Progress of economic geography in China's mainland since 2000

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Abstract: Economic geography in China's mainland has developed in a different way from that in many other countries. On the one hand, it has been increasingly active in participating in academic dialogues and knowledge development led by Anglophone countries; on the other hand, it takes practice-based and policy-oriented research, i.e. satisfying the demands from the Chinese government and society, as the linchpin of research. Since there has been a lot of literature reviewing the development of economic geography in the country before the new millennium, this paper will make a comprehensive analysis of the discipline in 2000–2015, based on a bibliometric survey and research projects done by Chinese economic geographers. The analysis indicates that (1) economic geography research in China's mainland is unevenly distributed but concentrated in several leading institutions; (2) traditional research fields like human-nature system, regional disparity, industrial location and transportation geography remain dominant while new topics such as globalization, multinational corporations and foreign direct investments, information and communication technology, producer services, climate change and carbon emission emerge as important research areas; (3) Chinese economic geography is featured by policy-oriented research funded by government agencies, having considerable impacts on regional policy making in China, both national and regional. To conclude, the paper argues that the development of economic geography in China's mainland needs to follow a dual track in the future, i.e. producing knowledge for the international academic community and undertaking policy-oriented research to enhance its role as a major consulting body for national, regional and local development.

Keywords: economic geography; intellectual development; bibliometrics; practice-based

1 Introduction

Economic geography is a discipline studying the location, distribution and spatial organization of economic activities (Barnes, 2001; Liu *et al.*, 2011; Scott, 2000). It is one of the most dynamic branches of geography with diverse and evolving scopes and approaches (Fan, 2008; Li *et al.*, 2014; Liu *et al.*, 2014). The intellectual progress of economic geography is influenced not only by its inner intellectual research tradition/paradigm (Kuhn, 1962), but

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also by changes in society and the generations of scholars. In this field of research, new generations of scholars in general are more willing to import fresh thoughts and methods from neighboring and related disciplines to theoretically and empirically investigate new topics. As such, the objects of enquiry and the conceptual and methodological tools that economic geographers use vary through time. Although “conventional” themes such as regional disparities, industrial location and agglomeration, transport geography, corporate geography and trade geography still remain important in contemporary economic geography research, many new issues have emerged as increasingly significant research topics. They include but are not limited to producer services, ecological environment, energy and carbon emissions, and information and communication technology. Moreover, the development trajectory and concrete research topics of economic geography are affected by the social, economic, political and ideological contexts in which scholars are embedded (Liu and Lu, 2002; Cai *et al.*, 2004; Liu, 2007). Thus, there is increasing intuitive awareness of the necessity to trace the trajectory of the economic geography research from an evolving and spatial perspective (Liu *et al.*, 2014).

In the last decade, economic geographers began to reflect on their intellectual progress on their home bases (e.g. for the post-World War II Anglo-American economic geography, see Barnes, 2001 and Scott, 2000; for the history of the 20th century economic geography in France, see Benko and Desbiens, 2004; for German economic geography since the 1970s, see Schamp, 2007; and for Chinese economic geography since the 1950s, see Liu and Lu, 2002). Undoubtedly, economic geographies in non-Anglophone countries are heavily influenced by external academic thoughts, particularly by the predominance of Anglophone journals, but many have tried to keep their own intellectual traditions to fit into national socioeconomic and institutional contexts and developmental issues, which in turn shapes the development of economic geography in these countries (Liu and Lu, 2002; Liu *et al.*, 2014; van Leeuwen, 2013; Wang and Liu, 2013). China’s mainland (China hereafter) is among such countries; its history of economic geography since the founding of New China in 1949 has been characterized by continuous readjustments, which can be summarized as “promoting academic advance by undertaking practice-based research”.

In general, Chinese economic geography research since 1949 has been influenced first by the notion of territorial production complex from the Soviet Union, then by German version of the spatial approach and recently by Anglophone research. This is because the three generations of Chinese outstanding economic geographers mainly received professional trainings in succession in the above three language regions. Different from their western colleagues who are interested in more theory-oriented free research, however, Chinese economic geographers are engaged much more in short-term research contracts and consultancies, funded by government agencies, and aimed at practical problems (Webber, 2010). In other words, economic geography research in China is more policy-oriented, which Liu (2009) described as “practice-based”. Such practice-based or policy-oriented research has enabled economic geographers in China to have a considerable impact in regional policy-making communities, both national and regional. In the meantime, it should be noted that Chinese economic geographers have published a growing number of papers in international journals and received more and more citations, making greater contributions to the international academic community.

A complete compilation and systematic review of the economic geography research seem to be very difficult due to the evolving definition of economic geography and the ever increasing number of publications in various forms. It is against this background that we try to make a comprehensive analysis of economic geography research in China based on a bibliometric survey and research projects undertaken by Chinese economic geographers. Bibliometric analysis empirically complements the traditional narrative-based literature reviews that are typically qualitative and largely based on personal judgment. Bibliometric is a quantitative method to assess research performance and research impact, and to analyze development trajectories, emerging trends of a given research field in natural and social sciences as well (Pritchard, 1969).

Such a study is useful in the following aspects. Firstly, it can provide useful information on research performance of individual institutions and on active journals, supporting prospective students and young faculty in their career planning. Secondly, it can help better understand the recent development trajectory of research areas, enabling scholars to identify research gaps and research frontiers, where they might contribute to the field. Finally, it can help western scholars understand the development trajectory of Chinese economic geography, which may be different from that of their home countries.

Since there has been a lot of literature reviewing the history of economic geography in China before the new millennium (e.g. Liu and Lu, 2002; Liu, 2009), this paper will focus on the time period from 2000 to 2015. It is organized as follows. The next section will introduce the data source and research methodology. After analyzing the general features of publications in the third section, we will examine the major developments in main research fields in the fourth section. In the fifth section, we summarize the characteristic of the economic geography research in China. We will conclude with some suggestions for further development.

2 Data and methodology

Although scientific research results can be published in many forms, e.g. monographs, journal articles, conference proceedings, and even personal blogs or web pages, peer-reviewed journals, a primary means of communication in the scientific community, are frequently used as a major data source for bibliometric analysis. There are two reasons for using journal article as data source: on the one hand, it seems impossible, at least it is rather time-consuming, to collect all publications in other forms; on the other hand, the research outputs in other forms are often transformed into journal articles. It should be noted that such a choice of data source can be risky in that the impact of individual authors, institutions and research directions may be under-evaluated, in particular in China where policy-oriented consulting research is a major part of economic geography. In order to avoid this bias, data of key national and regional planning projects and other important policy-oriented projects are used in our analysis.

The data for bibliometric analysis in this study were retrieved from China Academic Journals Full-text Database provided by China National Knowledge Infrastructure (CNKI) database. This database has a comprehensive coverage of important and influential research outputs including the most influential journals in the field of economic geography. Each ar-

title in the CNKI database is assigned to one or more subject categories, according to the Chinese Library Classification (CLC). The current CLC system (the fifth edition), published in 2010, contains 22 main classes or categories, each divided into subcategories. The F category is economics, having nine subcategories, i.e. Economics (F0), World Economy, Economic History, Economic Geography (F1), Economic Planning and Management (F2), Agricultural Economics (F3), Industrial Economics (F4), Economics of Transport (F5), Economics of Postal and Cable Services (F6), Economics of Commerce (F7) and Finance, Banking (F8). The corresponding subcategories of F59 (Tourism Economics), F3 (Agriculture Economics) and F29 (Urban and Municipal Economics) are excluded, as tourism, agriculture and urban geography become independent discipline in China. As mentioned previously, we will focus on the period from 2000 to 2015.

