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Inclusive Green Growth and Regional Disparities: Evidence from China

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Abstract: It is determined that inclusive green growth comprises processes of economic development and inclusiveness as a system of inclusions, taking into account the anthropogenic burden on the ecosystem, as well as the relational nature of socio-economic transformations. This article is an evaluation of this issue in the context of a contemporary Chinese society beset by regional inequalities that uses the Yangtze River basin as a case study. An index system has been constructed for inclusive green growth measurement, and kernel density and the Dagum Gini coefficient are used to analyze and describe characteristics regarding the distribution and spatial disparities within and between city clusters. The article then concludes that all city clusters are developing towards an inclusive green economy. There are still significant inequalities in inclusive growth among city clusters. Most city clusters are converging so slow that it will take a long time for weaker cites to catch up with stronger cites. City clusters also suffer major inner imbalances and gaps are widening. This paper argues that the profession needs to be more proactive in promoting strategic and targeted policies within such an unequal growth context.

Keywords: inclusive green growth; the Yangtze river basin; regional disparities; convergence

1. Introduction

Due to resource restriction and climate change, most countries have chosen a greener way to realize social equity and economic development. In 2012, the United Nations Environment Program proposed the concept of inclusive green growth [1]. The World Bank [2] states that inclusive, efficient and affordable green growth is essential for future economic development. Inclusive green growth is a suitable indicator to describe the harmony of economy and ecology.

In recent years, many city clusters have emerged in China, and these contribute significantly to green and inclusive development, among which three major city clusters along the Yangtze River are most promising. They are the Yangtze River delta, the central region (of the Yangtze River), and the Chengyu region. They account for 41% of the total GDP, 7.5% of the territory and 31.79% of the population. They also play an important role in the ecological sustainability of the Yangtze River basin. However, there are still many social and environmental problems, such as regional education inequality and soil erosion. How do we measure the imbalance between economy, society and environment? Is the difference between regions widening and narrowing?

This paper aims to construct property indexes to evaluate inclusive green growth in major city clusters in the Yangtze River basin, and calculate, decompose and trace the relative and absolute regional differences. We hope to provide professions some evidence for promoting strategic and targeted policies within such an unequal growth context.

This study makes a contribution in three ways: Firstly, we not only calculated the inclusive green growth in the city clusters in the Yangtze River basin, but also made comparisons and predictions regarding absolute and relative difference between regions. We aim to address gaps concerning this issue.

Secondly, we evaluated inequality within a cluster and its contribution to regional disparities, which has been neglected by existing studies.

Finally, we employed kernel density distribution and the Dagum Gini coefficient to analyze and trace regional differences in inclusive green growth in the Yangtze River basin. The results we got are more comprehensive and of more practical significance.

The remainder of this paper is organized as follows: Section 2 reviews the related literature and background. Section 3 provides the data and method, including the evaluation system of inclusive green growth, the method of regional disparities' estimation and convergence tests, and data sources and definitions. Section 4 presents the result of inclusive green growth, regional disparity estimation and convergence tests. The discussion is provided in Section 5, and conclusions are outlined in Section 6.

2. Literature Review and Background

2.1. Related Literature

In 2012, the World Bank put forward the concept of inclusive green growth as a form of sustainable development economics with the balance of social equality and ecological sustainability [2]. The World Bank noted that in order to reduce poverty, the economy must grow rapidly. If the growth is not "green" or "inclusive", it is not sustainable in the long run, and so inclusive green growth should be promoted for sustainable development. The OECD defines green growth as a way of sustainable resource usage that can alleviate climate change and environmental pollution [3]. Since the concept of inclusive green growth was put forward, many countries have adopted it as the essence of development strategies. Inclusive green growth is divided into three aspects by researchers: green growth, inclusive growth and inclusive green growth [4–8].

Albagoury [9] believed that inclusive green growth aims at present and future well-being. Bouma and Berkhout [10] pointed out that inclusive green growth emphasizes the trade-off between green, inclusive and economic growth. Rauniyar and Kanbur [11] and Sugden [12] argued that all countries should contribute to inclusive growth, and the fruits are shared by all. Dinda [13] and Wang et al. [14] interpreted green growth as a way of developing with effective resource utilization and less environmental pollution.

