

The Impact of Artificial Intelligence on High-Quality Economic Development in the Yangtze River Delta Region

Jing Yang, Qianyu Shen, Yaru Liu

College of Finance and Economics, Jiangxi Normal University, Nanchang, Jiangxi, China

Abstract: This paper employs panel data from 41 cities in the Yangtze River Delta (YRD) region from 2010 to 2019 to investigate the impact of artificial intelligence (AI) on the high-quality development of the economy in terms of innovation, greenness and coordination. The findings demonstrate that AI has a considerable impact on the advancement of economic innovation, green development and coordinated development in the YRD region. This has a notable positive effect on the quality of economic development, with the region at the forefront of the country in this regard. Further analysis shows that the Yangtze River Delta region is a follower of the eastern region in terms of economic innovation and development, but a leader in the central and western regions, and a leader in coordinated economic development.

Keywords: Artificial Intelligence; High-quality Economic Development; Yangtze River Delta Region; Innovative Development; Coordinated Development

1. Introduction

The advancement of the economy to a high level of quality is a crucial element in the process of modernization. China's economy has now progressed beyond the phase of high-speed growth and entered a new era of high-quality development based on quality. At this pivotal juncture of transformation, it is imperative to investigate and nurture nascent growth engines. Artificial intelligence, a novel information technology, is regarded as a new source of kinetic energy capable of driving the high-quality development of the economy. As the foremost region in China in terms of economic development, the Yangtze River Delta boasts a well-developed economy and a high degree of industrial agglomeration. Furthermore, it is at the vanguard of the

domestic AI industry. Consequently, examining the influence of AI on the high-quality development of the Yangtze River Delta economy is not only conducive to promoting the region's economic transformation and upgrading, but also provides invaluable insight and inspiration for other regions in the country.

2. Literature Review

The extant literature on high-quality economic development is primarily concerned with the conceptualisation, measurement and determinants of this phenomenon. With regard to the concept of high-quality economic development, the extant studies employ a variety of expressions, yet they exhibit certain similarities. From a regional perspective, Li posits that high-quality development entails the core elements of improving efficiency, enhancing stability, improving coordination, ensuring sustainability and expanding sharing [1]. In terms of measurement, a single indicator can be selected for measurement [2,3], or alternatively, a multidimensional comprehensive indicator system can be constructed to reflect it comprehensively. In terms of its determinants, these are primarily the degree of government intervention [4,5], the degree of openness to external influences [4,5], the level of infrastructure [5,6], and the level of financial development [7].

The extant literature on artificial intelligence (AI) is primarily concerned with the conceptualisation of AI, the methodologies employed to quantify it, and its economic ramifications. Despite extensive research, there is still no consensus among scholars regarding the concept of AI. McCarthy first proposed the concept of 'artificial intelligence' at the Dartmouth Conference in the United States [8]. Cockburn defined AI as a new technology with a universal purpose that can reshape the innovation process and industrial development [9]. In light of the

mentioned studies, this paper defines AI as a technological progress and innovation. The advancement of AI can be gauged through the utilization of AI patent data [10-12], the number of industrial robots [13,14], the proportion of fixed asset investment accounted for by the information transmission, computer services and software industry [15] and the comprehensive evaluation index system of AI [16].

The extant literature indicates that the influence of artificial intelligence (AI) on the advancement of the economy is primarily concentrated on the industrial and employment structures. From the perspective of industrial structure, Wei posits that AI facilitates economic growth by enabling the optimization and upgrading of industrial structure [17]. With regard to the employment structure, Shi & Ye posit that adjustments to this structure can serve to reinforce the positive impact of AI on the promotion of high-quality economic development [18].

The existing literature has established a robust foundation for this paper, however, research on the relationship between AI and regional economic high-quality development, particularly at the prefecture-level city level, remains limited. This paper employs a panel data set comprising 41 cities in the Yangtze River Delta from 2010 to 2019 to empirically analyse the role of AI on innovation development, green development and coordinated development. The objective is twofold: firstly, to address the research gap in this field and secondly, to provide theoretical and empirical support for the high-quality development of the regional economy.

3. Theoretical Analysis and Research Hypothesis

In light of the findings presented by Zhang et al. [19], this paper posits that economic innovation and development represent the fundamental criteria for evaluating high-quality economic growth. Green development serves as a crucial indicator of high-quality economic advancement, while coordinated development encapsulates the core essence of the Yangtze River Delta (YRD) integrated development strategy. Consequently, this paper examines the influence of AI on the high-quality development of the YRD region's economy from three perspectives: innovation,

greenness, and coordination.

