Journal of Global Change Data & Discovery. 2025, 9(1): 14-19
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Global Change Research Data Publishing & Repository

Dataset Development on Integrative Level and Radiative Capacity of Urban Agglomerations in China (2006–2019)

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Abstract: As the main spatial carrier of regional economic development, urban agglomerations should not only pay attention to their internal integrative level, but also play a role in external radiative effects so as to promote high-quality economic development. The spatial spillover effect of 284 cities' factors in China from 2006 to 2019 was decomposed using a production function embedded in an endogenous spatio-temporal weight matrix, on the basis of which the integrative level and radiative capacity of China's 19 urban agglomerations (2006–2019) were measured. It is found that regions exhibiting a higher integrative level and radiative capacity of urban agglomerations are mainly concentrated in the southeastern coast. The integrative level and radiative capacity of urban agglomerations show a significant positive relationship. Meanwhile, this dataset elucidates the spatial and temporal evolution characteristics of the integrative level and radiative capacity of 19 urban agglomerations in China during the period from 2006 to 2019. This dataset includes the following data from 2006 to 2019: (1) the spatial spillover effect of urban factors for 284 cities in China; (2) the integrative level of the 19 urban agglomerations; and (3) the radiative capacity of the 19 urban agglomerations. The dataset is archived in .xlsx format and consists of 1 data file with a file size of 89.3 KB.

Keywords: spatial spillover of factors; integration level; radiation capacity; urban agglomerations

DOI: https://doi.org/10.3974/geodp.2025.01.02

Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2024.11.01.V1.

1 Introduction

"Improving the mechanism of regional integration and development, and promoting Beijing-Tianjin-Hebei, the Yangtze River Delta and the Guangdong-Hong Kong-Macao Greater Bay Area to better fulfil their roles as powerhouses of high-quality development" is an important development strategy of China. Improving the internal integrative level and

Received: 10-11-2024; **Accepted:** 10-02-2025; **Published:** 25-03-2025

Foundation: Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (NIGLAS2022GS06)

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Data Citation: [1] Qiu, S. Y. Dataset development on integrative level and radiative capacity of urban agglomerations in China (2006–2019) [J]. *Journal of Global Change Data* & *Discovery*, 2025, 9(1): 14–19. https://doi.org/10.3974/geodp.2025.01.02.

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external radiative capacity of urban agglomerations is the economic geographical embodiment of the aforementioned development tasks. The prerequisite for improving the integrative level and radiative capacity of urban agglomerations involves reasonably measure and analyse the integrative level and radiative capacity of Chinese urban agglomerations[1]. particularly within the framework of the new development paradigm, how to assess the internal factor flow pattern and external economic diffusion capacity of urban agglomerations through the spatial spillover effect of factors, and subsequently conduct an accurate and effective analysis of their internal integrative development status and external radiation-driven capacity has emerged as a pressing scientific inquiry that must be addressed to facilitate the promotion of Chinese modernization.

Existing research predominantly measures the integrative level of urban agglomerations mainly by the indicator construction method, which synthesises multi-dimensional indicators such as economic, cultural and environmental indicators of urban agglomerations[2], but the selection of indicators tends to be more subjective, with a lack of economic significance. Moreover, the study area is often limited to to certain urban agglomerations or specific regions such as the Yangtze River Economic Belt[3–5]. The radiative capacity of urban agglomerations is measured by field strength models or global spatial econometric models[6,7], which often lacks rigorous statistical inference and comprehensive spatial and temporal weighting matrices. In fact, a high degree of integration within urban agglomerations often results in a "physical reaction" or "chemical reaction" that contributes to the radiatve capacity of urban agglomerations by enhancing factor mobility and total factor productivity. Therefore, further exploration and research are needed to accurately measure the integrative level and radiative capacity of urban agglomerations.

In summary, the current methods for measuring the integrative level and radiative capacity of urban agglomerations fail to consider the spatial spillover effects of factors. Moreover, there are fewer studies related to urban agglomerations that align with national policies in China. Therefore, this dataset utilizes a multivariate city-level database and a Cobb-Douglas (CD) production function integrated within a spatial econometric model to assess the urban Integrative level and radiative capacity in China, which offering valuable data support for the study of high-quality development for urban agglomerations in China.

