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Can Confucian Culture Enhance the Peer Effect of Innovation Input in Manufacturing Enterprises? Evidence from China

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KEYWORDS

Peer effect；
Confucian culture；
Innovation input；
Moderating effect

ABSTRACT

The purpose of this study is to explore the peer effect in innovation input in manufacturing enterprises from the perspective of Confucian culture, and to use the data of listed manufacturing companies in China from 2011 to 2020. The findings show that there is a peer effect in the innovation input of manufacturing enterprises. The influence of Confucian culture has a positive impact on the innovation input of manufacturing enterprises, and enhances the peer effect in innovation investment of manufacturing enterprises. Heterogeneity analysis reveals that non-state-owned enterprises and enterprises operating in areas with higher business environment index show more peer effects in manufacturing enterprises' innovation input, and the moderating effect of Confucian culture is more obvious. Further analysis shows that firm age, firm size, market competition and digital financial index and other factors affect the peer effect in innovation input in manufacturing enterprises. The innovation input of peer firms has a positive impact on the innovation output of focus firms by promoting the innovation input of focus firms, and these mechanisms are more effective under the influence of Confucian culture. The findings of this study reveal the importance of Confucian culture and peer effect in innovation input in manufacturing enterprises, and provide an important decision-making reference for enterprise managers.

INTRODUCTION

In today's global and competitive business environment, innovation is widely recognized as one of the key factors for the sustainable development and success of enterprises. Especially in the manufacturing industry, the importance of innovation input has become increasingly prominent, as it can help enterprises improve product quality, enhance competitiveness, and meet changing market demands. However, although the benefits of innovation input have been widely demonstrated, many manufacturing enterprises still face the dilemma of insufficient innovation input. In the decision-making process of research innovation input, an important influencing factor is peer effect, that is, individuals or organizations are influenced by peers in the decision-making process. Peer effect has been widely studied in the field of organizational behavior and decision making. Many studies show that individuals or organizations tend to imitate or be influenced by their peers' decision-making. However, the research on the role and influencing factors of peer effect in innovation input of manufacturing enterprises is relatively limited. The purpose of this study is to explore the influence of peer effect in innovation input of manufacturing enterprises, and focus on the moderating role of Confucian culture in this relationship. As an important part of Chinese traditional culture, Confucian culture has a profound influence on Chinese manufacturing enterprises. Confucian culture emphasizes social relationships among individuals, family values, and community interests, and advocates adherence to traditional values and moral codes. Therefore, we speculate that Confucian culture may have a moderating effect on the influence of peer effect in innovation input of manufacturing enterprises. The results of this study will help to understand the role of peer effect in innovation input of manufacturing enterprises, and provide relevant decision-making

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suggestions for manufacturing enterprise managers.

The contributions of this paper may be reflected in the following aspects. First, it helps enrich the driving factors of manufacturing enterprises' innovation input. Previous research has mainly explored the relationship between peer effect and manufacturing enterprises' innovation input or between Confucian culture and manufacturing enterprises' innovation input, but few studies have connected these three elements: Confucian culture, peer effect, and manufacturing enterprises' innovation input. This paper takes the perspective of Confucian culture to study the influence of peer effect in manufacturing enterprises' innovation input, which is innovative in its research perspective and helps address the limitations of existing research on manufacturing enterprises' investment input.

Second, it contributes to the application research of peer effect. Existing literature mainly measures peer effect among firms based on the same industry, region, or social networks. However, this paper classifies manufacturing listed companies as peer firms based on the three-level classification standard of the manufacturing industry in China. It finds that the peer effect is applicable within the manufacturing industry, providing important empirical evidence to complement the understanding of the applicability of the peer effect. Additionally, this paper further explores the factors of the peer effect that influence manufacturing enterprises' innovation inputs. It finds that the peer effect of manufacturing enterprises' innovation input is influenced by internal and external factors such as firm age, firm size, market competitiveness, and digital finance index. Moreover, it reveals the mechanisms by which the peer effect in manufacturing enterprises' innovation input affect innovation performance.

Last, this paper helps deepen the research on manufacturing enterprises' innovation input under the influence of Confucian culture. Existing literature has not reached a consensus on the impact of Confucian culture on manufacturing enterprises' innovation input, and most studies assume the independence of manufacturing enterprises' decision-making and ignore the interactive influence of innovation input decision-making among peer firms. This paper investigates the influence of Confucian culture on manufacturing enterprises' innovation input using a sample of Chinese listed manufacturing companies. It is found that Confucian culture is both a positive factor influencing manufacturing enterprises' innovation investment input and a moderating variable of the peer effect in manufacturing enterprises' innovation input. This not only provides a theoretical basis for further research on the influence of Confucian culture on manufacturing enterprises' innovation inputs, but also provides theoretical support for improving the effectiveness of the peer effect in manufacturing enterprises' innovation inputs. These studies are important for understanding the relationship between peer effect, Confucian culture, and manufacturing enterprises' innovation input in the Chinese context, as well as for guiding and optimizing resource allocation to improve the innovation capability of the manufacturing companies.