We use the above mentioned subject categories as search words to collect articles in the core Chinese geography-related journals in 2000–2015, and 4275 articles were downloaded. Moreover, considering economic geographers contribute to journals of non-geography, more than one hundred articles that are assigned to the K902 category in all Chinese journals were collected as well. All the search results were combined, and duplications were removed. The articles that are not about economic geography were manually deleted by examining their titles and abstracts. A total of 4399 journal articles were selected with records including titles, authors, dates, author affiliation, subject categories, citation, etc. The following analysis is based on the bibliometric data of these journal articles.

3 General features of the publications

3.1 Article outputs

As shown in Figure 1, the number of articles on economic geography published in Chinese journals from 2000 to 2015 grew very fast. The number was 155 at the turn of the century, reached a peak in 2010 with 430 articles, fell down to a lower point, i.e. 307 in 2012, and then begun to rebound. This rapid growth trend can be attributed to increasing concern about economic development among Chinese geographers on the one hand, and the strong drive to institutionalize economic geography as a strong academic discipline on the other.

Figure 1 The number of published articles on economic geography in China in 2000–2015

3.2 Active scholarly journals

In consistence with observations in other research fields, articles on economic geography are published in a few major journals. The top 10 active journals published 4238 (96.34%) out of a total of 4399 articles, each one publishing no less than 100 articles. Table 1 lists the 10 most active Chinese journals in economic geography with the number of articles, host institution, and founding year and impact factor. The most active one is *Economic Geography* (*Jing Ji Di Li*), established in 1981 by the Hunan Institute of Economic Geography in collaboration with the Geographical Society of China (Commission on Economic Geography). This journal published 1858 articles on economic geography in the period under study. *Human Geography* (*Ren Wen Di Li*) ranks the second, publishing 498 articles on economic geography. Other major journals publishing no less than 200 articles on economic geography include *Geographical Research* (*Di Li Yan Jiu*), *Progress in Geography* (*Di Li Ke Xue Jin Zhan*), *Acta Geographica Sinica* (*Di Li Xue Bao*) and *Scientia Geographica Sinica* (*Di Li Ke Xue*). Of these four journals, the first two were established in the 1980s by the Institute of Geographic Sciences and Natural Resources Research (IGSNRR hereafter) of the Chinese Academy of Sciences (CAS hereafter), the third one was established in 1934 by the Geographical Society of China, which is the most esteemed journal of geography in China, and the last one was established in 1981 by the Northeast Institute of Geography and Agro-ecology of CAS.

Table 1 Top 10 most active Chinese journals in economic geography

Journal name	Article number	Host institution	Founding year	Impact factor
Economic Geography	1858	Hunan Institute of Economic Geography	1981	2.122
Human Geography	498	Xi'an International Studies University	1986	1.172
Geographical Research	381	Institute of Geographic Sciences and Natural Resources Research (IGSNRR), CAS	1982	1.936
Scientia Geographica Sinica	349	Northeast Institute of Geography and Agro-ecology (IGA), CAS	1981	2.214
Progress in Geography	295	Institute of Geographic Sciences and Natural Resources Research, CAS	1982	2.154
Acta Geographica Sinica	255	Geographical Society of China	1934	3.144
Geography and Geo-Information Science	190	Hebei Institute of Geography	1985	0.754
World Regional Studies	156	East China Normal University	1992	0.718
Arid Land Geography	141	Xinjiang Institute of Ecology and Geography (XIEG), CAS	1978	1.464
Tropical Geography	115	Guangzhou Institute of Geography	1980	0.768

3.3 Most-prolific institutions

By identifying each article's institutional affiliation, research productivity (measured by the number of journal articles) of individual institution can be calculated. The published articles on economic geography in the study period are very unevenly distributed but concentrated in

several leading institutions. The institutional productivity analysis reveals that a small group of prolific institutions made a great contribution to publications of economic geography in China. Table 2 lists the most productive institutions with their article numbers. These top 10 institutions together published 1359 articles, accounting for 31% of the total articles under study. The most productive institution is IGSNRR of CAS, with 488 articles. The next ones with publishing no less than 200 articles include Peking University, East China Normal University and Sun Yat-sen University. It should be noted however that the contributions from some institutions may be over- or under-estimated because co-authored articles were allocated to all institutions on the basis of the affiliations of the authors.

Table 2 The most productive institutions in economic geography research in China

Institution name	Article number	Institution name	Article number
Institute of Geographic Sciences and Natural Resources Research, CAS	488	Beijing Normal University	118
Peking University	237	Liaoning Normal University	108
East China Normal University	230	Hunan University	82
Sun Yat-sen University,	206	Xinjiang Institute of Ecology and Geography (XIEG), CAS	66
Nanjing University	198	Zhejiang University	64
Northeast Normal University	173	South China Normal University	64
University of Chinese Academy of Sciences	172	Xuzhou Normal University	63
Henan University	146	Northeast Institute of Geography and Agroecology (IGA), CAS	60
Nanjing Normal University	140	Northwest Normal University	59
Nanjing Institute of Geography and Limnology, CAS	121	Capital Normal University	49

3.4 Co-word analysis of keywords

CiteSpace provides a useful content analysis technique, which uses patterns of co-occurrence of pairs of items (i.e., keywords or noun phrases) to identify the strength of relationships between items. As keywords of individual article provide information about its research focus and core content, co-word analysis of keywords is widely used to reveal themes, intellectual structures, and development of a field. Here we use CiteSpace to produce the keyword co-word network of the 4399 collected articles on economic geography in 2000–2015. The simplified network consists of 124 nodes and 125 links (Figure 2). A node represents one keyword. The size of each node is proportional to the co-occurrence frequencies of the corresponding keyword.

As shown in Figure 2, the high-frequency keywords in published articles on economic geography in China are mostly traditional research topics in economic geography. The top 10 highest frequency keywords include spatial pattern (101), sustainable development (90), regional economy (88), industrial structure (86), regional difference (77), industrial cluster (72), economic growth (70), influence factor (69), spatial structure (63), and regional de-

velopment (61). Manufacturing has a more frequency (47) than producer services (32) and services (22). Yangtze River Delta (33), Northeast China (32), Guangdong province (28), and Shandong province (24) are more studied than other areas. Other keywords with a frequency over 20 are coordinated development, temporal and spatial evolution, foreign direct investment, regional policy and informationalization.

Figure 2 Keywords co-occurrence network of articles on economic geography in China in 2000–2015

A node with a red inner ring in the visualization (Figure 2) indicates that co-occurrence frequencies of the corresponding keyword increased rapidly in a given time period. The size of the red ring represents the strength of its burst property. From Table 3, Western China development, sustainable development, economic globalization, knowledge economy, competitive advantage, circular economy, industrial cluster and Main Function Zoning were once hot-debated research topics between 2000 and 2010 in the field of economic geography in China. County-level economy, spatial and temporal evolution, spatial linkage and accessibility, explore spatial data analysis (ESDA), and spatial auto-correlation have become more popular keywords in 2010–2015, implying that study unit becomes smaller, spatial and

quantitative methods become mainstream, and evolutionary mechanisms and spatial linkage are dynamic research topics.

