emphasis on innovative ideas. Ng et al. [40] find that there is a positive relationship between Hofstede's power distance, uncertainty avoidance and embeddedness, and it negatively correlates with autonomy. Power distance and uncertainty avoidance often have the opposite impact on innovation performance [49]. Therefore, in contrast to autonomy, in a society emphasizing embeddedness, it is more difficult to transform regional innovation input into regional innovation performance (where cultural resistance is greater). Because of the opposite relationship between embeddedness and autonomy, this paper uses the ratio of embeddedness to autonomy to measure the relativity between the two. Therefore, this paper proposes the following hypothesis:

Hypothesis 3. *Embeddedness negatively moderates the relationship between regional innovation input and regional innovation performance in comparison to autonomy. The stronger the degree of embeddedness in comparison to autonomy, the weaker the relationship between regional innovation input and innovation performance.*

Egalitarianism and hierarchy describe "how to adjust interdependence among people in a fruitful or destructive way" [36] The hierarchy emphasizes the legitimacy of hierarchical role and resource allocation, while egalitarianism emphasizes self-transcendence [40]. The higher the level of hierarchy, the greater the power distance [50]. Therefore, for a society with a high hierarchy level (high power distance), the sharing of information, which is an important source of innovation, is greatly restricted by power [51]. Many studies, through empirical analysis, have proved that high-level hierarchy is not conducive to the formation of innovation [52]. On the contrary, a higher degree of information sharing appears in an egalitarian society, which is more conducive to innovation. Therefore, in contrast to hierarchy, regional innovation input is more easily transformed into innovation in an egalitarian society, making the relationship between regional innovation input and innovation performance stronger. To reflect the relativity of egalitarianism to hierarchy, this paper uses its ratio to measure the opposite relationship between the two. Therefore, this paper proposes the following hypothesis:

Hypothesis 4. *Egalitarianism positively moderates the relationship between regional innovation input and regional innovation performance in comparison to hierarchy. The greater the degree of egalitarianism in comparison to hierarchy, the stronger the relationship between regional innovation input and innovation performance.*

Harmony and mastery describe "to what extent individuals and groups should be able to control and change their social and natural environment, or do not interfere and change" [36] Harmony emphasizes the harmonious coexistence with nature; mastery emphasizes the control of the social environment and others. Harmony is often positively related to Hofstede's uncertainty avoidance, while mastery is positively related to masculinity [40]. Since innovation is often linked to transformation and uncertainty, a higher degree of harmony is not conducive to innovation [47]. In a society with high degrees of mastery, individual achievements are given enough attention, and the driving force for innovation is stronger. Therefore, in comparison with mastery, in a society with high harmony, it is harder to transform regional innovation input into regional innovation performance. To reflect the opposite relationship between mastery and harmony, this paper uses its ratio to measure their relativity. Therefore, this paper proposes the following hypothesis:

Hypothesis 5. *Mastery positively moderates the relationship between regional innovation input and regional innovation performance in comparison to harmony. The greater the degree of mastery in comparison to harmony, the stronger the relationship between regional innovation input and innovation performance.*

3. Methodology

This paper examines the relationship between regional innovation input, policy support for innovation, cultural values, and regional innovation performance. In the regression model, it uses data from 31 provinces in China. Meanwhile, in view of the sample size limitation, this paper expands the time of the sample from 2006 to 2018. Therefore, it is suitable to make regression analysis through panel data. However, due to the stability (or small variation) of cultural values, there may be a serious multi-collinearity problem in the application of panel data regression. Therefore, regression analysis using ordinary least squares (OLS) is employed as it has certain rationality only considering the differences among each sample [53].

