Research Article

Mechanism and Test of the Impact of Lack of Human Capital on Ecological Development in Innovation Sector

Xing Xu

School of Economics, Anhui University, Hefei 230610, China

Correspondence should be addressed to Xing Xu; suiyingbi198607@163.com

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Based on the endogenous growth model and scenario simulation, this paper theoretically analyzes the internal mechanism of the impact of the lack of human capital in innovation departments on ecological development. The simulation results show that the lack of human capital in the innovation sector not only has a significant inhibitory effect on ecological development, but this inhibitory effect positively depends on the accumulation effect of R&D stock on knowledge production and the effect of learning-by-doing. On this basis, the empirical test of the above conclusions with the help of interprovincial panel data confirms its correctness, and the empirical results are robust. Therefore, it is recommended that the government builds an appropriate human capital allocation and compensation mechanism to induce human capital to enter the innovation sector, so as to shape a development and innovation efficiency model that is consistent with economic and ecological goals.

1. Introduction

Ecological development involves two main aspects: first, ecological development should include economic goals and ecological goals; second, economic growth must be accompanied by ecological development. This means that the future economic growth model needs to be focused on the endogenous growth path, which achieves industrial upgrading and ecological benefits through independent innovation; that is to say, technological progress can lead to economic growth and create a high-quality economic growth model driven by innovation, thereby realizing continuous improvement of ecological benefits. Grossman and Krueger [1] believe that “technical effects” are one of the factors that affect the environment, and technological progress can significantly improve environmental pollution. Chiou et al. [2] used corporate data to study it and found that green technological innovation can significantly improve environmental conditions through research on the automotive industry. Zailani et al. [3] found that the R&D and application of green technology have a significant effect on improving environmental pollution and enterprise performance. In recent years, many scholars have also proposed to

promote the adjustment of industrial structure and technological progress to drive the improvement of ecological efficiency, weaken the pressure of regional environmental pollution, and achieve ecological development [4–6].

To achieve China’s economic ecological development at this stage, it is crucial to shift from factor-driven and investment-driven to innovation-driven model, improving human capital level and optimizing human capital allocation [7].

The growth model supported by human capital can more effectively promote economic development to an innovation-driven model, thereby reducing dependence on resources and the environment [8]. There are also some scholars who try to incorporate human capital as a renewable human resource into the analysis framework, believing that the development of education and the improvement of human capital level are of great significance to energy conservation and emission reduction and environmental protection [9]. Human capital plays a key role in transforming production methods. Some scholars have found that areas with high human capital are easy to apply new technologies, thereby reducing environmental pollution and achieving ecological goals [10]. Kurtz and Brooks [11]

used transnational sample data to find that human capital is an important factor affecting the regional resource condition. The improvement of human capital level can help improve the efficiency of the use of natural resources, so as to make the environmental conditions develop in a greener direction. As far as the EKC curve of provincial environmental pollution is concerned, when other factors remain unchanged, every 1% increase of high-level human capital will reduce environmental pollution losses by 0.14% [12]. Zhang [13] discussed the impact of heterogeneous human capital in rural China on agricultural development and found the improvement of agricultural green growth rate, thereby reducing production pollution and pollution emissions. Relying on the above literature, human capital has a positive impact on ecological development.

At present, the level of human capital in China is still extremely low. In 2010, the average number of years of education for people over 15 years old in China was only 7.5 years, compared with 13.2 years in the United States and 11.6 years in Japan (Research Group on China's Economic Growth, 2014), which were far higher than those in China during the same period [7]. In addition, China's limited human capital still has a serious mismatch, and a large number of talents with innovative potential flow into the government and monopoly and other nonproduction and noninnovative sectors due to salary incentive [14]. The Research Group on China's Economic Growth (2014) found that, in China, workers in low-market sectors have a high level of education, such as government departments and monopoly sectors, but in highly market-oriented sectors, that is, market departments that only rely on innovation to obtain superprofits in fierce competition, the level of human capital is extremely low. And with the increase of the scale of human capital, the allocation of human capital between departments has gradually precipitated [15], leading to lack of human capital in the innovation department.

