Original Paper

Characteristics of the Evolution of China's Regional Economic Differences Based on the Perspective of Urban Agglomerations

Shichao Li[1] & Deyou Meng[1*]

[1] College of Resources and Environment, Henan University of Economics and Law, Zhengzhou, China

Abstract

Urban agglomerations are becoming an important spatial carrier for China's industrialisation and new-type urbanisation, and an important engine to drive the national economic development, and regional economic differences based on urban agglomerations have also become a new feature of China's regional differences in the new period. Based on the urban agglomeration perspective, we quantitatively measure China's regional economic differences from 2001 to 2020 through the two-stage nested decomposition method of the Theil Index, and analyse the evolutionary characteristics of the economic differences within the 19 urban agglomerations in the country by decomposing them into four major regions: East, Central, West and Northeast, and the differences between the urban agglomerations within the regions and the economic differences within the urban agglomerations. The study found that: (1) Overall the overall differences of the region with urban agglomerations as the core were gradually shrinking. In terms of the trend of changes in the differences at all levels, the economic differences between regions and within urban agglomerations were significantly reduced, and the changes in the economic differences between urban agglomerations were not obvious. In terms of contribution rate, the contribution rate of intra-urban agglomeration differences had always remained at a high level, reaching about half of the overall economic differences in the country, and was the primary contributing factor to the overall economic differences. (2) In terms of absolute differences, the economic differences among urban agglomerations in the four regions showed a clear pattern of "East > West > Central ≈ Northeast". (3) The intra-cluster economic differences of each urban agglomeration in 20 years were at different levels and showed a differentiated trend of evolution, and the areas with relatively more prominent intra-cluster economic differences were the Pearl River Delta urban agglomeration in the east, and the Lan-xi urban agglomeration and the North Slope of Tianshan Mountain urban agglomeration in the northwestern region. The economic differences of urban agglomerations are the result of a variety of factors, and the reasons for the formation of regional economic differences are analysed from the factors of economic

location, national regional development policies, human resource factors and high-speed traffic differences within the urban agglomerations.

Keywords

urban agglomeration, Theil index, economic differences

1. Introduction

Regional differences exist significantly at different spatial scales, whether analysed at the national or regional geospatial level, and have therefore long been one of the major themes of research in human and economic geography. Social, cultural, economic and environmental differences in different regions have a direct impact on the development and prosperity of different regions. An in-depth study of regional differences can provide a basis and reference for understanding the development status and trends of different regions, formulating corresponding development strategies and policies, promoting balanced regional development and enhancing economic efficiency. In addition, the study of regional differences can also reveal the links and interactions between different regions and provide an important reference for promoting regional integration and development.

Currently, scholars' research on regional disparities focuses on the use of different methods of measuring regional disparities for different scales of geographical units, and empirical analyses of the process and appearance of the expansion of regional disparities to study the changes in China's regional disparities on both the spatial and temporal scales. On the research scale, it is mainly manifested in the eight comprehensive economic zones (Yao & Wang, 2023; Wang, Jiao, & Jiang, 2021), four major plates (Xu & Zhang, 2021; Dong & Chi, 2020), three major zones (Xu, Liu, & Feng, 2023; Zhang, et al., 2015), North-South Difference (Zhao & Liu, 2023; Sheng & Zhang, 2021) the Yellow River Basin (Zhou et al., 2016; Zhang & Zhang, 2020) Yangtze River Economic Belt (Chao et al., n.d.) single or multiple Urban agglomerations (Wang, 2018; Si & Wang, 2021) and other provinces, cities, counties as the basic unit of a variety of scales, the scope of the study is more and more extensive, the research scale gradually tends to be smaller. In terms of research methods, there are more methods to measure regional economic differences and their evolutionary characteristics, and scholars have widely used traditional statistical methods such as coefficient of variation, Gini coefficient, Theil index, factor analysis, etc. These methods usually select GDP or GDP per capita, etc., as evaluation indexes, and then decompose them by using the characteristics of some of these indexes, expanding to the use of time series analysis to analyse the economic growth on time series Convergence and the use of ESDA spatial statistical analysis to analyse spatial interactions and spatial heterogeneity, as well as the introduction of Markov chains and spatial Markov chains to detect the dynamics of the evolution of regional economic differences (Chen & Zhu, 2012; Jiang et al., 2020; Feng, Zeng, & Cui, 2015; Che & Zhu, 2013). In addition, more and more attention is paid to the diversification of spatial statistical methods, multi-scale comparative studies, and to the influence of spatial dependence, heterogeneity and scale effects. In summary, in the perspective of urban agglomerations, the research on regional disparities mainly focuses on individual urban

131

agglomerations, and a few scholars have explored economic differences among urban agglomerations, which is not conducive to the exploration of the general regularity of economic differences in urban agglomerations as a whole.

In the transition period of China's rapid economic development, many new features of regional differences have appeared, among which the regional economic differences from the perspective of urban agglomerations is a very obvious new feature. Therefore, the multi-spatial scale analysis of China's regional economic differences with urban agglomerations as the main body has become an important research direction in humanistic economic geography. Urban agglomeration is an important carrier of industrialisation, urbanisation and economic development in China, and its integration and development is of strategic importance for cultivating new growth poles for national economic development and promoting the economy to achieve stable growth and structural adjustment. However, there is still a large gap in the level of regional development in China, and the phenomenon of regional differentiation is more prominent, so reducing the regional economic development gap has become the core objective of achieving coordinated regional development, and it is necessary to explore more about the regional economic differences of urban agglomerations under the vision of scale reconstruction.

In order to explore the extent of economic growth differences between and within urban agglomerations in China, and how much of the total differences are caused by differences between urban agglomerations, and how much of the total differences are caused by internal differences within urban agglomerations, this paper is based on the urban agglomeration perspective city scale, and targets the nineteen urban agglomerations explicitly proposed in the National 13th Five-Year Plan, and makes use of the 2001-2020 regional GDP and population data to decompose the Theil index, and further analyse the differences between urban agglomerations, the differences within urban agglomerations, and the degree of their contribution to the overall regional differences, in order to reveal the size of the differences in the economic development of the urban agglomerations, the evolution of the law, in order to promote the coordinated development of the regional economy to provide strong support.

