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The Interactive Effect of Talent Gathering, Technological Innovation and High-Quality Economic Development: An Empirical Analysis Based on China's Provincial Panels

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Abstract

Based on the panel data of 30 provinces in China from 2006 to 2019, this paper uses the panel vector autoregression model to empirically analyze the interaction and lagging influence among talent gathering, technological innovation and high-quality economic development. The research results indicate that the variance decomposition of high-quality economic development shows that talent aggregation and technological innovation are both driving forces for high-quality economic development, but the lag effect of talent aggregation is relatively small. For every 1% increase in talent aggregation level, the level of high-quality economic development increases by 0.154%. For every 1% increase in technological innovation level, the level of high-quality economic development increases by 0.325%; in the variance decomposition results of talent aggregation, high-quality economic development and technological innovation have a positive effect on talent aggregation and the effect is gradually increasing, but the lag effect of talent aggregation itself is becoming smaller and smaller. For every 1% increase in the level of high-quality economic development, the level of talent aggregation increases by 1.204%. For every 1% increase in technological innovation level, the talent aggregation level increases by 0.212%; in the variance decomposition results of technological innovation, the lag effect of high-quality economic development and talent aggregation is relatively large, but the proportion of talent aggregation is relatively small. For every 1% increase in the level of high-quality economic development, technological innovation increases by 1.700%. For every 1% increase in talent aggregation, technological innovation increases by 0.141%. Therefore, relying solely on talent aggregation cannot achieve the goal of high-quality economic development. It is also necessary to increase innovation investment, enhance the effect of talent aggregation, allocate resources reasonably, and form a positive interaction among the three.

Keywords

Talent Gathering, Technological Innovation, High Quality Economic Development, PVAR

1. Introduction

Technological innovation is the strategic support for building a modern economic system. As an important indicator to measure the competitiveness of regional economic development and technological innovation, talents are also the most active intellectual resources in economic and social transformation and development. The report of the 19th National Congress of the Communist Party of China further clarifies the important position of innovation in leading economic and social development, as a strategic support for economic development; talent is the driving force of innovation. Therefore, how to use talents as the development engine, improve the stock and agglomeration level of regional scientific and technological talents, and promote high-quality economic development is of great research significance. Based on the research of previous scholars, this paper takes the three as dependent variables and studies the impact of each other, selects sample data from 30 provinces (municipalities directly under the central government and autonomous regions) in China (considering the possibility of data and other issues, excluding Hong Kong, Macao and Taiwan), and studies the interaction and lagging impact between talent agglomeration, technological innovation and high-quality economic development, so as to provide reference for formulating relevant policies.

2. Literature Review

2.1. Talent Aggregation and High Quality Economic Development

He et al. (2019) calculated the role of talent aggregation in China's regional economic growth, but there is not a strict positive relationship between the two. Romer (1990) and Lucas (1988) believe that the investment and accumulation of human capital is an internal driving force for the sustained economic development of a country or region.

2.2. Talent Gathering and Technological Innovation

Pater and Lewandowska (2015) believe that the process of innovation involves the creation process and knowledge transformation, and it is necessary to invest a sufficient number of talents and innovative resources. Ma (2012), Niu & Song (2012), Niu, Zhang, & Feng (2012), Zhang & Ni (2022) all used spatial econometric models to estimate the relationship between talent and innovation. Rui et al. (2014) conducted cointegration tests, Gran causality tests, and pulse analysis on the relationship between technological talent aggregation and technological innovation.

2.3. Technological Innovation and High Quality Economic Development

Hasan & Tucci (2010) found that the quality of patents owned by a country's enterprises is directly proportional to economic growth. Gene & Lai (2004) pointed out that effective patent protection and incentive systems can promote innovation activities and keep the economy on a balanced growth path. Yu & Li (2021) explored the impact of innovation on the level of high-quality regional development from different perspectives. Xin & Luo (2020) believe that the promoting effect of technological innovation on economic growth is reflected in a lag of 1 - 2 years.

