Research on the Development Mechanism of In-situ Urbanization Driven by Industry--Evidence from 87 cities in central China

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ABSTRACT: Some problems caused by traditional urbanization are becoming prominent. Compared with traditional urbanization, the rural population does not migrate to large and medium-sized cities in the process of in-situ urbanization. Rural residents realized the transition from traditional to modern production and lifestyle in their native land, which avoids the problems of 'rural diseases' and 'urban diseases' in the process of traditional urbanization. This study explores the influence mechanism of three industries on in-situ urbanization through the System Generalized Method of Moments and Ordinary Least Square. We found that (1) The simple development of agriculture does not directly promote in-situ urbanization. The process of agriculture driving in-situ urbanization needs to separate some non-agricultural industries from agriculture, which could accelerate the in-situ transfer of rural labor force for non-agricultural employment. (2) The secondary industry plays a significant direct role in driving the in-situ urbanization. Simultaneously, it is conducive to promoting the in-situ urbanization under the joint action of industry and agriculture. (3) The influence of the tertiary industry on in-situ urbanization is mainly reflected in the rural service industry and rural tourism. Through the combined development of agriculture, service industry and tourism, rural residents could achieve local non-agricultural employment and civic lives.

1 INSTRUCTIONS

After decades of development, the current urbanization rate has exceeded 60% in China, marking that China has entered a stage of rapid urbanization. As China's urbanization enters a new development stage, the upgrading of traditional industries and the constraints of resources make it difficult for large and medium-sized cities to withstand the transfer of large-scale rural surplus labor. At the same time, the "urban diseases" and "rural diseases" derived from traditional urbanization have become increasingly prominent. For example, "rural diseases" include agricultural desertion, rural left-behind children, and "urban diseases" include traffic jams, housing difficulties and environmental pollution. Particularly, these problems are conspicuous in central China, where a large amount of rural labor gathered. Compared with traditional urbanization, in the process of in-situ urbanization, the rural population does not migrate to large and medium-sized cities but realizes the transition from traditional to modern production and lifestyle in the original residence [21]. The driving force of urbanization development shows that agriculture is the initial driving force of urbanization [16]. In the initial stage of urbanization, the thrust of agriculture and the pull of industrialization became the main driving forces of urbanization in this period [3][11]. With the improvement of the level of urbanization, the tertiary industry, represented by the service industry, has gradually become the main driving force to promote urbanization in the later stage [8]. The main body is the rural labor force and the regional scope is rural in the process of in-situ urbanization, and industry also serves as the core driving force of in-situ urbanization. So, the process of in-situ urbanization is bound to be inseparable from the role of agriculture. Then, we believe that the mechanism of the industry driving in-situ urbanization is mainly embodied in the following two points. The first is the subdivided development of agriculture itself, that is, the industrialization of agriculture. The second is the integrated development of agriculture and non-agricultural industries (secondary and tertiary industries). The essence of these two industrial development modes is to vigorously develop the secondary and tertiary industries based on agriculture, and promote the in-situ urbanization by giving play to the basic driving force of agriculture (primary industry), the core driving force of secondary industry and the follow-up driving force of the tertiary industry. In this way, the in-situ transfer of rural labor and the transformation of lifestyle can be realized. Therefore, focusing on central China where the rural labor force is concentrated, this paper profoundly explores the impact mechanism of the three major industries in the process of in-situ urbanization through an empirical analysis.