Inclusive green growth is evaluated from different perspectives, such as economic, environment and social equality [15], to establish an index system, and the entropy method [16], entropy TOPSIS method [17] and factor analysis method have been used to get the weight. Some scholars discussed this issue with the input and output method [18]. George [19] constructed the Inclusive Green Industrial Performance (IGIP) index in terms of inclusiveness and ecological sustainability to measure the industrial performances of 83 economies. Herrero [20] calculated the Inclusive Green Energy Index for 157 countries based on data in terms of social inclusion, clean production, and energy consumption, so as to evaluate progress regarding the key aspects of the United Nations' Sustainable Development Goals.

Some researchers have analyzed inclusive green growth via simple statistical comparisons, and found that despite a growing level of inclusive green growth, regional gaps are widening. Other studies have used the Theil index and Gini coefficient to get the regional differences, the trends of which are obtained by alpha and beta convergence tests, revealing that inclusive green growth shows strong and stable spatial agglomeration, and low-growth cities are catching up with leading growth cities rapidly [21].

With the Yangtze River basin having become an important objective of national economic strategy, many scholars have performed related studies. Mao and Jiang constructed an innovative index and found that innovation capacity in the Yangtze River basin showed a largely ladder-like distribution pattern and a center–periphery spatial structure [22]. Such

a severely polarized structure should be broken up and coordinated development should be advocated. Chen et al. evaluated inclusive green growth and predicted the trend using data of 108 cities in the Yangtze River basin [23]. The Yangtze River basin has obvious alpha convergence characteristics overall and in the downstream cities, and absolute beta convergence characteristics both overall and in three basins.

Overall, the existing literature has made significant contributions but ignored the following considerations: 1. A comprehensive evaluation system has been built in existing papers; however, the weight of each index was not determined by the proper method. 2. Although regional difference is evaluated, variations within regions are overlooked, which has an important impact on the overall inclusive green growth level of the region.

2.2. Major City Clusters in the Yangtze River Basin and Regional Disparities

The Yangtze River flows through almost the whole of China and feeds over 400 million people, and half the population live in three major city clusters in the Yangtze River basin, which are the Yangtze River delta, the central region (of the Yangtze River) and the Chengyu region (Figure 1). These contribute two fifths of the total GDP and have several national ecological preservation areas.
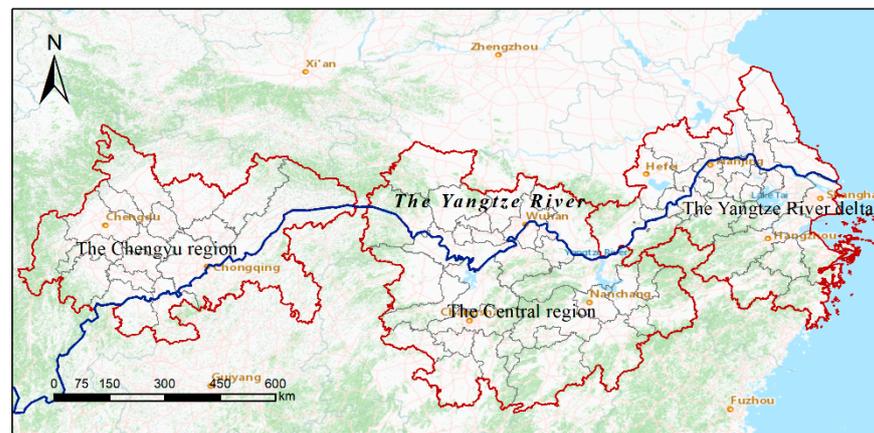

Figure 1. Major city clusters in the Yangtze River basin.

The Yangtze River delta lies in the downstream area of the Yangtze River and includes Shanghai, Hangzhou and Nanjing. It has contained many of busiest ports in the world for over 100 years, so it is the most economically developed region in China. The central region includes Wuhan, Changsha, and Nanchang, and is growing rapidly. There are plenty of universities and research institutions, and countless inland waterways. The Chengyu region is the source of the Yangtze River and includes Chengdu and Chongqing. It is of strategic importance for social fairness and ecological conservation to consider that many minorities have been living here for centuries, and rare animals are often seen in great abundance.

