Chin. Geogra. Sci. 2022 Vol. 32 No. 1 pp. 1−15
https://doi.org/10.1007/s11769-022-1255-7

Springer Science Press
www.springerlink.com/content/1002-0063

Revisiting the Relationship Between Urbanization and Economic Development in China Since the Reform and Opening-up

LIANG Longwu[1, 2, 3], CHEN Mingxing[1, 2, 3], LU Dadao[1, 2, 3]

(1. *Institute of Geographic Sciences and Natural Resources Research*, *Chinese Academy of Sciences*, *Beijing* 100101, *China*; 2. *Key Laboratory of Regional Sustainable Development Modeling*, *Chinese Academy of Sciences*, *Beijing* 100101, *China*; 3. *College of Resources and Environment*, *University of Chinese Academy of Sciences*, *Beijing* 100049, *China*)

Abstract: The relationship between urbanization and economic development has become a hot topic in the scientific community due to its great practical significance, and economic and social value. However, this relationship continues to change dynamically. In the new stage of urbanization, it is urgent to reveal the causal relationship quantitatively and diagnose the future direction systematically. Based on this, this paper calculates the contribution rate of China's urbanization to economic development from 1978 to 2019 and uses the panel data cointegration test method to explore the causal relationship between urbanization and economic development in China. The study has three principal results. First, the contribution rate of urbanization to economic growth has maintained the overall growth trend from 1978 to 2019, but the growth rate of urbanization's contribution to economic growth has been relatively low since 2012. It is an important reason that the real estate sector has moved into a new stage of transformation. Second, the cointegration test shows that economic development is a significant factor in advancing urbanization and the urbanization is the product of economic development. Urbanization has a positive feedback effect on economic development, but this effect does not pass the 5% significance level test. The impulse response function shows that the impact of urbanization on economic development is relatively small and stable, indicating that it is limited that the boost of economic development by land-centered urbanization. Third, China's urbanization and economic development have both shown rapid growth for some time, but their relationship is still the low level of coordination, which has also led to a downward trend in the contribution of new-type, people-oriented urbanization to economic growth in recent years. In the future, China's urbanization and economy need to maintain relatively medium-low speed growth in the medium-long term, and we should boost the coordinated development of urbanization and economy from low level to high level.

Keywords: urbanization; economic development; causal relationship; people-oriented; medium-low growth speed

Citation: LIANG Longwu, CHEN Mingxing, LU Dadao, 2022. Revisiting the Relationship Between Urbanization and Economic Development in China Since the Reform and Opening-up. *Chinese Geographical Science*, 32(1): 1−15. https://doi.org/10.1007/s11769-022-1255-7

1 Introduction

Urbanization has created tremendous value in economic and social development and significantly improved residents' quality of life (Bloom et al., 2008; Christine et al., 2020), and has a significant effect on mitigating urban-rural income disparity (Wang et al., 2019a). Urbanization and economic development in China have resulted in world-renowned achievements since 1978; the urbanization rate has increased from 17.90% in 1978 to 60.60% in 2019, and total economic output has rose from eleventh place in the world to second place (Liu et al., 2016a; Chen et al., 2019). The two accomplishments have made great contributions to global urbaniza-

Received date: 2021-05-09; accepted date: 2021-09-08
Foundation item: Under the auspices of National Natural Science Foundation of China (No. 41530634, 41822104, 42171204)
Corresponding author: CHEN Mingxing. E-mail: chenmx@igsnrr.ac.cn

tion and economic development. However, the rapid economic growth and extensive urban development have also led to ecological damage (Lu, 2013; Wang et al., 2019b), environmental pollution (Chen et al., 2010; He et al., 2018; Liang et al., 2019), increased the carbon emissions (Sadorsky, 2014) and the challenges to the sustainable development of the economy and society (Lin and Yi, 2011; Deng et al., 2015; Chen et al., 2015a). The release of the 'National New Urbanization Plan (2014–2020)' in 2014 marked a major transformation from 'quantity growth' to 'quality improvement' in China's urbanization (Chen, 2015). Urbanization focused on promoting urban-rural integration and equality of basic public services. Economic development seeks innovative, high-quality development and green, low-carbon growth, focusing on improving the residents' welfare (Lu and Wan, 2014; Chen, 2017a; Zhang and Li, 2018). In the mid-late stages of urbanization, compared with the initial and accelerated stages, the relationship between urbanization and economic development has reached a major turning point, and urbanization and economic development are facing many new challenges and opportunities. Thus, it needs an in-depth exploration of the relationship between these factors in the context of the new era of mid-late stage urbanization, to clarify the evolution trend of urbanization and its contribution to economic growth, and quantitatively account for the internal causal feedback mechanism between them.

The exploration of the relationship between urbanization and economic development is a classic scientific issue of the humanities and economic geography. A large amount of literature study this topic because of its academic significance and economic and social value (Zhou and Ma, 2003; Bettencourt et al., 2007; Liu et al., 2016b; Chen, 2017b). Foreign scholars discussed the relationship between urbanization and economic development as early as the 1950s (Reiss, 1954), and China' scholars began to study this relationship in the 1980s (Zhou, 1982). They have conducted the in-depth discussions on it and have come to several widely recognized viewpoints: the relationship is fundamentally reciprocal, urbanization does not seriously lag behind economic development (Chen et al., 2009), urbanization experienced rapid growth from 2000 to 2010 (Lu et al., 2007; Chen et al., 2013), and it has spawned a series of regional issues (Fang and Liu, 2007). In recent years, urbanization and economic development in China have shown a slowdown after long period of rapid growth, in which economic growth has exceeded the carrying capacity of the environment and faced serious structural issues. This transition is inevitable in the medium rate of growth (Lu, 2015). China's economic growth will gradually fall back to the 'new normal' of medium-low growth (Chen et al., 2016), with the shrinking international demand and the gradual decline of the demographic and environmental dividends.

The academic community generally believed that there is a relationship of mutual reinforcement between urbanization and economic development, developed the relationship model and re-quantified the curve parameters (Northam, 1975; Laumas and Williams, 1984; Di Clemente et al., 2021). Chennery and Syrquin (1975) obtained the matching model of the relationship between them based on the regression results by using the datasets of more than 100 countries from 1950 to 1970, and China's scholars re-estimated the relevant quantitative forms of the Channery Model based on new data (Zhao and Zhang, 2009; Chen et al., 2015b). The interprovincial pattern of the relationship between them in China shows obvious differences between the east and the west. The urbanization led the economic development in the eastern coastal areas, while the urbanization lagged behind the economic development (Chen et al., 2014b). There are also significant regional differences in the relationship between them at the level of the prefecture, the types include the under-urbanization, basic coordination and over-urbanization (Yang et al., 2020). These similar characteristics can be found at the county level (Yang et al., 2019). Northam's urbanization speed curve reflects the inverted U-shaped characteristics of the speed of urbanization, depicting the cyclical law of urbanization and economic development at the time level (Chen et al., 2014a).

The academic community has made remarkable progress in understanding the relationship between urbanization and economic development, but there are two points that need further study. First, the existing literature mainly discusses the relationship between them, but few studies quantitatively reveal the causal relationship between them in the long run. Second, the relationship between them changed, the existing research mainly focuses on the changes in the relationship between them in

the early and middle stages of urbanization. At present, the development of urbanization is in the middle and late stages, so it is urgent to re-explore the relationship between them by integrating the characteristics of the new stage. We analyze the evolution process of population urbanization, land urbanization and economic development, use the contribution rate identification method to quantitatively analyze the changes of urbanization's contribution to economic development, use the panel data cointegration model to measure the causality between them in China from 1978 to 2019. Finally, we discuss the future trends of urbanization and economic development and their relationship. At present, China's urbanization and economic development have entered a new stage of high-quality development, which further determines the new-type urbanization of people-oriented principles and innovation-driven economic development. However, the future development trend is still not clear. This study provides a theoretical basis for the scientific understanding of their relationship, the causal feedback mechanism and the future trends.