2. Study Area, Methodology and Data Sources

2.1 Study Area

For a long time, China's urbanisation process has been developing rapidly, and according to data from the National Bureau of Statistics, the urbanisation rate of the resident population will reach 65.22% by the end of 2022. urban agglomerations are an important organisational basis and regional spatial pattern formed after the process of urbanisation has entered into an advanced stage, with increased spatial roles between cities and close linkage mechanisms (Army., 2021). Urban agglomerations Since the 11th Five-Year Plan, when the urban agglomeration strategy was first proposed, the influence of the urban agglomeration development strategy has become more and more significant, along with the continuous increase of China's urbanisation level and the evolution of the spatial pattern of urbanisation. In 2016, the pace of urban agglomeration construction was further accelerated, and the 13th Five-Year Plan clearly

proposed the construction of 19 urban agglomerations, and the focus of urban agglomeration development also shifted from the regionally concentrated development mode dominated by the three major urban agglomerations of Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta to the coordinated development mode of the 19 major urban agglomerations. The focus of urban agglomeration development has also shifted from the centralised regional development mode dominated by the three major urban agglomerations of Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta to the coordinated development mode of 19 major urban agglomerations. The "two horizontal and three vertical" strategic pattern linked by the 19 urban agglomerations covers almost all the key nodes of future development, and the urban agglomerations will gradually play the role of strategic support and growth poles in the national productivity layout. Accordingly, this paper is based on these 19 urban agglomerations.

As of June 2023, the State Council has successively approved the Development Plan for urban agglomerations in the Middle Reaches of the Yangtze River, the Development Plan for Chengdu-Chongqing urban agglomeration, the Development Plan for the Yangtze River Delta urban agglomeration, the Development Plan for the Haerbin-changchun urban agglomeration, the Development Plan for the Central Plains urban agglomeration, the Development Plan for the Beibu-Gulf urban agglomeration, the Development Plan for the Hu-Bao-E-Yu urban agglomeration, the Development Plan for the Lanzhou-Xinning urban agglomeration and the Development Plan for the Guanzhong Plain urban agglomeration. "Guangdong-Hong Kong-Macao Greater Bay Area Development Plan," "Central Yunnan urban agglomeration Development Plan," while the Guizhou Provincial People's Government approved the "Qianzhong urban agglomeration Development Plan" in December 2016, and the Shandong Provincial People's Government approved the "Shandong Peninsula urban agglomeration Development Plan" in January 2017 (Zeng et al., 2023). Since relevant studies at home and abroad have different definitions of the concept and spatial scope of urban agglomerations, the scope of the urban agglomerations selected in this paper is firstly based on the State Council and the regional governments' approvals and announcements, and if there is not yet an official and clear scope, we will refer to the book of "China's urban Agglomerations Development Report" written by Chuanglin Fang scholars in 2016, which is based on the 13th Five-Year Plan's 19 urban agglomerations of 213 prefectures, autonomous regions, states and zones as the object of the study, and classified into four major regions according to the "quadratic method", i.e., the eastern region, the central region, the western region, and the northeastern region.

Due to the long time span, the administrative divisions of the national prefecture-level units have not small changes, this paper always adopts the 2020 administrative division to correct the previous data, Xiantao, Qianjiang, Tianmen, Jiyuan and other cities are not included in the scope of this paper's study of urban agglomerations. A comprehensive understanding of the current status of economic development of different urban agglomerations and their geographical differences can help to eliminate barriers to resource flows, optimise administrative division settings and resource allocation, enhance the

comprehensive carrying capacity of the central city, strengthen the role of radiation-driven regional development, and promote high-quality and synergistic development of various urban agglomerations.

2.2 Data Sources

This paper takes the 19 urban agglomerations 213 prefecture-level cities, autonomous regions, states and autonomous prefectures as the basic research unit, and analyses the evolution of regional economic differences across the country using GDP and population data for each city from 2001 to 2020. A total of 124 non-urban agglomeration prefectures, autonomous regions, states and prefectures are involved for comparative analyses between urban agglomerations and non-urban agglomerations. Hong Kong SAR, Macau SAR and Taiwan Province are not included in this study. The data on GDP and total population of prefecture-level units in this paper are mainly obtained from the China urban Statistical Yearbook, some prefecture-level city yearbooks, and some statistical bulletins on national economic and social development of prefecture-level units in each year. The GDP and total population of each urban agglomeration and the four regions are calculated based on the sum and average of the data of each prefecture-level administrative unit. Missing data values for individual years for some cities were supplemented by linear interpolation.

2.3 Research Methodology

The Theil index can be used to measure differences in the level of economic development between regions, with the great advantage of being able to measure the contribution of intra-group disparities and inter-group disparities to the total disparities (Zhang et al., 2018). The most important advantage is that it can measure the contribution of intra-group disparities and inter-group disparities to the total disparities. The first-order decomposition of the Theil index has been widely studied, but relatively little has been done to explore the second-order decomposition of the Theil index. The Theil index includes two decomposition indicators (T and L), the difference between the two is that the Theil index T is weighted by the proportion of GDP, and the Theil index L is weighted by the proportion of the population, and the Theil index T indicator is mostly used in general studies. Therefore, the decomposition in this paper is carried out by the Theil index T indicator, which is calculated by the formula:

$$T = \sum_{i=1}^{N} y_i log \frac{y_i}{p_i} \qquad (1)$$

where N is the number of regions, y_i is the share of region i's GDP in the country, and p_i is the share of region i's population in the country. The larger the value of the Theil index T, the greater the difference in the level of economic development between regions; conversely, the smaller it is.