1.Literature Review

Some scholars have conducted extensive research on manufacturing enterprises' innovation input from various perspectives. Firstly, from an internal perspective of the firm, the main focus is around financing constraints [1], financial performance [2], and managerial incentives [3]. Secondly, from an external perspective of the firm, it mainly focuses on environmental regulations, policy reforms and government subsidies. The above literature mainly assumes the independence of corporate decision-making and ignores the interaction effects of decision-making within peer firms. Given similar technological challenges and operational risks, decision-making interaction among peer firms can help reduce risks and uncertainties. The phenomenon of firm decision-making being influenced by and aligned with peer firms is known as the "peer effect" [4].

Confucian culture, as the mainstream and important component of traditional Chinese culture, has permeated various aspects of Chinese politics, economy, and corporate management. However, there is still debate about whether Confucian culture can promote manufacturing enterprises' innovation input. Some scholars support the view of Confucian culture promoting corporate innovation [5]. However, other scholars argue that the hierarchical concept, collectivism, and harmonious culture emphasized by Confucian culture inhibit innovative thinking and information exchange, which hinder corporate innovation.

Therefore, this study examines the positive impact of Confucian culture on corporate innovation input by focusing on listed manufacturing companies and considers the impact of peer effect in social interactions. This study analyzes Confucian culture, peer effect, and corporate innovation

input within the same theoretical framework to complement and extend the existing literature. Additionally, this study examines the moderating role of Confucian culture in the peer effect of corporate innovation inputs, taking into account the nature of the firm ownership and characteristics of the business environment. Under the influence of different degrees of Confucian culture, this study also examines the different effects of internal and external factors, such as firm age, firm size, market competitiveness, and digital financial index, on the homogeneity of firm innovation inputs, revealing the mechanisms by which innovation input homogeneity affects innovation performance. These findings provide new insights for enhancing corporate innovation input and output.

2.Research Hypotheses

2.1.Peer Effect in Innovation Input

The peer effect of manufacturing enterprises' innovation input refers to the tendency of firms to adjust their innovation input decision-making based on the innovation inputs of peer firms due to social interactions. Referencing to or balancing the innovation input of peer firms in decision-making can effectively alleviate the negative impact of insufficient innovation or innovation failure. Under the same economic, technological, and policy environments, the cost for focal firms to obtain information or experience from peer firms is relatively low, while the cost of relying solely on internal experience for decision-making is relatively high. Therefore, in order to reduce the risk of innovation input decision-making and minimize uncertainty, focal firms adjust their decision-making based on the innovation input levels of peer firms, leading to convergence in innovation input decision-making among focal firms and their peer firms [6]. According to competitive imitation theory, focal firms weigh or imitate the decision-making of peer competitors to maintain the competitive status quo or restrict competitors. When peer firms increase innovation input, focal firms also imitate their innovation input decision-making to alleviate competitive pressure or reduce risks, leading to an increase in their own innovation input in response [7]. In summary, in order to reduce information acquisition costs or maintain competitive advantages, firms tend to make innovation input decision-making consistent with their peer firms, generating a peer effect in manufacturing enterprises' innovation input. Based on this, Hypothesis 1 is proposed.

Hypothesis 1: *There is a peer effect in manufacturing enterprises' innovation input.*

2.2.Confucian Culture and Innovation Input

Manufacturing enterprises' innovation relies on funding, technological knowledge, and talent. Confucian culture advocates "Ren, Yi, Li, Zhi" ("benevolence, righteousness, propriety, wisdom" in English) (Mencius), where "Zhi (wisdom)" influences firms to value the intelligence, skills, and creativity of their employees, thereby helping firms increase their innovation input. Confucian culture emphasizes moral cultivation, as reflected in concepts such as "put righteousness before profit and honor, put profit before righteousness and disgrace" (Xunzi), which can impose moral constraints on managers. Confucian culture's concept of "Ge Wu Zhi Zhi" ("investigate things, acquire knowledge" in English) emphasizes the spirit of practical and scientific exploration, which stimulates firms' practical and exploratory spirit, thus positively influencing their innovation input. Based on this, Hypothesis 2 is proposed

Hypothesis 2: *Confucian culture has a significant positive impact on manufacturing enterprises' innovation input.*

2.3.Confucian Culture, Peer Effect and Innovation Input

The "Zhong Yong" (Doctrine of the Mean) in Confucian culture embodies the idea that firms accept or reference external information and use it to deal with risks. Firms influenced by Confucian culture are more likely to imitate and refer to the innovation input decisions of their peer firms in order to avoid risks. When peer firms increase innovation inputs, firms that are strongly influenced by Confucian culture are more likely to learn from their decisions and adjust their own innovation inputs accordingly. The collective ideology in Confucian culture is embodied in the saying "the world belongs to everyone when the great path prevails" (Li ji). Some scholars suggest that under the influence of collective ideology [8], information exchange and interaction are more effective within a collective, and high-quality information cannot be obtained outside the collective. Through internal connections established within the collective, firms can obtain market information necessary for innovation [9]. The stronger the influence of

Confucian culture on peer firms, the lower the cost of acquiring internal collective information, the stronger the effectiveness of information, and the promotion of imitation, reference, and learning among peer firms, thereby enhancing the peer effect in manufacturing enterprises' innovation input. Based on this, Hypothesis 3 is proposed.