2 Data and Methods

2.1 Data sources

This paper uses 'the proportion of urban permanent population in the total population' to measure the urbanization rate, which fully reflects the actual number of urban residents' normalization. Urbanization is essentially a lifestyle location choice, and a person who lives in the city represents urbanization. Using per capita GDP to reflect the level of economic development can eliminate the impact of population size on economic development. The data sets of the study are the population, urbanization rate urban expansion and economic development data from 31 provinces from 1978 to 2019 in China. The research areas exclude Hong Kong, Macao and Taiwan of China, considering the availability and connectivity of data. These data are from the China Statistical Yearbook from 1979 to 2020 (China Bureau Statistics, Survey Office of the National Bureau of Statistics, 1979–2020). In the process of the cointegration test, to eliminate possible heteroscedasticity of the data, this paper carries out natural logarithm processing on the indicators, and the urbanization rate and economic development indicators are recorded as $\ln UR_t$ and $\ln PGDP_t$, respectively.

2.2 Contribution rate identification method

Since the reform and opening-up in 1978, the main characteristics of China's urbanization have been the influx of rural population into cities, land sprawl and acceleration of urban construction, which promoted the rapid increase in the urbanization rate and urban spatial scope. The process of urbanization has led to the vigorous development of the real estate industry (Wu, 2001), the construction industry (Wang et al., 2015a), and the accommodation and catering industry, as well as to the rapid growth in the industry's output value. Based on this, to comprehensively reflect the contribution of the urbanization process to economic growth, this paper uses the sum of the abovementioned industrial output values to characterize the economic contribution value of the urbanization process. The formula is:

$$CV_j = REI_j + CI_j + ACI_j \tag{1}$$

where CV_j represents the contribution value of the urbanization process to economic growth in year j, and REI_j, CI_j, and ACI_j represent the contribution values of the real estate industry, construction industry, accommodation and catering industry to economic growth, respectively.

This paper draws on the relevant measurement methods (Cao and Liu, 2011) of the contribution rate to quantitatively evaluate the contribution rate of urbanization to economic growth. The formula is:

$$CR_j = \frac{CV_j}{GDP_j} \tag{2}$$

where CR_j represents the contribution rate of the urbanization process to economic growth in year j, GDP_j represents value of GDP in year j. At the same time, this method can also be used to calculate the contribution rate of each industry to economic growth.

2.3 Causality identification methods of panel data

2.3.1 Unit root test method

Stationarity is the premise of time series analysis; if the time series data have a stable mean, variance and autocovariance, it is stable; otherwise, it is unstable (He et al., 2015). If the nonstationary time series data become the stationary series after d order difference, then the data are called integrated of order d. Because the premise of the cointegration test is that the tested variables must be time series with the same root, this paper selects the unit root method to test the stationarity of the

time series data. The model of the panel data unit root test is as follows:

$$y_{it} = \rho_i y_{it-1} + X_{it}\delta_i + \varepsilon_i (i = 1, 2...N; t = 1, 2...T) \quad (3)$$

where y_{it} and $y_{it\text{-}1}$ represent the time series data of t and t–1 period, respectively, and X_{it} represents exogenous variables, including individual fixed effect or time trend, ρ_i represents autoregressive coefficients, ε_i represents error terms and δ_i represents residual coefficients, i represents the number of units. If $|\rho_i| < 1$, then y_{it} is stationary; if $|\rho_i| = 1$, then y_{it} contains a unit root, and y_{it} is non-stationary (Wang et al., 2014).

2.3.2 Cointegration test method

There are two main methods for panel cointegration tests. The first is the zero hypothesis that 'there is no cointegration relationship', and the statistical test is constructed based on the residuals obtained from stationary regression, which is applicable to both homogeneous and heterogeneous panels. The representative test is the Pedroni test (Pedroni, 2004). The second is the LM test based on regression residuals, and its representative tests include the Kao test (Kao, 1999) and the Westerlund test (Westerlund, 2005). Considering the robustness of the panel cointegration test, this paper uses the Pedroni test and the Kao test, which are widely used in domestic and foreign research. The Pedroni test used the cointegration equation to estimate the skew coefficients, fixed effect coefficients and individually determined trends of different sections under the null hypothesis without cointegration relationships. The method tests the stationarity of regression residuals by constructing seven types of panel cointegration test statistics, including panel v, panel rho, panel PP and panel ADF statistics of the intragroup dimension and group rho, group PP and group ADF statistics of the intergroup dimension.

2.3.3 Granger causality test method

After using the cointegration test to determine whether there is a long-term stable relationship between variables, if we want to judge the causal relationship between variables, we need to carry out the Granger causality test on variables. The Granger causality test was proposed by Granger and is only used for stationary series tests. Granger proposed a new definition of causality from the perspective of prediction: if X is helpful to predict Y, then X is the Granger cause of Y; that is, the past information of X contained in the information set can improve the accuracy of Y prediction, and the test process is the Granger causality test (Granger, 1988).

3 Results

3.1 Progress of the urbanization and economic development since the reform and opening-up

Since the reform and opening-up, China's urbanization and economic development have made remarkable achievements and contributed greatly to global urbanization and economic development. Although they have long maintained a positive relationship of mutual reinforcement, the coordinated relationship has aimed primarily at quantitative growth; the quality of development remains at a relatively low level and need to further improve the quality.

China's permanent population urbanization rate increased from 17.92% in 1978 to 60.60% in 2019, with an average annual growth rate of 1.04%, far higher than the world average (0.42%) (China Bureau Statistics, Survey Office of the National Bureau of Statistics, 1979–2020). China has experienced the largest scale and fastest urbanization process in world history. In comparison, the urbanization speed of the east region of China is higher than those of other regions. There are five provinces in the east, among the six provinces with urbanization rate growth value exceeding 0.50 (Fig. 1a). The urbanization rate exceeded 30% in China in 1996, entering the urbanization rapid development stage described in the 'Northam curve' (Chen et al., 2014a). There are several periods of China's urbanization in the pattern of world since the reform and opening-up, which is the stable stage of ascension (1979–1995), the rapid promotion stage (1996–2013) and the transition to a higher, slower growth stage (2014–2016) (Chen et al., 2013, 2018; Gu et al., 2017). However, the characteristics of China's semiurbanization are evident. The household population urbanization rate is not high, only 44.38% in 2019, and the difference between the permanent and household population urbanization rate has increased to 16.22%, with an increasing proportion of the population separated from their registered homes. Migrant workers work in cities for higher labor remuneration and retain rural household registration, but their basic living needs are difficult to meet.

Through the land financial system, the city can accelerate the expansion of development space. Since the re-