Over time, the trend of differentiation between urban agglomerations and non-urban agglomerations, and between urban agglomerations and urban agglomerations has been intensifying, and this differentiation runs through the three spatial scales of macro, meso and micro, resulting in the imbalance of regional development manifesting itself in the nesting of different spatial scales. Through a one-stage decomposition of the Theil index, we can decompose the overall national disparities into the disparities among the four major regions of the east, centre, west and north-east, as well as the disparities among

134

the urban agglomerations within the four major regions, so as to realise a comprehensive assessment of the disparities in economic development across the country, which is computed by the following formula.

$$T_d = T_{BR} + T_{WR} = \sum_{i=1}^{4} y_i \log \frac{yi}{pi} + \sum_{i=1}^{4} y_i \left[\sum_j y_{ij} \log \frac{y_{ij}}{p_{ij}} \right] \tag{2}$$

A two-stage nested decomposition of the Theil index allows for the decomposition of regional differences in the country as a whole into differences within urban agglomerations (T_{WP}), differences between urban agglomerations (T_{BP}) and differences between regions (T_{BR}). The specific decomposition process is as follows.

$$T_d = \sum_i \sum_j \sum_k \left(\frac{\gamma_{ijk}}{Y} \right) \log \left(\frac{\gamma_{ijk}/Y}{p_{ijk}/P} \right) \tag{3}$$

Define the variance within region i as T_{di}.

$$T_{di} = \sum_j \left(\frac{y_{ij}}{y_i} \right) \log \left(\frac{y_{ij}/y_i}{p_{ij}/p_i} \right) \tag{4}$$

$$T_{ij} = \sum_k \left(\frac{y_{ijk}}{y_{ij}} \right) \log \left(\frac{y_{ijk}/y_{ij}}{p_{ijk}/p_{ij}} \right) \tag{5}$$

Then T_d can be further decomposed as.

$$
\begin{aligned}
T_i &= \sum_i \left(\frac{y_i}{Y} \right) \left[\sum_j \left(\frac{y_{ij}}{y_i} \right) T_{ij} + T_{di} \right] + \sum_i \left(\frac{y_i}{Y} \right) \log \left(\frac{y_i/Y}{p_i/P} \right) \\
&= \sum_i \sum_j \left(\frac{y_{ij}}{Y} \right) T_{ij} + \sum_i \left(\frac{y_i}{Y} \right) T_{di} + \sum_i \left(\frac{y_i}{Y} \right) \log \left(\frac{y_i/Y}{p_i/P} \right) \\
&= T_{WP} + T_{BP} + T_{BR}
\end{aligned}
\tag{6}
$$

where y_{ijk} is the GDP of the kth municipality of the jth urban agglomeration in region i, Y is the sum of the GDP of the 19 urban agglomerations, p_{ijk} is the population of the kth municipality of the jth urban agglomeration in region i, P is the total population of the 19 urban agglomerations; T_{WP} is the intra-agglomeration variance, T_{BP} is the inter-agglomeration variance, and T_{BR} is the inter-regional variance.

3. Result

3.1 Comparison of the Economic and Demographic Evolution of Urban Agglomerations and Non-urban Agglomerations
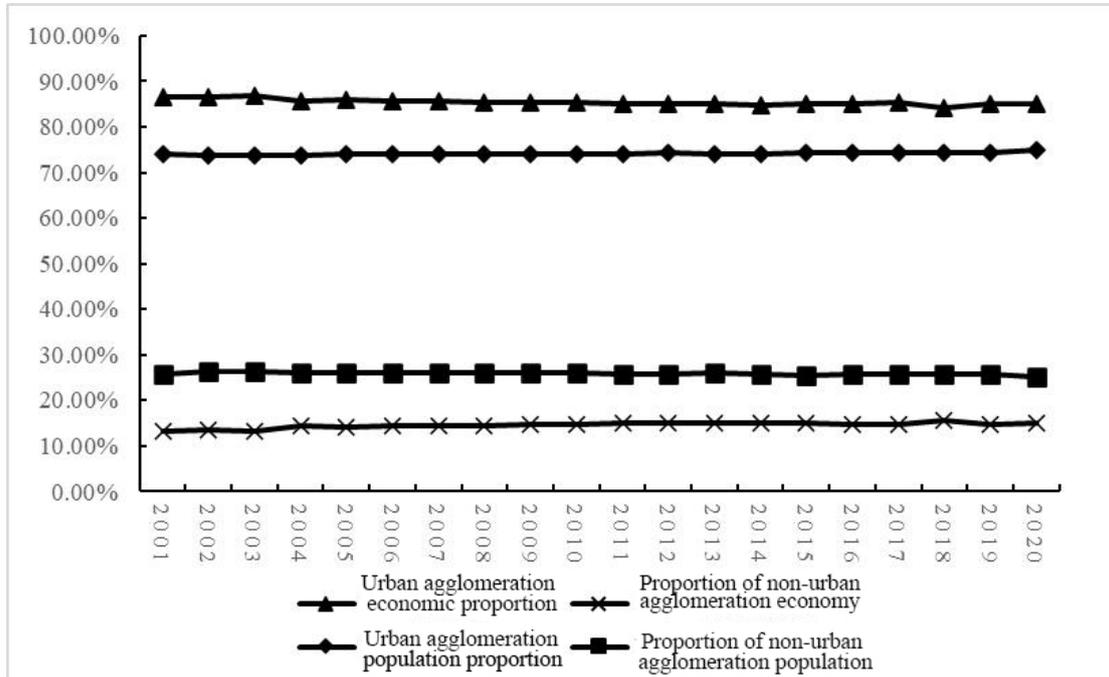
Figure 1. Economic and Demographic Evolution of Urban Agglomerations vs. Non-urban Agglomerations

Based on the economic and demographic data of 337 cities and municipalities across the country, they are divided into urban agglomeration economy and non-urban agglomeration economy, urban agglomeration population and non-urban agglomeration population according to urban agglomeration and non-urban agglomeration. From 2001 to 2020, the average ratio of urban agglomeration economy to non-urban agglomeration economy is 85.43%:14.57%, or about 8.5:1.5, and the average ratio of urban agglomeration population to non-urban agglomeration population is 74.13%:25.87%, or about 3:1. As can be seen from the change of the ratio over the 20-year period in the figure 1, both in terms of the economic ratio and population ratio, the ratio between urban agglomerations and non-urban agglomerations has been relatively stable and basically unchanged. ratio has been relatively stable and basically unchanged.

As a result of economies of scale and agglomeration, factors of production and economic activities continue to cluster in cities at the centre of urban agglomerations. This agglomeration phenomenon has led to an increase in the size and spatial extent of the population of the centre city and the urban agglomeration as a whole, thus affecting the spatial distribution of the population of the country as a whole. The dominance of the urban agglomeration economy in the national economy can be seen in the

136

fact that the 19 urban agglomerations gather about three quarters of the country's population and generate about 85% of its gross domestic product. Therefore, it is of theoretical and practical significance to carry out a multi-scale study of regional differences in urban agglomerations.