3.1. Model Construction

Based on the research hypotheses, this paper constructs the following moderating effect model:

$Natinno_i = \alpha + \beta_1 \ln GDPper_i + \beta_2\, R\&D_i + \beta_3\, import_i + \beta_4\, policy_i + \Sigma_1^4 \lambda_j\, culture_{ij} + \Sigma_1^4 \eta_j\, culture_{ij} \times R\&D_i + \Sigma_1^4 \varphi_j\, culture_{ij} \times import_i + \Sigma_1^{31} \delta_j\, policy_{ij} \times R\&D_i + \Sigma_1^{31} \varepsilon_j\, policy_{ij} \times import_i,\ i = 1 \ldots 31;\ j = 1 \ldots 4.$

Where $Natinno_i$ is the innovation performance index of region i; $GDPper_i$ is GDP per capita of region i; $R\&D_i$ is the R&D expenditure of region i; $import_i$ is the value of technology import of region i; $policy_i$ is the degree of policy support for innovation in region i; and $culture_{ij}$ is the score of the dimension j of cultural values of region i.

3.2. Indicator Selection and Data Source

3.2.1. Regional Innovation Input

Regarding regional innovation input, as an important source of R&D input, regional R&D expenditure (independent R&D) plays a key role [54]. In addition, the introduction of external technology cannot be ignored. Therefore, this paper regards regional R&D expenditure and the value of technology import as important indicators of regional innovation input. The relevant data is captured from the *China Science and Technology Statistical Yearbook* (2006–2018).

3.2.2. Regional Innovation Performance

As mentioned above, in the literature on measuring innovation performance, some scholars put innovation performance into the innovation system to measure the efficiency of the innovation system [55]. However, the research method from the perspective of innovation efficiency often ignores the role of moderating variables—policy support and cultural values. Some scholars argue that the number of trademarks per capita can represent regional innovation performance. However, the correspondence between trademarks and innovations is often vague. For example, a single innovation process forms multiple trademarks. To reflect the characteristics of regional innovation performance, this paper uses the patent application volume, the number of patents granted, and new product output to comprehensively reflect regional innovation performance. The relevant data are captured from the *China Science and Technology Statistical Yearbook* (2006–2018).

3.2.3. Policy Support for Innovation

To improve the ability of regional innovation, local governments actively provide financial and policy support. These measures usually include research and development subsidies, tax incentives, and governmental procurement [33]. However, for local governments in China, tax incentives vary little between regions. In view of the difficulty of data collection, this paper uses the proportion of local government finance that is invested in science and technology activities to measure policy support for innovation, and this indicator has certain rationality in measuring the governmental role in regional innovation performance [8]. The relevant data are captured from *the China Science and Technology Statistical Yearbook* (2006–2018).

3.2.4. Cultural Values

This paper uses Schwartz's cultural values to measure the cultural characteristics of Chinese regions. For related data, this paper uses the data of Zhao et al. [36] as the data source. They adopt the dimensions of Schwartz's cultural values to carry out cultural research from 2010 to 2011 in 31 provinces in China with 3,690 observations. The study of Zhao et al. [36] contains the cultural values at the regional level for a time similar to that of our study, which makes the measures more accurate. Due to the stability of cultural values, this paper extends the time of data to 2006–2018, matching with other variables to facilitate further analysis of the model.

3.2.5. Control Variables

To be able to test the hypotheses, this study introduces control variables. In general, the level of economic development in a country can affect its rate of innovation [53]. The more economic resources per capita, the stronger the ability to transform input into innovative output. Therefore, this paper uses the GDP per capita of China's provinces from 2006 to 2018 as a control variable to be introduced into the model (unit: 10,000 RMB).

4. Research Results

According to the above research hypotheses, this paper takes regional innovation input (R&D expenditure and value of technology import) as independent variables, policy support for innovation and cultural values as moderating variables, regional innovation performance index as dependent variable (latent variable), and GDP per capita as control variables.

Firstly, the regional innovation performance is composed of the regional patent application volume, the number of patents granted, and the output of new products. Therefore, this paper integrates the three-dimensional indicators into regional innovation performance through factor analysis (including the process of data standardization). The results are listed in Table 1, indicating that the reliability analysis (Cronbach $\alpha = 0.97$) meets the requirements. Meanwhile, regional innovation performance through standardization presents a good level of validity, in which the indicators CFI, GFI, RMR, RMSEA etc. are close to the ideal value. In addition, because the autonomy in cultural values is divided into intellectual autonomy and emotional autonomy, the factor analysis shows that the effect is relatively ideal (*KMO* is not less than 0.5, $\alpha = 0.90$).

Table 1. Factor analysis results of regional innovation performance.