The expanded theory of endogenous economic growth posits that artificial intelligence (AI) fosters high-quality economic development. It has been demonstrated that AI plays a contributory role in the promotion of economic innovation and development. To illustrate, Zhang et al. have demonstrated that AI technology plays a pivotal role in advancing urban economic innovation [20]. Technological progress and innovation enhance production efficiency, guide the flow of production factors to high-efficiency industries, optimize the industrial structure, strengthen regional competitiveness, promote the upgrading of industrial clusters and industrial chains, and drive the development of economic innovation. In light of the above, this paper puts forward the following hypotheses:

H1: Artificial intelligence has the potential to significantly promote economic innovation and development.

The theory of discontinuous innovation posits that the advancement of Artificial intelligence (AI) is typified by discontinuities and breakthroughs, and plays a constructive role in facilitating the environmentally sustainable growth of the economy [16]. A substantial body of research indicates that AI plays a pivotal role in facilitating the green development of the economy. For example, Chen & Liu have demonstrated that AI technology has a significant impact on the green development of urban economies [15]. The implementation of intelligent green production methods and growth modes encourages industrial development in a manner that is environmentally friendly, low-carbon and sustainable, thereby facilitating the achievement of green economic growth. In light of the aforementioned evidence, this paper puts forth the following hypothesis:

H2: Artificial intelligence has the potential to significantly promote the green development of the economy.

Artificial intelligence (AI) exhibits a number of noteworthy characteristics at the techno-economic level, including permeability, synergy, substitution effect, and innovativeness. These attributes have the potential to directly and efficiently promote coordinated economic development. This assertion has been

corroborated by studies such as that conducted by Chen & Cai [12], which demonstrated that AI has a significant role to play in promoting the coordinated development of regional economies. The geographical boundaries are transcended by AI technology, which optimizes the flow of resource allocation, enhances effectiveness, and accelerates regional economic integration and coordinated growth. In light of the above, this paper puts forward the following hypothesis:

H3: Artificial intelligence has the potential to significantly promote coordinated economic development.

4. Research Design

4.1 Data Sources

As the core of the Yangtze River Economic Belt and a region of significant economic prosperity, the Yangtze River Delta (YRD) is a valuable area of study with regard to the intrinsic connection between its high-quality economic development and artificial intelligence. This paper employs panel data from 41 cities in the YRD region from 2010 to 2019 to empirically investigate the impact of AI on economic innovation and development, green development, and coordinated development. Various econometric models are utilized to analyse data from the Incopat Patent Library and the National Bureau of Statistics.

4.2 Definition of Variables

The central explanatory variable of this study is artificial intelligence (AI). The data were obtained from Incopat using the IPC with keyword search and subsequently employed for regression analyses after the addition of a

$$\text{innovation}_{it} = \alpha_0 + \beta_1 \ln ai_{it} + \sum_{j=2}^n \beta_j \text{control}_{it}^j + u_i + \varphi_t + \varepsilon_{it} \quad (1)$$

$$\text{ged}_{it} = \alpha_0 + \beta_1 \ln ai_{it} + \sum_{j=2}^n \beta_j \text{control}_{it}^j + u_i + \varphi_t + \varepsilon_{it} \quad (2)$$

$$\ln \text{pcgdp}_{it} = \alpha_0 + \rho W \ln \text{pcgdp}_{it} + \beta_1 \ln ai_{it} + \sum_{j=2}^n \beta_j \text{control}_{it}^j + WX\theta + u_i + \varphi_t + \varepsilon_{it} \quad (3)$$

In equation (1), innovation_{it} denotes economic innovative development; $\ln ai_{it}$ denotes artificial intelligence; control_{it}^j is the control variable; α_0 is the constant term, u_i is the city effect, φ_t is the time effect, ε_{it} is

value of one to facilitate the calculation of the logarithm of the 2010-2019 data for the Yangtze River Delta cities.