3.2 Spatial and Temporal Evolution of Regional Differences in China's Urban Agglomerations

3.2.1 Decomposition of Overall and Regional Variances
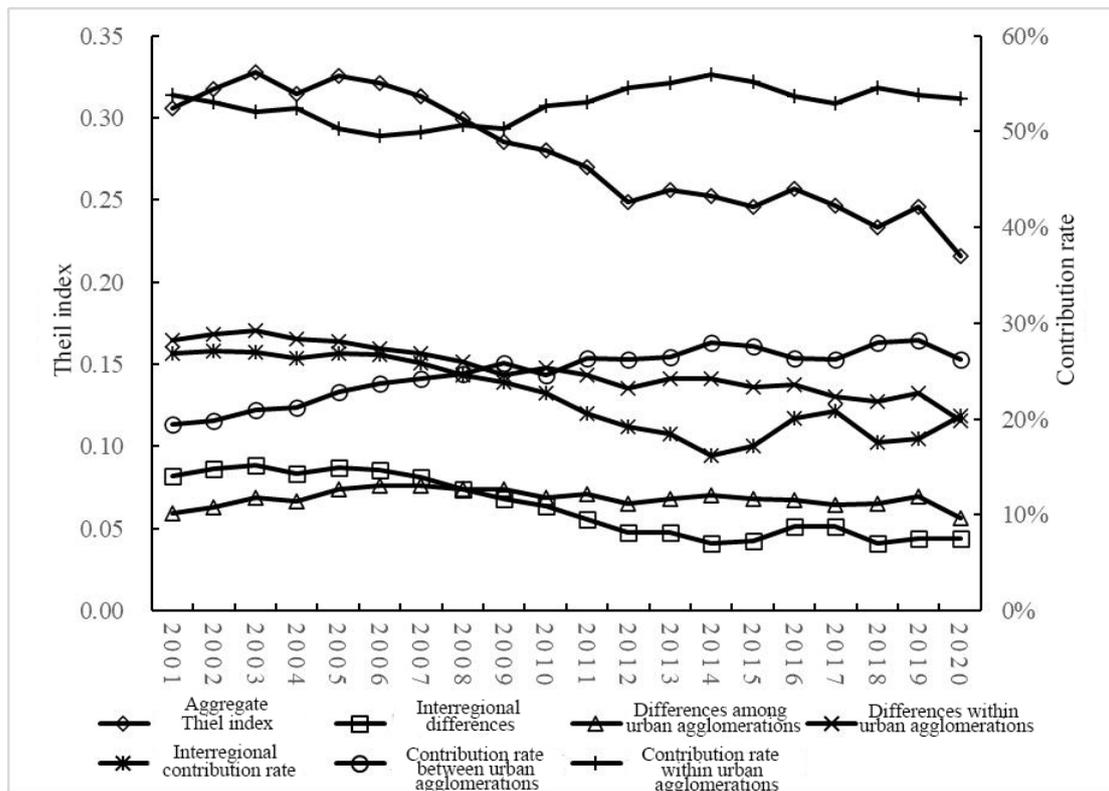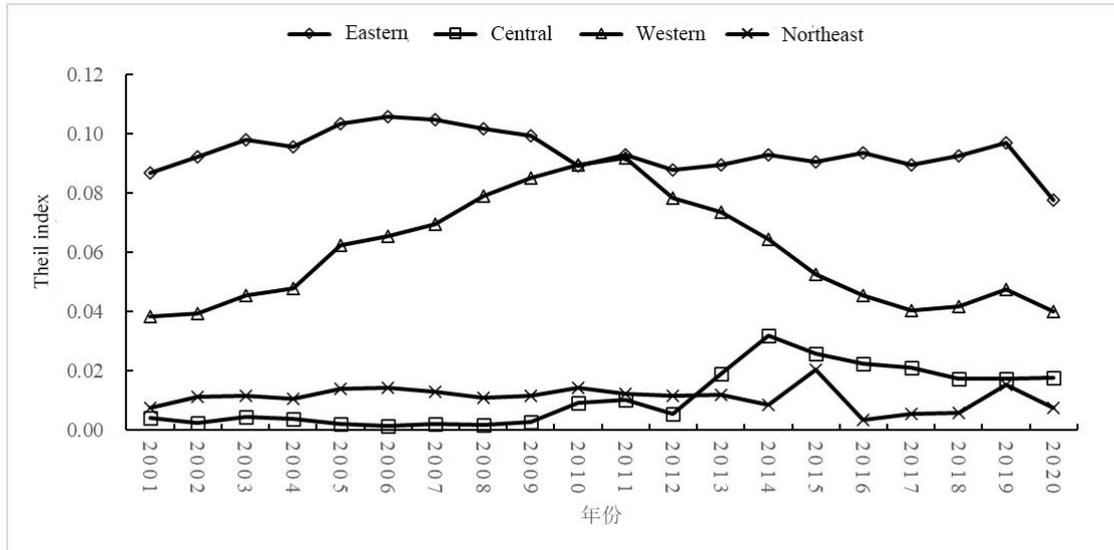

Figure 2. Economic Differences at Different Spatial Scales

Based on the 19 urban agglomerations, a two-stage nested decomposition of the Theil index is carried out, and the regional economic differences of the country are divided into three parts: differences among the four major regions of the eastern region, the central region, the western region and the northeastern region, differences among urban agglomerations and differences within urban agglomerations in the regions, and the calculated results of the Theil index are shown in Figure 2. From the decomposition results of the Theil index in 2001-2020, it could be seen that the average value of the overall differences in China's regional economy is 0.2782, and the changes in the overall differences in the Theil index are divided into two phases: the period from 2001 to 2005 was a "slight increase" phase, with an increase of 6.32%, and the period from 2005 to 2020 was a "continuous decrease" phase, with a decrease of 50.72%. The overall trend of the economic disparity Theil index is one of decline with fluctuation, indicating that the overall regional disparities in China are gradually shrinking.