2.4. The Relationship between Talent Aggregation, Technological Innovation, and High-Quality Economic Development

Promoting talent aggregation and enhancing innovation capabilities can accelerate regional economic transformation and assist in high-quality economic development. Xu & Wu (2019) believe that there is a lag effect and potential spillover benefits in the impact of talent aggregation and innovation drive on economic development. Ge & Hu (2019) found that the degree to which talent aggregation and technological innovation drive China's economic growth is different. Economic growth attracts talent aggregation, which in turn promotes technological innovation.

In summary, currently, research on talent aggregation, technological innovation, and high-quality economic development in China mostly focuses on a single indicator as the dependent variable to study the current impact, with less attention paid to the interaction and long-term lagging effects of the three. In order to comprehensively examine various indicators, this article takes the three as dependent variables and studies their impact on each other.

3. Variable Selection and Data Analysis

3.1. Variable Selection

In order to examine the relationship between the three, this paper uses the level of high-quality economic development (HQED), the level of technological innovation (TECH) and the level of talent accumulation (TAL) as the explanatory variables of the model. First, we conduct fixed effect regression analysis on panel data, and then use the PVAR model to analyze the degree of influence and lag effect between variables.

High quality economic development level (HQED). This article selects a total of 21 variables from the five development dimensions of innovation, coordination, green, openness, and sharing, and constructs an indicator system using principal component analysis (**Table 1**). For ease of calculation, the economic high-quality development index is logarithmically processed.

Table 1. Construction system of high quality economic development indicators.

Primary indexes	Secondary indexes	Index interpretation	code	unit
Economic Innovation (in)	R & D personnel investment intensity	R & D funding/GDP	EHQD1	rate
	R & D funding strength	R & D personnel per 10,000 people/GDP	EHQD2	person/yuan
	Technical market trading capabilities	Technology Innovation Contract Turnover/GDP	EHQD3	rate
	Number of patents granted by R & D personnel	Number of patent applications granted/R & D practitioners	EHQD4	pieces/person
Coordinated development (co)	Urbanization rate	Urban population/permanent population at the end of the year	EHQD5	%
	Income disparity between urban and rural areas	Ratio of disposable income of urban and rural residents	EHQD6	ratio
	The gap between urban and rural consumption	Ratio of consumption level of urban and rural residents	EHQD7	ratio
	Investment rate	GDP accounted for by the gross capital formation/expenditure method	EHQD8	rate
	The industrial structure is advanced	Tertiary industry added value/GDP	EHQD9	rate
Green development (gr)	The degree of air pollution	Sulphur dioxide emissions/GDP	EHQD10	Tons/10,000 yuan
	Degree of sewage discharge	Wastewater discharge/GDP	EHQD11	Tons/10,000 yuan
	Industrial pollution control capabilities	Industrial pollution control investment completed/GDP	EHQD12	Tons/10,000 yuan
		Comprehensive utilization rate of industrial solid waste	EHQD13	Tons/10,000 yuan
	Power consumption	Electricity energy consumption per unit of GDP	EHQD14	10 million hours/10,000 yuan
Open development (op)	Openness of foreign investment	Foreign Direct Investment/GDP	EHQD15	%
	balance of trade	Total import and export of goods/GDP	EHQD16	%
Shared development (sh)	Health capacity	Number of medical technicians/10,000 permanent residents at the end of the year	EHQD17	%

Continued

Leisure and entertainment level	Area of green space in the park/number of permanent residents at the end of the year	EHQD18	Square meters/10,000 people
Investing in education	Education expenditure/number of permanent residents at the end of the year	EHQD19	Yuan/person
Income level	Per capita disposable income	EHQD20	Yuan
jobless rate	Registered unemployment rate in towns	EHQD21	%

Technical innovation level (tech). Based on existing research results and considering the availability of data, this study selects the actual number of patent authorizations across the country, except for Hong Kong, Macao, Taiwan, and Tibet regions, as the measurement indicator. Considering the stability of the model, the index is taken as natural logarithm.