The explanatory variable of this paper is economic high-quality development. In line with the research [19], this paper defines economic high-quality development as comprising three aspects: economic innovation and development, economic green development and economic coordinated development. The indicator system for economic innovation and development is constructed from the perspectives of innovation inputs and outputs [21,22], while the indicator system for economic green development is constructed from the perspectives of energy consumption, the degree of pollution and green environmental protection [23]. Finally, the indicator system for economic coordinated development is based on the real GDP per capita measure [12]. Additionally, the entropy value method was employed to ascertain the degree of economic innovation and green development.

In this paper, we draw on the relevant literature to identify the control variables [10,11]. These include the degree of government intervention, the degree of openness to the outside world, the level of infrastructure, and the level of financial development.

4.3 Model Construction

In order to ascertain the influence of AI on the superior economic growth of the Yangtze River Delta region, fixed-effects models and spatial econometric models were employed for the analysis.

the error term. In equation (2), ged_{it} characterises economic green development; the rest of the variables are the same as in equation (1). In equation (3), $\ln \text{pcgdp}_{it}$ characterises the level of coordinated economic development; W is the spatial

weight matrix, the rest of the variables are the same as in equation (1).

5. Empirical Analyses

5.1 Benchmark Regression Analysis

Table 1 illustrates the findings of the regression analysis of AI on the high-quality development of the economy of the Yangtze River Delta (YRD) region. Columns (1) and (2) present the results of the regression of AI on the innovative development of the economy of the YRD region. The results demonstrate that the regression coefficient for AI is significantly positive. This suggests that AI has a considerable impact on the advancement of economic innovation within the YRD. This is in accordance with the findings of Zhang et al. [20]. It seems plausible to suggest that AI, as a technological innovation, plays a significant role in driving industrial change, expanding the boundaries of innovation possibilities and leveraging the multiplier effect of technological enablement. This, in turn, has the potential to promote economic innovation and development.

Columns (3) and (4) present the regression results for the influence of AI on the green development of the economy of the Yangtze River Delta (YRD) region. The results demonstrate that the influence of AI on the

green development of the economy of the YRD region is statistically significant at the 1% level. This suggests that AI has a considerable impact on the economic green development of the YRD region. This is more aligned with existing literature [16], which suggests that AI technology can facilitate the greening of production methods and the advancement of industry greening through its enabling effect, thereby promoting the green development of the economy.

Column (5) presents the regression results of AI on the coordinated economic development of the Yangtze River Delta (YRD) region. In order to verify the impact of AI development on neighbouring cities, this paper introduces the spatial Durbin model for regression analysis. The results demonstrate that the regression coefficient for AI is significantly positive, indicating that AI not only stimulates economic growth within the region but also has a positive impact on neighbouring regions. This finding is more consistent with the research of existing scholars [12]. The reason for this is that the technological and economic foundations of the YRD cities are similar, which in turn promotes the siphoning effect of AI technology, optimizes the allocation of resource flows and contributes to the synergistic development of the regional economy.

Table 1. Benchmark Regression Results

Variables	innovation		ged		lnpcgdp
	(1)	(2)	(3)	(4)	(5)
lnai	0.0113*** (0.0016)	0.0166*** (0.0045)	0.0368*** (0.0032)	0.0205*** (0.0055)	0.138*** (0.0188)
W*lnai					0.127* (0.0668)
fin		-0.0095 (0.0138)		0.0432 (0.0292)	
gi		0.0634 (0.0550)		-0.1980 (0.1239)	
fdirate		-0.4062** (0.1594)		0.3602 (0.3256)	
intnternetuser		-0.0139 (0.0100)		0.0377** (0.0148)	
Obs	410	410	410	410	400
R ²	0.9552	0.9568	0.7731	0.7892	0.690
City fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes

Note: Values in parentheses are t-values, and ***, **, and * indicate significance levels of 1%, 5% and 10%, respectively.

5.2 Endogeneity Discussion

In light of the potential for endogeneity issues,

such as reverse causality and omitted variables, to influence the relationship between AI and economic innovation, as well as green

development, in the Yangtze River Delta (YRD) region, Consequently, this paper employs instrumental variables and a two-stage least squares test, the results of which demonstrate that AI continues to exert a significant influence on economic innovation and development and green development in the YRD. This serves to validate the reliability of the benchmark regression.

5.3 Robustness Test

This paper replaces the core variables with the penetration stock of industrial robots to test the robustness of the model. The results demonstrate that the promotional effect of AI on the innovation and green development of the Yangtze River Delta economy remains significant, thereby verifying the robustness of the benchmark regression.