137

From the point of view of the trend of changes in differences at all levels, the average values of the Theil index of interregional differences, differences between urban agglomerations and differences within urban agglomerations from 2001 to 2020 were 0.0632, 0.0684 and 0.1466, and the differences within urban agglomerations were the largest, which indicates that the smaller the spatial unit is, the greater the degree of differences in the regional economy is. Among them, at the municipal scale, the overall trend of the Theil index of the differences within the urban agglomeration showed a gradual decline, in 2020 compared with 2001, a decline of 42.50%, the differences within the urban agglomeration narrowed significantly; at the scale of the urban agglomeration, the overall changes in the overall fluctuations of the gentle fluctuation was not significant; at the regional scale, the economic differences showed a fluctuation in the trend of narrowing, in 2020 compared with 2001, the Theil index decreased by 87.51%, and on the time series change, the average value of the Theil index in the first ten years was 0.0799, and the average value of the Theil index in the second ten years was 0.0465, and the inter-regional disparity was significantly reduced. Overall, the economic differences between regions and within urban agglomerations have been significantly reduced, and the economic differences between urban agglomerations have not changed significantly.

The results of the contribution of interregional, inter-urban agglomeration and intra-urban agglomeration differences to the overall economic differences of the country are visualised in Figure 2. It can be found that half of the country's overall economic disparity come from the disparity within urban agglomerations, with an average contribution rate of 52.85% over the past 20 years, which was the primary contributing factor to the overall economic disparity, while the average contribution rates of the interregional and inter-urban agglomeration disparities over the past years were relatively close, at 22.31% and 24.84%, respectively. Analysis of the trend of change over the past 20 years (Figure 2) found that the overall fluctuation of the contribution rate of economic differences within the urban agglomeration is relatively smooth, the change is not large; the contribution rate of economic differences between the urban agglomerations shows a long-term rising trend, from 2000 to 2020, the contribution rate gradually rose by 35.19%, and the contribution to the overall differences gradually increased; the contribution rate of economic differences between regions shows a long-term decline and then some the contribution rate of inter-regional economic differences, on the other hand, shows a trend of long-term decline and then rebound, with the contribution rate decreasing by as much as 66.11% from 2001 to 2014, and then rising by 25.58% in 2020, which is a clear sign of rise. Taken together, the overall fluctuation of the contribution rate of differences within urban agglomerations is stable and always maintains a high level, the contribution rate of differences between urban agglomerations rises, the contribution rate of differences between regions declines, and the contribution rate of differences between urban agglomerations exceeds the contribution rate of differences between regions, with the two behaving in opposite ways.

3.2.2 Intra-regional Variations

Figure 3. Economic Differences between Urban Agglomerations within Regions

Intra-regional differences reflect the economic differences within each region, and the results of the calculation of the Theil index within each region are shown in Figure 3. It can be seen that from 2001 to 2020, in terms of absolute differences, the Theil indexes of the East, Central, West and Northeast regions are 0.0941, 0.0112, 0.0600 and 0.0111 respectively, and the economic differences within the four major regions showed a clear "East > West > Central ≈ Northeast" pattern of differentiated distribution. From the perspective of each region, the economic disparity within the eastern region fluctuated little on the whole except for the obvious decline in 2020, and in comparison, the economic disparity was always at a high level, and the phenomenon of unbalanced development still existed obviously. Economic differences within the central region show three phases of change: a low-level period from 2001 to 2011, with little change in the Theil index; a period of rapid expansion from 2012 to 2014, with the Theil index rising by as much as 474.30%; and a period of slow decline from 2014 to 2020, with the Theil index dropping by 80.47% over the seven-year period. The economic differences within the western region show a clear two-phase characteristic: 2001-2011 was a significant slow expansion phase, with an average increase of 12.75% in the Theil index; 2011-2020 was a significant slow reduction phase, with an average decrease of 13.03% in the Theil index, and the differences within the region were basically unchanged between 2001 and 2020. The overall fluctuation of economic differences within the north-east region was not significant, with an average value of 0.0111 for the Theil index over the 20-year period, and economic differences were always at a low level.

139

3.2.3 Differences within Urban Agglomerations
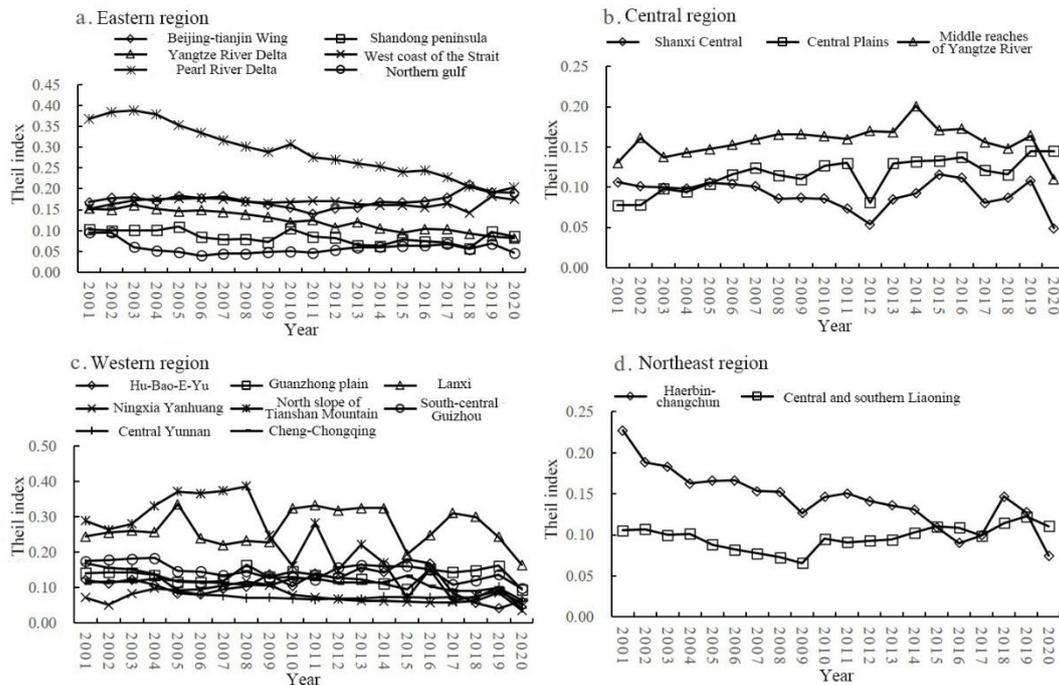
Figure 4. Differences within Urban Agglomerations in Different Regions

In order to clearly present the intra-cluster differences, the Theil Index of intra-cluster economic differences of the 19 urban agglomerations and its changes from 2001 to 2020 are shown by region, as shown in Figure 4. Overall, the intra-cluster economic differences of each urban agglomeration are at different levels in the 20-years period and show a differentiated evolutionary trend, and the relatively more prominent areas of intra-cluster economic differences are the Pearl River Delta urban agglomeration in the east and the Lan-xi urban agglomeration and the North Slope of Tianshan Mountain urban agglomeration in the northwestern region, with the mean values of the intra-cluster Theil indexes of 0.2896, 0.2670, and 0.2194, respectively, and the imbalance problem of the urban agglomerations is very obvious, but there is a decreasing trend on the whole. balance problem is obvious, but there is an overall decreasing trend.