Talent aggregation level (tal). This article selects logarithmic values to measure the proportion of graduates with master's degrees or above in the total number of employed people in each province.

This article standardizes the variables included in the five development dimensions of innovation, coordination, green, openness, and sharing, and draws on previous research to forward process the reverse indicators:

$$y_t = \max_{1 \le i \le n} \{x_t\} - x_t \tag{1}$$

Among them, x_t represents the t-th original indicator value, and y_t represents the t-th indicator value after forward processing.

3.2. Data Sources and Descriptive Statistical Results

The data sources of this article are the National Bureau of Statistics, CSMAR database, China Science and Technology Statistical Yearbook, and China Population and Employment Statistical Yearbook. Table 2 shows that there is a significant difference between the maximum and minimum values of the three types of indicators, reflecting the uneven development of the three across 30 provinces in China.

4. Empirical Model and Result Analysis

4.1. Unit Root Test of Panel Data

To ensure the stationarity of the data for each variable and prevent bias in the estimation results caused by pseudo regression, this study used LLC test, IPS test, and ADF test to conduct unit root tests on the three variables. After testing, the original sequences of the three variables are all stationary sequences. At this point, the data can be further analyzed and tested, and the test results are shown in Table 3.

Table 2. Statistical descriptions of related variables.

VARS	Obs	Mean	Std. Dev	Min	Max
HQED	420	1.043	0.526	−1.619	2.337
tech	420	9.484	1.598	4.575	13.18
tal	420	−1.051	1.119	−5.257	2.262

Table 3. Unit root test.

VARS	LLC		IPS		ADF		LEVIN	
tech	−6.67***	stable	−1.47*	stable	0.36***	stable	−7.80***	stable
HQED	−3.65***	stable	−2.33***	stable	3.60***	stable	−13.83***	stable
tal	−11.75***	stable	−6.20***	stable	13.71***	stable	−8.54***	stable

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

4.2. Estimated Results

Based on the selected variables, establish the regression equation as follows:

$$\text{HQED} = c_0 + c_1\text{TAL} + c_2\text{TECH} \quad (2)$$

$$\text{TAL} = c_0 + c_1\text{HQED} + c_2\text{TECH} \quad (3)$$

$$\text{TECH} = c_0 + c_1\text{HQED} + c_2\text{TAL} \quad (4)$$

Estimating the three formulas separately and conducting Hauseman test, the original hypothesis of rejecting random effects is accepted with a probability of over 99%, indicating that the fixed effects model is the best choice for all three models. The estimated results are shown in Table 4.

The Goodness of fit of the estimation model in Formula (2) is 0.956, which is mainly used to estimate the impact of high-quality economic development and talent accumulation on technological innovation. All variables pass the statistical test at the confidence level of 1%. From the perspective of elasticity coefficient, the elasticity coefficient of high-quality economic development is 1.700, and the elasticity coefficient of talent aggregation is 0.141, indicating that high-quality economic development and talent aggregation have a positive effect on technological innovation. That is, for every 1% increase in the level of high-quality economic development, technological innovation increases by 1.700%; for every 1% increase in talent aggregation, technological innovation increases by 0.141%.

The Goodness of fit of the model in Formula (3) is 0.922, which examines the impact of talent gathering and technological innovation on high-quality economic development. All variables pass the statistical test at a confidence level of 1%. From the perspective of elasticity coefficient, the level of technological innovation (0.325) is higher than the level of talent aggregation (0.154), indicating that the former has a greater positive effect on high-quality economic development. That is, for every 1% increase in technological innovation level, the level

Table 4. Estimated results.