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2 LITERATURE REVIEW

The process of in-situ urbanization needs to take industrial development as the core driving force, especially the secondary and tertiary industries, which are dominated by manufacturing and service industries, as the powerful driving force of in-situ urbanization [21]. Then, how do various industries promote in-situ urbanization in the process of in-situ urbanization? What is the mechanism of the industry as the core driving force of local urbanization? Currently, there are a few studies on the relationship between in-situ urbanization and industry. Most scholars thought industrialization formed by the change of industrial structure is the fundamental driving force for the continuous development of urbanization, while the tertiary industry is the main driving force for the rapid development of urbanization. Domestic attention and research on the above issues are relatively late, and the initial researches were also carried out overall and typical regions of China from the perspective of traditional urbanization. Many studies have analyzed the impact of industrial structure on urbanization from the dimensions of employment structure, urban-rural gap, technological innovation, and economic growth [12-13]. In recent years, new urbanization models such as in-situ urbanization have also been studied gradually. The views of Chu (2020) and Zhang (2020) indicated that the growth of producer services, high-tech industries and green industries not only promotes the process of new-type urbanization but also accelerates the structural transformation and sustainable development of the economy [5][19]. However, a few scholars hold the view that urbanization has a negative impact on industrial upgrading [10][20]. Their studies showed that the industrial division entered the advanced stage in developing countries when the urbanization rate reaches a certain level [14], and developing countries are at the bottom of the global industrial division chain. So, the “three high” industries (high consumption, high pollution and high emissions) make developing countries promote industrialization with extensive economic growth [9], even become a “Pollution Haven” of developed countries, which is not conducive to the optimal transformation of industrial structure [15]. At the same time, this process will form a development model centered on the agglomeration of traditional manufacturing industries, resulting in low innovation capacity in the urbanization process of developing countries [6], and even deforming the development of the tertiary industry, which is not conducive to promoting industrial upgrading.

It can be seen from the above literature that the process of urbanization is mainly driven by the adjustment of industrial structure in two paths. On the one hand, the succession of the leading industries in the three industries is from “secondary industry” to “tertiary industry”, which leads to the transition from the primary stage to the advanced stage of urbanization. On the other hand, the structural adjustment and upgrading within the leading industry have accelerated the extension of the industrial chain and the value chain's appreciation. Also, it formed a new development trend of “servitization” in the manufacturing industry and “manufacturing” in the service industry, which promote industrialization and urbanization to enter a new stage of “City-Industry Integration”.

Throughout most of the existing literature, we think there are the following two improvements. First, due to the historical period of research and the limitations of research ideas, most scholars still focus on the relationship between traditional urbanization and industrial development. The development model of in-situ urbanization has shown a vast difference from the traditional urbanization. The exploration of the relationship between in-situ urbanization and industrial development is meaningful for the sustainable development of China's economy. Second, the existing studies on in-situ urbanization and industrial development are mostly focused on theoretical reviews and analysis, lacking empirical evidence. In view of this, our study takes the panel data of 87 prefecture-level cities (autonomous prefectures) from 2009 to 2018 in central China as the research sample, and adopts the dynamic panel model to analyze the impact of industrial development on in-situ urbanization through the System Generalized Method of Moments (SGMM) and Ordinary Least Square (OLS).

3 METHODOLOGY

3.1 Regions and Variables

The central region includes six provinces, Hubei, Hunan, Henan, Anhui, Jiangxi and Shanxi, covering a land area of 1.03 million km2. At the same time, the central regions rely on 10.7% of the country’s land to support 26.51% of China’s population and create about 21.69% of China’s GDP. So, this is a large population area, a transportation hub and an important market region, which plays a vital role in regional labor distribution in China. In 2019, the urbanization rate of the six central provinces was 57.37%, still lower than the national average of 60.60%. Also, there are still some problems in the central regions, such as unbalanced development between urban and rural areas, the large income gap between urban and rural residents, and insufficient industrial promotion in small and medium-sized cities [18]. Therefore, this paper selected 87 prefecture-level cities in central China as research areas, explored the development mechanism of in-situ urbanization driven by different industries.

This study conducted an empirical analysis based on panel data from 87 prefecture-level cities (autonomous prefectures) in central China from 2009 to 2018. In this study, the in-situ urbanization level is the explained variable, represented by the in-situ urbanization rate (IU). We calculate the IU based on the connotation of in-situ urbanization as following formula.

$$IU = \frac{RNEP}{REP} \tag{1}$$

Where IU is the in-situ urbanization rate, RNEP is the population of rural non-agricultural employment, and REP is the total population of rural employment.

The core explanatory variable is industrial output value (STR), which is represented by the output value of primary industry (PI), secondary industry (SI) and tertiary

industry (TI) respectively. As for the control variables in the model, for the consideration of data accessibility and comparability, and referring to some existing classical literature [12][13][21], we selected the following control variables: 1. Urban-rural income gap (GAP). In order to eliminate the impact of price factors, we adjust the per capita disposable income of urban residents and the per capita net income of rural residents based on the consumer price indexes in prefectural-level cities (autonomous prefectures) from 2009 to 2018. 2. Educational resources (EDU). We chose the number of full-time college teachers as the proxy variable of educational resources (EDU), and the estimated coefficient of this variable is expected to be negative. 3. Government support (GOV). This article uses governmental fiscal expenditure in the agriculture portion to represent governmental support for rural economic development. The estimated coefficient of this variable is expected to be positive. 4. Traffic accessibility (TRA). We use the Urban Road Area Ratio (the ratio of the total urban roads acreage to the total acreage of the city) to represent traffic convenience (TRA). 5. Medical level (MED). In this paper, the average number of medical practitioners per thousand in each prefecture-level city (autonomous prefecture) is used to represent the medical level (MED).