Hypothesis 3: *Confucian culture can enhance the peer effect in manufacturing enterprises' innovation input.*

In summary, the research framework of this paper is shown in Figure 1.

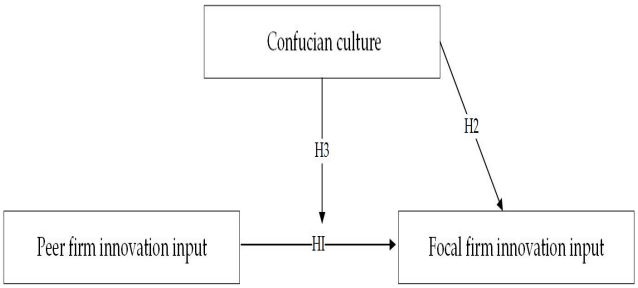

Fig.1. Research framework

3.Research Design

3.1.Sample Selection and Data Sources

In this study, we selected listed companies in the Chinese manufacturing industry from 2011 to 2020 as the initial sample and performed data screening and processing. The specific procedures were as follows: excluding samples with abnormal asset-liability ratios; excluding ST and PT samples; excluding samples with missing data for variables. Ultimately, we obtained 11,655 observed samples. To eliminate the interference of extreme values, the variables are tailed by 1%. The financial data, corporate governance data, corporate innovation data, and the latitude and longitude data of Confucian temples and company registration locations were obtained from the CSMAR database. Data processing was conducted using STATA 14.0 software.

3.2.Variable Descriptions

3.2.1.Explained Variable

Focal Firm Innovation Input(RD): Following the research methods of Griffiths and Webster [10], this study measures manufacturing enterprises' innovation input by the ratio of research and development (R&D) expenditure to operating income. In subsequent robustness tests, the ratio of R&D expenditure to total assets will be used as an alternative measurement.

3.2.2.Explanatory Variable

Peer Firm Innovation Input($PeerRD$): Drawing upon the research methods of Zhang and Du [11], this study defines peer firms within the manufacturing industry through a three-level industry classification of listed companies. The innovation input of peer firm is measured by the average innovation input of peer firms excluding the focal firm itself. The calculation method is as follows:

$$PeerRD_{-i,j,t} = \sum_{k \in j, k \neq i} RD_{k,j,t} \div (n_{j,t} - 1) \quad (1)$$

Where, i represents the focal firm, j represents the three-level classification of the manufacturing industry, t represents the year, k represents other peer firms within the manufacturing industry j excluding focal firm i, and $n_{j,t}$ represents the total number of firms in industry j. $\sum_{k \in j, k \neq i} RD_{k,j,t}$ represents the total innovation input of peer firms.

3.2.3.Moderating Variable

Confucian Culture ($Conf$): Following the research methods of Xu, Li and Lee [12], this study measures Confucian culture based on the addresses of Confucian temples and companies by counting the number of Confucian temples within 100 km of the focal firm's registered address

3.2.4.Control Variables

Drawing on existing literature [13], this study selects relevant variables that affect innovation input as control variables. Specifically, these variables include: firm size, leverage ratio, operating cash flow, growth potential, profitability, CEO duality, shareholding concentration, independent directors, board size, executive compensation, while controlling for industry and year. Please refer to Table 1 for specific variables and explanations.(Attachment1)

3.3.Model Construction

In order to test Hypothesis 1, following the approach of Manski [14], we construct the baseline model as follows:

$$RD_{i,j,t} = \alpha_0 + \alpha_1 PeerRD_{-i,j,t} + \sum \alpha_{2\sim10} Control_{i,j,t} + \varepsilon \quad (2)$$

Where the dependent variable RD represents the focal firm's innovation input. The explanatory variable $PeerRD$, represents the peer firms' innovation input. The control variables are denoted by $Control$, and their details can be found in Table 1. α_0 is the intercept term, and the estimated coefficient α_1 of $PeerRD$ is the main focus of investigation for Hypothesis 1. If α_1 is greater than zero and statistically significant, it indicates the presence of peer effects in manufacturing enterprises' innovation input, supporting the validity of Hypothesis 1. The term ε represents the error term.

To test hypothesis 2, the model is constructed as follows:

$$RD_{i,j,t} = \beta_0 + \beta_1 Conf_{i,j,t} + \sum \beta_{2\sim10} Control_{i,j,t} + \varepsilon \quad (3)$$

Where, β_0 represents the constant term. The estimated coefficient β_1 of $Conf$ is the key focus of hypothesis 2. If β_1 is greater than 0 and significant, it indicates a significant positive influence of Confucian culture on manufacturing enterprises' innovation input, supporting the validity of hypothesis 2.

To test hypothesis 3, the model is constructed based on Model (1) as follows:

$$RD_{i,j,t} = \chi_0 + \chi_1 PeerRD_{-i,j,t} + \chi_2 Conf_{i,j,t} + \chi_3 PeerRD_{-j,j,t} \times Conf_{i,j,t} + \sum \chi_{4\sim12} Control_{i,j,t} + \varepsilon \quad (4)$$

Where, χ_0 represents the constant term. $PeerRD \times Conf$ represents the interaction term between innovation input of peer firms and Confucian culture. If the estimated coefficient χ_3 of $PeerRD$ is greater than 0 and significant, it indicates a positive moderating effect of Confucian culture on the relationship between $PeerRD$ and RD. This implies that Confucian culture can strengthen the peer effect in focal firm's innovation input.