VARS	(1)	(2)	(3)
	tech	HQED	tal
HQED	1.700***		1.204***
	(0.148)		(0.113)
tal	0.141***	0.154***	
	(0.049)	(0.031)	
tech		0.352***	0.212***
		(0.020)	(0.063)
Constant	7.859***	−1.882***	−4.319***
	(0.205)	(0.214)	(0.503)
Observations	420	420	420
Adjusted R-squared	0.956	0.922	0.865

Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

of high-quality economic development increases by 0.325%; for every 1% increase in talent aggregation level, the level of high-quality economic development increases by 0.154%. Compared to the level of technological innovation, talent aggregation has limited driving force for high-quality economic growth.

Formula (4): the Goodness of fit of the model is 0.865, which is mainly used to estimate the impact of high-quality economic development and technological innovation on talent gathering. All variables passed the statistical test at the confidence level of 1%. From the perspective of elasticity coefficient, high-quality economic development is 1.204, and technological innovation is 0.212, indicating that both have a positive effect on talent aggregation. That is, for every 1% increase in technological innovation level, talent aggregation level increases by 0.212%; for every 1% increase in the level of high-quality economic development, the level of talent aggregation increases by 1.204%.

4.3. Determination of Lag Order and Model Stability Testing

The PVAR model was first proposed by Holtz Eakin, which retains the advantages of the VAR model and adds new content. Not only can it reflect the conflicts between variables and introduce individual effects α_i. It shows the impact of the change of each variable on its own change, and panel data is added to the time series. Before conducting impulse response and variance decomposition, the lag order needs to be determined. According to the AIC criterion, after multiple attempts, the optimal lag order is determined to be 3 orders. Therefore, the regression equation can be expressed as:

$$y_{it} = \alpha_i + \beta_t + Ay_{it-1} + \beta y_{it-2} + Cy_{it-3} + \varepsilon_{it}, i = 1, \cdots, 31; t = 1, \cdots, 20 \quad (5)$$

In Equation (5), $y_{it} = \{\text{EG}, \text{TIL}, \text{TAL}\}$ is a vector containing three dependent variables, A, B, and C are all coefficient matrices, which are the parameters to be estimated in this paper (Table 5).

Before conducting PVAR pulse response and variance decomposition, the stability of the model should be tested. The stable results of the model are shown in Figure 1. All feature roots of the three variables are less than 1, located within the unit circle, indicating that the model is stable. At this point, pulse response and variance decomposition can continue.

To determine whether the subsequent impulse response and variance decomposition are meaningful, the Granger causality test is first performed, which is used to analyze whether there is a causal relationship between each variable. If the Granger test fails, it indicates that there is no significant causal relationship between the three, and continuing with impulse response or variance decomposition is meaningless. The results of the Gran causality test are shown in Table 6. From the Prob value, it can be seen that there is a significant causal relationship between high-quality economic development, talent aggregation, and technological innovation level, which can be further analyzed.

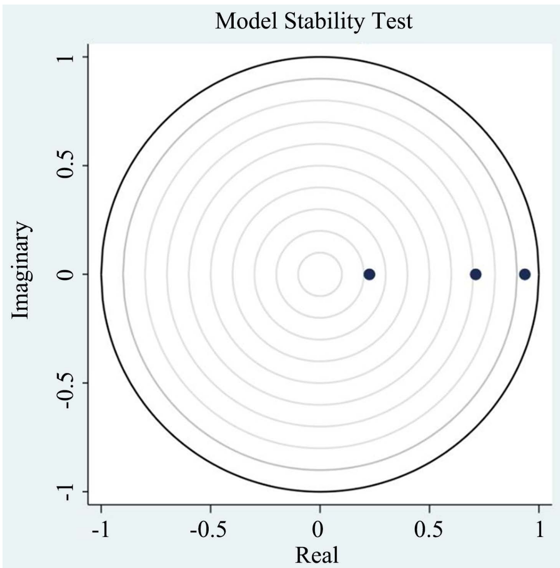

Figure 1. Model stability results.

Table 5. Selection of model lag order.