Considering the possible fluctuations and heteroscedasticity in the samples, we treated all variables logarithmically. All the data of explanatory variables and control variables were collected from the statistical yearbook of Chinese cities and the statistical yearbooks of the six provinces.

3.2 Model

In order to explore the influence mechanism of different industries in the process of in-situ urbanization, we analyze and compare the impact of the three major industries on the level of in-situ urbanization. The basic econometric model is as follows.

$$\ln IU_{it} = \mu + \theta_1 \ln STR_{it} + \theta_2 \ln GAP_{it} + \theta_3 \ln EDU_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln TRA_{it} + \theta_6 \ln MED_{it} + \varepsilon_{it} \quad (2)$$

Where μ is a constant, θ is the coefficient of each variable, ε_{it} is the random error, i represent the different cities, t represents the year (2009 to 2018), IU is the in-situ urbanization rate, STR (industrial output value) is the core explanatory variable. The control variables include urban-rural income GAP (GAP), educational resources (EDU), government support (GOV), transportation convenience (TRA), and medical care (MED).

Considering that there may be a lag effect of the in-situ urbanization level, we introduce the first-order lag of the in-situ urbanization rate based on the formula (2), and then set the following dynamic panel model.

$$\ln IU_{it} = \mu + \theta_0 \ln IU_{it\text{-}1} + \theta_1 \ln STR_{it} + \theta_2 \ln GAP_{it} + \theta_3 \ln EDU_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln TRA_{it} + \theta_6 \ln MED_{it} + \varepsilon_{it} \quad (3)$$

According to the different industry classifications (explanatory variables), this paper divides the dynamic panel model into the following three groups. Considering the joint effect of agricultural and non-agricultural industries on in-situ urbanization, we introduce the interaction terms of primary and secondary industries (*PI*×*SI*), primary and tertiary industries (*PI*×*TI*) in the model.

$$\ln IU_{it} = \mu + \theta_0 \ln IU_{it\text{-}1} + \theta_1 \ln PI_{it} + \lambda_1 \ln PI_{it} \times \ln SI_{it} + \lambda_2 \ln PI_{it} \times \ln TI_{it} + \theta_2 \ln GAP_{it} + \theta_3 \ln EDU_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln TRA_{it} + \theta_6 \ln MED_{it} + \varepsilon_{it} \quad (4)$$

$$\ln IU_{it} = \mu + \theta_0 \ln IU_{it\text{-}1} + \theta_1 \ln SI_{it} + \lambda \ln PI_{it} \times \ln TI_{it} + \theta_2 \ln GAP_{it} + \theta_3 \ln EDU_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln TRA_{it} + \theta_6 \ln MED_{it} + \varepsilon_{it} \quad (5)$$

$$\ln IU_{it} = \mu + \theta_0 \ln IU_{it\text{-}1} + \theta_1 \ln TI_{it} + \lambda \ln PI_{it} \times \ln TI_{it} + \theta_2 \ln GAP_{it} + \theta_3 \ln EDU_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln TRA_{it} + \theta_6 \ln MED_{it} + \varepsilon_{it} \quad (6)$$

In the above models (4), (5) and (6), *PI*, *SI* and *TI* are the output value of the primary, secondary and tertiary industries respectively, and ln*PI* × ln*SI* and ln*PI* × ln*TI* are the interaction terms.

In general, we use ordinary least squares (OLS) to estimate parameters in a panel model, but the impact of industry on the in-situ urbanization may exist endogenous problems, especially as the explained variables in the model are calculated based on the formula (1) in the third part of this paper, there may be some errors in the measurement of the explained variables. Furthermore, there may be mutual influence between industry and in-situ urbanization, and the mutual causality between explanatory variables and the explained variable will lead to endogeneity to a great extent.