The earlier literature that analyzed the impact of human capital allocation on the economy is Murphy et al. [16]. They concluded that if a country's most capable human capital is allocated to the production sector, it can promote technological innovation. But if it is allocated to nonproductive sectors, it can only use innovative talents in the redistribution of wealth, thereby hindering innovation and economic development. Innovation burst is the result of the joint effect of human capital accumulation and human capital allocation, and the reasonable allocation of human capital is the key to innovation burst [17].

In summary, this means that, for the innovation department, when there is a lack of higher quality and greater quantity of human capital inflow, the innovation department lacks talents, has low innovation efficiency, and has insufficient endogenous growth momentum, which affects the current "transformation of methods and structural adjustment strategy," and this hinders the ecological development process. Specifically, first, the lack of human capital stock in the innovation sector has a typical lock-in effect on the extensive growth model, so the industrial structure is fixed on the low-end industries, which are often high pollution and high emission industries; second, the lack of

human capital in innovation departments means that the innovation power is insufficient, and economic growth still needs to rely on the driving mode of increasing factor input, making it difficult to achieve the endogenous growth that promotes ecological benefits through technological progress, which is not conducive to the improvement of ecological benefits. Lan et al. [18] found that there is a significant "pollution refuge" phenomenon in areas with low level of human capital; the reason is that such areas lack human capital and are less attractive to external investment, and they can only lower environmental standards or even sacrifice the environment in exchange for more external investment.

From the existing literature, most of them examine the total relationship between the ecological environment and economic growth or analyze the evolution trajectory of each component of the ecological environment. Few literatures introduce the impact of production factors on the ecological environment in the framework of total amount, especially the impact of the allocation of production factors on ecological development. The innovation of this article lies in trying to study the impact of the lack of human capital in innovation departments on ecological development from the perspective of technology-induced. This paper discusses the logic of the endogenous growth process of human capital mismatch, lack of innovation motivation, and stagnant technological progress, and the endogenous growth process of ecological benefit improvement is hindered, and the paper finally proposes corresponding solutions.

Based on the above background, this paper first constructs a growth model to analyze the internal mechanism of the impact of the lack of human capital in innovation departments on ecological development. On this basis, this article uses macrodata to empirically test the theoretical conclusions. The policy implication of this paper is that the scale efficiency model driven by capital to increase labor productivity at the current stage will be replaced, and the effective utilization of generalized human capital brought by social development will become the key to reshape the new efficiency model. Therefore, it is advisable to construct an appropriate human capital allocation and compensation mechanism to guide the effective allocation of human capital, and then to shape an innovative efficiency model with consistent development of economic and ecological goals.

2. Theoretical Analysis

2.1. Basic Model. Referring to Li et al. [14], we assume that the proportion of low ability and high ability workers (human capital) is ε and $1 - \varepsilon$. Meanwhile, it is assumed that all types of workers can be competent for the work of the final product department, but if they enter the innovation department, they need to accept the education of $1 - \lambda$ length of time.

Assume that the proportion of human capital entering the innovation sector during t is μ_t , and the total number of people is $\bar{L}$. Therefore, the human capital numbers L_t^Y and L_t^R

in the final product department and the innovation department are, respectively,

$$\begin{aligned} L_t^Y &= [\varepsilon + (1 - \varepsilon)(1 - \mu_t)]\bar{L}, \\ L_t^R &= (1 - \varepsilon)\mu_t\bar{L}, \end{aligned} \quad (1)$$

where $1 - \mu_t$ can be used to measure the lack of human capital in innovation department under the given total amount of human capital.