Table 3 The top 36 keywords with high burst strength

Keywords	Strength	Begin	End	Keywords	Strength	Begin	End
Western China development	7.3101	2000	2004	Scientific outlook on development	3.2438	2004	2007
Sustainable development	18.5514	2000	2006	Foreign direct investment	3.0294	2004	2007
Ecological environment	4.1145	2000	2005	Industrial cluster	10.4	2006	2009
Economic globalization	5.9471	2000	2005	Regional difference	2.8748	2007	2008
Regional development	5.1125	2000	2004	Yangtze River Delta	3.4372	2008	2015
Development strategy	5.7598	2000	2005	Main Function Zoning	3.2463	2008	2010
Regional economic development	3.8885	2000	2008	YRD	2.8834	2010	2012
Knowledge economy	7.2029	2000	2002	Fujian province	2.8834	2010	2012
Indicator system	5.1743	2000	2003	Research progress	3.334	2010	2011
Economic geography	4.7544	2000	2004	County-level economy	3.9503	2010	2013
Evaluation method	3.3445	2000	2005	Spatial pattern	10.2709	2011	2015
Regional policy	3.4868	2000	2005	Spatial and temporal evolution	4.4704	2011	2015
Competitive advantage	3.49	2002	2006	Influencing factor	6.5542	2011	2015
Industrial structure	2.9456	2002	2004	Explore spatial data analysis	4.5733	2011	2015
Urbanization	3.5847	2002	2006	Spatial autocorrelation	4.7421	2011	2015
Circular economy	4.0863	2004	2009	High speed railway	3.0958	2012	2015
Regional economy	3.7057	2004	2005	Spatial linkage	3.8387	2013	2015
Investment environment	3.003	2004	2005	Accessibility	5.4835	2013	2015

4 Development of research areas

In order to accurately identify the recent development trajectory of economic geography in China, we make a data analysis in two steps. Firstly, we classify all articles of economic geography into major research fields. Secondly, we calculate the distribution of the total number of the top 10 highly cited papers each year in 2000–2015 among research sub-fields. As shown in Table 4, traditional research fields like man-land system and regional sustainable development, regional development and regional disparity, industrial location and industrial clustering, and transportation geography remain dominant, but new issues such as multinational corporations (MNC) and foreign direct investments (FDI), information and communication technology (ICT) and producer services, climate change and carbon emission emerge as important research areas. As traditional research fields are confronted with new practical issues, e.g. ecological compensation in spatial planning, new approaches and tools have been introduced to tackle on these issues. The most significant example is the introduction of visualization and simulation tools into the field of spatial planning.

4.1 Human-nature system and regional sustainable development

The notion of “the territorial system of human-nature relationship” (the human-nature system, hereafter) was coined by Wu Chuanjun, who was a leading economic geographer in China for more than half a century. In recent years, the human-nature system has become one of the most important approaches used by economic geographers in China to study regional sustainable development (Liu, 2007). As rapid economic growth in China has exerted tremendous impacts on the natural ecosystems and has sharply changed the relation between natural environment and socio-economic structures across this country, it has become a major concern of the Chinese governments at various levels to achieve sustainable development. By employing the approach of human-nature system that pays close attention to the interactions between human systems and the environment, economic geographers in China have been intensively involved in studies of practical issues regarding regional sustainable development.

Table 4 Distribution of highly cited papers among sub-fields of economic geography in China in 2000–2015 (the accumulative number of the top 10 highly cited papers in each year)

Sub-fields	Research trends	%
Man-land system and regional sustainable development	Multi-regional CGE model, spatiotemporal synergy model of multi-factors PRED system, territorial differentiation of the man-land system	18
Regional development and regional disparity	Club convergence, new factors, smaller scale and cross-regional disparity, public service, Regional Development Report of China	16
Industrial location and industrial clustering	Evolutionary mechanisms, spatial econometrics and input-output techniques, agriculture, producer services and innovative clusters	14
Transportation geography	Aviation network, logistics network, high-speed rail, regional transport dominance	8
Globalization, MNCs and FDI	Obligated embeddedness, geographical patterns of FDI, technology spillover and other impacts of FDI on regional development, international trade in energy, mineral products and resources	9
Information technology and producer services	Electronic commerce, the influence of information technology on the enterprise location, time-cost and time dependence, spatial concentration, creative industries and financial industries	12
Climate change and carbon emission	Calculation and decomposition method of carbon emissions, the identification of affecting factors, countermeasures to reduce carbon emission, industrial transfer and carbon emissions	9
Spatial planning	Main Functional Zoning, ecological compensation, problem regions, cross-regional development, marine economy, national spatial planning projects, the Belt and Road Initiative	14

The research on human-nature system and regional sustainable development involves a wide range of disciplines, including natural resources research, environmental sciences and social sciences. Thus, this area of enquiry is interdisciplinary and cross-disciplinary. Recently, funded by the National Natural Science Foundation of China (NSFC), CAS Knowledge Innovation Project, the Ministry of Science and Technology of China (MSTC), this field of study has made remarkable progress in revealing the characteristics and dynamics of the human-nature system, modeling and simulation of the system, and examining its territorial differentiation. For example, there are remarkable academic achievements in resources

and environmental foundation of regional development and urbanization, the simulation of the human-nature system (e.g. multi-regional CGE model, spatiotemporal synergy model of multi-factors PRED system, etc.), evolutionary dynamics of social-ecological system, the relationship between economic development and environmental change of old industrial base and its regional differences, the human-nature system of inland river basins and typical ethnic regions (Xu and Zhang, 2001; Shi and Wang, 2005; Fan, 2008; Cao and Zhang, 2013; Fan, 2014).

4.2 Regional disparity and regional development

Since the 1990s, regional disparity has become a key policy issue in China. Apart from such traditional topics as club convergence and provincial-level regional differences, economic geographers in China have paid more attention to smaller-scale and cross-regional disparity in the past decade. Moreover, new factors affecting regional development including globalization, ICT, regional development strategy and their spatial impacts were studied (Xu *et al.*, 2005; Chen, 2008). Chinese economic geographers examined regional policies and related measures of both the central and provincial governments, assessed the effectiveness of these policies and measures, revealing the factors behind changes in regional disparities, and also making policy suggestions. By undertaking this kind of research, Chinese economic geographers have made important intellectual contributions to regional policy formulation in China.

An important output in this regard is the book series of *Regional Development Report of China*, 10 volumes of which have been published (e.g., Lu *et al.*, 1998; Liu *et al.*, 2014). These reports have played a significant role in helping the central and local governments make regional policies and in helping the public understand regional development status and disparities in China. With the CAS support, *Regional Science and Technology Development in China: A Roadmap to 2050* (Lu and Fan, 2009) addresses the directions of the development of regional studies in China. Other influential publications include the book series of *Development Report of Northeastern China* (Deng *et al.*, 2004; Zhang *et al.*, 2009), etc.

4.3 Industrial location and industrial clustering

Industrial location and spatial organization of industries are a worldwide traditional research area in economic geography. Industrial agglomeration, industrial districts and new industrial space were prevalent notions in the 1980s. Since the 1990s, however, such concepts have been replaced by industrial cluster, which is invented by economists but has got spatial meanings with the work of economic geographers. Like in many other countries, industrial cluster has become a policy umbrella with multiple connotations in China. Indeed, studies of industrial agglomeration in China can be traced back to more than forty years ago, in particular in the field of industrial geography. As such, since the late 1990s, economic geographers have pioneered the study of industrial clusters in China. In 1998, supported by NSFC, Wang Jici from Peking University initiated the study of industrial clusters in China. Based on intensive investigations in Zhejiang and Guangdong Provinces, Wang published in 2001 *Innovative Space: Enterprise Clusters and Regional Development* (Wang, 2001), a benchmark book on industrial cluster study in China. In 2003, Wang also created and led the re-

search network for local cluster studies in China.

Since then, industrial cluster has become a major research area of economic geography in China and a huge number of articles and books on this topic were published by Chinese economic geographers, including the book series of *Industrial Clusters in China* (Wang *et al.*, 2010; Mei *et al.*, 2010). In recent years, research on industrial clusters in China has been shifting to paying more attention to upgrading and sustainable development of clusters. The sectors studied are broadened from manufacturing to agriculture and producer services. Economic geographers have applied various approaches and methods to study clusters, such as evolutionary dynamics, spatial econometrics and input-output techniques. They try to reveal knowledge and technology-centered mechanisms, and examine the relation between different types of proximity and the performance of clusters, and roles of social embeddedness, institutions, and internal and external linkages in making and sustaining the competitiveness of industrial clusters (Miao, 2006; Teng and Zeng, 2009; He and Yeung, 2011; Liu *et al.*, 2011; Yang *et al.*, 2012; Zhu and Wang *et al.*, 2013; Miao and Hu, 2015).