Table 1. Results of Hausmann test.

	Mode (4)	Mode (5)	Mode (6)
Statistics	3.42	2.98	0.00
P value	0.0645	0.0844	0.9558

Based on the above considerations, this article will adopt the instrumental variable method for estimation to weaken the impact of endogeneity as much as possible. Before introducing the instrumental variable, we first test the endogeneity of the explanatory variable. Hausman test was carried out for the three models with the output value of primary industry (PI), secondary industry (SI) and tertiary industry (TI) as explanatory variables respectively (see Table 1). The results showed that model (4) and model (5) reject the null hypothesis, while model (6) accepts the null hypothesis in Table 1. Referring to the system generalized method of moments (System GMM, SGMM) proposed by Arellano and Blundell [1][2], we choose the lag 2 periods of the explained variable (IU) as the instrument variable, then adopt two-step system GMM to estimate the models (4) and (5), and used dynamic panel OLS estimation for the model (6).

4 RESULTS AND DISCUSSION

Based on the above model, variables, and estimation method, we will conduct an empirical test on the panel data in 87 prefecture-level cities (autonomous prefectures) of central China from 2009 to 2018. In order to avoid collinearity problems and enhance the robustness of results, this paper adopts the stepwise regression method to introduce control variables in turn. Results corresponding to models (4), (5), and (6) are shown in Table 2, Table 3, and Table 4 respectively, where the estimated results of OLS and GMM are compared in Table 2 and Table 3.

From Table 2, we can find that the P-value of Sargan estimated by the two-step system GMM is 0.707 in regression (5), which cannot reject the null hypothesis that the instrumental variable is valid. Meanwhile, the P values of AR (1) and AR (2) for residual autocorrelation tests are 0.014 and 0.419, respectively. The five regressions, from (1) to (5), have significant first-order sequence correlation, but no second-order sequence correlation, which indicates that the instrumental variables we selected are reasonable. The estimated coefficients of regressions (1) to (5) for the lag term of the in-situ urbanization rate are 0.3852, 0.3630, 0.3178, 0.2967, and 0.2944 respectively, which are all significant. This sufficiently indicates that the explanatory variables have a significant lag effect. So, it is necessary to consider the dynamic panel model to study the problem of in-situ urbanization in China, and we select the results of regression (5) in Table 2 for analysis.

Table 2. Results of stepwise regression in model (4).

Variables	GMM					OLS
	(1)	(2)	(3)	(4)	(5)	(6)
L1. ln*IU*	0.3852***	0.3630***	0.3178***	0.2967**	0.2944***	0.2456***
	(0.1326)	(0.1031)	(0.1106)	(0.1452)	(0.1026)	(0.0807)
ln*PI*	-0.0161***	0.01738***	-0.0192**	-0.0257***	-0.0251***	-0.0681
	(0.0029)	(0.0041)	(0.0083)	(0.0051)	(0.0054)	(0.0759)
ln*PI* × ln*SI*	0.0799**	0.0701***	0.0730***	0.0664**	0.0588**	0.0534***
	(0.0380)	(0.0234)	(0.0211)	(0.0319)	(0.0281)	(0.0139)
ln*PI* × ln*TI*	0.1066***	0.1196**	0.0947***	0.0881***	0.0835***	-0.0528
	(0.0274)	(0.0602)	(0.0311)	(0.0308)	(0.0261)	(0.0845)
ln*GAP*	-1.1748***	-0.8252***	-0.5361***	-0.5357***	-0.4920***	-0.3166***
	(0.1205)	(0.1690)	(0.1501)	(0.1624)	(0.1439)	(0.0531)
ln*EDU*		0.0045	0.0069	0.0140	0.0088	0.0145
		(0.0039)	(0.0046)	(0.0801)	(0.0087)	(0.0253)
ln*GOV*			0.1511***	0.1883*	0.2286***	0.4522*
			(0.0624)	(0.1080)	(0.0712)	(0.2660)
ln*TRA*				-0.0412***	-0.0331***	-0.0382
				(0.0151)	(0.0079)	(0.0457)
ln*MED*					-0.0657***	-0.1863
					(0.0187)	(0.3329)
N	850	850	850	850	850	860
AR(1)	0.004	0.004	0.006	0.009	0.014	/
AR(2)	0.580	0.667	0.599	0.481	0.419	/
Sargan	0.791	0.658	0.883	0.698	0.707	/

*, ** and *** indicate statistical significance at the10%, 5% and 1% levels, respectively.

