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Measurement of Coordinated Development Level of Cross-Regional Urban Agglomerations from the Perspective of Industrial Transformation and Upgrading

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Abstract. Based on the panel data of Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta city agglomerations in China from 2014 to 2020, this paper uses dynamic models to measure the coordinated economic development level of cross-regional urban agglomerations from the perspective of industrial transformation and upgrading, and estimates and analyzes relevant variables. The results show that the coordinated economic development degree of the Yangtze River Delta urban agglomeration, the Beijing-Tianjin-Hebei urban agglomeration and the Pearl River Delta urban agglomeration shows a fluctuating upward trend, but there are differences within and between urban agglomerations. There is a significant lagging effect of industrial transformation and upgrading on the coordinated development of cross-regional economy. The driving capacity of tertiary industry plays a role in promoting the impact of industrial transformation and upgrading on the coordinated economic development of cross-regional urban agglomerations, and the effect is stronger than the direct role of industrial transformation and upgrading.

Keywords: Industrial Transformation and Upgrading; Cross-Regional Urban Agglomerations; Driving Capacity of Tertiary Industry.

1. Introduction

The development of regional finance is the means and power to promote regional economic development. However, due to the risks of financial agglomeration, differences in regional economic development, different government policy arrangements, and the imbalance between population and production, the substantial gap in regional development has not narrowed. . At the same time, there are administrative, information, and interest barriers between regions, making it difficult to build a complete financial system. Therefore, exploring how to establish a regional risk financial security system, maximizing the advantages of regional financial agglomeration and the relationship between industrial transformation and upgrading and the coordinated development of cross-regional economy is of great significance to promote the coordinated development of my country's regions.

At present, the research on the risk of the coordinated development of regional economy in our country can be divided into two categories. The first is to study the risk differences of the coordinated development of regional economy in my country with different research methods. First of all, Zhongshen (2018) and Du Lei (2018) conducted empirical research using panel data from 30 regions in China by constructing a panel data fixed effect and spatial econometric model, and further concluded that there is a relationship between financial agglomeration and regional economic growth. highly positive relationship. Shen Yue (2017) and Wang Qing (2018) integrated banking institutions and other multi-angle financial risks in China, and obtained the upgrade differences of our financial risks through direct comparison of values. Shen Li (2019) and Zhang Ying (2019) used the SMR and Gini coefficient methods to conclude that there are still relatively high financial risks in most provinces in my country, and there are large differences in regional financial risks. Wang Qing (2018) and Liu Jun (2018) learned from the "CAMELS" rating method of the Fed's commercial bank risk, explored and summarized the diversity and diversity of our regional financial risks, and the single convergence of my country's regional economic growth model. Wang Qing (2018) and Liu Jun (2018) and others used analysis of variance (ANOVA) mixed OLS estimation, fixed effect model and other methods to analyze the risk of transmission process of mutual influence of local economic models.

Analyze the influencing factors of regional development imbalance through multi-party effects. Bernat (2006) and Baldwin (2004) constructed a global spillover model through empirical research and found that there is a spatial spillover correspondence between financial agglomeration and regional economy. The "financial accelerator" of Bernanke et al. (2001) and the "debt-deflation" mechanism of Fisher (1933) both explained the spillover effect of corporate debt on financial risk. Ren Yinghua et al. (2010) selected the cross-sectional data of 28 inter-provincial regions in my country, used the method of spatial measurement to study the factors affecting financial agglomeration, and believed that there is a strong spatial dependence effect of financial agglomeration in my country between provinces.