4.4 Transportation geography

Since 2000, investments in regional infrastructures in China have grown rapidly, significantly changing the spatial structure of the country's socio-economic development. A series of changes in spatial patterns, network attributes, operational modes and management skills of regional infrastructures have taken place in line with rapid expressway construction, railway construction and optimization of passenger transport system, civil airport construction and network reorganization, container port construction, and intra-metropolitan transport construction. These practical issues give rise to many academic questions to be answered by economic geographers. Against such a background, geographers have studied issues related to these turbulent changes, delineating their spatial results and implications for the socio-economic system. In general, the research focuses on change from place of transport to flow of transport, i.e. from the study on transport allocation and selection of railway lines to the discussion on transport linkages, spatial patterns of passenger and good flows, container and passenger transport network, logistics network and urban transport issues (Jin *et al.*, 2010; Wang and Zhang, 2010).

Chen *et al.* (1992, 2007) reviewed and analyzed transportation development in China, and published *China Transport Geography*. Other major topics include transportation dominance, regional logistics network and accessibility, simulation and evaluation of spatial flow, the complexity of transport networks, urban transport and organization (Jin and Wang, 2004; Liu *et al.*, 2008). For example, Jin *et al.* (2010) put forward the concept and theory of regional transport dominance, a comprehensive method to evaluate regional transportation development. Wang (2008) proposed the notion of "comprehensive regional transportation costs" based on research of spatial organizational network of logistics companies in China. Cao *et al.* (2005) studied urban accessibility of national trunk highway system in China, and revealed the spatial relationships between traffic organization, accessibility, urban spatial structure, and land use evolution in metropolitan areas as well as their dynamics. Meanwhile, complexity theory was introduced to improve the simulation and evaluation methods of spatial flows in transport geography (Wang, 2011).

4.5 Globalization, MNCs and FDI

Globalization is an essential force affecting regional development in China (Liu, 2007; Liu and Dicken, 2006). Since the reform and opening-up in the early 1980s, China has attracted a huge amount of FDI, which was an important factor affecting regional development in China. In the early days, research on FDI by Chinese economic geographers focused on its spatial distribution. In recent years, attention has been paid to patterns of FDI location and disparities of FDI performance (He and Xiao, 2011), as well as the impacts of FDI on regional economic development in China (Teng and Zeng, 2009). Liu and Dicken (2006) developed the notion of ‘obligated embeddedness’ to capture the dynamics of FDI development in China. They found that automotive FDI in China is a type of market-led and embedded investment which is characterized by joint ventures and the follow-up network configurations. Using this case study, they argue that state intervention and potential market size are two key factors for embedding FDI to the benefit of host country.

In general, FDI has simulated economic growth in China, but it also plays a role in the enlarging of regional disparities in the country. Pan *et al.* (2013) found that the spatial pattern of the degree to which regions in China are involved in economic globalization is by and large in accordance with that of GDP per capita. Liu *et al.* (2007) indicated that economic globalization strengthens the ‘T-shaped’ spatial pattern of economic development in China and leads to the rise of a number of major city-regions on the ‘T-shaped’ spatial framework. Chinese economic geographers also argued that spatial relationships between regions can no longer be understood by static geographical distance and location, but should be examined by intensity and extensity of flows, which has been applied in making regional planning (Liu and Lu, 2005; Lu, 2007; Xue *et al.*, 2010). Other research topics in this sub-field include technology spillover of FDI and international trade in energy, mineral products and resources.

4.6 ICT and producer services

ICT is another new key factor that has profound impacts on regional development. Geographers in China have engaged in studying this globally hot-debated issue. Generally speaking, there are four major topics in this research field, i.e. spatial impacts of ICTs, ICT’s impacts on resident activities and travel, ICTs development and its spatial distribution, and the Internet and electronic commerce (Song *et al.*, 2009; Lu *et al.*, 2011; 2009; Zhen *et al.*, 2012; Fang *et al.*, 2013; Song and Liu, 2013). In addition to the spatial-temporal features of ICTs application and electronic commerce development in China, Chinese economic geographers are concerned about the spatial transformation driven by ICTs at different scales and from different sectors and activities. At regional level, they argued that ICTs could enhance the role of mega-cities on one hand, and on the other ICTs could disperse economic activities into peripheral regions owing to the improvement in ICTs infrastructures (Liu and Zeng, 2004). At city level, Wang and Ning (2006) argued that new accessibility of cities follows the urban hierarchy, and the three national network access points (Beijing, Shanghai and Guangzhou) and several regional hub cities are at the top of the accessibility hierarchy. At firm level, Liu *et al.* (2004) indicated that wide application of ICTs has made time-cost and time dependence a crucial factor in the spatial organization of production of firms as a result

of shorter product life and mass customization in particular among other dynamics. That is, the factor of time cost plays a critical role in transforming the spatial organization of production chain although the role of money-cost cannot be ignored.

The Chinese economy has witnessed a shift from manufacturing to producer services in the last decade. Compared with those in developed countries, producer services still make a less significant contribution to economic growth of China but their role is getting more and more important (Yang and Yeh, 2013). Producer services, as intermediate inputs for the production of other goods or services, have important impacts on the society in several aspects, e.g. increasing employment, expanding consumption, upgrading industrial structure, reducing resource consumption, and strengthening the long-term development capacity. Thus producer services have become a hot-debated topic among Chinese economic geographers. Attention has been paid to the location and spatial distribution, spatial structure, spatial pattern and evolution dynamics of producer services as a whole at various scales (from national through metropolitan areas to city level) and of particular sectors of producer services in China. For example, Yang and Yeh (2013) examined change in China's service industries to access the degree to which this process has affected contemporary urban transformation. The input-output method was employed to conduct empirical studies on the growth and structural changes of China's producer services and as well their influences on China's economy and industries. Empirical studies are focused on the spatial distribution of particular sectors of producer services, particularly creative industries and financial industries including banking, securities, and insurance services (Li *et al.*, 2006; Shen *et al.*, 2007; Wu *et al.*, 2007; Zhu *et al.*, 2010).

4.7 Climate change and carbon emission

China is experiencing rapid industrialization and urbanization, and hence its emission of CO₂ has grown phenomenally. At the 2009 United Nations Climate Change Conference at Copenhagen, China announced its target of CO₂ emission reduction, i.e. by 2020 the amount of CO₂ emission per output unit (GDP) will drop by 40%–45% compared to that in 2005. At the 2015 Paris Climate Summit, China made another commitment that its carbon emission will no longer rise by 2030 and the share of renewable energy in its total energy consumption will be lifted to 20%. As such, the relationship between industrial restructuring and CO₂ emission becomes an important research topic in the field of economic geography in China. In recent years, with the highlight of global climate change issues, economic geographers have studied the impacts and dynamics of the human factors (e.g. cross-national and cross-regional industrial transfer and industrial restructuring) on environmental changes at national and sub-national levels.

The research topics on climate change and carbon emission by economic geographers in China include the calculation and decomposition of carbon emissions (focusing on industry, agriculture, transportation, construction and consumption), the identification of affecting factors (e.g. economic growth, population, industrial structure, energy structure and efficiency, and international trade) and countermeasures to reduce carbon emission (Liu *et al.*, 2008; Zhang, 2009; Wang *et al.*, 2010). Empirical investigation is concentrated on three main aspects. They are: (1) the relationship between industrial transfer and carbon emissions,

and the spatial differences and features of carbon emissions at sub-national scale; (2) different paths to low-carbon economic development, e.g. a sketch map of low-carbon economic development in China (Ding *et al.*, 2009; Liu *et al.*, 2010); and (3) the impacts of land use on global environmental change (Zhang, 2003; Zhang *et al.*, 2005; Shi *et al.*, 2012; Wang *et al.*, 2012).