4.Results

4.1.Empirical results

4.1.1.Peer effect in innovation input

Table 2, columns (1) to (3), report the regression results for Hypothesis 1. Among them, column (1) controls for industry dummy variables, column (2) controls for year dummy variables, and column (3) simultaneously controls for industry and year dummy variables. The results show that the estimated coefficients of $PeerRD$ on RD are all significantly positive. In column (3), the estimated coefficient of $PeerRD$ is 0.542 ($t=12.55$, $p<0.01$), significant at the 1% level. This means that for every 1 percentage point increase in innovation input of the peer firms, the focal firms' innovation input will increase by 0.542 percentage points. The above results indicate that the innovation input of the peer firms has a significant positive impact on the innovation input of focal firm, verifying the existence of the peer effect in manufacturing enterprises' innovation input and supporting Hypothesis 1.

4.1.2.The impact of Confucian culture

Table 2, columns (4) to (6), report the regression results for Hypothesis 2. Among them, column (4) controls for industry dummy variables, column (5) controls for year dummy variables, and column (6) simultaneously controls for industry and year dummy variables. The results show that the estimated coefficients of $Conf$ on RD are all significantly positive. In column (6), the estimated coefficient of $Conf$ is 0.001 ($t=4.67$, $p<0.01$), significant at the 1% level. This indicates that for every 1 percentage point increase in the degree of influence of Confucian culture, innovation input of focal firm will increase by 0.001 percentage points. In other words, manufacturing enterprises' innovation input is significantly positively influenced by Confucian culture, supporting Hypothesis 2.

4.1.3.The moderating effect of Confucian culture

Table 2, columns (7) to (9), report the regression results for Hypothesis 3 using the full sample. Among them, column (7) controls for industry dummy variables, column (8) controls for year dummy variables, and column (9) simultaneously

controls for industry and year dummy variables. In column (9), the estimated coefficient of PeerRD × Conf is 0.022 (t=3.72, p<0.01), significant at the 1% level. This indicates that the deeper the influence of Confucian culture, the more significant the positive impact of innovation input of the peer firms on the innovation input of focal firm. In other words, Confucian culture enhances the peer effect in manufacturing enterprises' innovation input, supporting Hypothesis 3. The results in columns (10) and (11). (Attachment 2)

Variable	(1)	(2)	(3)
PeerRD	0.498*** (5.69)	0.451*** (5.19)	0.444*** (3.87)
$PeerRD^2$			0.800 (0.82)
Focal Firms' Controls	-	*Control*	*Control*
Peer Firms' Controls	*Control*	*Control*	-
Industry	*Control*	*Control*	*Control*
Year	*Control*	*Control*	*Control*
Constant	0.013 (1.35)	0.039*** (3.44)	0.026*** (2.60)
Observation	11 655	11 655	11 655
R^2	0.177	0.220	0.218

Note: t-values are in parentheses.
*p<0.1, **p<0.05, ***p<0.01.
Tab.3. Results of omitted variable and model polynomial tests

4.2.Robustness Tests

To ensure the robustness and reliability of the empirical findings, various methods were employed to conduct robustness tests, including omitted variable tests, high-order polynomial tests, lagged period tests and reduced sample tests.

4.2.1.Omitted Variable Test

To address potential omitted variable bias, the average control variables of peer firms were added to the baseline regression. The core coefficient remained significantly positive (0.498 and 0.451, p<0.01), supporting Hypothesis 1.

4.2.2.High-Order Polynomial Test

A high-order polynomial test was conducted by including a quadratic term. The linear term remained significant while the quadratic term was insignificant, confirming a linear relationship and validating the baseline model specification.

4.2.3.Lagged Period Test

To address endogeneity, columns (1) to (3) of Table 4 present the lagged period test. The estimated coefficient of PeerRD is 0.645 (t=8.16, p<0.01), supporting Hypothesis 1. The coefficient for lagged Conf is 0.001 (t=4.39, p<0.01), supporting Hypothesis 2. The estimated coefficient of PeerRD × Conf is 0.018 (t=2.54, p<0.01), indicating Confucian culture positively moderates the innovation peer effect, supporting Hypothesis 3.

4.2.4.Small Sample Test

The sample is restricted to high-tech manufacturing industries (C25, C26, C27, C35, C36, C37, C38, C39, C40; n=2,113). Results in columns (4) to (6) of Table 7 remain consistent: the coefficient of PeerRD is 0.689 (t=10.48, p<0.01); for Conf is 0.001 (t=1.98, p<0.05); and for the interaction term is 0.036 (t=2.46, p<0.05). All hypotheses are again supported. (Attachment 3)