From the result of regression (5), the coefficient of the core explanatory variable (PI) is -0.0251, and it is significant at 1% level, which indicates that the increasing value of the primary industry will lead to the decrease of in-situ urbanization rate. The primary industry is dominated by agriculture. With the improvement of agricultural production in the national economy, the employees engaged in agricultural production is increasing. From the perspective of non-agricultural employment, this is not conducive to the non-agricultural employment of rural residents, which also explains the impact of the raised primary industrial value on the lowered in-situ urbanization level. This result is different from the views of some scholars. Some studies believed that the development of the agricultural industry plays a certain role in promoting in-situ urbanization [4], which is mainly reflected in the following two aspects.

On the one hand, agricultural production, processing, sales, and service clusters have emerged through cluster-type industrialization. A part of the rural labor force has been separated from the agricultural production field to engage in non-agricultural industries. It forms an integration of agriculture and non-agriculture, which promotes the transfer of rural labor and the balanced development of in-situ urbanization. On the other hand, the role of agriculture in promoting in-situ urbanization is not direct but indirect by modern agriculture. In fact, agricultural modernization has accelerated the further refinement of the industrial division of labor and formed the separation of non-agricultural industries, which promoted the development of non-agricultural industries. Finally, the process of in-situ urbanization was influenced by the transfer of rural labor to secondary and tertiary industries.

The effects of the above two aspects can be confirmed by the interaction term coefficient in Table 2. The coefficients of the interaction terms lnPI × lnSI and lnPI × lnTI are 0.0588 and 0.0835, respectively, and they are significant at the level of 5% and 1%, which indicate that the in-situ urbanization level can be improved under the joint action of agriculture and non-agricultural industries. Meanwhile, the coefficient of lnPI is negative at 1% level, which means that the development of agriculture does not directly drive the in-situ urbanization. When agriculture and non-agriculture are integrated or agriculture indirectly affects in-situ urbanization through non-agriculture, the development of agriculture will play a significant role in promoting in-situ urbanization. The above analysis shows that the simple development of agriculture does not play a direct role in promoting the development of in-situ urbanization. On the contrary, it will have some adverse effects on the development of in-situ urbanization. In

order to drive the process of in-situ urbanization through agriculture, it is essentially necessary to separate some non-agricultural industries from agriculture, which can accelerate the in-situ transfer of rural labor for non-agricultural employment.

Table 3. Results of stepwise regression in model (5).

Variables	GMM					OLS
	(1)	(2)	(3)	(4)	(5)	(6)
L1. ln*IU*	0.6599***	0.5913***	0.5118**	0.5402*	0.4579**	0.4164***
	(0.1338)	(0.1278)	(0.2699)	(0.3016)	(0.2180)	(0.1073)
ln*SI*	0.1417**	0.1369***	0.1173**	0.0955***	0.0836***	0.0053
	(0.0693)	(0.0403)	(0.0587)	(0.0150)	(0.0186)	(0.0097)
ln*PI* × ln*SI*	2.3128***	1.6069***	1.2684***	1.2437***	1.0978***	0.8785*
	(0.4091)	(0.3850)	(0.2795)	(0.3113)	(0.3459)	(0.4801)
ln*GAP*	-5.0272***	-4.9453***	-4.2475***	-3.5584***	-2.4998***	-2.5564***
	(0.5159)	(0.5866)	(0.8962)	(0.7033)	(0.5731)	(0.4652)
ln*EDU*		0.0348	0.0167	0.0059	0.0104	0.0045
		(0.0706)	(0.0158)	(0.0045)	(0.0200)	(0.0071)
ln*GOV*			0.7436**	0.7285***	0.6996***	0.8553***
			(0.3611)	(0.1123)	(0.1559)	(0.2165)
ln*TRA*				-0.0300***	-0.0296*	-0.1205
				(0.0106)	(0.0157)	(0.0443)
ln*MED*					-0.1382***	-0.0056
					(0.0303)	(0.0104)
N	850	850	850	850	850	860
AR(1)	0.007	0.007	0.012	0.009	0.032	/
AR(2)	0.731	0.805	0.683	0.720	0.444	/
Sargan	0.914	0.847	0.862	0.737	0.741	/

*, ** and *** indicate statistical significance at the10%, 5% and 1% levels, respectively.