- (1) Final product department: The final product sector employs labor L_t^Y and a series of intermediate products $x_t(s)$ for production. Lanjouw and Mody [19] believe that environmental protection policies have an important impact on technological progress. On one hand, enterprises need to pay taxes for the pollution they cause in the production process, which will promote enterprises to pay attention to the ecological environment and stimulate enterprises to invest in technology research and development. On the other hand, the government can use the collected environmental taxes to invest in the development of pollution control technologies to promote technological progress. Therefore, the ecological environment constitutes a constraint on the production of intermediate varieties. Let A_t represent the technological stock in the economy of the period t . e_t is the level of ecological environment in the t era. $\varphi > 0$ is used to reflect the externality of ecological environment. Therefore, the form of the output function of the i enterprise in the final product sector is

$$Y_t = (L_t^Y)^\alpha \int_0^{A_t e_t^\varphi} [x_t(s)]^{1-\alpha} ds. \quad (2)$$

The final product production department maximizes its profit level by selecting intermediate products and the amount of labor:

$$\max \left\{ Y_t - \int_0^{A_t e_t^\varphi} p_t(s) x_t(s) ds - w_t^Y L_t^Y \right\}, \quad (3)$$

where $p_t(s)$ represents the price of the s intermediate product, and w_t^Y is the wage of the workers in the final product department. By solving the above maximization problem, we can get the demand function of labor and the s intermediate product invested by representative enterprises.

$$w_t^Y = \alpha (L_t^Y)^{\alpha-1} \int_0^{A_t e_t^\varphi} [x_t(s)]^{1-\alpha} ds, \quad (4)$$

$$p_t(s) = (1 - \alpha) L_t^\alpha [x_t(s)]^{-\alpha}. \quad (5)$$

- (2) Intermediate products sector: It is assumed that only one enterprise can produce each intermediate product by purchasing the patent from the R&D department. To simplify the analysis, it is assumed that one unit of final product is required to produce one unit of intermediate product; that is, the

marginal cost of producing intermediate product is 1. The optimal decision-making behavior of intermediate product department is as follows:

$$\max \{ p_t(s) x_t(s) - x_t(s) \}. \quad (6)$$

By combining formula (4) and equation (5) and solving the above optimization problem, the total input of the intermediate product is $x_t(s) = (1 - \alpha)^{(2/\alpha)} L_t^Y$ and the profit $\Pi = (1 - \alpha)^{-1} L_t^Y$ of the intermediate product department is obtained. According to arbitrage conditions, the price of patent is as follows:

$$p_t^R = \Pi = (1 - \alpha)^{-1} L_t^Y. \quad (7)$$

- (3) Innovation department: Referring to Romer's R&D function [20], R&D output depends on the amount of human capital that is willing to enter the innovation sector L_t^R and the R&D stock A_t in the economy. Considering the accumulation effect and learning-by-doing effect of R&D stock on knowledge production, and setting A_t contribution to R&D increment as $A_t^{\varphi+1}$, the R&D output function is as follows:

$$A_{t+1} - A_t = \delta A_t^{\varphi+1} \cdot \lambda L_t^R, \quad (8)$$

where δ is the production efficiency of innovation department, w_t^R is the labor wage of innovation department, R&D product price p_t^R and R&D efficiency are given, the innovation department maximizes the profit of innovation department by selecting the amount of human capital, and then the optimal decision-making behavior of innovation department will be made:

$$\max \{ p_t^R (A_{t+1} - A_t) - w_t^R \cdot \lambda L_t^R \}. \quad (9)$$

Combining with equation (8) to solve the above optimization problem, the optimal wage level of innovation department can be obtained:

$$w_t^R = \delta (1 - \alpha)^{-1} A_t^{\varphi+1} L_t^Y. \quad (10)$$

Further combining formula (4) and equation (10), the following relationship can be obtained:

$$\frac{w_t^R}{w_t^Y} = \delta \alpha^{-1} (1 - \alpha)^{((\alpha-2)/\alpha)} A_t^\varphi e_t^{-\varphi} L_t^Y. \quad (11)$$

- (4) The family department: Assuming that consumers live for two periods, the income in the first period is used for consumption and savings in the current period, and the savings are used for consumption in the second period. Let the consumer income at the end of t be $(I_t / (1 - \tau)) \in \{\delta w_t^R, \delta w_t^Y, w_t^Y\}$, where τ is the uniform personal income tax rate. The current consumption level $c_{t,t}(I_t)$ and savings level $s_t(I_t)$ meet $c_{t,t}(I_t) + s_t(I_t) = I_t$. In the second period,

consumers get the principal and interest repayment of $r_{t+1}s_t(I_t)$, and all of them are used for the second period consumption, where r_{t+1} is the return on capital. The expected utility maximum in period t is

$$E(\max U_t | I_t) = \frac{\ln E(r_{t+1})}{1+\rho} + \frac{2+\rho}{1+\rho} \left[\ln \frac{1+\rho}{2+\rho} + \ln I_t \right], \quad (12)$$

where $E(r_{t+1})$ is the individual's expectation of the rate of return on savings.