From the perspective of the trend of the evolution of differences within the regional urban agglomerations, in the eastern region: the economic differences within the Beijing-Tianjin-Hebei urban agglomeration had not changed much, and the overall situation is relatively stable, with an average value of the Theil index of 0.1723, and the differences within the urban agglomeration reached a minimum in 2011 and then slightly expanded; the economic differences within the Shandong Peninsula urban agglomeration have changed in stages over four or five years, and the Theil index remained at the same level in the period from 2001 to 2004. In 2005-2009, 2010-2014, and 2015-2018, it showed the characteristics of a phased "sliding downward spiral"; within the Yangtze River Delta urban agglomeration, the Theil index

140

gradually declined from 0.1520 in 2001 to 0.0812 in 2020, with an average annual decline of 4.36%, and the overall differences within the urban agglomeration showed a slow and steady decline. Overall the differences within the urban agglomerations showed a slow decline; the economic differences within the Pearl River Delta urban agglomerations as a whole showed a slow decline in the characteristics of the Theil Index from 0.3681 in 2001 to 0.2036 in 2020 with an average annual decline of 4.04%, and the mean value of the Theil Index was 0.2896, with the economic differences as a whole at the highest level of the 19 urban agglomerations; the economic differences of the West coast of the Strait urban agglomeration stayed at the same level, with basically no change in the Theil index, with an average value of 0.1670; the economic disparity within the Northern gulf urban agglomeration had experienced a process of rapid decline and gradual increase, with the Theil index decreasing by 57.83% from 0.095 in 2002 to 0.0401 in 2006, and then gradually increasing to reach 0.0678 in 2017.

Central region: the economic disparity within the Shanxi Central urban agglomeration showed the characteristics of slow narrowing and then wave-like changes, with the Theil index decreasing from 0.1060 in 2001 to 0.0534 in 2012, then increasing to 0.1158 in 2015 and then decreasing to 0.0488 in 2020; the economic disparity within the urban agglomeration of the Central Plains as a whole shows the trend of slow expansion, with the Theil index rose from 0.0775 in 2001 to 0.1449 in 2020; the economic differences within the middle reaches of the Yangtze River urban agglomeration showed a trend of gradual expansion followed by gradual narrowing, with the Theil index rising slowly from 0.1032 in 2001, reaching a peak of 0.2007 in 2014, and then falling to 0.1099 in 2020.

Western region: the economic differences within the Hu-bao-E-Yu urban agglomeration had experienced three stages of slow reduction, gradual expansion in fluctuation and "L"-shaped reduction, and the Theil index fell from 0.1214 in 2001 to 0.0794 in 2006, with a decline of 34.60%, and then gradually rose in fluctuation to reach 0.1800 in 2015, and then fell sharply to 0.0411 in 2019. reached 0.1800, and then declined sharply to 0.0411 in 2019, with a decline of 77.17%; the economic differences within the Guanzhong Plain urban agglomeration did not change much, and the average value of the Theil index was 0.1317; the economic differences within the Lan-xi urban agglomeration went through the three stages of relatively low-level differences, relatively high-level differences, and wave changes, and the Theil index basically stabilised from 2001 to 2009 around 0.2517, stable at around 0.3237 in 2010-2014, and from 0.1937 in 2015 to 0.1633 in 2020, which is a wave-like change; the overall change in economic differences within the urban agglomeration along the Yellow River in Ningxia was not significant, and the average value of the Theil index was 0.0755, which maintained at a low level, with small economic differences; the changes in economic differences within the North Slope of Tianshan Mountain urban agglomeration were more obvious, first expanding to a higher level and then shrinking in fluctuation, with the Theil index rising from 0.2880 in 2001 to 0.3854 in 2008, with a growth rate of 33.82%, and then decreasing in fluctuation to 0.0561 in 2020, with a decline rate of 85.44%; the economic differences in the Guizhou Central-South urban agglomeration had fluctuated, but were in a shrinking trend on the whole; the economic differences within the Central Yunnan urban agglomeration showed a trend of

141

decreasing and then remaining stable, with the Theil index decreasing by 52.61% from 2001 to 2006, and then remaining stable at about 0.07; the economic differences within the urban agglomeration of Chengdu-Chongqing remained stable as a whole, with the average value of the Theil index at 0.1101, and the economic differences were relatively low.

Northeast region: the economic differences within the Haerbin-Changchun urban agglomeration as a whole showed a gradually narrowing trend, with the Theil index decreasing by 67.30% from 2001 to 2020; the economic differences within the central and southern of Liaoning urban agglomeration showed the characteristics of first narrowing and then expanding, with the Theil index slowly decreasing by 37.60% from 2001 to 2009, and then gradually increasing from 2009 to 2020 with the growth rate of 68.09%.

3.3 Analysis of the Causes of Variations in Regional Economic Differences

From the perspective of urban agglomerations, the factors that influence regional economic differences are wide-ranging, covering all socio-economic aspects, and they permeate different spatial dimensions while acting at different spatial scales to collectively lead to economic differences. Therefore, there are many similarities between the factors that cause economic differences at different scales, but the intensity of their effects at different spatial scales varies. In this paper, we will explore regional economic differences from the perspectives of economic location, national regional development policies, human resources and high-speed transport.

