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Review of Domestic Studies of Urban Agglomerations

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Abstract Urban agglomeration is the mainstream and trend of global urban development, and it is also the "major form" of China's new urbanization. Based on the evolution of the concept of urban agglomeration, this paper focuses on the identification of urban agglomeration, benefit assessment, developmental rules and future trends. This paper sorted out the research process of domestic scholars on urban agglomerations, and summarized the problems in the existing research status of urban agglomerations in China. Finally, it came up with recommendations that the urban agglomeration life development theory system should be established with the cultivation base, network flow, quality core, and energy radiation circle as evaluation criteria, to study the three representative urban agglomerations in China from the perspective of regional function evaluation.

Key words Urban agglomeration, Range recognition, Benefit evaluation, Rules, Prospects

1 Introduction

With the acceleration of economic globalization and the development of urbanization, competition between cities is no longer merely a competition of individual cities, but a competition of urban agglomerations or urban groups centered on core cities. The urban agglomeration with the big city as the core has become a city-region development model and the spatial combination model with global significance. In addition, only the urban agglomeration can have enough industrial agglomeration and economic scale to participate in global urban competition and cooperation, to form strong economic communities and a community of destiny to cope with the challenges of globalization. Thus, as a new regional unit of the country's participation in global competition and international division of labor, the urban agglomeration will determine the new pattern of world political economy in the 21st century. In the beginning of 2014, the CPC Central Committee and State Council printed and distributed *State Plan for Development of New Type of Urbanization (2014–2020)*, clearly setting forth the new urbanization development road of promoting coordinated development of large, medium and small sized cities and towns with urban agglomeration as the major form. Based on such understanding, government at all levels has carried out various planning and research in China, which sets off a wave of promoting the development of urban agglomerations.

2 Current situations of domestic and foreign researches of urban agglomerations

The idea of urban agglomeration was spurred by the British scholar Howard's *Garden Cities of Tomorrow* in the late 19th century. The book proposed that the rural population in the UK continues to be concentrated in cities, cities become deformed, and the rural areas are further declining due to population loss, it put forth setting the group development idea of "Town – Country Magnet". Later, domestic and foreign research on the concept, definition and spa-

tial structure of urban agglomerations emerges in an endless stream. In 1915, Geddes proposed the concept of "Conurbation", that is, a city region resulting from the expansion of several cities or towns so that they coalesce but usually retain their separate identities. During the 1950s and 1990s, the US Census Bureau and the federal government delineated "one or a number of central cities and a number of adjacent towns with a certain number of scales"; based on "central nuclear, flow measurement, metropolitan areas and basic geographic unit, they identified and classified metropolitan areas, and established a Standard Metropolitan Area, Standard Metropolitan Statistical Area, and Metropolitan Statistical Area and the Metropolitan Areas^[2].

Foreign countries started the study of urban agglomerations earlier. In the study of definition of the urban agglomeration, foreign scholars studied the classification types of urban agglomerations. For example, the physicist J. Gottmann proposed the urban agglomeration space as early as 1957, and based on the definition, he introduced five major criteria for scope identification. In the evaluation of urban agglomeration development benefits, foreign scholars studied the spatial diffusion of urban agglomerations, the evaluation of the economic development stage of urban agglomerations, the evaluation of the network relationship of urban agglomerations, as well as the evaluation of urban flows^[3–8]. In terms of the development rules of urban agglomerations, they studied the structural evolution, the economic development, and spatial evolution of urban agglomerations. For example, British regional scientist Friedman established a spatial organization evolution model associated with technological progress and divided the evolution of urban agglomerations into four stages^[9].

Domestic research on urban agglomerations began in the 1980s, and the concept originates from foreign terms such as "megalopolis" and "metropolitan area". In the opinion of Chinese scholar Fang Chuanglin, the urban agglomeration refers to a highly urbanized and highly integrated urban cluster with compact spatial organization and closely connected economy through taking a megalopolis as the core, consisting of at least three big cities, relying on developed transportation and communication infrastructure net-

works in a specific geographical area. In the context of economic globalization, urban agglomeration has become the most dynamic and potential growth point of a country's economic development, and it is the core regional unit for the state to participate in global competition and undertake industrial transfer^[10].