2.2. Equilibrium Solution and Analysis. Let $\Delta_t = (\{\ln(E(r_{t+1})) - (2+\rho)[\ln(2+\rho) - \ln(1+\rho)]\}/(1+\rho))$; therefore, the expected utility of consumers' education is as follows:

$$E(\max U_t) = \Delta_t + \frac{2+\rho}{1+\rho} \cdot [\mu_t \ln(1-\tau)\lambda w_t^R + (1-\mu_t)\ln(1-\tau)\lambda w_t^Y]. \quad (13)$$

The expected utility of consumers not receiving education is as follows:

$$E(\max U_t) = \Delta_t + \frac{2+\rho}{1+\rho} [\ln(1-\tau)w_t^Y]. \quad (14)$$

Comparing formulas (13) and (14), when $(w_t^R/w_t^Y)^{\mu_t} \geq (1/\lambda)$ is satisfied, consumers born in phase t will choose to receive education at the beginning of period t . Therefore, in order to encourage individuals to enter the innovation sector through education, the utility of entering the innovation sector should be no less than that of entering the end product sector. Otherwise, individuals will choose to give up their education and work directly in the final product department. Therefore, the wage ratio of the two sectors meets the following conditions:

$$\left(\frac{w_t^R}{w_t^Y} \right)^{\mu_t} = \frac{1}{\lambda}. \quad (15)$$

This means that the salary level of the innovation department must be sufficient to compensate for the opportunity cost of individual education. Otherwise, when the wage of innovation department w_t^R is lower than $(w_t^Y/\lambda^{(1/\mu_t)})$, all individuals will choose to give up education and directly enter the final product department. Therefore, combined with formula (11), the following relationship is obtained:

$$\lambda^{(1/\mu_t)} \delta \alpha^{-1} (1-\alpha)^{((\alpha-2)/\alpha)} [\varepsilon + (1-\varepsilon)(1-\mu_t)] \bar{L} = \left(\frac{e_t}{A_t} \right)^\varphi, \quad (16)$$

Here, (e_t/A_t) is the ecological development caused by technological progress, which is used to measure the improvement degree of ecological environment caused by the change of unit technology.

Since equation (16) cannot be solved in an explicit solution, this paper uses numerical simulation to solve the above optimization problem. According to the usual value of the parameter, the share of labor income in total output is $\alpha = 0.6$, and the production efficiency of R&D department is $\delta = 0.0211$ [21], since λ represents the proportion of the whole life working time of high-capacity workers who enter the R&D department and sets $\lambda = (1/3)$ in this paper. According to the calculation of the main data bulletin of the sixth national census, the proportion of the population with high school and below in the total population is 0.8991, so $\varepsilon = 0.8991$ is taken. In order to investigate the accumulation effect and learning-by-doing effect of R&D stock on knowledge production, the φ values of this paper are 0.5, 1.0 and 1.5, respectively. Similarly, in order to simplify the analysis, the total amount of labor $\bar{L} = 1$ [21].

Then, based on the above parameter settings, this paper examines the impact of different values of $1-\mu_t$ in the innovation department's human capital deficiency on (e_t/A_t) . The simulation results are shown in Table 1.

According to the results, the greater the degree of human capital deficiency in the innovation sector, the lower the degree of improvement in the ecological environment through technological progress, and the greater the accumulation effect and learning-by-doing effect of R&D stock on knowledge production, the more obvious this negative effect. The mechanism of action is as follows: first, if a large number of human capital is employed in nonproduction and no-technological innovation sectors because of salary incentive, the lack of human capital in the innovation department makes the human capital stock of R&D department insufficient, which has a typical lock-in effect on the extensive growth mode, the industrial structure is solidified on the low-end industries, and the low-end industries are often of high pollution and high emission industries; second, the lack of human capital in the innovation sector means that the innovation efficiency of R&D department is low, the future innovation-driven growth mode is hindered, and the economic growth still depends on the increase of factor input driven mode, so it is difficult to turn to the endogenous growth path of improving ecological benefits through technological progress, indicating that green technological progress is facing the distortion of human capital allocation. It is not conducive to the improvement of ecological benefits.