Next, we analyze the impact of the secondary industry on in-situ urbanization. It can be seen from regression (5) in Table 3 that the Sargan value is 0.741, which fails to reject the null hypothesis that the instrumental variable is valid. The P values of residual autocorrelation test AR(1) and AR(2) are 0.032 and 0.444, respectively. There are significant first-order sequence correlations in the five regressions but no second-order sequence correlations, which indicated that the instrumental variables we selected were reasonable. The estimated coefficients of regressions (1) to (5) for the lag term of the in-situ urbanization rate are 0.6599, 0.5913, 0.5118, 0.5402, and 0.4579, respectively, which are all significant. This indicates that the explanatory variables have a significant lag effect, and we also select the results of regression (5) in Table 3 for analysis.

According to the results of regression (5) in Table 3, the coefficient of the secondary industrial value (SI) is 0.0836 and significant at 1% level. The results show that the increased secondary industrial value in the national economy has an obvious promoting effect on the process of in-situ urbanization. Intuitively, the increased secondary industrial value will directly lead to the increase of employment opportunities provided by the non-agricultural industry, which means that the in-situ urbanization level will manifest a significant upward trend with the advancement of industrialization. This result is similar to the views held by many scholars currently. Many studies found that the process of urbanization is driven by industry development [8][11][16][21]. Specifically, the promotion effect of industrial development on in-situ urbanization is mainly manifested in the following two aspects.

On the one hand, the development of industry has changed the mode of production in rural areas, which makes agricultural labor productivity increase rapidly and provides production factors support for in-situ urbanization. On the other hand, with the gradual advance of industrialization, a new situation of integrated development of agriculture and industry will be formed in rural areas [5]. At the same time, the industry as a vast employment container will be conducive to the non-agricultural employment of rural labor, promoting the development of in-situ urbanization. Further, we can see in Table 3 that the coefficient of interaction term lnPI × lnSI is 1.0978 and significant at the level of 1%, which indicates that the joint development of manufacture and agriculture is also beneficial to promote the process of in-situ urbanization. In general, in the process of driving in-situ urbanization by the manufacture, there will be both direct effects and the synergy of combining with agriculture.

Table 4. Results of stepwise regression in model (6).

Variables	(1)	(2)	(3)	(4)	(5)
L1. ln*IU*	0.1916***	0.1632***	0.1132***	0.1524***	0.1335***
	(0.0293)	(0.0347)	(0.0326)	(0.0391)	(0.0286)
ln*TI*	0.1228***	0.1195***	0.0956***	0.0932***	0.0728***
	(0.0217)	(0.0274)	(0.0230)	(0.0311)	(0.0206)
ln*PI* × ln*TI*	2.5369***	2.4017**	2.3576***	2.0530***	1.8649***
	(0.8001)	(1.3124)	(0.5070)	(0.6861)	(0.6475)

ln*GAP*	-5.5865***	-5.4569***	-5.6339***	-4.4449***	-4.1866***
	(0.4402)	(0.8419)	(1.2083)	(1.1545)	(1.0734)
ln*EDU*		0.0050	0.0787	0.0205	0.0191
		(0.0062)	(0.0939)	(0.0458)	(0.0275)
ln*GOV*			0.1056***	0.0946***	0.0775**
			(0.0312)	(0.0188)	(0.0354)
ln*TRA*				-0.0407***	-0.0261***
				(0.0040)	(0.0058)
ln*MED*					-0.1255***
					(0.0349)
N	860	860	860	860	860

*, ** and *** indicate statistical significance at the10%, 5% and 1% levels, respectively.

As for the tertiary industry's impact, according to the results of the endogeneity test in Table 1, the OLS was used in the model (6), and the estimated results are shown in Table 4. From Table 4, the estimated coefficients of regressions (1) to (5) for the lag term of the in-situ urbanization rate are0.1916, 0.1632, 0.1132, 0.1524, and 0.1335 respectively, which are all significant at 1% level. This indicates that the explanatory variables have a significant lag effect, and we also select the results of regression (5) in Table 4 for analysis. It can be seen that the coefficient of tertiary industrial value (TI) is 0.0728 and significant at 1% level. It implies that the increased tertiary industrial value has a significant positive effect on the process of in-situ urbanization. Some scholars believe that the influence of the tertiary industry in rural areas is mainly reflected through the service industry and tourism, especially the agricultural recreation formed by the combination of agriculture and tourism [7][17]. According to the interaction term coefficient (lnPI × lnTI) in Table 4, the combined development of primary and tertiary industry sectors does play a significant role in promoting the in-situ urbanization process (the coefficient of lnPI × lnTI is 1.8649 and significant at the 1% level). Therefore, the impact of the tertiary industry on in-situ urbanization can be attributed to the rural service industry and rural tourism's impact on the employment and life of rural residents.