5.Further Analysis

5.1.Heterogeneity Analysis

5.1.1.The heterogeneity of property rights

Different types of corporate property rights have inherent differences in their strategic objectives. State-owned manufacturing firms, for example, are required to assume social responsibilities such as maintaining economic market order, ensuring employment, and improving people's livelihoods. Therefore, their innovation investments are more likely to be influenced by the government. On the other hand, non-state-owned firms face intense market competition and are more likely to be influenced by innovation input of peer firms. To examine the heterogeneity of peer firm innovation input and the moderating effect of Confucian culture among firms with different property rights, this study divides the sample into state-owned and

non-state-owned enterprise groups. (Attachment 4)

5.1.2.The heterogeneity of business environment

The business environment in which an enterprise operates is one of the important factors influencing corporate innovation input. According to China Provincial Enterprise Operating Environment index 2017 Report, when the business environment index of the sample firm is greater than the mean, it is classified as the high business environment group; otherwise, it is classified as the low business environment group. This means that the higher the business environment index, the stronger the promoting effect of Confucian culture on peer effect in manufacturing enterprises' innovation input. In conclusion, there is a significant peer effect in innovation input when the enterprise operates in a high business environment index, but not when it operates in a low business environment index. (Attachment 5)

5.2.Analysis of Moderating Effect

5.2.1.Negative moderating effect of firm age

Established and successful companies in the same industry may have more resources to acquire high-quality information and the ability to evaluate, absorb, and integrate information. Firms in information disadvantage or lack may refer to mature firms with excellent information advantages to reduce decision-making risks [15]. Pomorski has found that younger firms are more likely to be influenced by other mature firms in the same industry [16]. Therefore, the natural logarithm of the firm's listing age plus one (AGE) is used to measure firm age, where a smaller value represents a younger firm. The test results of the impact of firm age on the peer effect in manufacturing enterprises' innovation input are shown in Table 7, Columns (1)-(3). In Column (1), the estimated coefficient of is -0.161 (t=-5.15, p<0.01), which is significant at the 1% level. This indicates that firm age negatively moderates the peer effect in manufacturing enterprises' innovation input. It means that the younger the firm, the more it is influenced by the peer effect in manufacturing enterprises' innovation input. In Columns (2) and (3), the results of the grouping test on whether the firm is influenced by Confucian culture are shown. When the firm is influenced by Confucian culture, the estimated coefficient of in Column (2) is -0.168 (t=-5.16, p<0.01), which is significant at the 1% level, indicating the effective negative moderating effect of firm age. This means that under the influence of Confucian culture, the older the firm, the more significant the impact of the peer effect on innovation. When the firm is not influenced by Confucian culture, the estimated coefficient of in Column (3) is -0.055 (t=-0.45, p>0.10), which is not significant. This means that the negative moderating effect of firm age is ineffective for firms not influenced by Confucian culture.

5.2.2.Negative moderating effect of firm size

Leary and Robert have argued that decision-makers in smaller firms are more likely to imitate the top performers in the same group [17]. The natural logarithm of total assets plus one ($Size$) is used to measure firm size, where a smaller value represents a smaller firm. The test results of the impact of firm size on the peer effect of innovation input are shown in Table 7, Columns (4)-(6). In Column (4), the estimated coefficient of $PeerRD \times Size$ is -0.073 (t=-4.00, p<0.01), which is significant at the 1% level, indicating that firm size negatively moderates the relationship between peer firms' innovation input and focal firm's innovation input. It means that the smaller the firm size, the more it is influenced by the peer effect in manufacturing enterprises' innovation input. The results of the grouping test on whether the firm is influenced by Confucian culture in Columns (5) and (6) show that the estimated coefficients are positive and significant at the 1% level, but the t-value in Column (8) is larger, indicating stronger significance. This means that the negative moderating effect of firm size is effective for firms influenced by Confucian culture, but ineffective for firms not influenced by Confucian culture.

5.2.3.Positive moderating effect of market competition

Faced with same-group competitors with similar resource endowments or comparable market positions, imitating peer firms' decision-making is a common means to alleviate competition [15]. To maintain competitive advantage or catch up with competitors, decision-makers choose to make decisions consistent with those of same-group competitors to mitigate decision-making risks or gain competitive advantage. Referring to research by Dhaliwal, Huang,

Khurana and Pereira [18], the negative reciprocal of the Herfindahl-Hirschman Index is used to measure market competition (COM), where a larger value represents more intense market competition. The test results of the impact of market competition on the peer effect in manufacturing enterprises' innovation input are shown in Table 7, Columns (7)-(9). In Column (7), the estimated coefficient of $PeerRD \times COM$ is 2.041 (t=9.73, p<0.01), which is significant at the 1% level, indicating that market competition positively moderates the relationship between peer firm's innovation input and focal firm's innovation input. It means that the higher the market competition, the more easily that the focal firm's innovation input is influenced by the peer effect. The results of the grouping test on whether the firm is influenced by Confucian culture in Columns (8) and (9) show that the estimated coefficients are both significant and positive at the 1% level, but the t-value in Column (8) is larger, indicating stronger significance.