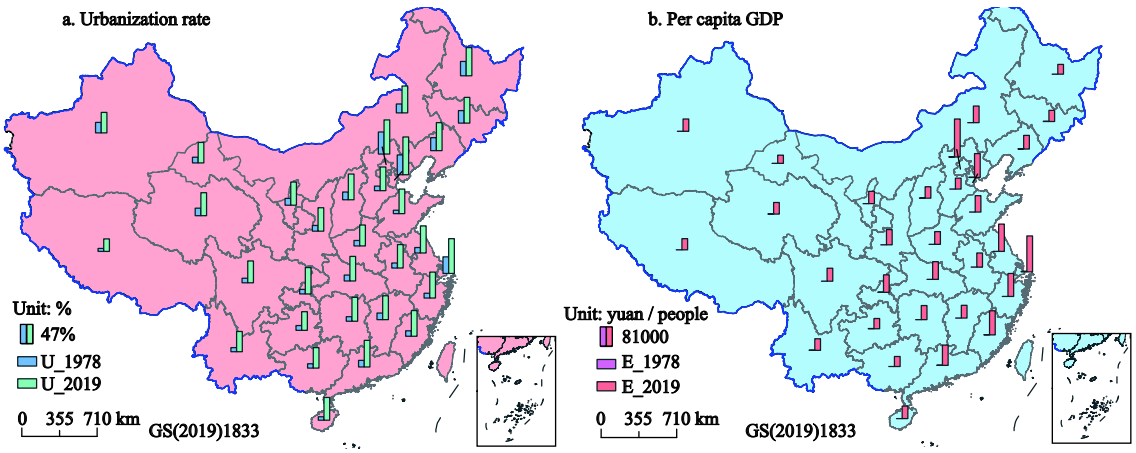

Fig. 1 Spatial pattern of urbanization rate and per capita GDP of China in 1978 and 2019. (Not including Hong Kong, Macao and Taiwan of China due to unavailable data)

form and opening-up, China's urban construction land area has increased from 672 km^2 in 1981 to 56 100 km^2 in 2018. Urban land development has brought huge profit space for the urban economy (Huang et al., 2016), and the revenue of the national land transfer fee was approximately 7.8 trillion yuan (RMB) in 2019, which greatly contributed to China's economic growth. The expansion of urban space has resulted in closer contact among cities. Large and medium-sized cities have sprawled and merged for development (Fang et al., 2019), forming the local urban agglomerations (metropolitan area) with big cities as the core. The development of metropolitan areas avoided the phenomenon of large-scale enclosures (Lu, 2020).

China's economic aggregate ranks second in the world, with per capita GDP increasing from 384.73 yuan per person in 1978 to 70.500 thousand yuan per person in 2019. Through the space, the economic growth level of the east is higher than those of other regions (Fig.1b). There are seven provinces (or autonomous region, municipality) with the per capita GDP of more than 80 thousand yuan/person in 2019, all of which are in the east. The industrial structure has been optimized and adjusted. The output value ratio of three industries has been adjusted from 27.7 : 47.7 : 24.6 to 7.1 : 38.6 : 54.3, with the output value structure changed from 'first, second, third' to 'third, scond, first', and the industrial structure has become more reasonable. However, long-term rapid economic development has also caused ecological and environmental issues, such as ozone (Wang et al., 2020), $PM_{2.5}$ (Chen et al., 2020), nitrogen oxide NO*x*, volatile organic compound VOCs and other serious air pollution.

3.2 Contribution rate of urbanization to economic growth

3.2.1 Change trend of urbanization's contribution to economic growth

According to formulas (1)–(2), this article calculates the value of the contribution and the contribution rate of urbanization to economic growth from 1978 to 2019. Fig. 2 shows that, since the reform and opening- up, the contribution rate of urbanization to economic growth has shown a fluctuating growth trend, from 7.15% in 1978 to 15.86% in 2019, and the overall level is not high. The average growth rate of the contribution value of urbanization to economic growth was from 17.23% in 1978 to 15.86% in 2019, but the growth rate had fallen below 15.00% since 2012, reaching as low as 8.14% in 2019. The reports of the 18th National Congress of the Communist Party of China insisted on the path of new urbanization, indicating that the contribution of people-oriented new urbanization to economic growth is showing a trend of medium-low growth. This is mainly because the development of new urbanization pays more attention to economic green growth and sustainable development, while rapid economic growth brought about by the urbanization process can not meet the needs of sustainable development. Against the backdrop of the new era, economic development needs to be adjusted to medium-speed growth, with full consideration of the sustainability requirements of resource utilization and environmental protection. The main reason for the rising contribution rate of urbanization to economic growth is the rapid growth of the real estate industry. With the swift development of land urbanization, urban housing prices continue to rise and the real estate industry has

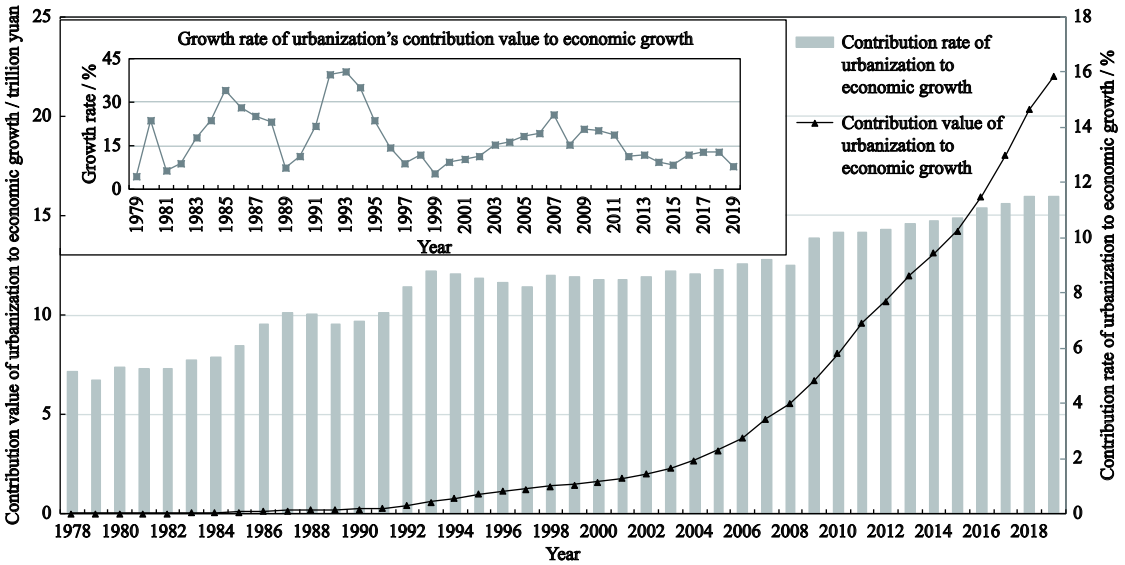

Fig. 2 Change trend of the contribution rate of urbanization to economic development from 1978 to 2019 of China. (Not including Hong Kong, Macao and Taiwan of China due to unavailable data)

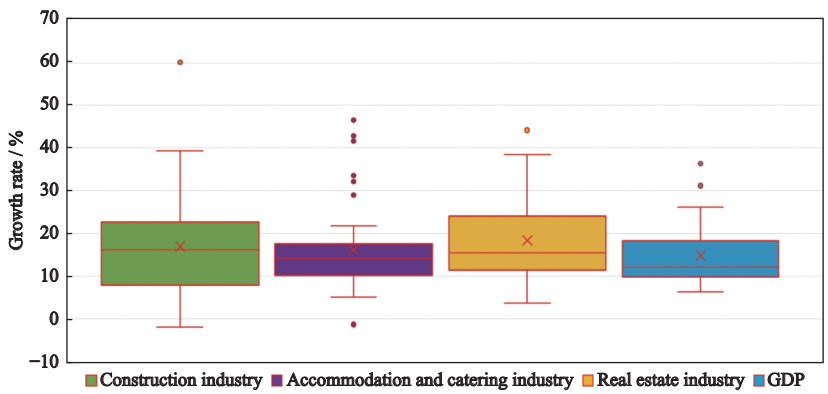

Fig. 3 Growth rates of the China's three major industries and GDP from 1978 to 2019. (Not including Hong Kong, Macao and Taiwan of China due to unavailable data)

experienced corresponding growth. Fig. 3 shows that the overall growth rate of the real estate industry is higher than that of the construction industry, accommodation and catering industry, and GDP. The output value of the real estate industry increased from 7.9 billion in 1978 to 6.96 trillion yuan in 2019, an increase of 872 times, 509 times greater than that of the construction industry and 403 times greater than that of the accommodation and catering industry. The next section explores the development trend of the real estate industry.