Since the entry to the 21st century, the existing literature on the study of China's urban agglomerations has focused on the following four aspects. (i) Research on the definition and identification of urban agglomerations. Some scholars defined the spatial scope of urban agglomeration based on the indicator system, while other scholars used models and algorithms to study the urban agglomeration scope. Some scholars combined the first two research methods to define the urban agglomeration scope^[11-12]. (ii) Research on the evaluation of the development benefits of urban agglomerations. Many scholars have measured the ecological, resource, environmental, economic and spatial connections of urban agglomerations based on comprehensive methods such as factor analysis, mathematical modeling, algorithms and models, or social network analysis methods. Besides, based on the patent cooperation relationship in the evaluation of the innovation ability of urban agglomerations from the perspective of social network relations and spatial organization, some scholars compared and analyzed the Yangtze River Delta and the northeastern US urban agglomeration. (iii) Research on the development rules of urban agglomerations. This mainly refers to the study of the spatial structure distribution and network evolution characteristics of urban agglomerations. (iv) Research on the future development trends and strategies of urban agglomerations. This mainly includes the development direction and strategies for the functional positioning, spatial structure, ecological environment, resources and economy of urban agglomeration.

3 Definition and identification

By now, neither the academic theory nor the planning practice circle has not reached a unified opinion about the definition of the spatial development scope of urban agglomeration. Therefore, from the perspective of effectively guiding the scientific development of urban agglomerations and the rational definition of planning scope, it is very necessary to sort out the research ideas and identification methods to clarify the research context for the identification of spatial scope of urban agglomeration development.

Due to the different viewpoints, periods, regions, *etc.*, the methods for defining and identifying urban agglomerations are also different. Some scholars defined the spatial scope of urban agglomerations based on the indicator system. First, they established the indicator system as the basis for determining the spatial scope of the urban agglomeration. Then based on the statistical data, they divided the urban agglomeration taking the prefecture-level or county-level administrative divisions as the basic unit. Based on the concept of urbanization in the international community, Zhou Yixing proposed the urban economic statistical area corresponding to the metropolitan area of the western countries, and introduced the five major standards defined by the urban economic statistical area and the five criteria for the identification or definition of the spatial scope of the metropolitan interlocking region. His study

opened the prelude to the study of the identification and definition of urban agglomerations of Chinese scholars^[13]. In the "China Urban Agglomeration", Yao Shimou proposed the top 10 identification criteria for the spatial scope of China's urban agglomerations^[14]. In the *Annual Report on Urban Competitiveness (2008)*, using a qualitative analysis method, Ni Pengfei divided the identification criteria of urban agglomeration into urban cluster development stage identification standards and urban cluster space level identification standards^[15]. Fang Chuanglin made an overall analysis on the indicators and standards of domestic and foreign experts on metropolitan areas, metropolitan circles, urban agglomerations, urban areas, *etc.* Based on the absorption of relevant authoritative indicators and standards, Fang Chuanglin fully considered the stage of China's urbanization development and national characteristics of Chinese government leading in the formation and development of urban agglomerations, and introduced 10 basic evaluation criteria for identification of spatial scope of China's urban agglomerations^[10]. Ning Yuemin considered that the definition of urban agglomeration must be based on the metropolitan area, and proposed five indicators, and then used these five indicators to define 13 large urban agglomerations^[16]. In addition, many scholars such as Dong Qing and Huang Jinchuan used similar indicator identification methods to explore the spatial scope of urban agglomeration^[17-18]. So far, there is no unified technical process and method system for the identification of the spatial development scope of urban agglomerations, and the relevant identification results vary greatly.

4 Assessment of development benefits

Many scholars have assessed the ecological, resource, environmental, economic and spatial connections of urban agglomerations based on comprehensive methods such as factor analysis, mathematical modeling, algorithms and models, or social network analysis methods. Using the daily API data of nine representative cities of the Beijing – Tianjin – Hebei, Yangtze River Delta and Pearl River Delta cities for the past 10 years from 2001 to 2010, Sun Dan *et al.* studied the interannual and seasonal variations of API in various urban agglomerations and cities, and counted the number of days with the mild pollution or above level^[19]. With the aid of gravity model and social network analysis method, Lu Jinping *et al.* carried out empirical research on the economic linkage network between 13 cities in Beijing – Tianjin – Hebei urban agglomeration^[20]. From the relationship between the input and output of inter-city industries, Zhu Xiaochuan *et al.* built a model of input-output gravity between industries. Based on the classification of 28 urban agglomerations in China, they measured the linkage strength of urban agglomerations, analyzed the driving factors of linkage intensity, and finally came up with pertinent recommendations for different urban agglomerations from the industrial scale adjustment, industrial structure coordination and transportation network construction^[21]. Using the gravity model and the social network analysis method, Lao Xi *et al.* measured the economic linkages among the cities in the middle reaches of the Yangtze River in 2013, and analyzed the centrality of the nodes in the economic network, the influence scope of the central cities, and the sub-

regions of the urban agglomerations^[22]. In the evaluation of the innovation ability of urban agglomerations, from the perspective of social network relations and spatial organization, based on the patent cooperation relationship, Wu Zhiqiang *et al.* compared the Yangtze River Delta with the urban agglomerations in the north-eastern United States, which breaks the traditional innovation capability evaluation system and provides a highly practical and credible research idea^[23]. In the research of the evaluation of the development benefits of urban agglomerations, many scholars have studied urban agglomerations from the perspectives of urban agglomeration development dynamics, stages, and regions. However, these studies only remain at the single level of urban agglomeration economy and spatial connection. The research should be improved in the intensity of the interaction between various related factors such as transportation, culture, innovation and the influence of urban agglomerations.