6. Further Analysis

The aforementioned study demonstrates that AI plays a pivotal role in fostering the innovative, green, and coordinated growth of the Yangtze River Delta (YRD) economy. However, the preeminent position of the YRD within the national city clusters warrants

further examination. Accordingly, this paper selects the Beijing-Tianjin-Hebei region and the Pearl River Delta region in the eastern region, the city cluster in the middle reaches of the Yangtze River in the central region, and the Chengdu-Chongqing city cluster in the western region as representatives to explore the impact of AI on the high-quality development of the economy of each region, with the aim of elucidating the position of the YRD.

6.1 Innovative Economic Development

Table 2 presents a comparative analysis of the influence of AI on the advancement of economic innovation within the eastern region. The results demonstrate that the impact of AI on economic innovation development, from greatest to least, is observed in the Beijing-Tianjin-Hebei region, the Yangtze River Delta (YRD) region, and the Pearl River Delta region. This indicates that the YRD region is in a relatively inferior position within the eastern region. This finding is not entirely consistent with the results of existing studies [24], which may be attributed to the substantial capital influence exerted by Beijing.

Table 2. Comparison of Impact Results in the Eastern Region

Variables	Yangtze River Delta		Beijing-Tianjin-Hebei region		Pearl River Delta	
	(1)	(2)	(3)	(4)	(5)	(6)
lnai	0.0113*** (0.0016)	0.0166*** (0.0045)	0.0119*** (0.0045)	0.0255** (0.0124)	0.0076** (0.0030)	0.0073* (0.0042)
Obs	410	410	140	140	150	150
R ²	0.9552	0.9568	0.9250	0.9285	0.9719	0.9747
Control variables	No	Yes	No	Yes	No	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Note: Values in parentheses are t-values, and ***, **, and * indicate significance levels of 1%, 5% and 10%, respectively.

Table 3. Comparison of Impact Results in the East Central and West Regions

Variables	Yangtze River Delta		Triangle of Central China		Chengdu-Chongqing urban agglomeration	
	(1)	(2)	(1)	(2)	(1)	(2)
lnai	0.0113*** (0.0016)	0.0166*** (0.0045)	0.0093*** (0.0015)	0.0062*** (0.0019)	0.0094*** (0.0025)	0.0069** (0.0031)
Obs	410	410	280	250	160	160
R ²	0.9552	0.9568	0.9846	0.9886	0.9880	0.9891
Control variables	No	Yes	No	Yes	No	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Note: Values in parentheses are t-values, and ***, **, and * indicate significance levels of 1%, 5% and 10%, respectively.

Table 3 presents a comparative analysis of the influence of AI on economic innovation across the Yangtze River Delta (YRD) region and the

central and western regions. The results demonstrate that the impact of AI on economic innovation development, from greatest to least,

is observed in the YRD region, the Chengdu-Chongqing urban agglomeration (west) and the Triangle of Central China (central). This suggests that the YRD region is a primary driver of economic innovation in the central and western regions on a national scale. This conclusion is more aligned with the findings of existing studies [25]. It can be inferred that the YRD region has become a regional development leader due to its economic resources and geographic advantages, which have enabled it to attract talent, entrepreneurs and capital, and combine these with AI technology to significantly improve economic innovation.

6.2 Coordinated Economic Development

Table 4 presents a comparative analysis of the

Table 4. Comparison of Impact Results in the Eastern Region

Variables	Beijing-Tianjin-Hebei region	Pearl River Delta	Yangtze River Delta
	(1)	(2)	(3)
lnai	0.0102* (0.00541)	0.0358** (0.0143)	0.0595*** (0.0161)
rho	0.731*** (0.0463)	0.421*** (0.109)	0.417*** (0.0763)
sigma2_e	0.000680*** (8.83e-05)	0.0204*** (0.00254)	0.0522*** (0.00376)
Obs	130	120	400
R ²	0.547	0.808	0.717
Control variables	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes

Note: Values in parentheses are t-values, and ***, **, and * indicate significance levels of 1% 5% and 10%, respectively.