After combing the above literature, it is found that previous studies mostly analyzed the factors affecting the coordinated economic development from the perspectives of commerce and culture, and rarely discussed the effects of coordinated economic development of different urban agglomerations from the perspective of industrial transformation and upgrading. Moreover, most scholars analyze from a single effect, unable to accurately explore the risk and connection of economic development between urban agglomerations. Therefore, this paper takes the Yangtze River Delta, Beijing-Tianjin-Hebei and Pearl River Delta urban agglomerations as the main research objects, and uses the dynamic panel model to deeply analyze the relationship between industrial transformation and upgrading and the coordinated development of cross-regional urban agglomerations, in order to explore the impact of regional economic development imbalance. Factors provide empirical evidence to accelerate the coordinated development of regional finance.

2. Study Design

Variable selection and data source

Select the effect of industrial transformation and upgrading (ITG) as the explanatory variable. The effect of industrial transformation and upgrading should not only meet the requirements of the advanced development level of industrial structure, but also follow the C. Clark's law. To measure the effect of industrial transformation and upgrading, we should focus on the proportion of the tertiary industry, and at the same time focus on measuring the advanced level of the industry. The degree of coordinated cross-regional economic development (Regio) is selected as the explanatory variable, and in the calculation, we select the per capita gross domestic product (GDP) to reflect the degree of coordinated development of the cross-regional economy (Regio). This indicator can reflect the "cross-regional" linkage development characteristics between cities and the coordinated development ability of economic ties. As far as the control variables are concerned, the coordinated development of cross-regional economy is affected by multiple factors, so this paper controls the model from three aspects: education, economy and population, and selects the indicators of industrial development level (Ind), consumption vitality (ENE), infrastructure (Base), education level (Cul), population density (Pop), and tertiary driving capacity (TLP). Among them, population density usually uses the ratio of the land area of the administrative region to the permanent population of the region as a quantitative analysis index. The measurement of infrastructure indicators is based on the scope and quantity of public goods and services that fiscal revenue can provide in the economy and society, and its logarithm is selected as a quantitative analysis index. The measurement of industrial development level indicators mainly selects the logarithmic analysis of the number of industrial enterprises above designated size to reduce the error in enterprise scale, technology, profitability and other aspects. The literacy level index is measured, and the logarithmic value of the number of secondary school students is selected for quantitative analysis. The consumption vitality index, considering the pulling effect of financial institutions and residents' savings in the consumer market, uses the ratio of residents' year-end deposit balance to the loan balance of financial institutions as a quantitative analysis index. The index of tertiary production driving capacity is analyzed by the ratio of the added value of the tertiary industry to the average value of the permanent population; To ensure the availability of data, the number of registered population was selected instead of the average resident population. When studying the coordinated development level of cross-regional urban agglomerations,

comprehensively considering the comparability and similarity of administrative divisions, industrial undertaking, and economic center construction, this paper finally selects 5 major cities in the Yangtze River Delta city agglomeration, 5 major cities in the Beijing-Tianjin-Hebei urban agglomeration and 5 major cities in the Pearl River Delta as the research objects. The data in this paper are mainly derived from the 2014-2020 China Statistical Yearbook, the Yangtze River Delta Urban Cluster Development Plan (2015-2030), the Outline of the Beijing-Tianjin-Hebei Coordinated Development Plan, the China Urban Statistical Yearbook, the China Tertiary Industry Statistical Yearbook, the 2018 Guangdong Province Cities Demographic Report and the national statistical data release database.

Calculation process

$$ITG_i = \sum_{n=1}^{3} \theta_{i,n}^{-1}, i = 1, 2, \ldots, N$$

$$\theta_{i,n} = \arccos\left(\frac{\sum_{m=1}^{3} \left(x_{i,m,n}, x_{i,m,0} \right)}{\left(\sum_{m=1}^{3} x_{i,m,n}^2 \right)^{\frac{1}{2}} \left(\sum_{m=1}^{3} x_{i,m,0}^2 \right)^{\frac{1}{2}}} \right), m, n = 1, 2, 3$$

$$i = 1, 2, \ldots, N$$

The focus of measuring the effect of industrial transformation and upgrading is to measure the level of industrial upgrading.