5 Development rules

This level of research is mainly about the spatial structure distribution and network evolution characteristics of urban agglomerations. It is based on three typical urban agglomerations in China, namely, the Yangtze River Delta urban agglomeration, the Pearl River Delta urban agglomeration and the Beijing – Tianjin – Hebei urban agglomeration, to explore their characteristics of development rules. For example, taking the three major urban agglomerations of the Yangtze River Delta, Beijing – Tianjin – Hebei and the Pearl River Delta as empirical research cases, and selecting the GDP, non-agricultural population, industrial output value, fixed asset investment and foreign direct investment from the perspective of the macroscopic form of urban agglomeration economic space, Wang Wei^[24] applied the spatial trend surface method to carry out the diachronic analysis of 3D map information in 1995, 2001 and 2005 with the aid of SURFER 8.0 software. Finally, he summarized and refined characteristics of energy leading balanced path for the three urban agglomerations. Taking the Christaller central place model as the spatial paradigm, under the economic principle, traffic principle and administrative principles Zhang Zhenbing divided the spatial units of the Wuhan City Circle, the Yangtze River Delta, the Pearl River Delta and the Beijing – Tianjin – Hebei urban agglomerations, and made a comparison with the space division of theoretical model. They used the ratio of the broken functional area to the total area of the theoretical functional unit and the theoretical spatial model as the indicator to evaluate the spatial self-organization evolution, to compare the respective model fitting degrees to objectively analyze the spatial self-organization evolution of China's urban agglomeration^[25]. Mei Zhixiong *et al.* used the modified gravity model and potential model, combined with GIS spatial analysis method, to analyze the spatial-temporal evolution of urban interactions in nearly 20 Pearl River Delta regions from the prefecture-level cities and counties^[26]. Using the panel data of China's top ten urban agglomerations from 2000 to 2013 and the Theil index and the Mono index, Zhang Xin *et al.* described and empirically studied the differences and spatial structure characteristics of the top ten urban agglomerations^[27]. Through introducing the sensitivity coefficient and the influence

coefficient, Sun Dongqi *et al.* established an industrial linkage strength measurement model, discussed the current industrial spatial relationship characteristics between the Yangtze River Delta and the Beijing – Tianjin – Hebei urban agglomeration, studied the spatial economic differences between the two urban agglomerations; besides, from the perspective of the industrial space connection, they made an empirical study on the "shadow area of the metropolis"^[28].

6 Development trends and strategies

Urban agglomeration is the mainstream and trend of global urban development, and it is also the "major form" of China's new urbanization. Many scholars have proposed the development trends and strategies for urban agglomeration function, spatial structure, ecological environment, resources and economy in the related research of urban agglomeration. Based on the existing research results, Fang Chuanglin introduced the key directions for the selection and cultivation of China's urban agglomerations in the future: taking the urban agglomeration as the main body, focusing on promoting the "5 + 9 + 6" new pattern of the spatial structure of China's urban agglomerations; relying on the urban agglomerations, focusing on promoting the formation of a new urbanization pattern of "connecting agglomerations with axis and supporting the axis with agglomerations"; guided by the national strategic needs, continuing to deepen the understanding of major scientific issues in the formation and development of urban agglomerations, including making an in-depth study of resource and environmental effects of high-density agglomeration of urban agglomeration, scientifically solving the resource and environmental carrying capacity of high-density agglomeration of urban agglomerations, making innovation in the urban agglomerations to form a developmental management system and a government coordination mechanism, studying the establishment of urban public finance system and public finance reserve mechanism, and studying and formulating technical regulations for the planning of urban agglomerations and determining the spatial scope of urban agglomerations^[29]. In the opinion of Gu Chaolin, the research on China's urban agglomeration has a very broad space in the future and needs to keep pace with the times. In the first place, the cultivation and spatial layout of global cities, the development of China's megacities and mega-regions of multi-polar and multi-level global urban networks are the main research contents. In the second place, the influence of de-industrialization on the spatial layout of China's urban agglomerations will become an important research content, especially the study of the impact of post-industrialization on the regional spatial structure changes of urban agglomerations in China^[30]. In the third place, the public policy research on unbalanced urbanization spatial growth, related public policies such as labor mobility policy, household registration policy, employment policy, public housing policy, social security policy, *etc.*, are particularly important to meet the demands for policy research of the development and prosperity of China's urban agglomerations.