LAG	CD	J	PVALUE	MBIC	MAIC	MQIC
1	0.999984	80.32229	3.150115	−116.981	8.322291	−42.1657
2	0.999981	50.73587	0.003738	−97.2414	−3.26413	−41.1301
3	0.999979	35.55302	0.008046	−63.0985	−0.44698	−25.691
4	0.999857	9.082304	0.429712	−40.2435	−8.9177	−21.5397

Table 6. Gran causality test.

	Equantion/Excluded	Prob > Chi^2
tech		
	tal	0.36
	HQED	0.488
	ALL	0.197
tal		
	tech	0
	HQED	0.093
	ALL	0
HQED		
	tech	0.012
	tal	0.696
	ALL	0.036

4.4. Pulse Response and Variance Decomposition

After conducting fixed effects regression analysis and a series of tests on the three variables, proceed with impulse response and variance decomposition. Figure 2 shows the pulse response diagram of the level of high-quality economic development (HQED), talent aggregation (TAL), and technological innovation (TECH). Overall, the self driving effects of the three are positive pulses. The self driving effect of high-quality economic development level weakens and then remains stable. The driving effect of talent aggregation level on oneself is mainly reflected in a stable state after the second period, and the driving effect of technological innovation on oneself is slowly weakening; specifically, the driving effect of high-quality economic development on talent aggregation is mainly reflected in the lag of two periods and shows a positive effect, gradually returning to a stable state in the lagging periods. And its impact on technological innovation is reflected in a lag of 7 periods, and eventually tends to stabilize; the impact of talent aggregation on the high-quality development level of the economy shows a positive effect, which is reflected in a lag of 2 periods and the state is relatively stable. Similarly, its pulse response to technological innovation remained stable after the second phase; the impact of technological innovation on high-quality economic development is mainly reflected in a lag of 7 periods, followed by a gradual decline. And its impact on talent aggregation is reflected in a lag of 2 periods, showing a slow decreasing pulse response and finally gradually returning to a stable state with a positive effect.

In order to explore the sources and degrees of impact on each variable during the lag period, variance decomposition was performed on the three variables. Tables 7-9 show the results of variance decomposition.

Table 7. Variance decomposition table for technological innovation.

response variable		impulse variable		
variable	period	tech	HQED	tal
tech	1	1	0	0
tech	2	0.99297	0.0002	0.00683
tech	3	0.98799	0.0007	0.01131
tech	4	0.98475	0.00137	0.01388
tech	5	0.98246	0.00211	0.01543
tech	6	0.98074	0.00284	0.01642
tech	7	0.97937	0.00353	0.01709
tech	8	0.97827	0.00416	0.01758
tech	9	0.97352	0.00471	0.01793
tech	10	0.97659	0.0052	0.01821

Table 8. Variance decomposition table for high-quality economic development.

response variable		impulse variable		
variable	period	tech	HQED	tal
HQED	1	0.13788	0.84081	0.02131
HQED	2	0.2509	0.7349	0.01422
HQED	3	0.35402	0.63394	0.01204
HQED	4	0.43922	0.54912	0.01166
HQED	5	0.50644	0.48155	0.01201
HQED	6	0.55857	0.42881	0.01262
HQED	7	0.8989	0.38782	0.01328
HQED	8	0.63028	0.35581	0.01391
HQED	9	0.65492	0.33062	0.01446
HQED	10	0.67477	0.31059	0.01494

Table 9. Variance decomposition table of talent aggregation level.

response variable		impulse variable		
variable	period	tech	HQED	tal
tal	1	0.01932	0	0.98068
tal	2	0.06657	0.00242	0.93102
tal	3	0.11444	0.00491	0.88065
tal	4	0.15561	0.00673	0.83766

Continued

tal	5	0.18986	0.008	0.80214
tal	6	0.21826	0.00888	0.77286
tal	7	0.24189	0.00951	0.7486
tal	8	0.26164	0.00998	0.72839
tal	9	0.27822	0.01033	0.71145
tal	10	0.29222	0.10599	0.69718