On the one hand, the development of the rural service industry and tourism can promote the personnel and material exchanges between urban and rural areas, break the relative isolation of agriculture in rural areas, and accelerate the urbanization and modernization of concept for the rural resident. Furthermore, the development of rural tourism and service industry will also drive the development of rural economy and the improvement of infrastructure, so that the rural residents are able to enjoy a civic life in their native land. On the other hand, the rural service industry and rural tourism are labor-intensive industries with the characteristics of multiple employment and extensive coverage [7]. Rely on these industries, a large number of the rural labor force can be employed in non-agricultural areas. In addition, it can give full play to the role of women, elderly and other rural vulnerable labor force, so as to realize diversified employment of labor force and provide a new way for the local transfer of rural labor force.

Based on the above analysis, we obtain the influence mechanism of three industries on in-situ urbanization (as shown in the following figure).

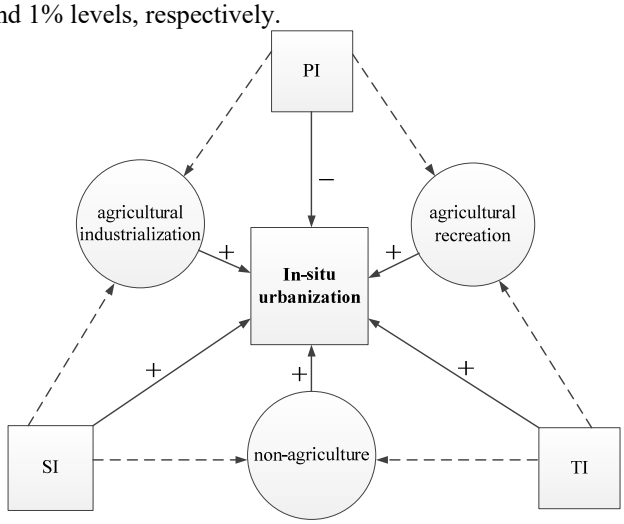

Figure 1. The influence mechanism of three industries on in-situ urbanization.

In Figure 1, the dashed arrow represents the integrated development of the two types of industries, while the solid arrow represents the impact of industries on in-situ urbanization, where '+' represents the positive impact and '-' represents the negative impact. It can be seen that the primary industry itself has a negative effect in the process of in-situ urbanization. However, the primary industry has a positive impact on in-situ urbanization after it is integrated with the secondary industry and the tertiary industry to form agricultural industrialization and ecological agriculture. In additional, the secondary and tertiary industries themselves have a positive impact on promoting the in-situ urbanization. In essence, the combined development of the two types of industries also has a positive effect in the process of in-situ urbanization. For comparing the influence of the three types of industries on the in-situ urbanization, we can compare the absolute values of coefficients lnSI, lnPI and lnTI in Table 5. It can be seen that the secondary industry has the strongest impact on local urbanization (coefficient lnPI is 0.0836), followed by the tertiary industry (coefficient lnTI is 0.0728), and the primary industry has the weakest impact (coefficient lnSI is -0.0251).

5 CONCLUSIONS

Based on the panel data of 87 prefectural cities (autonomous prefectures) in central China from 2009 to 2018, this paper explores the influence mechanism of three industries on in-situ urbanization through system

GMM and OLS estimation, and we draw the following conclusions.

(1) Simple agricultural development does not play a direct role in promoting the process of in-situ urbanization. On the contrary, it will have some negative effects on the development of in-situ urbanization. In the case of the integration of agriculture and non-agricultures or agriculture indirectly acting on in-situ urbanization through non-agricultures, the development of agriculture will promote the process of in-situ urbanization effectively. In essence, the process of driving in-situ urbanization through agriculture needs to separate some non-agricultural industries from agriculture and accelerate the in-situ transfer of rural labor force for non-agricultural employment.