3.2.2 The real estate industry has entered a new stage of transformation in recent years

Since the reform and opening up, the real estate industry has developed rapidly. With a growth rate of more than 40%, it has quickly become a pillar industry of economic growth and made great contributions to China's economy (Li et al., 2017). Fig. 4 shows that sales of commercial housing increased from 27 million m^2 in 1987 to 1.715 billion m^2 in 2019, with an average annual growth of 52.8 million m^2. However, since 2016, the growth in the sales of commercial housing has been stagnant, and the real estate industry has entered a downward growth stage. The added value of the real estate industry increased from 8 billion yuan in 1978 to 6.462 trillion yuan in 2019, with an average annual growth of 0.170 trillion yuan. However, since 2012, the growth rate has been lower than 15.00% (except for 17.37% in 2016), and the medium-low growth rate of the real estate industry is expected to become the norm. From the perspective of the contribution rate of the real estate industry to economic growth, the overall contribution rate maintained an upward trend since the re-

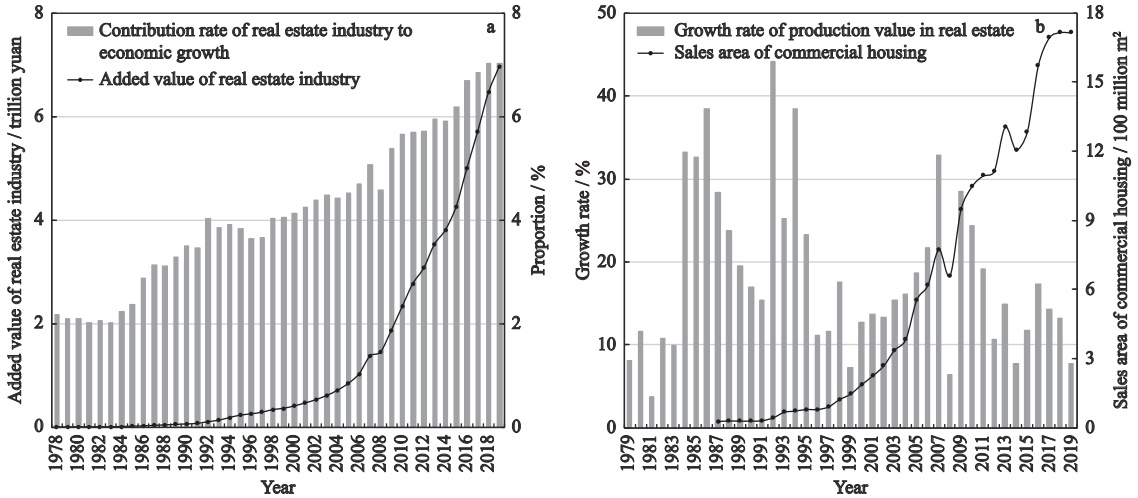

Fig. 4 Change trends of China's real estate industry from 1978 to 2019. (Not including Hong Kong, Macao and Taiwan of China due to unavailable data)

form and opening up, from 2.167% in 1978 to 7.027% in 2019, but declined in 2018–2019.

3.3 Causal relationships between urbanization and economic development

3.3.1 Unit root test of urbanization and economic development

Panel data unit root test methods are usually divided into two types: the first assumes that each section has the same unit root, such as the Levin Lin Chu (LLC) test, and the second assumes that each section sequence has a different unit root, such as the Im Pesaran and Shin (IPS) test (Guan et al., 2016).

The study selected the LLC and IPS test methods, which effectively avoid the uncertainty caused by a single method and improve test accuracy. Based on the model's maximum likelihood estimation, the AIC criterion is used to give the best estimate of the model's order and corresponding parameters. Stationarity tests can avoid the phenomenon of spurious regression in the model. The test results (Table 1) show that : 1) the original series ln*UR* and ln*PGDP* are not significant at the 5% level, and neither reject the null hypothesis of 'there is a unit root', and they are both nonstationary series, and 2) the original series of the first-order difference Δln*UR* and Δln*PGDP* are all significant at the 1% level, and both reject the null hypothesis of 'there is a unit root', and they are stationary series. Δln*UR* and Δln*PGDP* of 1978–2019 are the first-order stationary series, which can be tested by cointegration.

3.3.2 Cointegration test of urbanization and economic development

In the Pedroni test, the first four statistics are the test results of homogeneity alternative, that is, it is assumed that all sections have the same AR coefficient. The last three statistics are the test results of heterogeneity alternative, that is, the AR coefficient of each section must be less than 1. The Kao test requires that the exogenous variable coefficients of the model are homogeneous, that is, the exogenous variable coefficients of different sections are the same.

The results in Table 2 show that the conclusions of

Table 1 Unit root test results of urbanization level and per capita GDP

Variables	Test form (*C*, *T*, *P*)	LLC test	IPS test	Conclusion
ln*UR*	(1,1,0)	0.091 (0.536)	–0.459 (0.323)	Non-stationary
ln*PGDP*	(1,1,6)	4.326 (1.000)	–0.392 (0.348)	Non-stationary
Δln*UR*	(1,1,0)	–28.661 (0.000)	–25.062 (0.000)	Stationary
ΔLn*PGDP*	(1,1,5)	–7.171 (0.000)	–9.599 (0.000)	Stationary

Note: ln (*C, T, P*), *C* means intercept term, *C* = 0 means no intercept term, and *C* = 1 means there is intercept term. *T* means trend term, *T* = 0 means no trend, and *T*= 1 means there is a trend. *P* means the order of lag, here the value of *P* is selected according to the AIC rule; and Δ means the first-order difference. The numbers in brackets are Prob. values.

Table 2 Cointegration test results of urbanization level and per capita GDP

Test methods	Statistics	Model 1		Model 2	
		Statistics value	*P* value	Statistics value	*P* value
Pedroni test	Panel v-Statistic	1.545*	0.061	2.408***	0.008
	Panel rho-Statistic	–2.125**	0.017	–2.066**	0.019
	Panel PP-Statistic	–2.925***	0.002	–2.889***	0.002
	Panel ADF-Statistic	–2.102**	0.018	–2.173**	0.015
	Group rho-Statistic	–0.338	0.368	–1.040	0.149
	Group PP-Statistic	–1.581**	0.047	–2.680***	0.004
	Group ADF-Statistic	–2.308**	0.011	–3.084***	0.001
Kao test	ADF	–3.788***	0.000	–2.549***	0.005

Notes: 1) ***, **, and * represent that the results were significant at the levels of 1%, 5%, and 10% respectively; 2) In the Pedroni test, except the Panel v-stat statistic is the right test, the others are the left test; 3) In the model 1, ln*PGDP* is the dependent variable and ln*UR* is the independent variable, model 2 shows the opposite

the Pedroni test are not consistent; the within-group statistics Panel v and the between-group statistics Group rho are not significant at the 5% level, and the null hypothesis that there is no cointegration relationship can not be rejected. The Panel rho, Panel PP, Panel ADF, Group PP and Group ADF statistics reject the null hypothesis at the 5% or 1% significance level, which indicates that the model has a cointegration relationship. In a small sample, Panel ADF and Group ADF statistic tests have the best results, Panel v and Group rho statistic tests have the worst results, and the others are in the middle of them. Considering that the data sample is small in this paper, Panel v and Panel rho statistics can be ignored. Therefore, it can basically be considered that there is a cointegration relationship between variables. The ADF statistics of the Kao test reject the null hypothesis at the 1% significance level. In summary, both the Pedroni test and the Kao test indicate that there is a panel cointegration relationship between ln*PGDP* and ln*UR* in Model 1 and ln*UR* and ln*PGDP* in Model 2; that is, there is a long-term common trend between China's provincial urbanization level and per capita GDP from 1978 to 2019.