2 Metadata of the Dataset

The metadata of the Integrative level and radiative capacities dataset on urban agglomerations of China (2006–2019)[8] is summarized in Table 1. The dataset encompasses the dataset full name, short name, authors, year of the dataset, data format, data size, data files, data publisher, and data sharing policy, etc.

3 Methods

3.1 Methodology

3.1.1 Measurement of Spatial Spillover Effects of Factors

The CD production function is integrated with a general nested spatial econometric model to decompose the spatial spillover effects of capital and labor factors, as formulated below:

$$\ln Y_{it} = \ln A + \alpha \ln K_{it} + \beta \ln L_{it} + u_i + v_t + \varepsilon_{it} \tag{1}$$

$$\ln Y_{it} = \rho(SWE \times \ln Y_{it}) + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \theta_K(SWE \times \ln K_{it}) + \theta_L(SWE \times \ln L_{it}) + u_i + v_t + \xi_{it}$$
$$\xi_{it} = \lambda(SWE \times \xi_{it}) + e_{it} \tag{2}$$

where Y_{it}, K_{it} and L_{it} represent output (hundred million CNY), capital (hundred million

CNY) and labour factors (ten thousand people) respectively. u_i is individual fixed effects, and v_t is a time fixed effect. ξ_{it} and e_{it} are the random disturbance terms, where e_{it} is an

Table 1 Metadata summary of Integrative level and radiative capacities dataset on urban agglomerations of China (2006–2019)

Items	Description
Dataset full name	Integrative level and radiative capacities dataset on urban agglomerations of China (2006–2019)
Dataset short name	UrbanAggloIntgLevel&RadiCapacity
Author	Qiu, S. Y., School of Economics and Management, Wuhan University, qsypure@qq.com
Geographical region	284 prefecture-level cities and above in China
Year	2006–2019
Data format	.xlsx
Data size	89.3 KB
Data files	Spatial spillover of factors in 284 Chinese cities, 2006–2019; Integrative levels and radiative capacity of 19 urban agglomerations in China, 2006–2019
Foundation	Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (NIGLAS2022GS06)
Data computing environment	Matlab
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	(1) *Data* are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use *Data* subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute Data subject to written permission from the GCdataPR Editorial Office and the issuance of a *Data* redistribution license; and (4) If *Data* are used to compile new datasets, the "ten percent principal" should be followed such that *Data* records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[9]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC

independent and identically distributed random variable that follows a normal distribution with zero mean and homoskedasticity, and *t* is the specific period of the sample. *SWE* is the spatio-temporal weight matrix, which is the core of the spatial spillovers of the capital and labour factors in this dataset.

3.1.2 Measurement of the Integrative Level and Radiative Capacity of Urban Agglomerations

This dataset utilizes the spatial spillover effects of factors within and outside the urban agglomeration to quantify the integrative level and radiative capacity of the urban agglomeration. The specific measured integrative level and radiative capacity of urban agglomeration are presented in equations 3 and 4.

$$CI_{gt} = \frac{SE_{Kt1} + SE_{Lt1}}{\sum_{g=1}^{19}(SE_{Kt1} + SE_{Lt1})} \tag{3}$$

$$SI_{gt} = \frac{SE_{Kt2} + SE_{Lt2}}{\sum_{g=1}^{19}(SE_{Kt2} + SE_{Lt2})} \tag{4}$$

Where CI_{gt} denotes the integrative level of urban agglomeration *g* in period *t*, and SI_{gt} denotes the radiative capacity of urban agglomeration *g* in period *t*. It is worth noting that in order to compare the gap between the integrative level and radiative capacity of urban agglomeration, the range of integrative level and radiative capacity of the measured urban agglomeration are all within the (0, 1). Please refer to the literature[1] for details of the above specific formulae.