Table 5 presents a comparative analysis of the impact of AI on coordinated economic development between the Yangtze River Delta (YRD) region and the central and western regions. The results demonstrate that the impact of AI on coordinated economic development, from high to low, is as follows: the YRD region, the Triangle of Central China (central), and the Chengdu-Chongqing urban agglomeration (western). This suggests that

Table 5. Comparison of Impact Results in the East Central and West Regions

Variables	Yangtze River Delta	Triangle of Central China	Chengdu-Chongqing urban agglomeration
	(1)	(2)	(3)
lnai	0.138*** (0.0188)	0.0696*** (0.0114)	0.00716 (0.0108)
rho	0.300*** (0.111)	0.325*** (0.0714)	0.732*** (0.0600)
sigma2_e	0.0718*** (0.00540)	0.0249*** (0.00238)	0.00241*** (0.000374)
Obs	400	220	90
R ²	0.690	0.708	0.784

the YRD region is a primary driver of coordinated economic development at the national level, particularly in relation to the central and western regions. This finding is more consistent with existing studies [27] and can be interpreted as a significant effect of YRD policies on coordinated economic development, far more than that of the city clusters in the middle reaches of the Yangtze River and the Chengdu-Chongqing city cluster. This finding is at odds with the conclusions of other scholars in this field [26]. One potential explanation for this is that the integration of the YRD is facilitated by policies that aim to enhance cross-regional collaboration and foster coordinated regional development through the establishment of agreements and the implementation of synergistic mechanisms.

Control variables	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes

Note: Values in parentheses are t-values, and ***, **, and * indicate significance levels of 1%, 5% and 10%, respectively.

7. Conclusions and Policy Recommendations

This paper presents the findings of an empirical investigation into the impact of AI on the innovative, green and coordinated development of the economy of the Yangtze River Delta (YRD) region. The analysis is based on panel data from 41 cities in the region for the period 2010-2019. The findings of the study indicate that AI has a significant positive impact on economic innovation and green development in the YRD region, and this conclusion remains robust after the relevant tests. AI has a certain enhancement effect on the coordinated development of the YRD region's economy. Further analysis reveals that in terms of economic innovation and development, the YRD region is in a relatively backward position in the east of the country, while in the central and western regions, the YRD region is in a relatively advanced position. In terms of coordinated economic development, the YRD region is leading the way in terms of coordinated development of other regions. Based on the above research conclusions, the following policy recommendations are put forward:

(1) It is recommended that the role of AI be fully exploited in order to facilitate high-quality economic development. To achieve this, it is necessary for the government to continue to strengthen the support provided to AI technology and related industries in terms of talent, funding and policy. In addition, the dual roles of an effective market and a responsive government should be fully utilized in order to ensure the effective exploitation of China's institutional strengths. Furthermore, it is essential to fully exploit and give full play to China's institutional strengths, accelerate the mastery of core key technologies and ensure the stability of the industrial chain.

(2) It is essential to leverage the leading role of the Yangtze River Delta region and enhance the impact of AI on the high-quality development of the central and western regions. It is recommended that the central and western regions fully utilize their distinctive

resource endowments and cost advantages, capitalize on the spillover effects of AI development in the Yangtze River Delta region, enhance the 5G network and other new infrastructures, facilitate the transfer of the digital economy industry, and thereby propel the high-quality development of the regional economy.

Acknowledgments

This study was supported by Jiangxi Social Science Fund No. 20YJ12 and Jiangxi Graduate Education Reform Fund No. JXYJG-2022-051.

References

- [1] Li Wenyong. Measurement on high-quality development level of regional economy in China-Taking the Yangtze River Delta region as an example. *Statistics and Decision Making*, 2022, (13): 21-25.
- [2] Li Ping, Fu Yifu, Zhang Yanfang. Can the productive service industry become new momentum for China's economic growth. *China Industrial Economy*, 2017, (12): 5-21.
- [3] Liu Zhibiao, Han Yonghui. Structural transformation, TFP and high-quality development. *Management World*, 2020, (07): 15-29.
- [4] Feng Xiaohua, Qiu Siyuan. Measurement and convergence of high-quality economic development in the Yangtze River Delta cities. *East China Economic Management*, 2022, (11): 28-43.
- [5] Huang Ping, Xuan Changyong. Financial agglomeration, spatial spillover and high-quality economic development. *Journal of Jiangsu University (Social Science Edition)*, 2021, (06): 49-65.
- [6] Nie Changfei, Chen Zhi, Feng Yuan. Urban digital infrastructure construction and high-quality economic development. *Economic Issues*, 2023, (10): 26-35.
- [7] Wang Han. Services liberalisation, environmental regulation and high-quality economic development. *Statistics and Decision Making*, 2023, (16): 121-125.
- [8] McCarthy J, Minsky M L, Rochester N, et