(1) Economic location is a fundamental factor in the evolution of China's regional economic patterns. Coastal areas are rich in plains, lakes and rivers, and are influenced by the sea, with relatively high rainfall and favourable natural conditions for vigorous economic development. On the contrary, the inland areas are dominated by high mountains and rivers, with relatively few plains, scanty rainfall and the Gobi Desert, thus confronting the problems of survival and environmental protection in their economic development. Because of this unique economic location, the eastern coastal region is more likely to attract a variety of factors to gather, but also earlier by the preferential support of regional development policies. It is also because of the excellent external economic location of the urban agglomerations in the eastern seaboard that they have been at the forefront of China's economic globalisation process and have become the earliest and most influential region in China to open up to the outside world.

(2) National regional development policy is an important macro-factor leading to regional economic differences. At the beginning of the reform and opening-up period, the State implemented a regional development policy of "accelerating economic growth in favour of the eastern coastal regions", which accelerated the development of urban agglomerations in the eastern coastal regions. However, this also led to a huge gap between the urban agglomerations in the eastern region and those in the central and western as well as the northeastern regions. In order to alleviate this imbalance, the state has gradually increased its assistance and investment in the central and western regions, and has successively launched the Western Development, revitalisation of the old industrial bases in the northeast, promotion of the rise of the central region, as well as the "One Belt, One Road" and the Yangtze River Economic Belt, etc.,

142

which constitute the "Four Plates These strategies constitute a strategic layout of "four major blocks" + "three support belts". An overview of the evolution of China's region-related policies reveals that the implementation of these strategies has not only eased regional disparities, but has also been closely linked to the turning point in the economic growth trend of the regions concerned, indicating that the orientation of national regional development policies has played a very important role in regional economic development.

(3) Human resource factors have a significant impact on the economic differences among urban agglomerations. urban agglomerations with higher human capital have relatively higher efficiency in resource allocation and enterprise use, thus releasing higher productivity. Over the past two decades, due to the combined effects of marketisation, industrialisation and urbanisation, large-scale population flows from economically underdeveloped regions to developed regions, and from weak urban agglomerations to strong urban agglomerations, creating a sustained tendency for population to gather in large cities and urban agglomerations. The results of the Sixth National Population Census in 2010 show that inflows of population are more concentrated in the Pearl River Delta (PRD), the Yangtze River Delta (YRD), and the Beijing-Tianjin-Hebei (BJH) metropolitan areas, and Shi Guifen et al. found in a panel model constructed with the Yangtze River Delta urban agglomeration as the object of study that for every 1% increase in population flow, the per capita GDP of the Yangtze River Delta urban agglomeration increased by 8.72% (Shi & Li, 2020). There is an obvious relative surplus of human resources in the urban agglomerations in the central and western regions, while the urban agglomerations in the northeastern region suffer from a continuous loss of population, and the population continues to cluster in the urban agglomerations in the eastern region, and the imbalance in the economic development of the urban agglomerations leads to the flow of labour to the regions with better employment opportunities, and the large-scale mobile population injects vitality into the economy of the urban agglomerations in the places of inflow and drives the growth of the consumption and financial revenue of each urban agglomerations, while also At the same time, it also widens the economic differences between the urban agglomerations.

(4) Differences in high-speed transport within urban agglomerations are an important objective factor leading to economic differences within urban agglomerations. With the increasing investment in infrastructure by the national development strategy, the transmission speed of people, logistics and information flow has been greatly accelerated, and at the same time, the pattern of economic development has also undergone significant changes. In recent years, the rapid layout of high-speed rail network in China's urban agglomerations has brought about the spatial and temporal compression effect at the regional scale, weakened the distance constraints of factors such as labour, capital and technology, and facilitated the flow and reorganization of all kinds of factors in the urban agglomerations, thus promoting the evolution of the pattern of economic differences within the urban agglomerations, which has played a great role in promoting the economic development of the urban agglomerations, but at the same time, has also exacerbated the differences of the economic development in the urban agglomerations.

4.Conclusion and Discussion

4.1 Conclusion

Along with the deepening urbanisation process in China over the past 20 years, urban agglomerations have become an indispensable component of the regional economy, and are the most active areas of the regional economy with great potential. As growth poles in the regional economy, the core position of the urban agglomeration economy is becoming more and more prominent, and the following conclusions had been reached through analysing the evolution of economic differences among the 19 urban agglomerations in the country over the past 20 years:

(1) China's overall regional economic differences were divided into two phases: the "slight increase" phase from 2001 to 2005 and the "continuous decline" phase from 2005 to 2020, with economic differences as a whole showing a downward trend in fluctuation, indicating that the overall regional disparities in China were gradually shrinking. In terms of the trend of changes in differences at all levels, the economic differences between regions and within urban agglomerations had significantly narrowed, while the economic differences between urban agglomerations have not changed significantly. In terms of contribution rate, the overall fluctuation of the contribution rate of the differences within urban agglomerations was stable and always maintains at a high level, about half of the contribution of the overall economic differences in the country originated from the differences within urban agglomerations, which was the primary contributing factor to the overall economic differences, and the average contribution rate of the differences between regions and urban agglomerations in the past years was close to each other, accounting for about one quarter of the total. The contribution rate of the differences between urban agglomerations had increased, the contribution rate of the differences between regions had decreased, and the contribution rate of the differences between urban agglomerations exceeded that between regions. The contribution of inter-city differences exceeded that of inter-regional differences, with the two behaving in opposite ways.

(2) In terms of absolute differences, the economic differences within the four regions showed a clear pattern of differentiated distribution of "East > West > Central ≈ Northeast". From the perspective of each region, the economic differences between urban agglomerations in the eastern region were always at a high level and dominate the four regions; the economic differences in the central region showed three phases of change: a low-level period from 2001 to 2011, a rapid expansion period from 2012 to 2014, and a slow reduction period from 2014 to 2020; and the economic differences in the western region show obvious two-phase characteristics: 2001-2011 was a period of significant slow expansion, and 2011-2020 was a period of significant slow narrowing. Economic differences within the North-East region as a whole fluctuate little, and economic differences were always at a low level.

(3) Overall, the intra-cluster economic differences of each urban agglomeration over the 20-years period were at different levels and showed a differentiated evolutionary trend, with relatively more prominent economic differences within the urban agglomerations manifesting themselves in the Pearl River Delta urban agglomeration in the east and the Lan-xi urban agglomeration and the North Slope of the Tianshan

144

Mountain urban agglomeration in the northwest, and the imbalance within the clusters was very obvious, but overall there was a downward trend.