3.2 Data Sources

Considering data availability and temporal completeness, the sample of cities in this dataset is the 284 prefecture-level cities and above in China from 2006 to 2019, and the sample of city clusters consists of the 19 urban agglomeration specified in the 14th Five-Year Plan. When measuring GDP, capital stock, and labor force, the interpolation method is used to address the cities with a few missing data. The data are sourced from the China Urban Statistical Yearbook[10], the Development Research Center of the State Council (DRCnet) Database[1] and the CEIC database[2].

4 Data Composition and Results

4.1 Dataset Composition

The dataset consists of 3 parts: (1) the spatial spillover effects of 284 urban factors in China from 2006 to 2019; (2) the integrative level of 19 urban agglomerations in China from 2006 to 2019; and (3) the radiative capacity of 19 urban agglomerations in China from 2006 to 2019. The dataset is archived in .xlsx format, and consists of 1 data file.

4.2 Data Results

Figure 1 shows the spatial spillover effect of factors in Chinese cities from 2006 to 2019, which comprises the sum of the spatial spillover effect of the capital factor and the spatial spillover effects of the labour factor. The overall trend of spatial spillover effect of factors has decreased from 2006 to 2019, which is attributed to the spatial spillover effect of factors measured in this dataset integrates the dual attributes of time and space, and as time progresses, the weaker the spillover effect of factors become, which is in line with the characteristics of the mobility and depreciation of the real labour and capital factor. The specific reasons for this can be found in the literature[10]. From the spatial dimension, the top ten cities in terms of spatial spillover effects in 2006 are Shanghai, Beijing, Shenzhen, Suzhou, Guangzhou, Dongguan, Tianjin, Wuxi, Hangzhou and Nanjing. And the top ten cities in 2019 include Shanghai, Beijing, Shenzhen, Chongqing, Guangzhou, Suzhou, Wuhan, Tianjin, Hangzhou and Nanjing. It can be seen that Chinese cities with high spatial spillover effect of factors are mainly concentrated in the Yangtze River Delta and Pearl River Delta regions, while Chongqing and Wuhan have gradually risen to the top ten, which have displaced the traditional manufacturing powerhouses such as Wuxi. Meanwhile, the cities with lower spatial spillover effect of factors are primarily located in the western and northeastern regions, such as Qitaihe, Zhongwei and Jinchang, which have smaller economic volumes and population sizes, making it difficult for them to generate strong spatial spillover effect of factors. In summary, the spatial distribution of spillover effects in Chinese cities is closely related to the economic development of the cities, showing

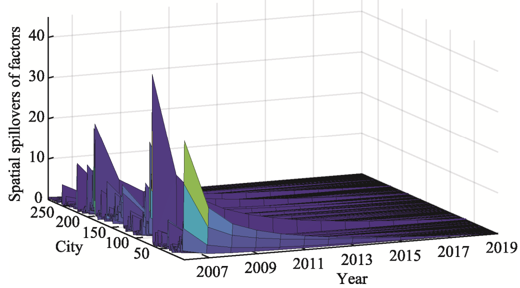

Figure 1 Spatial spillovers of urban factors in China (2006–2019)

[1] https://data.drcnet.com.cn. 2022-04-28.

[2] https://insights.ceicdata.com. 2022-04-30.

the characteristic of "high in the east and low in the west".

The integrative level of China's urban agglomerations from 2006 to 2019 is classified into 4 major segments according to the Statistical System and Classification Standard (16) developed by the National Bureau of Statistics. The trend in the integrative level of the four major urban agglomerations is illustrated in Figure 2. It can be seen that the integrative level of the eastern urban agglomerations has consistently been the highest throughout the period of 2006–2019, particularly the integrative level of the Yangtze River Delta urban agglomerations has consistently ranked at the top. The western urban agglomerations, on the other hand, have always ranked at the back during the sample period. Meanwhile, the integrative level of the central city cluster has gradually surpassed that of the northeastern urban agglomerations since 2018, with the urban agglomerations in the middle reaches of the Yangtze River playing a key role.