Model building

$$Regio_{it} = \beta_0 + \sum_{\upsilon=1}^{n} \beta_\upsilon Regio_{it-\upsilon} + \sum_{\tau}^{d} \gamma_\tau ITG_{it-\tau} + X_{it}^T \alpha + \eta_{it}$$

where i represents the city; t represents the degree of coordinated development of cross-regional economies; Regio refers to the degree of coordinated cross-regional economic development in the i(i =1, 2,...,61) city t(t =1, 2,..., 7) period, which is the explanatory variable; Regioit - υ refers to the degree of coordinated cross-regional economic development of the ith city lagging υ (υ =1, 2,...,n); βυ represents the index to be estimated in the degree of coordinated development of cross-regional economy in the lagging υ period, which is mainly used to measure the dynamic evolution characteristics; ITGit - τ refers to the industrial transformation and upgrading effect of the ith city lagging τ (τ =1, 2,...,d); γτ refers to the parameters to be estimated for the effect of industrial transformation and upgrading in the lagging τ period, which is mainly used to measure the lag effect of Regio; XIT is a set of control variables, mainly including industrial development level Ind, consumption vitality Enit, infrastructure baseit, cultural level culit, population density Popit; β0 characterizes the intercept term; α Coefficients of action representing control variables; ηit characterizes the random perturbation term, satisfying the assumption of normality.

3. Empirical Testing

Panel data smoothness check

In order to avoid the phenomenon of "pseudo-regression" caused by sequence instability, this paper tests the stationarity of the original data to ensure that there is a stable equilibrium relationship between the variables. ADF-Fisher, LLC, PP-FISHER, HT, IPS were used to perform unit root test on panel data to reduce the impact on the measurement results due to the limitations of the test method, and the results are shown in the table. Therefore, this paper argues that the panel data has stationarity and satisfies the cointegration conditions.

Table 1. Unit root test results

	Unit root test results			
变量	ADF-Fisher	LLC	PP-Fisher	IPS
regio	70. 9510*** (0. 0000)	−5. 4349*** (0. 0000)	160. 4894*** (0. 0000)	−3. 419*** (0. 0000)
itg	10. 4203*** (0. 0000)	11. 5453*** (0. 0000)	70. 7831*** (0. 0346)	−5. 1834*** (0. 0000)
pop	85. 6778*** (0. 0000)	0. 7958*** (0. 0 3567)	15. 6778*** (0. 0987)	−1. 50258*** (0. 0000)
base	22. 17856*** （0. 0071）	−3. 4944*** (0. 0005)	6454***（0. 043	−0. 4574*** （0. 0136）
ind3	87. 4652*** (0. 0000)	−1. 75555*** (0. 0132)	53. 8463*** （0. 0857）	−1. 4946*** （0. 0043）
cul	25. 3478*** (0. 0062)	−2. 4578*** （0. 0032）	'60. 0727*** （0. 0368）	−2. 0491*** （0. 0056）
ene	40. 5863*** (0. 0000)	−0. 42337*** (0. 0000)	62. 4941*** （0. 0854）	−1. 2552*** （0. 0083）
tlp	21. 1537*** （0. 0098）	−12745*** （0. 0078）	16. 8780*** （0. 0746）	−3. 2638*** （0. 0067）

In order to further study whether there is a lag effect and whether there is a difference between industrial transformation and upgrading and cross-regional economic coordinated development, this paper uses the differential generalized moment estimation method to estimate, and then uses STATA software to perform OLS regression on the variable data, and the results are as follows.