(4) The economic differences between urban agglomerations are the result of a combination of factors. First, economic location is the underlying factor that constitutes the evolution of China's regional economic pattern. Secondly, national regional development policies have been continuously adjusted and optimised over the past decades, playing an important macro-control role in the formation and alleviation of regional economic differences. Once again, human resource factors have a significant impact on the economic differences of urban agglomerations. Finally, the difference in high-speed transport within urban agglomerations has a significant impact on the economic differences within urban agglomerations.

4.2 Discussion

Due to the development foundation, resource endowment and geographical conditions of each urban agglomeration are widely different, the development imbalance between urban agglomerations in each region is notable, in order to balance the development gap, the key is to balance the per capita gap within the urban agglomeration rather than the size gap between the urban agglomerations, and it is unrealistic to try to reach the average of the size of the inter-regional scale, according to the hierarchy, it is necessary to balance the inter-regional gap first and then balance the gap between urban agglomerations, and then balance the gap finally. The gap within urban agglomerations. At present, China's various urban agglomerations are at different stages of development, and most of them are still in the cultivation stage, except for the relatively mature development of the Yangtze River Delta and the Pearl River Delta. In the future, there is still a need to increase support for urban agglomerations in central and western China and the northeast, enhance transfer payments to disadvantaged urban agglomerations, remove regional barriers, and promote cross-regional factor flows. Weak interconnections between urban agglomerations need to be strengthened in terms of economic ties and industry-wide links. Within urban agglomerations, it is necessary to promote the integrated development of urban agglomerations on the basis of infrastructure networking within urban agglomerations, strengthen functional integration, enhance the radiation and bandwagon power of urban agglomerations, give play to the trickle-down effect, and narrow the gap within urban agglomerations.

In conclusion, the multi-spatial scale analysis of regional differences in urban agglomerations has important theoretical and practical value in the context of the current economic development of China. Studying the characteristics and trends of regional differences in China from the perspective of urban agglomerations can provide scientific theoretical support and practical guidance for regional economic development, urban planning and policy formulation.

References

Army. (2021). The internal logic of China's urban agglomeration strategy evolution and transformation challenges. *People's Forum*, *2021*(25), 54-58.

Chao, J. et al. (n.d.). *Evolution of Economic Differences and Influencing Factors of Three Major City Clusters in the Yangtze River Economic Belt—A Comparative Study Based on Multi-source Lighting Data*.

Chen, P. Y., & Zhu, X. G. (2012). Regional economic differences in China based on different scales. *Journal of Geography*, *67*(8), 1085-1097.

Chen, P. Y., & Zhu, X. G. (2013). Regional economic convergence in China: A spatial Markov chain analysis based on county scale. *Geoscience*, *33*(11), 1302-1308.

Dong, X. B., & Chi, R. N. (2020). Spatio-temporal evolutionary characteristics of regional economic disparities and convergence in China. *Economic Geography*, *40*(10), 11-21.

Feng, C. C., Zeng, Z. R., & Cui, N. N. (2015). Spatial and temporal evolution of regional economic disparities in China since 2000. *Geography Research*, *34*(2), 234-246.

Jiang, X. J. et al. (2020). A multi-scale and multi-mechanism study of regional economic differences in the three northeastern provinces. *Geoscience*, *40*(3), 383-392.

Sheng, B., & Zhang, Z. Y. (2021). Research on the Influencing Factors of China's North-South Economic Differentiation—Based on the Perspective of Regional Innovation Capacity Differences. *Journal of Central China Normal University* (Natural Science Edition), *55*(5), 727-740.

Shi, G. F., & Li, Z. (2020). Research on the mechanism of population mobility fuelling regional economic growth—Based on the panel data of the Yangtze River Delta urban agglomeration. *East China Economic Management*, *34*(6), 10-18.

Si, L. J., & Wang, C. Q. (2021). Regional Economic Differences, Dynamic Evolution and Convergence of China's Urban Agglomerations—A Study Based on Nighttime Lighting Data of Ten Major Urban Agglomerations. *Shanghai Economic Research*, *2021*(10), 38-52.

Wang, J. J., Jiao, Y., & Jiang, S. L. (2021). Regional differences and dynamic evolution of the direction of technological progress in eight comprehensive economic zones in China: 1978～2017. *Research on Quantitative and Technical Economics*, *38*(4), 3-21.

Wang, Y. L. (2018). Research on economic spatial differences of city cluster in Central Plains. *Regional Research and Development*, *37*(6), 12-17.

Xu, S. X., Liu, Q., & Feng, L. (2023). Characteristics and causes of spatial and temporal evolution of regional economic disparities in China. *Economic Theory and Economic Management*, *43*(4), 69-84.

Xu, X., Zhang, W. Z. (2021). China's four regional sectors: growth differences, comparative advantages and development paths in the 14th Five-Year Plan. *Economic Geography*, *41*(7), 1-9.

Yao, Y. L., & Wang, Y. C. (2023). Multi-scale decomposition of regional development gaps in China. *Statistics and Decision Making*, *39*(3), 104-109.

Zeng, P. et al. (2023). Research on the impact of central city's primacy on the coordinated development of regional economy—An analysis based on 19 urban agglomerations in China. *Journal of Chongqing University* (Social Science Edition), *29*(1), 56-69.

Zhang, G. J. et al. (2018). Characteristics of population distribution evolution in China from the perspective of urban agglomerations. *Journal of Geography*, *73*(8), 1513-1525.

Zhang, K. Y., & Zhang, Y. (2020). Evolution of regional economic differences in the Yellow River Basin at different spatial scales. *Economic Geography*, *40*(7), 1-11.

Zhang, X. B. et al. (2015). Evolution of the spatial pattern of economic differences among counties at the interprovincial fringes in China. *Economic Geography*, *35*(7), 30-38.

Zhao, C.-S., & Liu, H. J. (2023). Study on the north-south gap in China's economic development based on the perspective of urban agglomeration. *China Population-Resources and Environment*, *33*(2), 134-142.

Zhou, X. Y. et al. (2016). Spatio-temporal dynamic analysis of regional economic differences in the Yellow River Basin. *Human Geography*, *31*(5), 119-125.

147