- al. A proposal for the dartmouth summer research project on artificial intelligence, august 31, 1955. AI magazine, 2006(4):12-12.
- [9] Cockburn I M, Henderson R, Stern S. The impact of artificial intelligence on innovation. Cambridge, MA, USA: National Bureau of Economic Research, 2018.
- [10] Zou Tieding, Xu Yingqin. Artificial intelligence, industrial advancement and economic growth. Western China, 2022(05): 24-36.
- [11] Chen Nan, Cai Yuezhou. AI, accommodating capacity and economic growth in China-The new “Solow Paradox” and an empirical analysis using the AI patent data. *Economic Perspectives*, 2022(11): 39-57.
- [12] Chen Nan, Cai Yuezhou. AI innovation and coordinated development of regional economy-Analysis of technological development and regional impact using patent data. *Research on Economics and Management*, 2023, 44(03): 16-40.
- [13] Cheng Chengping, Chen Zhi. Theoretical and empirical research on the mechanism of artificial intelligence promoting China's economic growth. *On Economic Problems*, 2021(10): 8-17.
- [14] Gao Zhigang, Tian Feng, Han Yanling, et al. Theoretical mechanism and empirical analysis of the impact of artificial intelligence on the high-quality development of China's regional economy: Taking industrial robots as an example. *Science and Technology Management Research*, 2023, 43(07): 182-192.
- [15] Chen Fang, Liu Songtao. Can artificial intelligence technology become a new engine of urban green development. *Journal of Nanjing University of Finance and Economics*, 2022(03): 78-86.
- [16] Zhou Jieqi, Chen Da, Xia Nanxin. Artificial intelligence, industrial structure optimization and green development efficiency: Theoretical analysis and empirical evidence. *Modern Finance and Economics (Journal of Tianjin University of Finance and Economics)*, 2023, 43(04): 96-113.
- [17] Wei Dongming, Gu Naihua, Han Yonghui. Does the artificial intelligence promote the upgrading of industrial structure-Empirical research based on industrial robot data of China. *Finance & Economics*, 2021(10): 70-83.
- [18] Shi Dan, Ye Yunling. Artificial intelligence, employment structure and high-quality development. *Contemporary Finance & Economics*, 2023(05): 3-14.
- [19] Zhang Junkuo, Hou Yongzhi, Liu Peilin, et al. The goals and strategy path of high-quality development. *Management World*, 2019, (07): 1-7.
- [20] Zhang Yinghao, Wang Mingfeng, Kuang Aiping, et al. Multidimensional mechanisms and spatial effects of digital economy enabling urban innovation and development in China. *Progress in Geography*, 2023, 42(12): 2283-2295.
- [21] Wang Wei. A study on the measurement and evaluation of the high-quality development of China's economy. *East China Economic Management*, 2020, (06): 1-9.
- [22] Kong Lingying, Dong Yiting, Zhao Xian. Digital economy, resource mismatch and high-quality economic development: Empirical analysis based on data from 261 cities in China. *China Science and Technology Forum*, 2023, (05): 123-133.
- [23] Gao Zhigang, Ke Han. A comparative study on the high-quality development of economy in the border areas of China. *Economy*, 2020, (02): 23-35, 2.
- [24] Ma Shuyan, Zhao Zuoxiang, Xu Xin, et al. Research on the innovation efficiency and its influencing factors of national high-tech zones in three major urban agglomerations in Eastern China. *Science and Technology Management Research*, 2021, 41(21): 1-9.
- [25] He Xionglang, Chen Xianqing. The impact of population mobility on regional innovation capacities and its spatial effect: A case study of 70 cities in three urban agglomerations of the Yangtze River Economic Belt. *West Forum*, 2023, 33(04): 109-124.
- [26] Sun Tieshan, Liu Yuqi. Explanation on characteristics of Beijing-Tianjin-Hebei urban network and its implications to regional coordinated development: Based on the comparisons among three major urban agglomerations in China. *Hebei Academic Journal*, 2023, 43(03): 153-161.
- [27] Tang Xiaochao. Can urban agglomeration

integration policies alleviate
agglomeration shadow? Based on
county-level data of the three major urban

agglomerations in the Yangtze River
Economic Belt. World Regional
Studies:1-12[2024-07-01].