4.8 Spatial planning

Since the 1950s, economic geographers in China have been intensively involved in regional planning and territorial planning at different scales. In recent years, based on basic geographic data, remote sensing data, thematic data of physiographic elements and socio-economic data, economic geographers have employed new methods in making spatial planning to satisfy the needs of multi-purpose decision making (Liu and Lu, 2005; Zhang *et al.*, 2005). By developing integrated database and relevant tools, they try to simulate the scenario of changes of major regional development elements and their spatial effects, including the assessment of construction land, regional accessibility in terms of transport network, dynamic characteristics of land use, spatial patterns of urban system, and comparison between different possible planning schemes. Evaluation methods of resources and environmental carrying capacity, functional zoning methods, and simulation methods based on spatial databases have provided scientific basis for improving regional planning.

Territorial planning was a major means of spatial governance in China in the 1980s and early 1990s, and economic geographers were intensively involved in such planning. Since 2000, as a result of administrative reforms, major tools of spatial governance in China have changed to regional planning and regional policies as well as ecological and environmental regulations. As such, Chinese economic geographers changed to undertake research on integrated planning. Two economic geographers from CAS, i.e. Lu Dadao and Fan Jie, were appointed members of the consulting board of National Development and Reform Committee (NDRC) for making the 12th National Five-Year Planning (FYP). Many economic geographers have provided scientific supports to national integrated planning projects, including Main Functional Zoning, and integrated planning for major mega-regions like Western China, Northeast China and Central China, as well as regions at a lower level such as Yangtze River Delta (YRD), Beijing-Tianjin-Hebei, and Chengdu-Chongqing region, and resources-exhausted cities.

Chinese economic geographers played a key role in making main function zoning a national strategy. It is based on the research and consulting report of economic geographers from CAS that NDRC made main function zoning a major means of spatial governance during the 11th FYP. Economic geographers have contributed to developing zoning methods, selecting assessment indicators, making preliminary zoning, and clarifying major function and development direction of each region. They also developed a technical guidance for making provincial functional zoning and connecting it to the central zoning (e.g. Fan, 2007). Functional zoning is made based on environmental and natural resource carrying capacity, contemporary density of exploitation, and development potentials.

Recently, the Silk Road Economic Belt and the 21st Century Maritime Silk Road, collectively known as the Belt and Road Initiative (BRI), become an important research topic in

China (Liu, 2015). The research team led by Liu Weidong from CAS has provided significant scientific supports to the BRI. Liu (2015) argues that the BRI is a call of China for inclusive globalization, which will coordinate all-around opening of China to the world and promote further integration of the country into the global economy. Its target is to promote orderly and free flow of economic factors, efficient allocation of resources, and deep integration of markets, enable the countries along the Belt and Road to achieve economic policy coordination and carry out broader, deeper, and more efficient economic cooperation. Major research made by economic geographers has focused on the BRI's general background, spatial connotation, framework, facilities connectivity, transnational trade, and cultural cooperation (e.g. Liu, 2015; Liu *et al.*, 2015; Gong *et al.*, 2015; Wang *et al.*, 2015).

5 Characterizing economic geography research in China

5.1 Planning-oriented and practice-based

Given the inter-disciplinary nature of economic geography, it is not surprising to witness that economic geographers in China have been intensively and extensively involved in spatial planning (Fan, 2004; Liu, 2008). In fact, economic geographers in other countries also participated to different degrees in spatial planning of various scales in their respective countries. In China, in the past central-planning regime, economic geographers were extensively involved in various kinds of spatial planning, such as industrial district planning in the 1970s, territorial planning in the 1980s and land-use planning in the 1990s. Since 2000, with the deepening of economic reforms, the past planning means have waned while integrated spatial governance becomes the principal measures. In such a context, economic geographers in China have taken the advantage of their comprehensive knowledge and tradition in spatial planning to undertake many spatial planning missions designated by the governments at various levels, as well as related research projects. For example, they have provided with their research strong scientific supports to the National Development and Reform Commission of China for making planning for implementing the Western Region Development Program and the Northeast Traditional Industrial Base Revitalization Program as well as planning for major economic zones and city clusters. They have become a major player in the field of spatial planning in China. Thus, the recent development path of economic geography in China has been stamped with a clear feature of spatial planning.

5.2 Integration-oriented

The development of economic geography in China has involved more and more interdisciplinary studies that intersect with natural sciences, including physical geography, environmental science, and ecology. Since the new millennium, sustainable development at various scales (global, national, regional and local) has gradually become an important field of academic enquiry of economic geography in China. This academic shift is in part because of the growing nationwide social concern about sustainable regional development in China. In recent years, economic geographers in China have undertaken more and more collaborative studies with colleagues from other disciplines, and are becoming an essential and active force in integrated studies of the earth surface. Thus economic geographers have made great

contributions to the interdisciplinary studies on resources and environmental carrying capacity, resources and environment effects of urbanization, industrial transformation and carbon emissions, etc. In addition, an integrated approach has been developed by economic geographers in making assessment of regional resources and ecological carrying capacity (Fan, 2007; Fan *et al.*, 2015), which was adopted in making the Wenchuan post-earthquake reconstruction planning, Yushu post-earthquake reconstruction planning and Zhouqu reconstruction planning.

5.3 Regionalism

Since the 1990s, regional development and regional differences has become a major study area of economic geography in China. In fact, there is a trend in China to take economic geography mainly as regional studies although there are always disputes (Liu, 2007). However, this by no means parallels the ‘new regionalism’ in Anglo-American economic geography. As widely known, in the flourishing period of quantitative revolution from the 1950s to the 1960s, regional geographical studies in Anglo-American countries were once put on the back shelf because they were considered ‘merely descriptive’. With the recognition of the importance of locality by most Western economic geographers, regional studies went back to the mainstream in the late 1980s. Although ‘region’ has long been an essential object of enquiry in economic geography in China (particularly regional geography), it is in the 1990s that regional studies turned to be a major area of study by economic geographers as a result of increasing regional disparity and related potential risk on national unity. Such issues have challenged relevant disciplines with a great variety of research questions. Among scholars in this research field, economic geographers in China are the pioneers and have undertaken intensive research on regional development and regional disparity, making a lot of consultative contributions to the formulation of regional policies in the country.

5.4 Application of new techniques

New techniques and simulation tools including GIS-based simulation analysis and visualization are more widely used in policy-oriented economic geography research in China. With the application of new techniques, regional development database and simulation of human-nature interaction process have been developed. On the one hand, new techniques and simulation tools have provided various research methods for economic geography research; on the other they also have reinforced the competitiveness of economic geographers, especially enhancing the capability of undertaking national strategic planning projects. It is under such a background that in 2009 CAS established a Key Laboratory of Regional Sustainable Development Modeling at IGSNRR to further explore and promote simulation analysis and visualization in the field of economic geography. The Laboratory has set up an open research platform since its establishment, and is becoming an innovation base for economic geographers to explore new techniques and simulation tools.

5.5 Going towards ‘international’

Since 2000, economic geographers in China, particularly those returnees who got Ph.D. overseas, have been making more and more contributions to international journals, in par-

ticular Anglophone journals. Such international publications are helpful for bridging the gap between economic geographies in China and other countries. On the one hand, there are more and more international academic exchanges between China and Western countries. For example, China held the Second Global Economic Geography Conference at IGSNRR in 2007, and the Regional Studies Association Global Conference in 2012. Besides, the past decade has witnessed more and more collaborations between Chinese economic geographers and scholars from Western countries, and more active participation of young Chinese economic geographers and students at international conferences. On the other hand, more and more Chinese economic geographers are invited to sit on advisory board of major academic journals such as *Progress in Human Geography*, *Eurasian Geography and Economics* and *Contemporary Social Science*, and board of such international organizations as commissions of the *International Geographical Union (IGU)*, *Regional Studies Association (RSA)*, etc. In 2016, in collaboration with RSA, a new journal *Area Development and Policy* whose editorial office is based at IGSNRR of CAS was launched. It will provide a new platform for internationalizing Chinese economic geography. It could be reasonably expected that with the rise of China as a leading economic power, Chinese economic geography will contribute more to knowledge accumulation of the international academic community, in particular providing more knowledge and experiences about development to other developing countries.