Table 2. Uses STATA software to perform OLS regression on the variable data

	OLS（1）		OLS（2）		OLS（3）		xtgls（1）		xtgls（2）		xtgls（3）	
变量	系数	显著性水平	系数	显著性水平	系数	显著性水平	系数	显著性水平	系数	显著性水平	系数	显著性水平
Itg	−8540. 2*	5%	-92306. 1*	5%	-92306.1*	5%	-8540.2*	5%	14609.6**	1%	-92306.1***	0%
Ind	2. 400**	1%	5. 852***	0. 10%	5.852***	0. 10%	2.400**	0. 10%	2.521***	0. 10%	5.852***	0. 10%
Ene	−26414. 8*	5%	14086		14086		-26414.8**		-30285.1***	0. 10%	14086	
Base	49492. 1***	0. 10%	−2643. 2		-2643.2		49492.1***	0. 10%	14047.8		-2643.2	
Cul	−1048. 2***	0. 10%	721. 1		721.1		-1048.2***	0. 10%	-1130.2***	0. 10%	721.1*	5%
Pop	0. 566		−16. 24		-16.24		0.566		1.378		-16.24	
Tlp	0. 227***	0. 10%	0. 713***	0. 10%	0.713***	0. 10%	0.227***	0. 10%	0.162***	0. 10%	0.713***	0. 10%
i • city	否		否		是		否		否		是	
i • year	否		是		是		否		是		是	
regio											395293.6***	0. 10%
交互项t1											5144.5	

Without considering the lagging effect of industrial transformation and upgrading on the coordinated development of cross-regional economy and the dynamic effect of coordinated cross-regional economic development, a simple OLS analysis is carried out directly. In the OLS estimate, we use GDP to describe the effect of industrial transformation and upgrading, and the following conclusions are drawn from the results of the panel estimation model.

In the panel model (1), the temporal and regional fixed effects are controlled. In the simplest OLS estimation of the GDP of the explanatory variable, the impact coefficient of the current period of industrial transformation and upgrading and the influence coefficient of the control variable are considered to evaluate. There is a negative impact between industrial transformation and upgrading in the current period and the coordinated economic development degree of cross-regional urban agglomerations. There are significant negative effects on consumption vitality and cultural level, and both have passed the 5% significance test. However, there are significant positive impacts between other variables industrial development level, infrastructure and tertiary industry driving capacity on the coordinated development of cross-regional economy, all of which have passed the 5%

significance test, while there is a positive correlation between population density and cross-regional coordinated economic development, but it is not significant enough.

Due to the consideration of time effect, the ITG coefficient is -0.923, which is more significant than the influence coefficient of only considering regional effect and considering regional and temporal effects at the same time, so the impact of industrial transformation and upgrading on cross-regional economic coordinated development mainly depends on the time path. The coefficients of action of other control variables present similar results when considering time effects.

By adding interactive items (ITG and Regio), we explain the interaction between current variables, the effect of enterprise transformation and upgrading, and the degree of coordinated development of cross-regional economy. The results show that the coefficient of the interaction term is positive, indicating that there is a multiplicative interaction between the two explanatory variables, and this result is reliable based on the significance level. Then, on the basis of adding the interactive term, we added the explanatory variable lagging phase I cross-regional economic coordinated development degree to the model, while controlling the time effect and regional effect, the interaction term and Regio both passed the significance test of 0.1%, indicating that the impact of the cross-regional economic coordinated development degree of lagging period I on the current period is positive, and there is also interaction with industrial transformation and upgrading, which jointly promotes the coordinated development of cross-regional economy.

Due to the heteroscedasticity of the variables in the model, the estimation of the effect of industrial transformation and upgrading is not significant, so we use XTGLS regression to correct the heteroscedasticity caused by the explanatory variables on the basis of OLS regression. Compared with general OLS, the significant level of consumption vitality and cultural level has been improved, but it is still a negative impact. Other variables that have a positive impact on the explanatory variables, such as the driving capacity of tertiary production and the level of industrial development, still passed the 1% significance level test. However, the positive correlation between population density and cross-regional coordinated economic development is still not significant enough.