Despite these great achievements, there are significant imbalances either within or between the regions. The central region and the Chengyu region are less economically developed than the Yangtze River delta, and it is an inescapable fact that almost all universities and institutions are located in the capital city of the central region, and education and innovation inequality have become a challenge. Natural resources, economy, and public services vary from city to city in the Chengyu region.

3. Method and Data

3.1. Measurement of Inclusive Green Growth

Based on the indicators of the World Bank, we construct the inclusive green growth index from the four dimensions of economy, social opportunities, green production and consumption, and the environment, each containing 2–5 secondary indicators (Table S1).

We nondimensionalize the data and use a fixed-base range entropy weight method to obtain the weights of indicators, as follows:

$$P_{ij}^t = x_{ij}^t / \sum_{i=1}^{n} x_{ij}^t, i \in [1, n], j \in [1, m] \tag{1}$$

where P_{ij}^t is the proportion of the ith city in the index under the jth index in year t. If the specific gravity value $P_{ij}^t = 0$, then $\lim_{P_{ij}^t \to 0} P_{ij}^t \times \ln(P_{ij}^t) = 0$. x_{ij}^t is the index data after the range standardization process, and the index percentage is calculated.

We use the following model to calculate the index information entropy:

$$E_j^t = -[\ln(n)]^{-1} \times \sum_{i=1}^{n} \left[P_{ij}^t \times \ln(P_{ij}^t) \right] \tag{2}$$

where E_j^t ($E_j^t \in [0,1]$) is the information entropy of the jth index in the year t. The smaller the index information entropy, the greater the degree of dispersion, indicating that the amount of information provided by the index is greater, so the index weight is also greater; on the contrary, the index weight is smaller.

Then, we calculate the weight of each index. Suppose W_j^t is jth index weight of the year t. The larger the index weight, the greater the contribution of the index to the result. The calculation formula is:

$$W_j^t = (1 - E_j^t) / \sum_{j=1}^{m} (1 - E_j^t) \tag{3}$$

Then, we use the sample's initial year, 2004, as the base year, and the fixed-base range method is used to process the original data:

$$X_{ij}^t = \frac{\dot{x}_{ij}^t - \dot{x}_{ij,\min}^{2004}}{\dot{x}_{ij,\max}^{2004} - \dot{x}_{ij,\min}^{2004}} \tag{4}$$

where X_{ij}^t is the dimensionless index value processed by the fixed-base range method for the jth index of the year t. $\dot{x}_{ij}^t$ is the original data, and $\dot{x}_{ij,\max}^{2004}$ and $\dot{x}_{ij,\min}^{2004}$ are the maximum and minimum values of all the original data of the jth index in the base year.

Finally, we set S_i^t as the comprehensive index of the ith city in the year t and weigh the index weight with the entropy weight method and the dimensionless index value with the fixed-base range method, and finally obtain the comprehensive index with the following model:

$$S_i^t = \sum_{j=1}^{m} (W_j^t \times X_{ij}^t) \tag{5}$$

3.2. Measurement of Regional Difference and Decomposition

3.2.1. Kernel Density Estimation

Kernel density estimation uses a smooth peak function to fit the sample data, and reflects the distribution of random variables via a continuous density curve. We assume that the density function of the random variable X is:

$$f(x) = \frac{1}{Nh} \sum_{i=1}^{n} K\left(\frac{X_i - x}{h}\right) \tag{6}$$

where K is the nuclear density, N is the number of observations, h is the bandwidth, X_i is the independent and identically distributed observations, and x is the average value. Kernel density is a weighting function and usually needs to meet the following conditions:

$$\begin{cases} \lim_{x \to \infty} K(x) \cdot x = 0 \\ K(x) \geq 0 \quad \int_{-\infty}^{+\infty} K(x)dx = 1 \\ \sup K(x) < +\infty \quad \int_{-\infty}^{+\infty} K^2(x)dx < +\infty \end{cases} \tag{7}$$

We use the Gaussian kernel function to estimate the dynamic distribution of inclusive green growth.

3.2.2. Dagum Gini Coefficient

Because the Dagum Gini coefficient reflects the contribution and source of regional variation, and effectively solves the cross-overlap within data, we use it to indicate the relative differences in inclusive green growth.