6 Conclusions

Economic geography in China has been, and still is, dominated by practice-based research although more and more economic geographers begin to devote themselves to academic research. The so-called practice-based research refers to the research appointed by state agencies, targeted directly at satisfying practical demands from these agencies. The analysis of this paper indicates that, as revealed by Webber (2010), economic geographers in China conducted many short-term research contracts and consultancies, funded by government agencies, and aimed at practical problems. As such, they have played a key role in making spatial planning at both national and regional levels in China. It can be concluded that economic geographers in China have made much more contributions to practice-based research, compared to their Western counterparts.

In the new millennium, traditional research topics still remain dominant in economic geography in China, which include human-nature system and regional sustainable development, regional disparity and policies, industrial location and industrial agglomeration, and transportation geography. In the meantime, new research topics are getting more and more important and popular, including function zoning, climate change and carbon emissions, producer services, ICTs, globalization, FDI, and MNCs. Besides, new theoretical approaches have been introduced into China, such as evolutionary economic geography and social network theory.

Although China's economic geography has made remarkable achievements in the past decades, it is facing challenges (Lu, 2015). Despite Chinese economic geographers begin to contribute to the knowledge accumulation of the international academic community by publishing in Anglophone journals and getting more and more citations, their contributions as a

whole are still limited given the number of economic geographers in China is huge. Thus we argue that the development of economic geography in the future should follow a dual track, i.e. producing knowledge for the international academic community and undertaking policy-oriented research to enhance its role as a major consulting body for national, regional and local development. To do so, Chinese economic geographers must continuously improve their capability to develop and apply new analysis techniques such as GIS tools, geo-computation and spatial intelligence on the one hand and expand international academic exchanges via more and more collaborative research on the other.

References

- Bao J G, Zheng H Y, Dai G Q, 2002. The evolvement of spatial structure and the significance of Guilin's domestic tourist origins. *Acta Geographica Sinica*, 57(1): 96–106. (in Chinese)
- Barnes T J, 2001. Retheorizing economic geography: From the quantitative revolution to the “cultural turn”. *Annals of the Association of American Geographers*, 91(3): 546–565.
- Benko G, Desbiens C, 2004. French economic geography: Introduction to the special issue. *Economic Geography*, 80(4): 323–327.
- Cai Y L, Lu D D, Zhou Y X *et al.*, 2004. Chinese progress and international trends of geography. *Acta Geographica Sinica*, 59(6): 803–810. (in Chinese)
- Cao J, Zhang W Z, 2013. Characteristics of resource-exhausted cities' industrial function in China. *Progress in Geography*, 32(8): 1216–1226. (in Chinese)
- Cao X S, Xue D S, Yan X P, 2005. A study on the urban accessibility of national trunk highway system in China. *Acta Geographica Sinica*, 60(6): 25–32. (in Chinese)
- Chen H, Jin F J, Zhang W C *et al.*, 1992. China Transport Geography. Beijing: Science Press. (in Chinese)
- Chen H, Jin F J, Zhang W C *et al.*, 2007. China Transport Geography. 2nd ed. Beijing: Science Press. (in Chinese)
- Chen W, 2008. Economic Analysis of Spatial Equilibrium. Beijing: China Commerce and Trade Press. (in Chinese)
- Deng W, Zhang P Y, Zhang Y *et al.*, 2004. Development Report of Northeastern China 2004. Beijing: Science Press. (in Chinese)
- Ding Z L, Duan X N, Ge Q S *et al.*, 2009. Content control of CO₂ in atmosphere through 2050: Emission rights of countries. *Science in China: Series D*, 39(8): 1009–1027.
- Fan J, 2004. Comprehensiveness of geography and integrated research on regional development. *Acta Geographica Sinica*, 59(Suppl.): 33–40. (in Chinese)
- Fan J, 2007. The scientific foundation of major function oriented zoning in China. *Acta Geographica Sinica*, 62(4): 339–350. (in Chinese)
- Fan J, 2008. “Man-land relationship territorial system” and economic geography. *Economic Geography*, 28(2): 177–183. (in Chinese)
- Fan J, 2014. Frontier approach of the sustainable process and pattern of human-environment system. *Acta Geographica Sinica*, 69(8): 1060–1068. (in Chinese)
- Fan J, Wang Y F, Tang Q *et al.*, 2015. Academic thought and technical progress of monitoring and early-warning of the national resources and environment carrying capacity. *Scientia Geographica Sinica*, 35(1): 1–9.
- Fang Y P, Xie M, Lin Z P, 2013. A spatial econometric analysis of impact of ICT on service innovation: Based on analysis of 21 cities in Guangdong Province. *Acta Geographica Sinica*, 68(8): 1119–1130. (in Chinese)
- Gong P P, Song Z Y, Liu W D, 2015. Commodity structure of trade between China and countries in the Belt and Road Initiative area. *Progress in Geography*, 34(5): 571–580. (in Chinese)
- Han Z L, You F, Zhang X J, 2001. Formation and evolution mechanism of economic zones along expressways and their allocation and planning. *Geographical Research*, 20(4): 471–478. (in Chinese)