3.3.3 Granger causality test of urbanization and economic development

The article proves that there is a long-term cointegration relationship between ln*UR* and ln*PGDP* by the cointegration test. To further reveal the causal relationship between them, a Granger causality test is performed on the panel data (Table 3). From one to six lags, the original hypothesis 'ln*PGDP* is not the Granger cause of ln*UR*' is significant at the 1% level, and the

Table 3 Granger causality test results of urbanization level and per capita GDP

Lag period	Original hypothesis	*F* value	*P* value
Lag one period	ln*PGDP* is not the Granger cause of ln*UR*	29.097***	0.000
	ln*UR* is not the Granger cause of ln*PGDP*	2.169	0.141
Lag second period	ln*PGDP* is not the Granger cause of ln*UR*	20.873***	0.000
	ln*UR* is not the Granger cause of ln*PGDP*	0.210	0.811
Lag three period	ln*PGDP* is not the Granger cause of ln*UR*	17.275***	0.000
	ln*UR* is not the Granger cause of ln*PGDP*	0.886	0.448
Lag four period	ln*PGDP* is not the Granger cause of ln*UR*	12.911***	0.000
	ln*UR* is not the Granger cause of ln*PGDP*	1.781	0.110
Lag five period	ln*PGDP* is not the Granger cause of ln*UR*	10.943***	0.000
	ln*UR* is not the Granger cause of ln*PGDP*	1.398	0.223
Lag six period	ln*PGDP* is not the Granger cause of ln*UR*	9.356***	0.000
	ln*UR* is not the Granger cause of ln*PGDP*	1.517	0.169

Note: *** means that the result is significant at 1% level

original hypothesis is rejected, indicating that economic development is always the key factor in boosting urbanization. The original hypothesis 'ln*UR* is not the Granger cause of ln*PGDP*' is not significant at the 5% level, and the original hypothesis is accepted, indicating that urbanization has the boosting effect on economy, but the effect is not significant at the 5% level. Since the reform and opening up, economic development has accelerated the concentration of the urban population, promoted the development of urban industrial clusters, optimized regional industrial structures, promoted urban construction and land sprawl, and thus accelerated the urbanization process.

3.3.4 Impulse response function of urbanization and economic development

The impulse response function can measure the response of endogenous variables to the error shock and describes the impact on the current value and future value of endogenous variables after applying a standard deviation shock to the random error term. Based on the VAR model, the impulse response function can describe the short-term relationship between variables in more detail and reveal the dynamic changes in the interaction of endogenous variables in multiple time periods. The article uses the impulse response function to study the short-term dynamic interaction between urbanization and economic development in China's provinces from 1978 to 2019 (Fig. 5).

1) ln*PGDP* immediately responded to one of its own standard deviations. In the first period, the response value was approximately 0.057 and then began to rise, reaching the highest value of approximately 0.108 in the sixth period, and then the response value slowly decreased, indicating that the influence of economic development on the later stage shows a downward trend. 2) ln*PGDP* did not immediately respond to the impact of ln*UR*, and the response value of ln*PGDP* in periods 1was 0. After that, the response value of ln*PGDP* to ln*UR* increased slowly with a small increase, indicating that the impact of urbanization on economic development was small and relatively stable; it was a low-value stable situation. 3) ln*UR* immediately responded to the impact of ln*PGDP*, which was approximately 0.003, dropped to 0 in the third period, and gradually increased thereafter, indicating that the impact of economic development on urbanization shows an upward trend. 4) ln*UR* immediately responded to its own standard deviation information. In the first period, the response

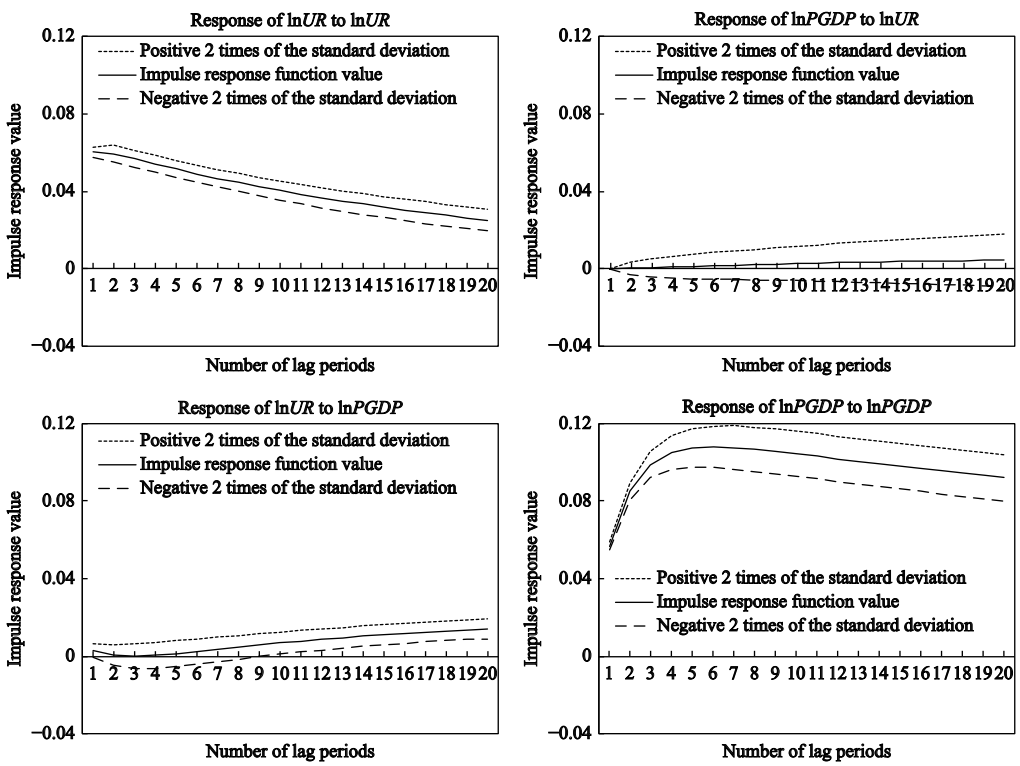

Fig. 5 Impulse response function based on VAR model

value was approximately 0.600, and the response value dropped rapidly after that, indicating that the impact of urbanization on the later period showed a gradual decline.

In summary, urbanization and economic development have a positive boosting effect on each other, and the inpact of economic development on urbanization is stronger than that of urbanization on economic development. The impact of economic development on urbanization shows an upward trend, and the impact of urbanization on economic development is relatively small and stable, indicating that the rapid development of land-centered urbanization has a limited role in promoting economic development and it is no longer suitable for implementation in the new era background (Wang et al., 2018). The new-type urban development should be people-oriented to effectively meet the development needs of urban residents and realize the citizenization of farmers (Wang et al., 2015b; Guan et al., 2018). The impacts of urbanization and economic development on themselves maintain a downward trend, especially the decline in the impact of urbanization on itself, which is more obvious than others, indicating that urbanization and economic development should continue to reform and plan high-quality development paths in the new era.

4 Discussion

4.1 Reduced contribution of people-oriented urbanization to economy compared to land-centered urbanization

Since 2014, China's urban have implemented the new urbanization plan in an orderly manner; urbanization is people-oriented and the speed of urbanization has been reduced. The GDP growth rate dropped from 7.80% in 2013 to 6.10% in 2019 and the economic growth rate declined. In this context, the driving effect of new-type urbanization on economic growth is slowing, mainly due to the following three reasons.

(1) The growth rate of the urban population slowed from 2.71% in 2013 to 2.05% in 2019, and the scale of the urban labor force and consumption decreased as a whole. On the one hand, in the stage of rapid urbanization, the rural population flows into the city rapidly, leaving behind the elderly and children as the principal residents in the countryside, and their mobility is weak. On the other hand, with the revitalization and development of rural areas, some migrant workers return home for entrepreneurial and employment opportunities.

(2) The growth of land finance slowed, and the proportion of land transfer fee income in GDP decreased from 6.60% in 2013 to 4.89% in 2017, reducing the driving effect on economic growth. The revenue of the land transfer fee was once the main source of local finance (Tao et al., 2010), but the new-type urbanization model has changed from land centered urbanization to people-oriented urbanization, and the land finance model will gradually come to an end.