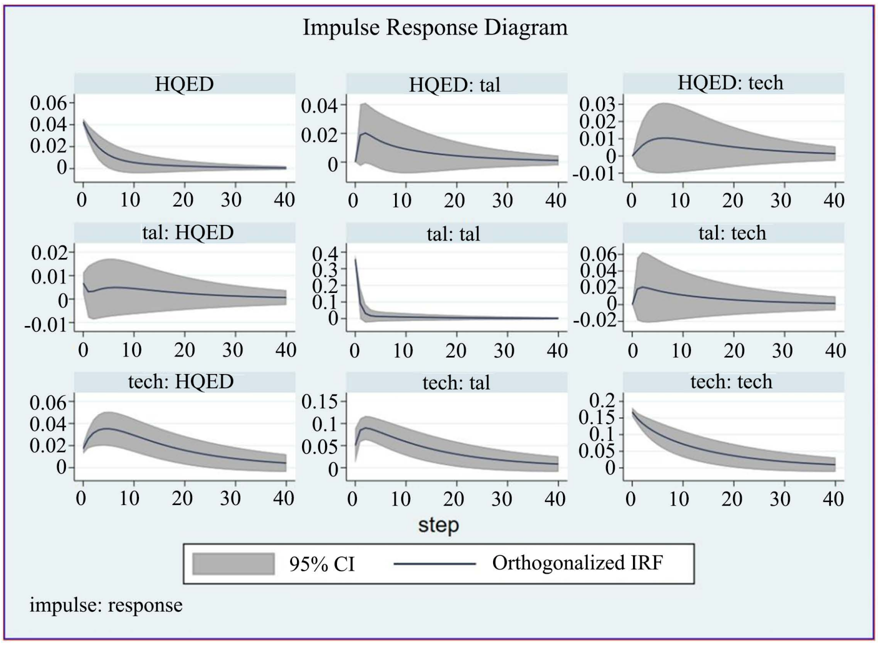

Figure 2. Pulse response diagram.

From **Table 7**, it can be seen that the changes in technological innovation itself have a significant impact, slowly decreasing from 100% in the first phase to 97.65% in the tenth phase. Compared to talent aggregation, the impact of high-quality development level on technological innovation is weaker, reaching 0.52% in the 10th phase.

Table 8 shows that since the first period, the high-quality development level of the economy has had an 84% impact on its own changes, and the proportion has gradually weakened since the second period. And its impact on technological innovation gradually increased from the first to the seventh period to 89.8%, and then decreased to 63% in subsequent periods. Similarly, its impact on talent aggregation level decreased from the second phase and eventually stabilized. The same as the regression estimation result of the above panel data, compared with talent gathering, technological innovation has a greater impact on the change of high-quality economic development.

Table 9 shows that since the first period, the main factors affecting the level of talent aggregation have been self changes and technological innovation. The changes in technological innovation are more sensitive and have an increasing impact on talent aggregation, ranging from 1.9% to 29%. The impact of high-quality economic development on talent aggregation is also gradually increasing, from 0% in the first phase to 10.6% in the tenth phase.

5. Conclusion and Suggestions

From the fixed effect model, compared to talent aggregation, technological innovation has a greater impact on high-quality economic development. On the contrary, technological innovation is superior to talent aggregation in the driving effect of high-quality economic development. From the pulse response function and variance decomposition results, it can be seen that high-quality economic development and technological innovation have a significant positive impact on talent aggregation. Compared to talent aggregation, technological innovation has a greater positive impact on high-quality economic development and its impact is long-lasting and stable. Through the PVAR model, the interaction and lagging effects between talent aggregation, technological innovation, and high-quality economic development were studied from both theoretical and empirical perspectives. The results indicate that talent aggregation and technological innovation are important driving forces for high-quality economic development. For every 1% increase in talent aggregation level, the high-quality economic development level increases by 0.154%; for every 1% increase in technological innovation level, the level of high-quality economic development increases by 0.325%; high quality economic development and technological innovation have a positive effect on talent aggregation. For every 1% increase in the level of high-quality economic development, the talent aggregation level increases by 1.204%; for every 1% increase in technological innovation level, the talent aggregation level increases by 0.212%; high quality economic development and talent aggregation also have a positive effect on technological innovation. For every 1% increase in the level of high-quality economic development, technological innovation increases by 1.700%; for every 1% increase in talent aggregation, technological innovation increases by 0.141%. Therefore, in implementing talent policies and standards, we continuously introduce high-end talents to drive high-quality teams and projects, and provide a good entrepreneurial atmosphere. The government should increase investment in innovation, increase expenditure on scientific research funds, and adopt incentive measures to enhance independent innovation capabilities. At the same time, it is necessary to strengthen the virtuous cycle between high-quality economic development (HQED), talent aggregation (tal), and technological innovation (tech), so as to maintain a mutually promoting relationship among the three.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Ge, L. Q., & Hu, H. (2019). Talent Agglomeration, Technological Innovation, and Economic Growth. *Journal of Fujian University of Business, No. 5,* 35-41.