- He C F, 2009. Geographic Concentration and Agglomeration of China's Manufacturing Industries. Beijing: Science Press. (in Chinese)
- He C F, Xiao X J, 2011. Geography of multinational corporations in China: An empirical study of Fortune Global 500 multinational corporations in electronics and medical and chemical industries. *Acta Geographica Sinica*, 66(12): 1669–1681. (in Chinese)
- He C F, Yeung G, 2011. The locational distribution of foreign banks in China: A disaggregated analysis. *Regional Studies*, 45(6): 733–754.
- Henry B, Lu Z, 2000. The change from the geographical space to geocyberspace: Review on the western scholars on regional effects by telecommunication. *Acta Geographica Sinica*, 55(1): 104–111. (in Chinese)
- Hong G Z, Hu H Y, Li X, 2010. Analysis of regional growth convergence with spatial econometrics in China. *Acta Geographica Sinica*, 65(12): 1548–1558. (in Chinese)
- Jin F J, 2013. Welfare-enhancement effect of socio-economic spatial organization. *Geographical Research*, 32(11): 2163–2169. (in Chinese)
- Jin F J, Wang C J, Li X *et al.*, 2010. China's regional transport dominance: Density, proximity, and accessibility. *Journal of Geographical Sciences*, 20(2): 295–309.
- Jin F J, Wang J E, 2004. Railway network expansion and spatial accessibility analysis in China: 1906–2000. *Acta Geographica Sinica*, 59(2): 293–302. (in Chinese)
- Kuhn T S, 1962. The Structure of Scientific Revolutions. Chicago: University of Chicago press.
- Li C G, Li P X, Tan X L *et al.*, 2003. Situation and countermeasures of industrial structure adjustment and escalation of Northeast China. *Scientia Geographica Sinica*, 23(1): 7–12. (in Chinese)
- Li E, Li X, Liu Z, 2011. Relationships and evolving networks of rural manufacturing clusters: A case study in Yucheng County, Henan Province of China. *Chinese Geographical Science*, 21(3): 364–376.
- Li G P, Sun T S, Lu M H, 2003. A study on the process, characteristics and influencing factors of Beijing's hi-tech industrial agglomeration. *Acta Geographica Sinica*, 58(6): 927–936. (in Chinese)
- Li X J, Fan X S, Luo Q, 2014. The development of Chinese economic geography: A review on papers published in *Acta Geographica Sinica* from 1934 to 2013. *Acta Geographica Sinica*, 69(8): 1093–1108. (in Chinese)
- Li X J, Zhou X F, Wei C J *et al.*, 2006. Locational changes of banking services in the less developed region of China since 1980. *Acta Geographica Sinica*, 61(4): 414–424. (in Chinese)
- Li X J, Zhou X F, Zheng C H, 2008. Geography and economic development in rural China: A township level study in Henan Province, China. *Acta Geographica Sinica*, 63(2): 147–155. (in Chinese)
- Li X X, Liu M L, Ge J Y, 2010. Geographical factor analysis for the household income in frontier region of Southwest China. *Acta Geographica Sinica*, 65(2): 235–243. (in Chinese)
- Liu H, Yeerken W, Wang C L, 2015. Impacts of the Belt and Road Initiative on the spatial pattern of territory development in China. *Progress in Geography*, 34(5): 545–553. (in Chinese)
- Liu H L, Bao A M, Chen X *et al.*, 2008. The effect of transport accessibility on regional economic performance. *Acta Geographica Sinica*, 63(4): 428–436. (in Chinese)
- Liu W D, 2007. Economic Geography. In: Cai Yunlong (ed.), Recent Progress of Geography in China: A Perspective in the 21st Century. Beijing: The Commercial Press, 92–147.
- Liu W D, 2009. Where is the bridge? *Progress in Human Geography*, 33(1): 7–9.
- Liu W D, 2015. Scientific understanding of the Belt and Road Initiative of China and related research themes. *Progress in Geography*, 2015, 34(5): 538–544. (in Chinese)
- Liu W D, Dicken P, 2006. Transnational corporations and 'obligated embeddedness': Foreign direct investment in China's automobile industry. *Environment and Planning A*, 38(7): 1229.
- Liu W D, Dicken P, Yeung H, 2004. New information and communication technologies and local clustering of firms: A case study of the Xingwang industrial park in Beijing. *Urban Geography*, 25(4): 390–407.
- Liu W D, Jin F J, Zhang W Z *et al.*, 2011. Progress in economic geography (2006–2011). *Progress in Geography*, 30(12): 1479–1487. (in Chinese)
- Liu W D, Liu H G *et al.*, 2012. Sector-specific spatial statistic model for estimating inter-regional trade flows. *Acta Geographica Sinica*, 67(2): 147–156. (in Chinese)

- Liu W D, Long H L, Zhang L X *et al.*, 2014. Regional Development Report of China 2013. Beijing: The Commercial Press. (in Chinese)
- Liu W D, Lu D D, 2002. Rethinking the development of economic geography in mainland China. *Environment and Planning A*, 34(12): 2107–2126.
- Liu W D, Lu D D, 2005. Methodological basis for making regional spatial planning in China in the new era. *Acta Geographica Sinica*, 60(6): 894–902. (in Chinese)
- Liu W D, Lu D D, Zhang L *et al.*, 2010. A Sketch Map of Low-carbon Economic Development in China. Beijing: The Commercial Press. (in Chinese)
- Liu W D, Zhen F, 2004. Spatial implication of new information and communication technologies. *Acta Geographica Sinica*, 59(Suppl.): 67–76.
- Liu Y H, Ge Q S, He F N, 2008. Countermeasures against international pressure of reducing CO₂ emissions and analysis on China's potential of CO₂ emission reduction. *Acta Geographica Sinica*, 63(7): 675–682. (in Chinese)
- Liu Z G, Wang C, Li E L *et al.*, 2014. Research progress of economic geography research in China. *Acta Geographica Sinica*, 69(10): 1449–1458. (in Chinese)
- Liu Z G, Yin Y M, Liu W D *et al.*, 2015. Visualizing the intellectual structure and evolution of innovation systems research: A bibliometric analysis. *Scientometrics*, 103(1): 135–158.
- Liu Z G, Yin Y M, Sun J, 2011. A review of the research progress on industrial cluster formation from the perspective of evolutionary economic geography. *Progress in Geography*, 30(6): 652–657. (in Chinese)
- Lu D D, 2001. An analysis of spatial structure and optimal regional development. *Acta Geographica Sinica*, 56(2): 127–135. (in Chinese)
- Lu D D, 2015. The value of geographical science and the feelings of geographers. *Acta Geographica Sinica*, 70(10): 1539–1551. (in Chinese)
- Lu D D, Fan J, 2009. Regional Science and Technology Development in China: A Road Map to 2050. Beijing: Science Press. (in Chinese)
- Lu D D, Xuan F, Fan J *et al.*, 1998. Regional Development Report of China 1997. Beijing: The Commercial Press. (in Chinese)
- Lu L C, 2007. Global city theory and building international cities in China. *Scientia Geographica Sinica*, 27(4): 449–456. (in Chinese)
- Lu Y Q, 2002. The mechanism of the model of dual-nuclei structure. *Acta Geographica Sinica*, 57(1): 85–95. (in Chinese)
- Lu Y Q, Yuan L W, Zhong Y X, 2011. The evolutionary model of central place system. *Chinese Science: Earth Science*, 41 (8): 1160–1171. (in Chinese)
- Lu Z, Li X N, Yang L H *et al.*, 2011. Location orientation of E-shops in China's major cities based on neighborhood facilities: Case studies of Shanghai, Shenzhen, Tianjin and Beijing. *Acta Geographica Sinica*, 66(6): 813–820. (in Chinese)
- Mei L X *et al.*, 2010. Globalization, Cluster Transformation and Innovative Enterprises. Beijing: Science Press. (in Chinese)
- Miao C H, 2006. Global-local nexus and technological learning in industrial cluster: A case study of hair-goods industry in Xuchang, Henan Province. *Acta Geographica Sinica*, 61(4): 425–434. (in Chinese)
- Miao C H, Hu Z Q, 2015. The nature of urban agglomeration space and the construction of Zhongyuan Urban Agglomeration. *Progress in Geography*, 34(3): 271–279. (in Chinese)
- Pan F H, Liu Z L, Xia Y B *et al.*, 2013. Location and agglomeration of headquarters of public listed firms within China's urban system. *Geographical Research*, 32(9): 1721–1736. (in Chinese)
- Pan F H, Xia Y B, Liu Z L, 2013. The relocation of headquarters of public listed firms in China: A regional perspective study. *Acta Geographica Sinica*, 68(4): 449–463. (in Chinese)
- Pritchard A, 1969. Statistical bibliography or bibliometrics. *Journal of Documentation*, 25(4): 348–349.
- Qiu L, Shen Y M, Ren W B, 2008. Industrial relevancy and spatial distribution between producer services and manufacturing in Beijing City. *Acta Geographica Sinica*, 63(12): 1229–1310. (in Chinese)