5.2.4.Positive moderating effect of digital finance

Hsu, Tian and Xu argue that the financial market environment is an important factor influencing firm innovation [19]. Digital finance, utilizing information technologies such as big data, cloud computing, blockchain, and artificial intelligence, has been considered to alleviate information asymmetry in the market, expand funding sources, and promote corporate innovation by alleviating financing constraints [20]. Therefore, the development of digital finance has a significant impact on firm innovation. This paper employs the "Digital Inclusive Finance Index" compiled by Peking University Internet Finance Research Center is used to measure the level of digital finance development in 31 provincial-level regions (autonomous regions, municipalities) in mainland China. Since the values of the digital finance index in the sample range from 10 to 500, the natural logarithm of the digital finance index plus one (DIF) is used to eliminate the dimensional impact. The test results of the impact of digital finance on the peer effect in manufacturing enterprises' innovation input are shown in Table 7, Columns (10)-(12). In Column (10), the estimated coefficient of $PeerRD \times DIF$ is 0.054 (t=2.64, p<0.01), which is significant at the 1% level, indicating that the digital finance index positively moderates the relationship between peer firm's innovation input and focal firm's innovation input. It means that the higher the digital finance index, the more easily firm innovation input is influenced by the peer effect. The results of the grouping test on whether the firm is influenced by Confucian culture in Columns (11) and (12) show that the estimated coefficients are both significant and positive, but the significance is stronger in Column (11).(Attachment 6)

5.3.Analysis of mediating effect

In order to examine the consequences of the peer effect in manufacturing enterprises' innovation input, this study constructs three consecutive regression models to test the mediating effects. Following the approach of Baron and Kenny [21], the models examine the impact of peer firms' innovation input on focal firm's innovation output, the impact of peer firms' innovation input on focal firm's innovation input, and the mediating effect of focal firm's innovation input on the relationship between peer firms' innovation input and focal firm's innovation output. Foal firm innovation output ($Inno$) is measured by the logarithm of the total number of invention patents, utility models, and design patents plus one. From Table 8, Columns (1)-(3), it can be observed that for the entire sample, the total effect estimate coefficient of peer firms' innovation input on focal firm innovation output is 6.266 (t=7.72, p<0.01), which is significant at the 1% level. This indicates a significant positive impact of peer firms' innovation input on focal firm innovation output. The estimated coefficient of peer innovation input (Column 2) is 0.542 (t=12.55, p<0.01), and the estimated coefficient of focal firm's innovation input (Column 3) is 2.713 (t=6.45, p<0.01), both significant at the 1% level. The mediating effect, calculated as $0.542 \times 2.713 \approx 1.470$, accounts for approximately 23.467% of the total effect. Columns (4)-(6) and Columns (7)-(9) present the results of the subgroup analysis based on whether firms are influenced by Confucian culture. Among them, the results in Columns (4)-(6) show that under the influence of Confucian culture, the estimated coefficients of peer firms' innovation input and focal firm innovation input are both positive and significant at the 1% level. The total effect coefficient on firm innovation output is 6.296, and the mediating effect is calculated as $0.553 \times 2.602 \approx 1.439$, accounting for approximately 22.854% of the total effect. This indicates that under the influence of Confucian culture, peer firms' innovation input promotes firm innovation output through

facilitating innovation input. However, in the group not influenced by Confucian culture (Columns (7)-(9)), the mediating effect becomes ineffective. The estimated coefficients of peer firms' innovation input are not significant, suggesting a weakened relationship between peer firms' innovation input and focal firm innovation input/output is not influenced by Confucian culture. (Attachment 7)

Conclusion

1.Research Conclusion

This study used data from Chinese listed companies in the manufacturing industry from 2011 to 2020 to examine the influence of Confucian culture and peer effect in manufacturing enterprises' innovation input. The research findings are as follows: there is a peer effect in manufacturing enterprises' innovation input, with an increase in manufacturing enterprises' innovation input associated with an increase in peer firms' innovation input. Confucian culture has a significant positive impact on manufacturing enterprises' innovation input, and it also positively moderates the peer effect in manufacturing enterprises' innovation input. The deeper the influence of Confucian culture, the more it facilitates the promotion of manufacturing enterprises' innovation input, and the stronger the peer effect in manufacturing enterprises' innovation input. The peer effect of manufacturing enterprises' innovation input and the moderating effect of Confucian culture have heterogeneous effects for firms with different ownership structures and different business environments. Non-state-owned firms exhibit a peer effect in innovation input, while state-owned firms do not. Confucian culture has a significant positive impact on innovation input for firms with different ownership structures, but its moderating effect is only effective for non-state-owned firms. The peer effect in innovation input exists only when the firm's business environment index is relatively high. Compared to the influence of a low business environment index, the positive effect of Confucian culture on innovation input and its moderating effect on the peer effect are stronger when the business environment index of the firm is high. Further analysis of influencing factors reveals that the younger the firm, the smaller its size, the higher the level of market competition it faces, and the higher the digital finance index of its region, the stronger the influence of the peer effect on its innovation input, and this mechanism is more effective under the influence of Confucian culture. In the analysis of economic consequences, it is found that the peer effect in innovation input can promote focal firm's innovation output through the mediating variable of focal firm's innovation input, and this mediating effect is only effective under the influence of Confucian culture. This study examines the relationship between Confucian culture, peer effect, and manufacturing enterprises' innovation input, contributing to a deeper understanding of the role of Confucian culture and peer effects in manufacturing enterprises' innovation input and providing valuable references for enhancing innovation in the manufacturing industry.