Specifically, relative differences between regions in inclusive green growth are estimated and decomposed to reveal the composition and source of differences.

3.3. Convergence Test
3.3.1. Alpha Convergence

The alpha convergence model tests the divergence of regional inclusive green growth from the overall average. An alpha convergence can be illustrated as a decreasing discretion of regional inclusive green growth over time. The calculation formula is:

$$\sigma_t = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\ln S_{it} - \frac{1}{n}\sum_{i=1}^{n}\ln S_{it})^2} \tag{8}$$

where t represents the year; n is the number of cities; i is the city; $\ln S_{it}$ is the logarithmic value of the inclusive green growth level in the city i in year t; and σ_t is the convergence test coefficient of the inclusive green growth level in year t. If $\sigma_{t+1} < \sigma_t$, the regional inclusive green growth level has converged.

3.3.2. Beta Convergence

Beta convergence is met when regions start with lower inclusive green growth levels but are growing rapidly and catching up with the higher areas. The gap gradually narrows and finally becomes steady. If areas share similar characteristics of factors other than inclusive green growth, such as human resources, innovations, and capital, it is a case of conditional convergence; otherwise, it is absolute convergence. The model for absolute beta convergence is:

$$\ln(\frac{S_{it+1}}{S_{it}}) = \alpha + \beta \ln(S_{it}) + \varepsilon_{it} \tag{9}$$

where i represents the city; t represents the year; S_{it+1} and S_{it} respectively represent the inclusive green growth level of the ith city in the period $t + 1$, and t $\frac{S_{it+1}}{S_{it}}$ represents the annual growth rate of the inclusive green growth level of city i from t to $t + 1$. α, β and ε_{it} respectively represent the constant term, the convergence coefficient, and the error term. If $\beta < 0$ and the significance test is passed, there is absolute beta convergence in the inclusive green growth level; otherwise, it indicates that there is no beta convergence; that is, the inclusive green growth level between regions tends to diverge. In addition, the conditional beta convergence model can be expressed as:

$$\ln(\frac{S_{it+1}}{S_{it}}) = \alpha + \beta \ln(S_{it}) + \delta \ln X_{it+1} + \varepsilon_{it} \tag{10}$$

where δ is the coefficient matrix, and X is the control variable matrix.

3.4. Data

We used the data of 58 cities in the Yangtze River basin, which were retrieved from *China City Statistical Yearbook* and *China Statistical Yearbook*. The missing data are filled in by interpolation.

4. Result

4.1. Inclusive Green Growth

Table 1 reports the statistical characteristics of the inclusive green growth of three city clusters in the Yangtze River basin. The mean of all cities from 2004 to 2017 was 0.3350, and the standard deviation was 0.2144. The minimum was 0.0939 in Neijiang in 2004 and the maximum was 1.4964 in Shanghai in 2017. Three of top five cities are in the Yangtze River delta, and the rest are in the Chengyu region. The mean of the central region and that of the Chengyu region are close, and both are lower than that of the Yangtze River Delta megalopolis. Compared with the other two regions, the growth of the Central region is relatively weak.

Table 1. Descriptive statistics of inclusive green growth in the Yangtze River basin.

Region	Mean	SD	Min. (City/Time)	Max. (City/Time)
The whole Yangtze River basin	0.3350	0.2144	0.0939 (Neijing/2004)	1.4964 (Shanghai/2017)
The Yangtze River delta	0.5083	0.2542	0.1834 (Zhoushan/2004)	1.4964 (Shanghai/2017)
The central region	0.2718	0.1178	0.1181 (Jinzhou/2005)	0.8930 (Wuhan/2016)
The Chengyu region	0.2644	0.1958	0.0939 (Neijing/2004)	1.1214 (Chongqing/2014)

In 2004, the top five cities were Shanghai, Chongqing, Hangzhou, Suzhou, and Chengdu, where the growth was 9.60, 5.15, 4.85, 4.59, and 4.51 times as much as in Neijiang, the last city. In 2017, the top 5 cities were Shanghai, Chongqing, Hangzhou, Suzhou, and Chengdu, where the growth was 6.60, 4.91, 4.45, 4.38 and 4.04 times as much as in Neijiang, indicating that the gap between developed cities and less developing cities is narrowing.