(3) Real estate development had entered the off-peak period, the output value growth has declined, from 14.92% in 2013 to 7.75% in 2019, and its overall contribution to economic growth has declined. In recent years, the unsustainability of the real estate development model has become prominent, instability factors such as real estate bubbles are greatly enhanced, and the industry development has entered the transformation period.

4.2 Weakened growth rate of China's urbanization and economy in the future

Since the reform and opening up, China's urbanization and economic development have experienced a long period of rapid growth and have become the key drivers of the world's urbanization and economic development, playing the leading roles in the recovery of the world economy. However, the high-speed growth is unsustainable. The intensive development model of urbanization and economy, and the rapid growth based on high consumption and high pollution must be transformed in the medium and long term. Medium- and low-speed growth will be maintained in the future, as the transitions from 'high-speed' quantitative growth to 'people-oriented' quality improvements (Lu and Sun, 2016).

The Northam curve theory of the urbanization stages suggests that the speed of urban development has an inverted 'U'-shaped characteristic, and that most countries will have a deacceleration and near-zero growth stage after the acceleration stage (Chen et al., 2011). In the high-speed development stage, the focus is on improving the urbanization rate and expanding the urban boundaries. The urbanization rate increased from 17.90% in 1978 to 60.60% in 2019, with an average annual growth rate of 1.04%, far higher than the global

growth rate of 0.42%. The area of urban built-up regions and urban construction land increased by 8.00 times and 8.38 times respectively from 1978 to 2018. After entering the middle and late stages, urbanization development will pay more attention to meet the living needs of urban residents and address the rationality of urban spatial layout (Yang et al., 2017).

High-speed and superhigh-speed economic growth have resulted in massive environmental damage. The total national energy consumption reached 4.87 billion t of standard coal in 2019, which was 8.52 times that of 1978. High consumption produced high emissions and high pollution, which seriously exceeded the carrying capacity of the ecological environment system, greatly challenging the economic and social sustainability. Against the backdrop of the new era, China's economic development practices the five development concepts of innovation, coordination, green, openness and sharing, and changes from simply pursuing GDP growth to pursuing high-quality and high-efficiency green economy.

4.3 Boosting the coordinated development of urbanization and economic from low level to high level

China's traditional urbanization takes land-centered urbanization as the main symbol, that is, large-scale land development and utilization and blind urban sprawl (Gu et al., 2017). They have led to high land transfer fees and a soaring real estate industry, which in turn boosted the high-speed economic growth (Lu, 2013). Rapid economic growth attracted migrant workers to gather in cities (Deng et al., 2020), with the influx of people leading to the blind advancement of land-centered urbanization.

Urbanization and economic development have maintained a positive relationship of mutual reinforcement for a long time (Moomaw and Shatter, 1996). However, urbanization is mainly land-centered urbanization, while economic development is mainly GDP growth; the cost of living in large and medium-sized cities is high, and some cities have a 'ghost town' phenomenon. Under this model, the coordination relationship of the urbanization and economic development is still at the low level with quantity growth as the core, and needs to be transformed into a high level interaction with quality improvement as the core (Fig. 6).

With the high level coordination of urbanization and economic development, urbanization has shifted from land-centered urbanization to people-oriented urbanization. Focusing on the requirements of human development, urbanization provides equal employment, medical care, children's education, social security and other basic public services for the migrant population and effectively improves the well-being of residents. Economic development stimulates the investment in innovation, research and development and personnel training in key scientific and technological fields, promotes technological innovation, shifts from simple GDP growth to a green and inclusive economy, and realizes the United Nations' Sustainable Development Goals (Lu, 2019). The sustainable development of the economy and the people-oriented urbanization will further construct the relationship of mutual reinforcement with the quality as the core.

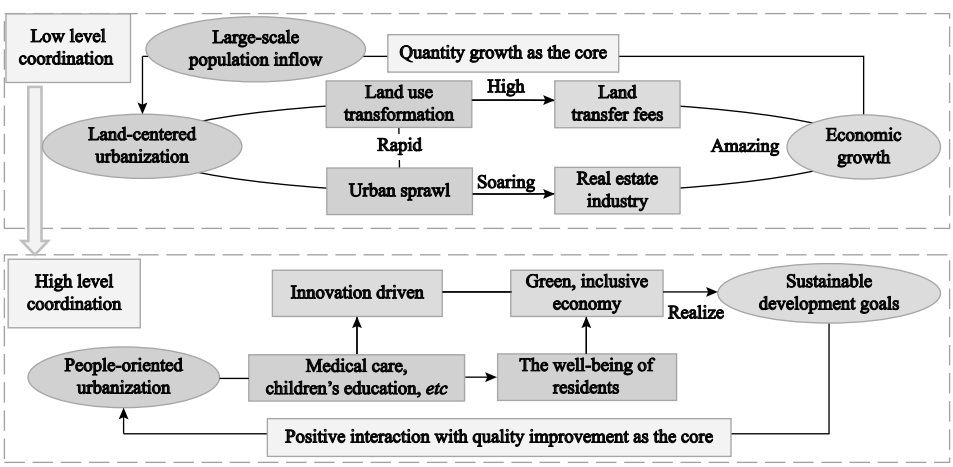

Fig. 6 The shift of coordinated relationship between urbanization and economic development from low level to high level

5 Conclusions and Suggestions

Based on the middle and late stages of urban development, this article quantitatively explores the causal relationship between urbanization and economic growth. It briefly analyzes the evolution process of population urbanization, land urbanization and economic development since the reform and opening up, summarizes the achievements and issues, and measure the contribution rate of the urbanization process to economic development from 1978 to 2018 based on the industries data, such as the real estate, construction, accommodation and catering industries. The rate of contribution growth has slowed in recent years. Based on the panel data cointegration test method, the causal relationship between urbanization and economic growth is quantitatively explored. It is found that economic development is the significant factor in boosting urbanization, urbanization has a certain boosting effect on economic development, and the boosting effect does not pass the 5% significance level test. The discussion section pointed out that China's urbanization and economy will maintain the relative medium-low growth rate in the future, and the contribution of people-oriented, new-type urbanization to economic growth is on the downward trend. It is urgent to boost coordinated development between them from low level to high level.

Since the implementation of the National New Urbanization Plan (2014–2020), China has carried out pilot projects for new-type urbanization in 62 cities at different levels of provinces, cities, counties and towns, and in different regions in the eastern, central and western regions. It is necessary to provide an in-depth summary of the development models of these pilot cities to provide a reference for the promotion of new-type urbanization models and the urbanization development in the future. The beginning of the '14th Five-Year Plan' in 2021 requires further research on how to achieve high-quality development of the urbanization in the future and how to achieve innovation-driven economic development. The development direction and practice path require top-level design and formulation of development roadmaps and timetables. The three-stage theory of the urbanization development is no longer suitable for interpreting the development characteristics of the middle and late stages of urbanization. It needs to systematically analyze the development experience of developed countries in the middle and late stages of urbanization, summarize the urbanization development traps of Latin American countries, simulate the characteristics of the middle and late stages of urbanization, and provide theoretical support for the new model of urban development.

In the early and mid-term stages of urbanization, the focus was on attracting rural populations to move to the cities to spur urbanization and to accelerate the land sprawl to achieve rapid fiscal growth. The middle and late stages of urbanization are no longer suitable for adopting this development model. It is necessary to focus on how to accelerate the citizenization of farmers, improve the well-being of urban residents, promote the sustainable green growth of the urban economy, and shift from the land-centered urbanization to the new-type, population-oriented urbanization that focuses on people and protects the ecological environment. Since the implementation of the national new-type urbanization plan, the academic community has interpreted the new-type urbanization theory at a macro level and constructed the idea of people-oriented, harmonious, inclusive and sustainable urban development. However, the current interpretation of the people-oriented theory is not developed enough and does not fully reflect the deeper implications of the concepts of 'new' and 'people'. It is thus necessary to further strengthen research on the theoretical framework of people-oriented, new-type urbanization.