On this basis, without considering the lagging effect of industrial transformation and upgrading on the coordinated development of cross-regional economy and the dynamic effect of coordinated development of cross-regional economy, our fixed regional effect introduces time virtual variables to control the time effect, and the coefficient of ITG has negative to positive, which is more significant than the impact coefficient compared with the simultaneous control time effect and regional effect, so the impact of industrial transformation and upgrading on the coordinated development of cross-regional economy mainly depends on the results of the time path.

Table 3. Used a dynamic panel model to evaluate the Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta urban agglomerations separately

	京津冀			长三角			珠三角		
	动态系数	全部变量	1阶滞后效应	动态系数	全部变量	1阶滞后效应	动态系数	全部变量	1阶滞后效应
Itg		13283			-115972.9			-28446.05	
Ind	2.6308	2.51	2.6308	0.4112	3.317561	0.91986	0.1817928	3.256175	0.1817928
Ene	3451.2	13506.28	3451.2	6009.1	102976.3	25220.18	-3051.558	25527.04	-3051.558
Base	1012.49	-3910.733	1012.49	-101264	-60548.3	127128.28	-767.0117	17636.1	-767.0117
Cul	306.9	600.6293	306.8947	389.2678	-49.10476	1476.038	-980.2226	-875.0145	-980.2226
Pop	-16.14	-73.8425	-16.14	489.0753	262.2423	262.28	-24.66154	30.18427	-24.66154
Tlp	0.5998	0.9343	0.59984	0.40001	0.3365887	0.21002	-0.12383	-0.1713637	-0.12383
i·city									
i·year									
regio	29716.8			493014.2			448339.6		
交互项t1	-49426.83		-49426.83	5130.44		-47032.75	-88367.06		-88339.6

Given the differences in the selection of three urban agglomerations from different regions of China, we also need to verify whether there will be differences at the urban agglomeration level when there are differences in the selection of experimental subjects. We used a dynamic panel model to evaluate the Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta urban agglomerations separately. The results show that the dynamic coefficient of the cross-regional coordinated economic

development of the Beijing-Tianjin-Hebei urban agglomeration in the lagging period is 29716.8, which passed the significance test of 0.1%. The dynamic coefficient of the cross-regional coordinated economic development of the Yangtze River Delta city agglomeration was 493014.2, which passed the significance test of 0.1%. The dynamic coefficient of cross-regional coordinated economic development of the Pearl River Delta urban agglomeration in the lagging period was 448339.6, which passed the significance test of 0.1%. However, in terms of impact effect, the dynamic effect of cross-regional coordinated economic development of the Yangtze River Delta city cluster is stronger, showing the cumulative effect of the early stage on the later stage. Industrial transformation and upgrading have a negative restraining effect on the Beijing-Tianjin-Hebei urban agglomeration and the Changsanjiao urban agglomeration, but the impact is not significant.

4. Conclusion

Based on a sample of 15 cities in the Yangtze River Delta, Beijing-Tianjin-Hebei and Pearl River Delta from 2014 to 2020, this paper uses a dynamic panel model to explore the impact of industrial transformation and upgrading on the coordinated development of cross-regional economy. The main conclusions are as follows: (1) On the whole, the coordinated development of cross-regional economy in the Yangtze River Delta city cluster, Beijing-Tianjin-Hebei city cluster and Pearl River Delta city cluster shows a fluctuating upward trend. From 2014 to 2020, with the change of time, the three urban agglomerations were closely connected, but the differences between urban agglomerations and within urban agglomerations did not narrow. (2) There is a significant lagging effect of industrial transformation and upgrading on the coordinated development of cross-regional economy. Even if other control variables are added, industrial transformation and upgrading still have a lagging effect on the coordinated development of cross-regional economy. (3) The improvement of the tertiary industry-driven capacity promotes the coordinated development of the cross-regional economy, thereby promoting industrial transformation and upgrading, and the intermediary role of the tertiary industry-driven capacity is much greater than the direct impact of industrial transformation and upgrading.

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