Index	Cronbach α	*KMO*	Latent Variable
Number of patent applications Number of patents granted New product output	0.97	0.752	Regional innovation performance

Secondly, the descriptive statistics and correlation analysis are listed in Table 2. The regression analysis was performed using the ordinary least squares method (OLS), and the detailed results are listed in Table 3.

The results in Table 2 show that there is a significantly positive correlation between regional innovation performance, R&D expenditure, value of technology import, policy support for innovation, GDP per capita, and cultural values, which provides a certain premise for the subsequent establishment of the regression model.

It shows from model 1 in Table 3 that R&D expenditures ($\beta = 0.21$, $p < 0.01$) and the value of technology import ($\beta = 0.02$, $p < 0.01$) have significantly positive impacts on regional innovation performance. Therefore, Hypothesis 1 is verified.

Table 2. Descriptive statistics and correlation analysis.

	Mean	S.D.	1	2	3	4	5	6	7
GDP per capita	3.23	1.93							
R&D expenditure	67.87	16.36	0.10						
Value of technology import	4.56	2.13	0.32	0.25					
Policy support	1.84	1.33	0.14	0.16	0.54				
Embeddedness/autonomy	1.70	39.72	−0.03	−0.00	−0.30 **	0.45			
Egalitarianism/hierarchy	1.30	0.05	−0.30 **	−0.20 **	0.16 *	0.15 *	0.32		
Mastery/harmony	0.98	0.02	−0.08	0.16 *	−0.22 **	−0.01	−0.39 **	0.12	
RIP	0.00	1.00	0.55 **	0.56 **	0.35 **	−0.04 *	−0.09 *	−0.09 *	0

Note: ** $p < 0.01$, * $p < 0.05$.

Table 3. Results of regression analysis.

Variables	Model 1	Model 2	Model 3
GDP per capita	0.13 **	0.11 **	0.10 **
R&D expenditure	0.21 **	0.31 **	0.41 **
Value of technology import	0.02 **	0.02 **	0.02 **
Policy support		0.23 **	0.10 **
Embeddedness/autonomy		0.00	−0.01 **
Egalitarianism/hierarchy		−1.50	−0.57
Mastery/harmony		−6.52 *	−3.47
Policy support × R&D expenditure			0.08 **
Policy support × Value of technology import			0.06
Embeddedness/autonomy × R&D expenditure			−0.20 **
Egalitarianism/hierarchy × R&D expenditure			0.13 **
Mastery/harmony × R&D expenditure			0.31 **
Embeddedness/autonomy × Value of technology import			−0.04
Egalitarianism/hierarchy × Value of technology import			0.31
Mastery/harmony × Value of technology import			0.18
R2	0.45	0.50	0.62
Adjusted R2	0.42	0.46	0.60
F	60.7 **	45.7 **	36.8 **

Notes: ** $p < 0.01$, * $p < 0.05$.

In order to test the moderating effect of institutional factors, it centralizes R&D expenditure, the value of technology import, policy support for innovation, the ratio of embeddedness to autonomy, the ratio of egalitarianism to hierarchy, and the ratio of mastery to harmony, then puts their product term into the regression model for regional innovation performance. As shown in model 3 in Table 3, the product term of policy support for innovation and R&D expenditure ($\beta = 0.08$, $p < 0.01$) has a positive impact on regional innovation performance, indicating the existence of its moderating effect. From the perspective of cultural values, the product term of the ratio of embeddedness to autonomy and R&D expenditure has a significantly negative impact on regional innovation performance ($\beta = -0.02$, $p < 0.01$), indicating the existence of its moderating effect. The product term of the ratio of egalitarianism to hierarchy and R&D expenditure has a significantly positive impact on regional innovation performance ($\beta = 0.13$, $p < 0.01$), indicating the existence of its moderating effect; the product term of the ratio of mastery to harmony and R&D expenditure has a significantly negative impact on regional innovation performance ($\beta = 0.31$, $p < 0.01$), indicating its existence of moderating effect.