7 Conclusions and prospects

Through reviewing the research process and achievements of urban

agglomerations both at home and abroad, most of the studies focus on urban agglomerations from the perspectives of urban agglomeration, benefit assessment, development rules, trends and strategies. In terms of research technology, most scholars studied the indicator system and model to explore the development of urban agglomerations. Although many factors are weighed in the selection of indicators, they are inevitably subjective and only based on traditional analytical models. The mechanical simplification does not return to the essence of the formation and development of urban agglomerations. Therefore, it is difficult to deeply describe the connection between space of cities and various network flows. In terms of research perspective, many scholars studied urban agglomerations from the perspectives of urban agglomeration development dynamics, stages, and regions. However, these studies only remain at the single level of urban agglomeration economy and spatial connection. The research should be improved in the intensity of the interaction between various related factors such as transportation, culture, innovation and the influence of urban agglomerations. In general, many scholars in China have carried out extensive studies on related field, but there is still no systematic method or unified technical process for the exploration of urban agglomerations, ignoring the role of urban agglomeration and radiation, and the intensity of urban agglomeration, and lacking long-term tracking contrasts. As a result, the study of the internal linkages and regional roles of urban agglomerations still remain on the surface.

In summary, the study of urban agglomeration should take into account both theoretical research and practical operation, and continuously improve the objective and scientific features of the study on the spatial scope identification and development rules of urban agglomerations. Through sorting the perspectives, theories and common characteristics of urban agglomerations in the existing literature, we studied and refined the theoretical system of life development of urban agglomerations based on four evaluation criteria: cultivation base, network flow, quality core, and energy radiation circle. Based on the perspective of regional role evaluation, we intended to select three typical urban agglomerations in China: the Yangtze River Delta urban agglomeration, the Pearl River Delta urban agglomeration, and the Beijing – Tianjin – Hebei urban agglomeration. At the four levels of cultivation base, network flow, quality core, and energy radiation circle, from the stages of development, the prime development and the future development trend, and with the support of big data and GIS technology, we would make a scientific dynamic monitoring of the development of urban agglomerations. Besides, we would study the spatial agglomeration density, diffusion effect and development threshold of these three typical urban agglomerations in the past 20 years, the spatial structure characteristics and flow intensity of the internal network flow, the DNA genetic innovation and metabolic capacity of the quality core, and change of energy radiation circle with the time, and change of economic density, population density, industrial density, *etc.*, to find out the common characteristics of the development of typical urban agglomerations, establish a standard system for the development stage of urban agglomerations, explore the key factors and differences in the development of typical urban agglomerations, and further explore the new trends of urban ag-

glomeration development. It is expected to grasp the development of urban agglomerations in a broader perspective and will bring some reference significance for the planning and development of urban agglomerations.

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net + agricultural industry poverty alleviation, solve the pre-production, mid-production and post-production problems encountered by poverty-stricken households in developing agricultural industries, and eliminate the doubts of poor households. Industry-supporting poverty alleviation rules and regulations such as the *Implementation Rules for Internet + Agricultural Industry Poverty Alleviation Plan* and the *Measures for the Use and Management of Poverty Alleviation Funds* can be formulated to simplify and standardize the poverty alleviation management process and improve poverty alleviation efficiency. At the same time, it is necessary to set up special industry-supporting poverty alleviation groups, resident work teams and other organizational structures to guide and supervise all aspects of poverty alleviation by developing agricultural industries, and provide institutional and organizational support for the poverty alleviation model of Internet + agricultural industry.

4.4 Establishing a good poverty alleviation path and mechanism In the process of using the Internet + agricultural industry model to alleviate poverty, we must fully protect the interests of poor farmers and ensure that the interests of farmers are not damaged. All or part of the profits from agribusiness operations is returned to poor households to maximize the benefits of poor households. We must remain true to our original aspiration, unwaveringly establish and maintain a poverty alleviation mechanism that maximizes the interests of poor households, recommend the good poverty alleviation models such as enterprise + base + farmer and cooperative + base + farmer to link the interests of the poor households with those of the agricultural industries^[11], let poor households participate in the production, processing and sales of the agricultural industries, provide jobs in the entire industry chain, and establish a variety of poverty alleviation paths and close linkage mechanisms for poor households. All aspects of the interests of peasants should be taken into account to maximize the poverty alleviation effect of the Internet + agricultural industry model.

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