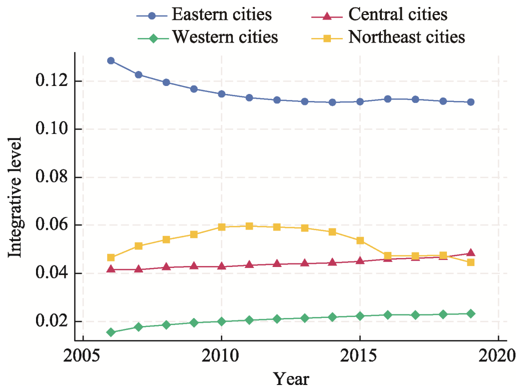

Figure 2 Integrative level of urban agglomerations in China (2006–2019)

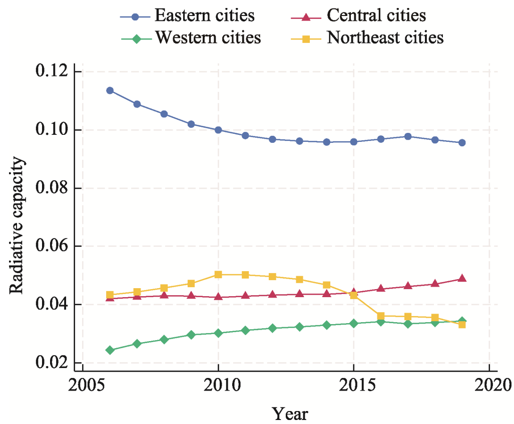

Figure 3 Radiative capacity of urban agglomerations in China (2006–2019)

The trends in the radiative capacity of urban agglomerations in China's 4 major sectors from 2006 to 2019 are illustrated in Figure 3. Figure 3 shows that there is a positive relationship between the radiative capacity and the integrative level, indicating that urban agglomerations with a higher level of integration exhibit a stronger radiative capacity, which is closely linked to the industrial expansion and productivity gains resulting from integration. However, in contrast to the trend in integration levels, the radiative capacity of central urban agglomerations began to surpass that of northeastern urban agglomerations after 2015, with the gap between the two widening. This indicates that the central region has emerged as a significant regional radiative hub, whereas the radiative capacity of the northeastern region is gradually declining due to natural and historical reasons, necessitating attention.

5 Discussion and Conclusion

Urban agglomerations are organic aggregates composed of individual cities characterized by two attributes: internal collaboration and external influence, and the integrative level and radiative capacity of urban agglomerations serve as a more intuitive representation. This dataset quantifies the spatial spillover effect of factors, internal integration and external radiative capacity of Chinese cities by constructing a CD production function embedded in a spatial econometric model, thereby mitigating the subjectivity inherent in the indicator construction method and aligning with the reality of increasingly interconnected factor flows between cities. Moreover, the results of this paper align with the 19 urban agglomerations described in China's 14th Five-Year Plan, demonstrating a high level of data accuracy. This dataset provides insights into the internal and external operational quality of China's urban agglomerations through the lens of spatial spillovers, thus offering empirical references for the high-quality development of urban agglomerations and the coordinated development of the region. The study finds:

(1) Spatial spillovers of factors are stronger in Yangtze River Delta, Pearl River Delta and certain large cities in the central and western parts of the country, while spatial spillover of factors are generally weaker in western cities.

(2) The level of integration is higher in the eastern urban agglomerations and weaker in the western urban agglomerations. The level of integration of the central urban agglomeration is gradually rising and exceeding that of the north-eastern urban agglomeration.

(3) The level of integration and radiative capacity of urban agglomerations show a clear positive relationship, while the radiative capacity of central urban agglomerations continues to strengthen and gradually widen the gap with northeastern city clusters.

This dataset measures the integrative level and radiative capacity of China's 19 urban agglomerations through an advanced decomposition of spatial spillover effects of factors. It provides data to enhance the quality of urban agglomeration development, mitigating regional development gaps, achieving regional economic convergence and securing Chinese modernisation. Future research can utilize this data to examine the influencing factors of the integrative level and radiative capacity of urban agglomerations through novel perspectives, new technologies and new data.

Conflicts of Interest

The authors declare no conflicts of interest.

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