To further examine the direction of moderating variables, this paper uses the procedure method of Aiken and West [56]. As shown in Figure 1, the greater the policy support for innovation, the greater the impact of R&D expenditures on regional innovation performance (dashed line); the smaller the policy support for innovation, the smaller the impact of R&D expenditures on regional innovation performance (solid line). Therefore, Hypothesis 2 is verified.

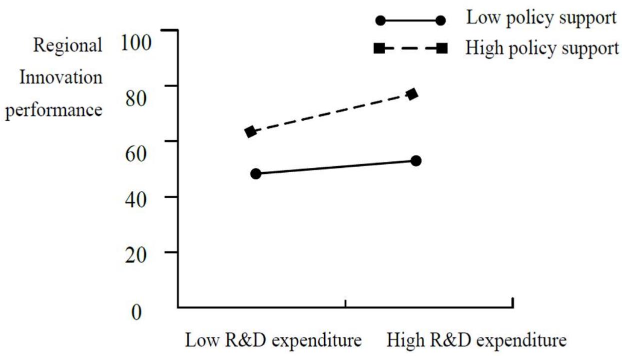

Figure 1. Moderating effect of policy support for innovation.

As shown in Figure 2, the greater the ratio of embeddedness to autonomy, the smaller the impact of R&D expenditure on regional innovation performance (dashed line); the smaller the ratio, the greater the impact of R&D expenditure on regional innovation performance (solid line). Therefore, Hypothesis 3 is verified.

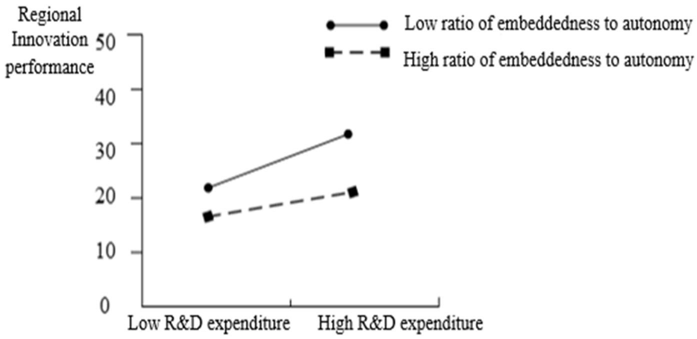

Figure 2. Moderating effect of the ratio of embeddedness to autonomy.

As shown in Figure 3, the greater the ratio of egalitarianism to hierarchy, the greater the impact of R&D expenditure on regional innovation performance (dashed line); the smaller the ratio, the smaller the impact of R&D expenditure on regional innovation performance (solid line). Therefore, Hypothesis 4 is verified.

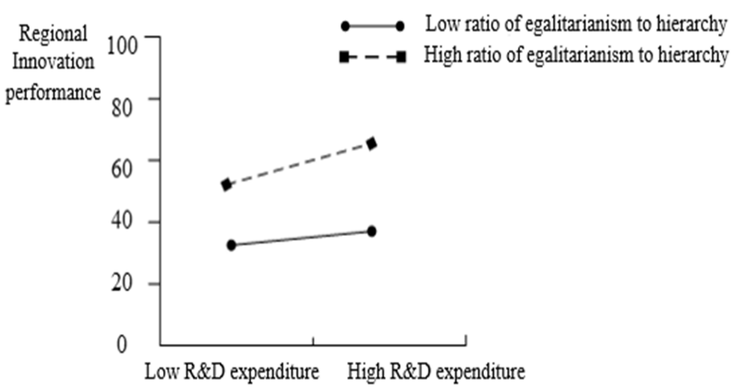

Figure 3. Moderating effect of the ratio of egalitarianism to hierarchy.

As shown in Figure 4, the greater the ratio of mastery to harmony, the greater the impact of R&D expenditure on regional innovation performance (dashed line); the smaller the ratio, the smaller the impact of R&D expenditure on regional innovation performance (solid line). Therefore, Hypothesis 5 is verified.