4.2. Spatial Distribution

4.2.1. Spatial Distribution

Figure 2a depicts the spatial distribution and dynamic evolution of inclusive green growth in the Yangtze River basin. The center and distribution interval gradually shift to the right, and the peak and curve width are decreasing, indicating that the inclusive green growth of the whole Yangtze River Basin is increasing, but the absolute difference is expanding. The distribution shows a clear tail in the right, and its distribution extension shows a trend of widening towards the right, implying that the gap between the higher growth cities and the average is widening. The overall inclusive green growth level of the Yangtze River basin has improved significantly, as it shows weakening polarization. However, due to differences in economy, population density, and resources, the gap between lower-growth cities and higher-growth cities still exists in the short term, and is likely to widen over time.
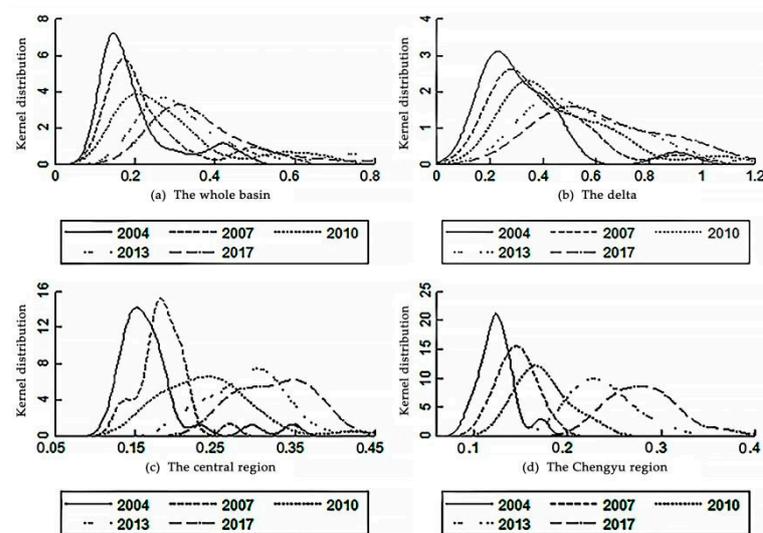
Figure 2. Distribution of inclusive green growth in city clusters in the Yangtze River basin.

Figure 2b–d describe the dynamic distribution of inclusive green growth levels in the Yangtze River delta, the central region, and the Chengyu region, respectively.

Firstly, all city clusters show a right-shifting trend in the kernel density curve, indicating that inclusive green growth in the three regions is increasing.

Secondly, in terms of distribution pattern, the main peak in the distribution curve of the Yangtze River delta and Chengyu region decreases significantly, and the curve becomes wider, showing an expanding absolute difference and a larger discretion. The central region shows the trend of decreasing height and widening width in the main peak, revealing a greater absolute difference within the region.

Thirdly, in terms of distribution malleability, the Yangtze River delta shows a trend of rightward widening, suggesting that cities with higher growth are growing and diverging from the average rapidly. The left-hand tail of the central region indicates a larger gap between lower-growth cities and the average. The tail of the Chengyu region is wider, indicating that the differences within the region are widening.

Finally, in terms of polarization, the twin peaks in the Yangtze River delta and the Chengyu region become a single peak, and the right-hand peak has gradually leveled off, indicating that there is no trend of bipolarity or multipolarity. In the central region, multiple peaks turn into a single peak, then become twin peaks, showing multipolarity.

The above results show that, concerning inclusive green growth, all city clusters in the Yangtze River basin show a clear upward trend and no polarization, except for the central region. Imbalance is significant within regions.

4.2.2. Regional Disparities Measurement and Decomposition

In order to measure and decompose the relative difference of inclusive green growth in the city clusters in the Yangtze River basin, we used the Dagum Gini coefficient.