In China, the urbanization contributes much to the economic development in many aspects of economy and society, such as the real estate industry, construction industry, accommodation and catering industry, urban innovation, urban construction, land sprawl, nighttime economy levels and so on. Considering the restrictions of the paper length and the principle of data availability, this paper only studied the contribution of urbanization to economic development from the first three aspects. We can continue to study the impact of urbanization on economic development in other aspects in the future. The spatio-temporal heterogeneity of the interaction between them is of great practical significance to the high-quality development of regional urbanization in China, but the panel data cointegration test method cannot get these results. In order to realize the coordinated and high-quality development of urbanization and economy, it is necessary to study the spatio-temporal het-

erogeneity of the interaction between them by using the comprehensive evaluation method, to compare the regional differences, to calculate the main influencing factors of urbanization and economic development from the perspective of humanity and nature, and to reveal the high-quality development mechanism.

References

China Bureau Statistics, Survey Office of the National Bureau of Statistics, 1979−2020. *China Statistics Yearbook*. Beijing: China Statistics Press.

Bettencourt L M A, Lobo J, Helbing D et al., 2007. Growth, innovation, scaling, and the pace of life in cities. *Proceedings of the National Academy of Sciences of the United States of America*, 104(17): 7301–7306. doi: 10.1073/pnas.0610172104

Bloom D E, Canning D, Fink G, 2008. Urbanization and the wealth of nations. *Science*, 319(5864): 772–775. doi: 10.1126/science.1153057

Cao Guangzhong, Liu Tao, 2011. Rising role of inland regions in China's urbanization in the 21st century: the New trend and its explanation. *Acta Geographica Sinica*, 66(12): 1631–1643. (in Chinese)

Chen Mingxing, Lu Dadao, Zha Liangsong, 2009. Urbanization and economic development in China: an international comparison based on quadrant map approach. *Geographical Research*, 28(2): 464–474. (in Chinese)

Chen Mingxing, Lu Dadao, Zha Liangsong, 2010. The comprehensive evaluation of China's urbanization and effects on resources and environment. *Journal of Geographical Sciences*, 20(1): 17–30. doi: 10.1007/s11442-010-0017-0

Chen Mingxing, Ye Chao, Zhou Yi, 2011. Urbanization rate and its policy implications: discussion and development of northam's curve. *Geographical Research*, 30(8): 1499–1507. (in Chinese)

Chen M X, Liu W D, Tao X L, 2013. Evolution and assessment on China 's urbanization 1960 –2010: under-urbanization or over-urbanization? *Habitat International*, 38: 25 –33. doi: 10.1016/j.habitatint.2012.09.007

Chen M X, Ye C, Zhou Y, 2014a. Comments on Mulligan's 'revisiting the urbanization curve'. *Cities*, 41(S1): S54–S56. doi: 10.1016/j.cities.2013.10.006

Chen Mingxing, Huang Yongbin, Tang Zhipeng et al., 2014b. The provincial pattern of the relationship between urbanization and economic development in China. *Journal of Geographical Sciences*, 24(1): 33–45. doi: 10.1007/s11442-014-1071-9

Chen Mingxing, 2015. Research progress and scientific issues in the field of urbanization. *Geographical Research*, 34(4): 614–630. (in Chinese)

Chen M X, Zhang W Z, Lu D D, 2015a. Examining spatial pattern and location choice of affordable housing in Beijing, China: developing a workable assessment framework. *Urban Studies*, 52(10): 1846–1863. doi: 10.1177/0042098014542133

Chen Mingxing, Tang Zhipeng, Bai Yongping et al., 2015b. Relational pattern of urbanization and economic development: parameter re-evaluation of the Chenery model. *Journal of Geographical Sciences*, 25(8): 991–1002. doi: 10.1007/s11442-015-1215-6

Chen Mingxing, Lu Dadao, Gong Yinghua, 2016. The pattern and regional type of China's 'new normal' from the view of economic geography. *Scientia Geographica Sinica*, 36(7): 965–972. (in Chinese)

Chen Mingxing, 2017a. Understanding and analysis of 2017 government work report from view of human and economic geography. *Bulletin of Chinese Academy of Sciences*, 32(4): 426–434. (in Chinese)

Chen M X, Liu W D, Lu D D et al., 2018. Progress of China's new-type urbanization construction since 2014: a preliminary assessment. *Cities*, 78: 180–193. doi: 10.1016/j.cities.2018.02.012

Chen Mingxing, Ye Chao, Lu Dadao et al., 2019. Cognition and construction of the theoretical connotations of new urbanization with Chinese characteristics. *Journal of Geographical Sciences*, 29(10): 1681–1698. doi: 10.1007/s11442-019-1685-z

Chen M X, Guo S S, Hu M G et al., 2020. The spatiotemporal evolution of population exposure to PM_{25} within the Beijing-Tianjin-Hebei urban agglomeration, China. *Journal of Cleaner Production*, 265: 121708. doi: 10.1016/j.jclepro.2020.121708

Chen Y G, 2017b. Multi-scaling allometric analysis for urban and regional development. *Physica A:Statistical Mechanics and its Applications*, 465: 673–689. doi: 10.1016/j.physa.2016.08.008

Chenery H B, Syrquin M, 1975. *Patterns of Development: 1950–1970*. London: Oxford University Press.

Christine K, Eduardo M, Ben A et al., 2020. *World Cities Report 2020: The Value of Sustainable Urbanization*. *Nairobi:United Nations Human Settlements Programme*, 4–6.

Deng Wei, Zhang Shaoyao, Zhou Peng et al., 2020. Spatiotemporal characteristics of rural labor migration in China: evidence from the migration stability under new-type urbanization. *Chinese Geographical Science*, 30(5): 749–764. doi: 10.1007/s11769-020-1147-7

Deng X Z, Huang J K, Rozelle S et al., 2015. Impact of urbanization on cultivated land changes in China. *Land Use Policy*, 45: 1–7. doi: 10.1016/j.landusepol.2015.01.007

Di Clemente R, Strano E, Batty M, 2021. Urbanization and economic complexity. *Scientific Reports*, 11(1): 3952. doi: 10.1038/s41598-021-83238-5

Fang Chuanglin, Liu Haiyan, 2007. The spatial privation and the corresponding controlling paths in China's urbanization process. *Acta Geographica Sinica*, 62(8): 849–860. (in Chinese)

Fang Chuanglin, Liang Longwu, Wang Zhenbo, 2019. Quantitative simulation and verification of upgrade law of sustainable development in Beijing-Tianjin-Hebei urban agglomeration. *Science China Earth Sciences*, 62(12): 2031–2049. doi: 10.1007/s11430-019-9430-7

Granger C W J, 1988. Some recent development in a concept of

causality. *Journal of Econometrics*, 39(1–2): 199–211. doi: 10.1016/0304-4076(88)90045-0

Gu Chaolin, Hu Lingqian, Cook I G, 2017. China's urbanization in 1949–2015: processes and driving forces. *Chinese Geographical Science*, 27(6): 847–859. doi: 10.1007/s11769-017-0911-9

Guan Weihua, Yao Yunxia, Peng Xin et al., 2016. The relationship of urbanization and economic growth in China based on the provincial panel data in 1978–2014. *Scientia Geographica Sinica*, 36(6): 813–819. (in Chinese)

Guan X L, Wei H K, Lu S S et al., 2018. Assessment on the urbanization strategy in China: achievements, challenges and reflections. *Habitat International*, 71: 97–109. doi: 10.1016/j.habitatint.2017.11.009

He C F, Mao X Y, Zhu X D, 2018. Industrial dynamics and environmental performance in urban China. *Journal of Cleaner Production*, 195: 1512–1522. doi: 10.1016/j.jclepro.2017.10.142

He Zhichao, Yu Zhaowu, Wu Bowei, 2015. Effect of China's R&D input on urbanization level based on panel data analysis. *Progress in Geography*, 34(8): 998–1008. (in Chinese). doi: 10.18306/dlkxjz.2015.08.007

Huang X J, Li Y, Hay I, 2016. Polycentric city-regions in the state-scalar politics of land development: the case of China. *Land Use Policy*, 59: 168–175. doi: 10.1016/j.landusepol.2016.08.037

Kao C, 1999. Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, 90(1): 1–44. doi: 10.1016/s0304-4076(98)00023-2

Laumas P S, Williams M, 1984. Urbanization and economic development. *Eastern Economic Journal*, 10(3): 325–332.