2.Research Implications

The policy implications of this study are as follows: First, fully recognize and leverage the promotion of innovation input in the manufacturing industry by peer effects. When making decisions about innovation input, pay attention to the influence of peer firms' innovation input decision-making on the focal firm's own decision-making. Consider the differential effects of different ownership structures and business environments on the peer effect in manufacturing enterprises' innovation input. Also, note that the influence of the peer effect in innovation input is also affected by internal and external factors such as the firm age, the firm size, the market competition, and the digital finance index. In the context of China's rapid development of the information economy, the social interaction between peer firm is increasingly playing a prominent role in promoting the healthy and orderly operation of the economy and society. Market participants should fully recognize and leverage the promotion of innovation input in the manufacturing industry by peer effects, make full use of the strengths of decision-making interaction among peer firms, and effectively accelerate the realization of the goal of building a technology-strong country. Second, fully leverage the positive impact of Confucian culture and guide and cultivate positive interactions among firms. Confucian culture is an important factor influencing innovation input in the manufacturing industry, as well as a moderating variable that enhances the effect of the peer effect in innovation input. Encourage eligible manufacturing enterprises to create a Confucian cultural atmosphere and foster the correct values

and innovation awareness within the organization. Under the influence of Confucian culture, the peer effect in innovation input is stronger, and this peer effect has a positive impact on innovation output. Conversely, it does not hold true. Firms can determine whether to follow and imitate the innovation input of peer firms based on the degree of influence of Confucian culture, as well as factors such as ownership structure, firm age, firm size, business environment, market competition, and digital finance index. Government regulatory authorities need to pay attention to promoting Confucian culture, actively guide and cultivate positive interactions among peer firms in the manufacturing industry, and effectively improve the level of innovation in the manufacturing industry.

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Attachment 1

Tab.1. Variable definition.

Type	Name	Symbol	Description
Explained Variable	Focal Firm Innovation Input	*RD*	Ratio of research and development (R&D) expenditure to operating revenue
Explanatory Variable	Peer Firm Innovation Input	*PeerRD*	See Model (1)
Moderating Variable	Confucian Culture	*Conf*	Number of Confucian temples within a 100-kilometer radius of the focal firm
Control Variables	Firm Size	*Size*	Natural logarithm of total assets plus one
	Leverage Ratio	*Lev*	Ratio of liabilities to total assets
	Operating Cash Flow	*Cash*	Ratio of cash and cash equivalents to total assets
	Growth Potential	*Tobin'Q*	Ratio of market value of equity plus book value of debt to book value of total assets
	Profitability	*ROA*	Ratio of net profit to total assets
	CEO Duality	*Dual*	Indicator variable: 1 if the Chairman and CEO roles are combined, 0 otherwise
	Shareholding Concentration	*Shtop*	Ratio of shares held by the largest shareholder to total shares outstanding
	Independent Directors	*Indep*	Ratio of independent directors to total board members
	Board Size	*Board*	Total number of board members
	Executive Compensation	*Salary*	Natural logarithm of the sum of compensation for the top three executives plus one
	Industry	*Industry*	Dummy variables based on three-level industry classification within the manufacturing sector
	Year	*Year*	Dummy variables representing each year

Attachment 2

Tab.2.The regression results of the models.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Variable	Model（1）			Model（2）			Model（3）			Model（1）	
	Full sample			Full sample			Full sample			Conf≥1	Conf=0
PeerRD	0.630***	0.699***	0.542***				0.477***	0.549***	0.381***	0.553***	0.111
	(17.83)	(28.35)	(12.55)				(10.47)	(12.77)	(7.67)	(12.40)	(0.78)

Conf				0.001*** (4.87)	0.001*** (4.60)	0.001*** (4.67)	0.0004* (1.75)	0.0004* (1.76)	0.0005* (1.87)		
PeerRD×Conf							0.021*** (3.56)	0.021*** (3.52)	0.022*** (3.72)		
Controls	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Industry	Control	-	Control	Control	-	Control	Control	-	Control	Control	Control
Year	-	Control	Control	-	Control	Control	-	Control	Control	Control	Control
Constant	0.004 (0.41)	0.016* (1.80)	0.009 (0.81)	0.003 (0.24)	0.057*** (5.95)	0.017 (1.59)	0.007 (0.65)	0.019** (2.08)	0.011 (1.06)	0.010 (0.79)	0.020 (0.96)
Observation	11 655	11 655	11 655	11 655	11 655	11 655	11 655	11 655	11 655	10 956	699
R^2	0.205	0.203	0.208	0.164	0.128	0.186	0.208	0.206	0.212	0.207	0.273

Note: t-values are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

Attachment 3

Tab.4. Results of lagged period and small sample test

Variables	(1)	(2)	(3)	(4)	(5)	(6)
PeerRD	0.645*** (8.16)		0.511*** (4.97)	0.689*** (10.48)		0.440*** (4.14)
Conf		0.001*** (4.39)	0.0003 (1.12)		0.001** (1.98)	0.002** (2.03)
PeerRD×Conf			0.018*** (2.54)			0.036** (2.46)
Controls	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Industry	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Year	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Constant	0.0003 (0.02)	0.011 (0.60)	0.002 (0.10)	0.004 (0.14)	0.008 (0.24)	0.012 (0.38)
Observation	11 655	11 655	11 655	2 113	2 113	2 113
R^2	0.152	0.130	0.154	0.203	0.160	0.208