3. Empirical Test

3.1. Variable Description and Measurement Mode. With the help of macrodata, this paper examines whether the lack of human capital in the innovation departments is not conducive to ecological development. The measurement model is set as follows:

$$\left(\frac{e}{A} \right)_{i,t} = \beta_0 + \beta_1 \text{mis}_{i,t} + \beta_2 \text{mis}_{i,t} \times \text{year}_i + \text{controls} + v_i + \lambda_t + \mu_{i,t}. \quad (17)$$

In formula (17), the subscript i represents the region, t represents the time, v_i represents the individual effect, λ_t

TABLE 1: Simulation result.

$\varphi = 0.5$					
$1 - \mu$	0.2	0.4	0.6	0.8	1
(e/A)	0.0048	0.0020	3.3723×10^{-4}	1.4468×10^{-6}	0
$\varphi = 1$					
$1 - \mu$	0.2	0.4	0.6	0.8	1
(e/A)	0.0695	0.0449	0.0184	0.0012	0
$\varphi = 1.5$					
$1 - \mu$	0.2	0.4	0.6	0.8	1
(e/A)	0.1690	0.1263	0.0696	0.0113	0

The results are compiled by the author's simulation calculation.

represents the time effect, and $\mu_{i,t}$ represents the random interference term. The specific meanings of the above variables are as follows:

- (1) The degree of ecological development caused by technological progress (e_t/A_t). In this paper, the pollution degree of R&D stock per unit is used to measure the improvement degree of ecological environment caused by technological progress. Specifically, it uses the ratio of industrial wastewater emissions to the number of patent applications granted in each region (p_{water}), and the ratio of industrial waste gas emissions to the number of patent applications granted (p_{gas}) is used as alternative indicator.
- (2) Lack of human capital in innovation department (mis). This article believes that the scientific and technological talents with innovative potential may be employed in nonproductive and nontechnological innovation sectors due to salary incentive, thus resulting in the shortage of human capital in innovation departments and mismatch of human capital in the whole society. According to the theoretical model setting ($1 - \mu_t$), this paper calculates the human capital deficiency degree of innovation department as follows: $mis = 1 - ((\text{Number of scientific researchers}) / (\text{Number of people with university degree or above}))$.
- (3) Other control variables, controls. This paper selects the following variables as control variables to be introduced into the econometric model, mainly including the following. (1) The level of economic development (gdp): in general, in the early stage of economic development, the economic development level of developing countries is significantly proportional to the degree of environmental pollution. Consequently, this paper uses per capital GDP as a variable to measure the level of economic development; (2) population density, posity: the greater the regional population density, the more serious the pressure on ecological environment. This paper uses the ratio of the population of the area at the end of the year to the local land area to express it; (3) fixed asset investment (finvest): it is used to examine the impact of investment on the ecological environment. This paper uses the formation rate of fixed assets in each region to measure the investment in fixed

assets; (4) industrial structure (intrue): industrial structure directly affects the development level of ecological environment, so it is necessary to introduce industrial structure variables as control variables; in this paper, the proportion of secondary industry output value is used as the substitute index of industrial structure; (5) the degree of openness (open): it is measured by the proportion of total import and export in GDP. The empirical samples in this paper are interprovincial panel data. The data comes from the Nation Bureau of Statistics of People's Republic of China, China Statistical Yearbook and local statistical yearbook of each year, and the China Compendium of Statistical 1949–2020. The time span is from 1995 to 2019.