The Gini coefficients of inclusive green growth in the Yangtze River basin and three city clusters are shown in Figure 3. The difference between the Yangtze River basin, the Chengyu region, and the Yangtze River delta shows a slight decrease, while that within the central region is stable.
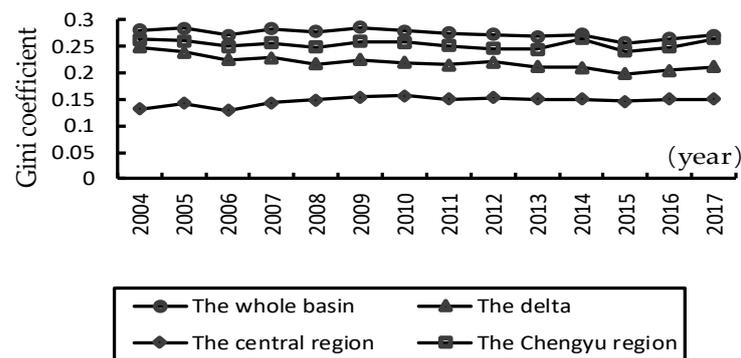
Figure 3. Gini coefficient within regions.

In terms of the magnitude of the differences, the difference within the Yangtze River basin is the largest, followed by the Chengyu region, the Yangtze River delta, and the central region.

The differences between regions is shown in Figure 4. The differences between the Yangtze River delta and other regions are large and stable, but they show a clear downward trend. The gap between the Chengyu region and the Yangtze River delta is decreasing at the fastest speed, while the gap between the central region and the Yangtze River delta is reducing slowly, implying that even though the Chengyu region started with a relatively low level of inclusive green growth, it is growing significantly, and will eventually catch up with the Yangtze River delta.
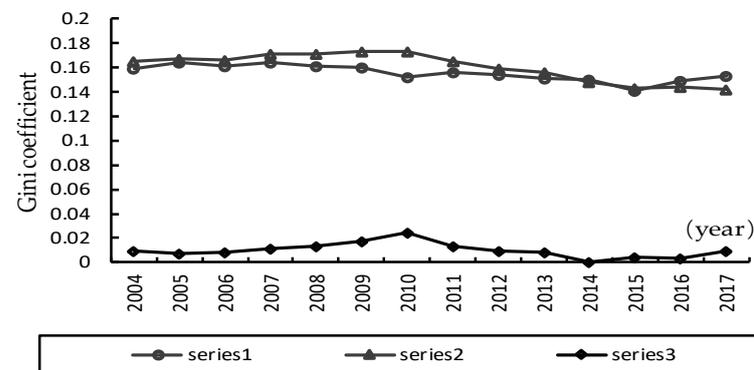
Figure 4. Gini coefficient between regions. Series 1 is the difference between the central region and the Yangtze River delta, series 2 is the difference between the Chengyu region and the Yangtze River delta, and series 3 is the difference between the Chengyu region and the central region.

The contribution to the regional difference in inclusive green growth is shown in Figure 5. The contributions of the differences between regions and that of the intensity of transvariation are negatively related and fluctuating, while that of differences within regions is stable. Differences between regions contributed to 50~56% of the overall differences, differences between regions made up 22~23%, and the intensity of transvariation made a contribution of 19~26%.
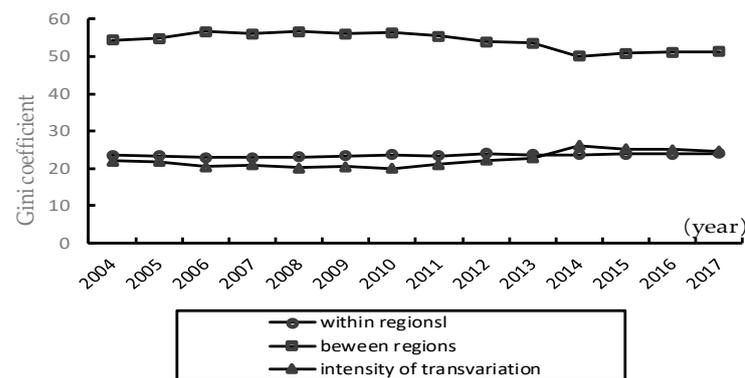
Figure 5. The contribution to the differences in the inclusive green growth.

4.3. Convergence Test

The previous analysis implicitly suggests that regional differences in the inclusive green growth in the Yangtze River basin are narrowing. We further conduct alpha convergence and beta convergence tests to verify this conclusion.

4.3.1. Alpha Convergence Test

According to Table 2, the inclusive green growth in the Yangtze River basin is converging at the fastest speed, followed by that in the Yangtze River delta and that in the Chengyu region. The convergence coefficient of the inclusive green growth in the central region is increasing, and there is no convergence, which is consistent with previous analysis.