Note: t-values are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

Attachment 4

Tab.5. Results of property rights heterogeneity test

Variable	State-Owned Group			Non-State-Owned Group		
	(1)	(2)	(3)	(4)	(5)	(6)

PeerRD	0.235		0.251	0.586***		0.369***
	(1.20)		(1.34)	(16.07)		(6.98)
Conf		0.0004*	0.001		0.001***	0.001***
		(1.66)	(0.98)		(4.96)	(3.56)
PeerRD×Conf			-0.003			0.030***
			(-0.26)			(4.59)
Controls	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Industry	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Year	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Constant	0.026	0.027**	0.022	0.016	0.028*	0.020
	(1.58)	(1.98)	(1.42)	(1.12)	(1.94)	(1.40)
Observation	2 751	2 751	2 751	8 904	8 904	8 904
R^2	0.185	0.184	0.187	0.213	0.182	0.218

Note: t-values are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

Attachment 5

Tab.6.Results of business environment heterogeneity test

Variable	Higher Business Environment Group			Lower Business Environment Group		
	(1)	(2)	(3)	(4)	(5)	(6)
PeerRD	0.611***		0.448***	-0.032		-0.168
	(17.62)		(9.04)	(-0.12)		(-0.73)
Conf		0.002***	-0.001***		0.001***	0.0002
		(2.80)	(-3.99)		(3.87)	(0.22)
PeerRD×Conf			0.023***			0.033*
			(3.82)			(1.90)
Controls	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Industry	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Year	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Constant	-0.003	0.008	0.003	0.058	0.061*	0.071**
	(-0.27)	(0.80)	(0.27)	(1.55)	(1.87)	(2.01)
Observation	10 183	10 183	10 183	1 472	1 472	1 472
R^2	0.255	0.216	0.257	0.142	0.160	0.163

Attachment 6

Tab.7.Results of the moderating effect test

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Firm Age			Firm Size			Market Competition			Digital Finance		
	Full sample	Conf≥1	Conf=0	Full sample	Conf≥1	Conf=0	Full sample	Conf≥1	Conf=0	Full sample	Conf≥1	Conf=0
PeerRD×AGE	-0.161*** (-5.	-0.168*** (-5.16)	-0.055 (-0.45)									

	15)											
PeerRD × Size				-0.073*** (-4.00)	-0.074*** (-3.81)	-0.038 (-0.86)						
PeerRD × COM							2.401*** (9.73)	2.382*** (9.51)	3.150*** (2.64)			
PeerRD × DIF										0.054*** (2.64)	0.057** (2.42)	0.045* (1.80)
PeerRD	0.720*** (15.17)	0.743*** (15.49)	0.051 (0.17)	2.12*** (5.52)	2.144*** (5.27)	0.934 (0.95)	0.612*** (12.65)	0.621*** (12.42)	0.213 (1.41)	-0.002*** (-2.74)	0.249* (1.80)	-0.035 (-0.24)
AGE	-0.0001 (-0.03)	-0.001 (-0.51)	-0.011*** (-2.59)									
COM							0.047*** (5.18)	0.047*** (5.02)	0.068 (1.63)			
DIF										0.259** (2.18)	0.003*** (2.82)	-0.00004 (-0.04)
Controls	*Contro*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Industry	*Contro*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Year	*Contro*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Constant	-0.030** (-2.44)	-0.030** (-2.28)	-0.007 (-0.30)	-0.057*** (-3.72)	-0.058*** (-3.50)	-0.008 (-0.21)	0.005 (0.49)	0.007 (0.55)	0.013 (0.63)	0.020 (1.63)	0.023* (1.65)	0.014 (0.67)
Observation	11 655	10 956	699	11 655	10 956	699	11 655	10 956	699	11 655	10 956	699
R^2	0.220	0.218	0.336	0.210	0.209	0.273	0.215	0.214	0.285	0.210	0.209	0.290

Attachment 7

Tab.8.Results of mediating effect test

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Full sample			Conf≥1			Conf=0		

	Inno	*RD*	*Inno*	*Inno*	*RD*	*Inno*	*Inno*	*RD*	*Inno*
RD			2.713***			2.602***			6.175***
			(6.45)			(6.24)			(3.14)
PeerRD	6.266***	0.542***	4.796***	6.296***	0.553***	4.857***	-2.019	0.111	-2.704
	(7.72)	(12.55)	(5.67)	(7.61)	(12.40)	(5.64)	(-0.52)	(0.78)	(-0.71)
Controls	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Industry	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Year	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*	*Control*
Constant	-8.640***	0.009	-8.663***	-8.890***	0.010	-8.915***	-7.285***	0.020	-7.405***
	(-22.38)	(0.81)	(-22.51)	(-22.21)	(0.79)	(-22.34)	(-6.02)	(0.96)	(-6.14)
Observation	11 655	11 655	11 655	10 956	10 956	10 956	699	699	699
R^2	0.210	0.208	0.217	0.208	0.207	0.215	0.318	0.273	0.334