Li S W, Ye X Y, Lee J et al., 2017. Spatiotemporal analysis of housing prices in China: a big data perspective. *Applied Spatial Analysis and Policy*, 10(3): 421–433. doi: 10.1007/s12061-016-9185-3

Liang L W, Wang Z B, Li J X, 2019. The effect of urbanization on environmental pollution in rapidly developing urban agglomerations. *Journal of Cleaner Production*, 237: 117649. doi: 10.1016/j.jclepro.2019.117649

Lin G C S, Yi F X, 2011. Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geography*, 32(1): 50–79. doi: 10.2747/0272-3638.32.1.50

Liu T, Cao G Z, Yan Y et al., 2016a. Urban land marketization in China: central policy, local initiative, and market mechanism. *Land Use Policy*, 57: 265–276. doi: 10.1016/j.landusepol.2016.06.001

Liu Yansui, Yan Bin, Zhou Yang, 2016b. Urbanization, economic growth, and carbon dioxide emissions in China: a panel cointegration and causality analysis. *Journal of Geographical Sciences*, 26(2): 131–152. doi: 10.1007/s11442-016-1259-2

Lu Dadao, Yao Shimou, Liu Hui et al. , 2007. *2006 China Regional Development Report: Urbanizaiton Process and Spatial Expansion.* Beijing: The Commercial Press. (in Chinese)

Lu Dadao, 2013. The research framework of geography in the field of urbanization. *Scientia Geographica Sinica*, 33(8): 897–901. (in Chinese)

Lu Dadao, 2015. Moderate-speed growth: sustainable development of China 's economy. *Scientia Geographica Sinica*, 35(10): 1207–1219. (in Chinese)

Lu Dadao, Sun Dongqi, 2016. Progress of research on the support system for economic growth. *Advances in Earth Science*, 31(6): 555–559. (in Chinese)

Lu Dadao, 2019. Preliminary study on development of some fields in fourteenth five year plan. *Bulletin of Chinese Academy of Sciences*, 34(10): 1143–1146. (in Chinese)

Lu Dadao, 2020. About the 14th five year plan: field and understanding. *Scientia Geographica Sinica*, 40(1): 1–5. (in Chinese)

Lu M, Wan G H, 2014. Urbanization and urban systems in the People's Republic of China: research findings and policy recommendations. *Journal of Economic Surveys*, 28(4): 671–685. doi: 10.1111/joes.12078

Moomaw R L, Shatter A M, 1996. Shatter. *Urbanization and economic development:a bias toward large cities?. Journal of Urban Economics*, 40(1): 13–37. doi: 10.1006/juec.1996.0021

Northam R M, 1975. *Urban Geography*. New York: John Wiley & Sons.

Pedroni P, 2004. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory*, 20(3): 597–625. doi: 10.10170S0266466604203073

Reiss Jr A J, 1954. Economic growth and the rate of urbanization: a comment on the paper by Davis and Golden. *Economic Development and Cultural Change*, 3(1): 27–29. doi: 10.1086/449674

Sadorsky P, 2014. The effect of urbanization on CO_2 emissions in emerging economies. *Energy Economics*, 41: 147–153. doi: 10.1016/j.eneco.2013.11.007

Tao R, Su F B, Liu M X et al., 2010. Land leasing and local public finance in China's regional development: evidence from prefecture-level cities. *Urban Studies*, 47(10): 2217–2236. doi: 10.1177/0042098009357961

Wang J, Lin Y F, Glendinning A et al., 2018. Land-use changes and land policies evolution in China's urbanization processes. *Land Use Policy*, 75: 375–387. doi: 10.1016/j.landusepol.2018.04.011

Wang S J, Fang C L, Guan X L et al., 2014. Urbanisation, energy consumption, and carbon dioxide emissions in China: a panel data analysis of China 's provinces. *Applied Energy*, 136: 738–749. doi: 10.1016/j.apenergy.2014.09.059

Wang T, Tian X, Hashimoto S et al., 2015a. Concrete transformation of buildings in China and implications for the steel cycle. *Resources, Conservation and Recycling*, 103: 205–215. doi: 10.1016/j.resconrec.2015.07.021

Wang X, Shao S, Li L, 2019a. Agricultural inputs, urbanization, and urban-rural income disparity: evidence from China. *China Economic Review*, 55: 67–84. doi: 10.1016/j.chieco.2019.03.009

Wang X R, Hui E C M, Choguill C et al., 2015b. The new urbanization policy in China: which way forward? *Habitat International*, 47: 279–284. doi: 10.1016/j.habitatint.2015.02.001

Wang Z B, Liang L W, Sun Z et al., 2019b. Spatiotemporal differentiation and the factors influencing urbanization and ecological environment synergistic effects within the Beijing-Tianjin-Hebei urban agglomeration. *Journal of Environmental Management*, 243: 227–239. doi: 10.1016/j.jenvman.2019.04.088

Wang Z B, Li J X, Liang L W, 2020. Spatio-temporal evolution of ozone pollution and its influencing factors in the Beijing-Tianjin-Hebei Urban Agglomeration. *Environmental Pollution*, 256: 113419. doi: 10.1016/j.envpol.2019.113419

Westerlund J, 2005. New simple tests for panel cointegration. *Econometric Reviews*, 24(3): 297–316. doi: 10.1080/07474930500243019

Wu F L, 2001. China's recent urban development in the process of land and housing marketisation and economic globalisation. *Habitat International*, 25(3): 273–289. doi: 10.1016/S0197-3975(00)00034-5

Yang Jun, Wu Tinghai, Gong Peng, 2017. Implementation of China's new urbanization strategy requires new thinking. *Science Bulletin*, 62(2): 81–82. doi: 10.1016/j.scib.2016.12.013

Yang Zhen, Zhang Xiaolei, Lei Jun et al., 2019. Spatio-temporal pattern characteristics of relationship between urbanization and economic development at county level in China. *Chinese Geographical Science*, 29(4): 553–567. doi: 10.1007/s11769-019-1053-z

Yang Zhen, Zhang Xiaolei, Li Jiangang et al., 2020. The spatial-temporal pattern of the relationship between urban-ization and economic development at prefecture-level units in China: a quantitative analysis based on 2000 and 2010 census data. *Geographical Research*, 39(1): 25–40. (in Chinese)

Zhang Li, Li Meng, 2018. Acquired but unvested welfare rights: migration and entitlement barriers in reform-era China. *The China Quarterly*, 235: 669–692. doi: 10.1017/s03057410 1800084x

Zhao M, Zhang Y, 2009. Development and urbanization: a revisit of Chenery–Syrquin's patterns of development. *The Annals of Regional Science*, 43(4): 907–924. doi: 10.1007/s00168-008-0240-0

Zhou Yixing, 1982. Regularity discussion of the relationship between urbanization and gross national product. *Population and Economics*, (1): 28–33. (in Chinese)

Zhou Yixing, Ma L J C, 2003. China's urbanization levels: reconstructing a baseline from the fifth population census. *The China Quarterly*, 173: 176–196. doi: 10.1017/s000944 390300010x