3.2. Estimated Results. Table 2 shows the regression results of the benchmark model (17). From the results in column (1), after controlling for regional individual effects, the variable coefficient of the degree of human capital deficiency in the innovation sector is significantly positive, which indicates that the greater the degree of human capital deficiency in the innovation sector, the greater the ratio of industrial wastewater discharge to the number of patent applications. That is, the greater the degree of human capital deficiency in the innovation sector, the more difficult it is to achieve ecological development through endogenous technological progress. Taking into account the changing trend of the impact of the lack of human capital in the innovation sector on ecological development over time, this paper introduces the interaction term between the degree of human capital loss in the innovation sector and the time trend in the model. The estimated results show that the interaction term coefficient is significantly negative. Considering that population density and economic development methods affect ecological development at the same time, especially the imbalance of industrial structure, if these factors are not effectively controlled, it may lead to missing variable and biases, thereby affecting the reliability of research results. After adding population density, industrial structure, and degree of openness to the outside world and controlling the regional individual effects, the empirical results are shown in (2). The variable coefficient of the degree of human capital deficiency in the innovation sector is still significantly positive, which shows the conclusion that the lack of human capital in innovation department is robust.

Column (3) of Table 2 examines the impact of human capital deficiency in innovation departments on exhaust emissions. The estimated results show that, after controlling regional individual effects, the variable coefficient of human capital deficiency degree of innovation departments is also significantly positive. This indicates that the lack of human capital in innovation departments has a significant positive effect on exhaust emissions, and the lack of human capital in innovation department has led to an increase in waste gas emission. Similarly, considering the impact of the omitted variables on the estimation results, after introducing posity, intrue, open and other variables in column (4) of Table 2, as

TABLE 2: Basic estimation results.

Variable	$(p \text{ water})$		Variable	$(p \text{ gas})$	
	(1)	(2)		(3)	(4)
Mis	0.3430*** (0.0344)	0.2693*** (0.0357)	Mis	0.3218*** (0.0984)	0.2594** (0.0991)
Mis $\times$ year	-0.0002*** (0.00002)	-0.0001*** (0.00002)	Mis $\times$ year	-0.0002*** (0.00001)	-0.0002*** (0.00001)
Posity		-0.1006*** (0.0151)	Posity		0.3343*** (0.0419)
Intrue		-0.4378*** (0.1072)	Inture		0.5190** (0.2975)
Open		-0.1813 (0.2609)	Open		-0.6297*** (0.0723)
Regional effect	Yes	Yes	Regional effect	Yes	Yes
Time effect	No	No	Time effect	No	No
F	48.12***	39.13***	F	14.71***	28.31***
R ²	0.1760	0.2586	R ²	0.0613	0.2015
Number of samples	680	680	Number of samples	680	680

***, **, and * are the significance levels of 1%, 5%, and 10%, respectively. The values in parentheses are standard errors. The table below is the same.

TABLE 3: Instrumental variable estimation results.

Variable	$p \text{ water}$		Variable	$p \text{ gas}$	
	(1)	(2)		(3)	(4)
Mis	1.5725** (0.8349)	1.6782** (0.7935)	Mis	0.8784*** (0.2554)	0.8560*** (0.2487)
Mis $\times$ year	-0.0007** (0.0004)	-0.0009** (0.0004)	Mis $\times$ year	-0.0004*** (0.0001)	-0.0004*** (0.0001)
Control variable	No	Yes	Control variable	No	Yes
Regional effect	Yes	Yes	Regional effect	Yes	Yes
Time effect	No	No	Time effect	No	No
Wald chi2	47.72***	118.75***	Wald chi2	36.77***	59.83***
R ²	0.1722	0.2478	R ²	0.0320	0.0770
Number of samples	650	650	Number of samples	650	650

well as the individual effects of the control area, the empirical results show consistent estimation results, and the estimation results in this article are credible.

3.3. Endogeneity and Sample Extreme Value Influence. Considering that the endogenous problem makes the estimation results biased, Table 3 adopts the instrumental variable estimation method to estimate.