- Scott A J, 2000. Economic geography: The great half-century. *Cambridge Journal of Economics*, 24(4): 483–504.
- Schamp E. W., 2007. Denkstile in der deutschen Wirtschaftsgeographie: Aktuelle Umbrüche seit 1970. *Zeitschrift für Wirtschafts Geographie*, 51(3/4): 238–252.
- Shen Y M, Qiu L, Wang Mao J *et al.*, 2007. Industry relevancy analysis of producer services in China. *Acta Geographica Sinica*, 62(8): 821–830. (in Chinese)
- Shi M J, Wang T, 2005. An application of bio-economic household model to analysis on man-land relationship behavior in ecologically fragile land of China. *Acta Geographica Sinica*, 60(1): 165–174. (in Chinese)
- Shi M J, Wang Y, Zhang Z Y *et al.*, 2012. Regional carbon footprint and interregional transfer of carbon emissions in China. *Acta Geographica Sinica*, 67(10): 1327–1338. (in Chinese)
- Song Z Y, Ding J H, Liu W D *et al.*, 2009. Spatial implication of new information and communication technologies on small and medium-sized enterprises: A case study of clothing industry. *Acta Geographica Sinica*, 64(4): 435–444. (in Chinese)
- Song Z Y, Liu W D, 2013. Spatio-temporal analysis of regional and provincial informatization in China. *Scientia Geographica Sinica*, 33(3): 257–265. (in Chinese)
- Song Z Y, Liu W D, 2014. The challenge of wide application of information and communication technologies to traditional location theory. *Journal of Geographical Sciences*, 23(2): 315–330.
- Teng T W, Zeng G, 2009. Cluster Innovation and the Transformation of High-tech Zone. Beijing: Science Press. (in Chinese)
- Van Leeuwen T N, 2013. Bibliometric research evaluations, web of science and the social sciences and humanities: A problematic relationship? *Bibliometrie-Praxis und Forschung*, 2: 1–18.
- Wang B, Zhen F *et al.*, 2013. A study of cybergeography based on micro-blog users' relationship: With a case of Sina micro-blog. *Geographical Research*, 32(2): 380–391. (in Chinese)
- Wang B L, Zhang X L, 2010. The contribution of highway traffic infrastructure construction to economic growth in Xinjiang based on I-O and ESDA. *Acta Geographica Sinica*, 65(12): 1522–1533.
- Wang C, Lin G C, 2013. Dynamics of innovation in a globalizing china: regional environment, inter-firm relations and firm attributes. *Journal of Economic Geography*, 13(3): 397–418.
- Wang C J, 2008. Spatial organizational network of logistics company in China. *Acta Geographica Sinica*, 63(2): 135–146. (in Chinese)
- Wang J C, 2001. Innovative Space: Enterprise Clusters and Regional Development. Beijing: Peking University Press. (in Chinese)
- Wang J C, 2004. Some related concepts in China's research of industrial cluster. *Acta Geographica Sinica*, 59(Suppl.): 47–52. (in Chinese)
- Wang J C *et al.*, 2010. Beyond the Cluster: Theoretical Exploration of Chinese Industrial Cluster. Beijing: Science Press. (in Chinese)
- Wang D, Li F, Chai Y, 2012. Activity spaces and sociospatial segregation in Beijing. *Urban Geography*, 33(2): 256–277.
- Wang J E, Mo H H, Wang F H *et al.*, 2011. Exploring the network structure and nodal centrality of China's air transport network: A complex network approach. *Journal of Transport Geography*, 19(4): 712–721.
- Wang J E, Wang H, Jiao J J, 2015. China's international aviation transport to the Belt and Road Initiative area. *Progress in Geography*, 34(5): 554–562. (in Chinese)
- Wang J Y, Liu Z G, 2014. A bibliometric analysis on rural studies in human geography and related disciplines. *Scientometrics*, 101(1): 39–59.
- Wang T, Hennemann S, 2011. Spatial structural evolution of knowledge network and its impact on the NIS. *Geographical Research*, 30(10): 1861–1872. (in Chinese)
- Wang M F, Ning Y M, 2004. The internet and the rise of information network cities in China. *Geographical Research*, 59(3): 446–454. (in Chinese)
- Wang Z, Zhu Y B, Liu C X *et al.*, 2010. Integrated projection of carbon emission for China under the optimal economic growth path. *Acta Geographica Sinica*, 65(12): 1559–1568. (in Chinese)
- Webber M, 2010. Re-emerging China and consequences for economic geography. *Eurasian Geography and Eco-*

- nomics*, 51(5): 583–599.
- Wu Q B, Ning Y M, 2010. Headquarter location of top 500 enterprises of Chinese manufacturing industries. *Acta Geographica Sinica*, 65(2): 139–152. (in Chinese)
- Xu J H, Lu F, Su F L *et al.*, 2005. Spatial and temporal scale analysis on the regional economic disparities in China. *Geographical Research*, 24(1): 57–68. (in Chinese)
- Xu X Q, Zhang J J, 2001. Comprehensive evaluation of Guangzhou urban sustainable development. *Acta Geographica Sinica*, 56(1): 54–63. (in Chinese)
- Xue D S, Huang G Z, Weng X L *et al.*, 2010. Urban globalization process of China's since the early 1980s. *Acta Geographica Sinica*, 65(10): 1155–1162.
- Yang F, Yeh A, 2013. Spatial development of producer service in the Chinese urban system. *Environment and Planning A*, 45: 159–179. (in Chinese)
- Yang X G, Fan J, Zhao Y X, 2002. Factors of production in regional economic growth of China in the 1990s. *Acta Geographica Sinica*, 57(6): 701–708. (in Chinese)
- Yang Z S, Sliuzas R, Cai J M, 2012. Exploring spatial evolution of economic clusters: A case study of Beijing. *International Journal of Applied Earth Observation and Geo-information*, 19: 252–265.
- Yeung H W C, Liu W D, 2006. Teaching economic geography in two contrasting Asian contexts: Decentering Anglo-American economic geography in China and Singapore. *Journal of Geography in Higher Education*, 30(3): 449–455.
- Yuan F, Wei Y H, Chen W *et al.*, 2010. Spatial agglomeration and new firm formation in the information and communication technology industry in Suzhou. *Acta Geographica Sinica*, 65(2): 153–163. (in Chinese)
- Zeng G, Bathelt H, 2011. Divergent growth trajectories in China's chemical industry: The case of the newly developed industrial parks in Shanghai, Nanjing and Ningbo. *GeoJournal*, 76(6): 675–698.
- Zeng G, Wen H, 2004. A study on the IT cluster in Pudong of Shanghai. *Acta Geographica Sinica*, 59(Suppl.): 59–66. (in Chinese)
- Zhang L, 2003. Economic development and its bearing on CO₂ emissions. *Acta Geographica Sinica*, 58(4): 629–637. (in Chinese)
- Zhang P Y *et al.*, 2009. Development Report of Northeastern China 2008. Beijing: Science Press. (in Chinese)
- Zhang W Z, Liu W, Meng B, 2005. On location advantage value of residential environment in the urban and suburban area of Beijing. *Acta Geographica Sinica*, 60(1): 115–121. (in Chinese)
- Zhang X P, 2009. Carbon dioxide emissions embodied in China's foreign trade. *Acta Geographica Sinica*, 64(2): 234–242. (in Chinese)
- Zhang Y G, Wei D L, Wang G L *et al.*, 2005. Analysis of interprovincial space difference in marine economy and the building of marine economically strong provinces in China. *Geographical Research*, 24(1): 46–56. (in Chinese)
- Zhao Y, Yang Z Y, Hao L S *et al.*, 2012. The evolution of spatial displacement pattern of China's crude oil flow source-sink system. *Acta Geographica Sinica*, 67(4): 455–466. (in Chinese)
- Zhen F, Gu C L, 2002. New perspectives on spatial structure research in information era. *Geographical Research*, 21(2): 257–266. (in Chinese)
- Zhen F, Wang B, Chen Y X, 2012. China's city network characteristics based on social network space: An empirical analysis of Sina micro-blog. *Acta Geographica Sinica*, 67(8): 1031–1043. (in Chinese)
- Zhong S E, Zheng F, Zhang J *et al.*, 2012. Retrospects and prospects: Information geography in Nanjing University. *Scientia Geographica Sinica*, 32(10): 1214–1219. (in Chinese)
- Zhu H Y, Wang J C, 2013. Delocalization and development: The practice from Euramerican countries and the enlighten to China. *Economic Geography*, 33(2): 6–11. (in Chinese)
- Zhu H S, Wu J Y, Wei J L *et al.*, 2010. Creative networking in developing countries: A case study of design industry in Shanghai, China. *Acta Geographica Sinica*, 65(10): 1241–1252. (in Chinese)