Table 2. The alpha convergence of inclusive green growth.

Year	The Whole Basin	The Delta	The Central Region	The Chengyu Region
2004	0.4600	0.4182	0.2350	0.4502
2005	0.4673	0.4052	0.2518	0.4502
2006	0.4497	0.3833	0.2317	0.4288
2007	0.4688	0.3898	0.2624	0.4395
2008	0.4618	0.3728	0.2650	0.4287
2009	0.4733	0.3862	0.2770	0.4426
2010	0.4662	0.3754	0.2752	0.4396
2011	0.4557	0.3686	0.2648	0.4307
2012	0.4511	0.3755	0.2697	0.4262
2013	0.4455	0.3601	0.2701	0.4225
2014	0.4501	0.3566	0.2667	0.4547
2015	0.4274	0.3391	0.2590	0.4265
2016	0.4385	0.3508	0.2668	0.4349
2017	0.4490	0.3615	0.2688	0.4554

4.3.2. Absolute Beta Convergence Test

We conducted an absolute beta convergence test to forecast the trend in inclusive green growth in the long term, and the results are reported in Table 3. Concerning the whole Yangtze River basin, there is an absolute beta convergence showing that difference within the basin is decreasing regardless of the control variables. The inclusive green growth in the Yangtze River delta is showing convergence at the fastest speed, followed by that in the central region and that in the Chengyu region.

Table 3. The absolute beta convergence of inclusive green growth.

Variable	The Whole Basin	The Delta	The Central Region	The Chengyu Region
B	−0.0638 ***	−0.0783 ***	−0.0699 ***	−0.0460 ***
	(−7.86)	(−4.47)	(−6.00)	(−3.05)
intercept	−0.0223 **	−0.0205	−0.0318 **	−0.0076
	(−2.12)	(−1.12)	(−2.12)	(−0.33)
R^2	0.0817	0.1002	0.1039	0.0464
F value	61.8350	19.9391	36.0431	9.2859

Note: ***, **, and * denote significance at the 0.01, 0.05, and 0.1 levels, respectively. T-values are in parentheses.

4.3.3. Conditional Beta Convergence Test

We took related variables that may affect inclusive green growth into consideration, and conducted a conditional convergence test. The variables we used include human resources, international trade, and technological innovations, the statistical features of which are represented in Table 4.

Table 4. Descriptive statistics of control variables.

Variable	Symbol	Observation	Mean	SD	Max.	Min.
Human capital	hum	754	195.6011	248.6131	1.8904	1270.4240
International trade	open	754	0.0067	0.0060	0.00003	0.0324
Innovation	tech	754	12.9933	41.3515	0.0200	541.3300

According to Table 5, whether control variables are added or not, the inclusive green growth in all city clusters is converging, among which that in the Yangtze River delta is converging at the fastest speed, followed by that in the Chengyu region and that in the central region.

Table 5. The conditional beta convergence of inclusive green growth.

Variable	The Whole Basin	The Delta	The Central Region	The Chengyu Region
B	−0.1776 ***	−0.3588 ***	−0.1448 ***	−0.2424 ***
	(−7.67)	(−6.29)	(−4.19)	(−4.53)
lnhum	0.0437 ***	−0.0044	0.0425 ***	0.0377 ***
	(4.62)	(−0.16)	(2.70)	(2.78)
lnopen	0.0041	0.0092	−0.0180 **	0.0126 **
	(0.94)	(0.68)	(−2.70)	(2.17)
lntech	0.0221 ***	0.0603 ***	0.0054	0.0484 ***
	(3.89)	(4.73)	(0.60)	(3.07)
intercept	−0.3600 ***	−0.3760 **	−0.4228 ***	−0.3623 ***
	(−5.46)	(−2.39)	(−3.82)	(−3.45)
R^2	0.1346	0.2117	0.1394	0.1579
F value	26.8490	12.6206	12.4757	8.8104

Note: ***, **, and * denote significance at the 0.01, 0.05, and 0.1 levels, respectively. T-values are in parentheses.