Gene, G. M., & Lai, E. L. (2004). Intellectual Protection of Intellectual Property. *The American Economic Review, 94,* 1635-1653. https://doi.org/10.1257/0002828043052312

Hasan, L., & Tucci, C. L. (2010). The Innovation-Economic Growth Nexus: Global Evidence. *Research Policy, 39,* 1264-1276. https://doi.org/10.1016/j.respol.2010.07.005

He, Y., Liao, N., & Zhang, Z. J. (2019). Measurement of the Contribution of Interprovincial Talent Agglomeration to Economic Growth in China. *Scientific Research Management, 40,* 247-256.

Lucas, R. (1988). On the Mechanism of Economic Development. *Journal of Monetary Economics, 22,* 3-42. https://doi.org/10.1016/0304-3932(88)90168-7

Ma, Y. X. (2012). Human Capital, FDI Technology Spillovers, and Regional Independent Innovation: An Empirical Study Based on Spatial Econometric Models. *Journal of Shanghai Business School, 13,* 57-62.

Niu, C. H., & Song, L. (2012). Spatial Econometric Analysis of Innovation Effects from the Perspective of Talent Aggregation Effect. *Journal of Taiyuan University of Technology (Social Science Edition), 30,* 25-29.

Niu, C. H., Zhang, F., & Feng, H. Y. (2012). Aggregation of Technological Talents, High tech Industries, and Regional Technological Innovation. *Science and Technology Progress and Countermeasures, 29,* 46-48+50-51.

Pater, R., & Lewandowska, A. (2015). Human Capital and Innovativeness of the European Union Regions. *Innovation, 28,* 31-51. https://doi.org/10.1080/13511610.2014.962487

Romer, P. M. (1990). Endogenic Technological Change. *Journal of Political Economy, 98,* S71-S102. https://doi.org/10.1086/261725

Rui, X. Q., Li, H. N., Niu, C. H., & Ren, Y. (2014). Empirical Study on the Interaction between Scientific and Technological Talent Gathering and Regional Innovation Capability—Based on the Inter Provincial Panel Data from 2001 to 2010. *Science and Technology Progress and Countermeasures, 31,* 2328.

Xin, L., & Luo, S. G. (2020). Research on the Lagging Effect of Scientific and Technological Innovation on Economic Growth—Based on the Provincial Panel Data Test. *Management Modernization, 40,* 39-42.

Xu, B., & Wu, Q. (2019). Talent Gathering, Innovation Driving and Economic Growth. *Soft Science, 33,* 19-23.

Yu, D. K., & Li, J. (2021). The Explanatory Power of Innovation Quality on Regional High-Quality Development: A Comparative Perspective of Innovation Investment Scale. *Science and Technology Progress and Countermeasures, 38,* 40-49.

Zhang, L. N., & Ni, Z. L. (2022). Technological Talent Agglomeration and Regional Innovation Efficiency: An Empirical Test Based on Spatial Spillover and Threshold Effect. *Soft Science, 36,* 45-50.