In this paper, we choose the human capital deficiency degree variable of innovation department with one lag period as the tool variable. The estimated results are shown in Table 3. Column (1) and column (2) of Table 3, respectively, examine the impact of human capital deficiency on wastewater discharge in innovation sector. The empirical results show that, regardless of whether other influencing factors and regional individual effects are controlled, the estimation coefficient of human capital deficiency in innovation sector is consistent and significantly positive. Therefore, after taking into account the endogenous problem, the conclusion that the lack of human capital in the innovation sector leads to the increase of industrial wastewater discharge is still robust. Similarly, columns (3) and (4) of Table 3 examine

the impact of the lack of human capital in the innovation sector on industrial emissions. After controlling for other influencing factors and controlling regional individual effects, consistent estimation results are also obtained.

Since the least square estimation is easily affected by the extreme value of the sample, the 0.25 and 0.75 conditional quantiles are selected for estimation in this paper. The specific results are shown in Table 4.

Firstly, columns (1) and (2) of Table 4 investigate the impact of human capital deficiency on industrial wastewater discharge. The quantile estimation results show that, after controlling other influencing factors, the estimated coefficients of human capital deficiency in innovation sector are significantly positive under 1% confidence level, indicating that, under different condition quantile levels, the lack of human capital in the innovation sector has significantly led to an increase in industrial waste gas emissions. Columns (3) and (4) of Table 4 examine the impact of human capital deficiency in innovation sector on industrial emissions. In the same way, after controlling for other influencing factors, the same estimation results are obtained under different quantile levels. Therefore, after overcoming the impact of sample extreme value on the

TABLE 4: Conditional quantile estimation results.

Variable	p water		Variable	p gas	
	(1) 0.25	(2) 0.75		(3) 0.25	(4) 0.75
Mis	1.0007*** (0.0069)	1.9111*** (0.1021)	Mis	0.3257*** (0.0225)	0.7266*** (0.0385)
Mis $\times$ year	−0.0005*** (0.00003)	−0.0009*** (0.0001)	Mis $\times$ year	−0.0002*** (0.00001)	−0.0004*** (0.00002)
Control variable	Yes	Yes	Control variable	Yes	Yes
Regional effect	No	No	Regional variable	No	No
Time effect	No	No	Time effect	No	No
Pseudo R^2	0.3275	0.3997	Pseudo R^2	0.1469	0.4042
Number of samples	680	680	Number of samples	680	680

estimation results, the empirical results of this paper are also robust.

4. Conclusions and Recommendations

This paper first builds a growth model and analyzes the internal mechanism of the impact of the lack of human capital in the innovation departments on ecological development through scenario simulation. The analysis results show that the lack of human capital in the innovation sector has a significant inhibitory effect on ecological development, and the greater the accumulation effect of R&D stock on knowledge production and the learning-by-doing effect, the more obvious its negative effect. Furthermore, this paper uses macrodata to empirically test the conclusions of the scenario analysis. The empirical results show that, after controlling for other influencing factors and regional individual effects, the lack of human capital in the innovation department has a significant positive effect on industrial wastewater and industrial waste gas emissions, indicating that the lack of human capital in the innovation sector leads to the increase of environmental pollution, and the empirical results are also robust after overcoming the influence of endogenous and sample extreme value. Accordingly, this paper makes the following recommendations:

First, we should formulate and improve the benefit distribution and incentive compensation mechanism of human capital allocation, guide human capital with innovation potential into R&D and innovation departments, increase the stock of human capital in the R&D department, stimulate the independent innovation power, and transform the growth mode to the endogenous growth path of simultaneous improvement of economic and ecological benefits through technological progress, so as to achieve green high-quality development of goals.

Second, we should give full play to the decisive role of the market in the allocation of resources, guide the appropriate matching of human capital through market forces, drive the industrial structure from the low-end industrial form with high pollution and high emission to the high-end industrial form dominated by high-tech industry and service industry, and promote the formation of a high-quality economic growth mode with economic and ecological goals consistent with development and innovation as the main driving force.

Third, while promoting the effective use of scientific and technological human capital, the government should also

actively take measures to suit local conditions, appropriately strengthen the intensity of environmental regulation, stimulate enterprises to take the initiative through environmental taxes and emissions trading, and adapt low-carbon production equipment and pollution, so as to achieve the ecological goal of reducing pollution and improving environmental performance.

Data Availability

The data used to support the findings of this study have not been made available but can be obtained from the author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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