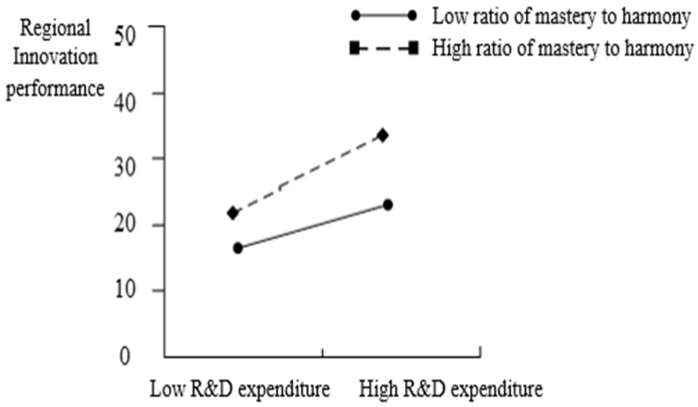

Figure 4. Moderating effect of the ratio of mastery to harmony.

5. Conclusions and Implications

This paper assesses regional innovation input (R&D expenditure, value of technology import) as independent variables, policy support for innovation and cultural values as moderating variables and constructs the moderating effect model of influence factors on regional innovation performance, testing the model through the data from 31 provinces in China. The conclusions and implications are as follows:

(1) With regards to the impact of regional innovation input on regional innovation performance, this paper verifies the positive effect of R&D expenditure and the value of technology import on regional innovation performance. The conclusion shows that capital investment and technology-driven are still the most powerful methods to improve regional innovation performance. The conclusion is consistent with some previous studies [2,3]. Therefore, each region should continue to increase input in research and development funding and rely on external technology spillover effects to enhance local innovation capabilities.

(2) Regarding the role of policy support for innovation, this paper not only verifies its direct effect on regional innovation performance but also verifies its moderating effect in the process of regional innovation input affecting regional innovation performance. It further demonstrates the importance of formal institutional factors. As Cooke et al. argued, regional innovation policy becomes exceptionally important in securing the appropriate external conditions in which such externalised learning and innovation can occur [57].

Therefore, the government should continue to strengthen support for innovation (research and development subsidies, tax incentives, government procurement, etc.), which is not only conducive to the formation of innovation but also improves consumer choice and reduces the monopoly power of the market due to innovative products that are brought into the market, which greatly enhance the regional competitiveness. Under the background of the country's implementation of an independent innovation strategy, all regions should strive to create a system and environment conducive to independent innovation, increase tax incentives for research and development activities, reduce research and development costs, and encourage innovative entities to engage in more research and development activities.

(3) With regards to the moderating effect of cultural values, the results highlight the importance of institutional theory in creating a conducive environment for enhancing regional innovation performance. Firstly, this paper verifies the negatively moderating effect of the embeddedness to autonomy ratio on the influential process of R&D expenditure on regional innovation performance. The conclusion shows that in a society with embeddedness higher than autonomy, the idea of individual innovation is easily restricted. This is similar to the conclusions of other studies [47,48]. Therefore, the government should strengthen the recognition of individuals with innovative ideas, attach importance to the contribution of individuals to society, and stimulate individual enthusiasm for innovation.

The ratio of egalitarianism to hierarchy positively moderates the impact of R&D expenditures on regional innovation performance. This conclusion shows that a stricter hierarchy leads to more difficulty in diffusing innovative ideas. For innovation-oriented projects, the level of hierarchy often manifests in the complexity of approval and reduces the efficiency of innovation. Therefore, the government should simplify the approval process for innovative projects, decentralize power, and actively create an equal culture for innovation. The ratio of mastery to harmony positively moderates the impact of R&D expenditure on regional innovation performance. Therefore, the government should promote the spirit of adventure, pay attention to individual achievements, and actively build a guarantee system to support and actively establish cultural values that encourage innovation.

Of course, this study also has some shortcomings. First, due to the stability of cultural values, the idea of moderating effect through panel data is limited. Second, the influence of Schwartz's cultural values on regional innovation performance sometimes does not show certain absoluteness. For example, although harmony promotes stability (higher degree of uncertainty avoidance), it also has a certain low power distance [50], so its impact on innovation is limited. In the future, on the one hand, the dimensions of cultural values and the support of theory can be built on according to existing literature; on the other hand, the comparison of cultural values between regions and the impact on innovation should be further studied. For China, with a vastly diverse culture, it is of theoretical and practical significance to study the relationship between cultural values and innovations in different regional contexts.

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