In addition, human resources significantly reduce the differences within the whole Yangtze River basin, as well as in the central region and the Chengyu region. Technological innovations are effective in narrowing the differences within the whole Yangtze River basin, the Yangtze River delta, and the Chengyu region. International trade is beneficial to accelerating the convergence in the Chengyu region, while it hurts that in the central region.

5. Discussion

This study differs from other studies in four ways: Firstly, we not only calculated the inclusive green growth of the Yangtze River basin, but also made comparisons and predictions regarding absolute and relative differences between city clusters. Most of the related studies have focused on differences within cities [18], whereas few have highlighted the impact of regional disparities. Among the studies considering the regional differences in inclusive green growth, most examined the convergence, with the homogeneity-related assumption that all cities are the same in factors other than inclusive green growth [23]. We aimed to address these gaps by conducting both absolute and conditional beta convergence tests.

Secondly, we looked deep into the imbalance within a city cluster and evaluated its contribution to overall imbalance. Studies considering inclusive green growth mostly examine gaps between regions or provinces [14,21]. Even for those considering internal imbalance, interactions between city clusters and the imbalance of the whole basin are neglected. We measured relative differences both within and between city clusters, and revealed the contribution of the former to the latter.

Thirdly, we employed kernel density distribution and the Dagum Gini coefficient to analyze and trace the regional differences in inclusive green growth in the Yangtze River basin. The most conventional models are the entropy method [16], the entropy TOPSIS analysis method [17] and slack-based measure [18,23], which ignore interactions between cities and fails to identify the contributions of differences within cities. To compensate for such shortcomings, we adopted the kernel density distribution to derive the dynamic distribution of the absolute difference, which was assessed and decomposed with the Dagum Gini coefficient. The results we derived are more comprehensive and of more practical significance.

Finally, we found that the Yangtze river basin has obvious alpha convergence characteristics overall, as well as in the upstream and downstream, which differs from the research of Chen et al. [23], who claimed that no alpha convergence could be found in the upstream. The explanation for the divergence is that we have included more indexes for social equality in our evaluation system, such as education, medical services and insurance, which are funded by the central government. As such, these indexes are more likely to be balanced between cities than the economy, and such an inclusion finally result in an alpha convergence. We also found some agreement with Chen et al. [23], on the basis that absolute beta convergence characteristics are present in all regions.

6. Conclusions

In this paper, we measured the inclusive green growth of major city clusters in the Yangtze River basin, and analyzed regional disparities and their convergences. We used a fixed-base range entropy weight method to assess the weights of indicators. Then, we applied kernel distribution to describe the spatial distribution, and calculated the Dagum Gini coefficient, which reflects the regional differences. Finally, we conducted alpha and beta convergence tests to support our conclusions.

We found that inclusive green growth in the three city clusters is steadily increasing, and that in the Yangtze River delta is the highest, followed by the central region and the Chengyu region. The Yangtze River delta is the leading region regarding growth rate, followed by the Chengyu region and the central region. The Chengyu region shows great potential, but there is significant imbalance within the region. Differences between regions make the biggest contributions to the overall difference. All regions have met the condition of alpha and beta convergence, with the exception that there is no evidence of alpha convergence in the central region. Differences between regions are decreasing, but will exist for a long time.

At present, the gap between the eastern, central and western regions still exists, and that within regions also exists. Although it is currently impossible to achieve fully balanced

development, the process is indispensable. Our findings offer practical policy implications in response to unbalanced development.

Firstly, the central and western regions are still in the stage of rapid urbanization, with a large population and great potential for consumption. It is necessary to adapt to the rapid growth of e-commerce, mobile payments, and other internet applications, and make use of the new means to stimulate consumption while providing an impetus for sustained growth during consumption.

Secondly, the central and western regions should accelerate industrial upgrading and structural adjustment, and seize the opportunities raised by the digital economy. Specifically, local governments should take advantage of rich resource endowment, formulate targeted and differentiated regional policies, and finally catch up with developed regions.

Thirdly, closer cooperation between regions, including guiding the flow of capital, technology, talents and other elements from the east to the central and western regions, should be conducted. Centralized development within regions should be broken up.

Due to limited space, this study has not considered specific analyses of economical, ecological and social inequality between the three city clusters, and this will be the focus of extensive future research.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su132111651/s1. Statistics summary of data provided in Table S1.

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