(2) The increased secondary industry value will directly lead to the increase of employment opportunities provided by the non-agricultural industry, which has a significant driving effect on the in-situ urbanization. This effect is mainly manifested in the two following aspects. On the one hand, the development of industry has changed the mode of production in the rural areas, making the agricultural labor productivity increase rapidly and providing the production factor support for the in-situ urbanization. On the other hand, the industrialization will form the integration of agriculture and industry in rural areas, which is conducive to the in-situ non-agricultural employment of rural laborers, thus improving the local urbanization level.

(3) The increased tertiary industry value has a significant positive effect on the process of local urbanization. We attribute this role to the impact of the rural service industry and rural tourism on the employment and life of the rural resident. This effect is also reflected in two aspects. On the one hand, the development of the rural service industry and tourism can promote the personnel and material exchanges between urban and rural areas, break the relative isolation of agriculture in rural areas, and accelerate the urbanization and modernization of concept for the rural resident. On the other hand, the rural service industry and rural tourism are labor-intensive industries with the characteristics of multiple employment and wide coverage. A large number of rural labor forces can be employed in non-agricultural areas. Simultaneously, it realizes diversified employment of labor force and accelerate the in-situ transfer of rural labor.

ACKNOWLEDGEMENTS

This study is sponsored by the Social Science Research Project of Xiamen University of Technology [grant number YSK22007R], Humanities and Social Science Research Youth Foundation of Chinese Ministry of Education [grant number 18YJC790048], and Social Science Research Project of Xiamen University of Technology [grant number YSK22005R].

REFERENCES

1. Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. J. Journal of econometrics, 68(1), 29-51.
2. Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. J. Journal of econometrics, 87(1), 115-143.
3. Chang, Y., Hou, K., Li, X., & Zhang, Y. (2019). Analysis of dynamic changes in the urbanization of Xixian National New Area and its driving forces. J. Indoor and Built Environment, 28(9), 1181-1189.
4. Chen, M., Liu, W., & Lu, D. (2016). Challenges and the way forward in China's new-type urbanization. J. Land Use Policy, 55, 334-339.
5. Chu, Y. (2020). China's new urbanization plan: Progress and structural constraints.J. Cities, 103, 102736.
6. Dong, G., Ge, Y., Zhu, W., Qu, Y., & Zhang, W. (2021). Coupling coordination and spatiotemporal dynamic evolution between green urbanization and green finance: a case study in china. Frontiers in Environmental Science, 8, 621846.
7. Gao, J., & Wu, B. (2017). Revitalizing traditional villages through rural tourism: A case study of Yuanjia Village, Shaanxi Province, China. J. Tourism Management, 63, 223-233.
8. Gu, C., Hu, L., & Cook, I. G. (2017). China's urbanization in 1949–2015: Processes and driving forces. J. Chinese Geographical Science, 27(6), 847-859.
9. Jiang, Z., & Lin, B. (2012). China's energy demand and its characteristics in the industrialization and urbanization process. J. Energy Policy, 49, 608-615.
10. Li, J., Lei, J., Li, S., Yang, Z., & Duan, Z. (2022). Spatiotemporal analysis of the relationship between urbanization and the eco-environment in the kashgar metropolitan area, china. J. Ecological Indicators, 135, 108524.
11. Li, L., & Liu, Y. (2019). Spatial-Temporal Patterns and Driving Forces of Sustainable Urbanization in China Since 2000. J. Journal of Urban Planning and Development, 145(4), 05019014.
12. Liang, W., & Yang, M. (2019). Urbanization, economic growth and environmental pollution: Evidence from China. J. Sustainable Computing: Informatics and Systems, 21, 1-9.
13. Liu, Y., Zhou, G., Liu, D., Yu, H., Zhu, L., & Zhang, J. (2018). The interaction of population, industry and land in process of urbanization in China: a case study in Jilin Province. J. Chinese Geographical Science, 28(3), 529-542.
14. Lu, S., Zhou, Y., & Song, W. (2021). Uncoordinated urbanization and economic growth—the moderating role of natural resources. J. Growth and Change, 52.
15. Nayaga, P., Adusah-Poku, F., Dramani, J. B., & Takyi, P. O. (2022). The threshold effect of electricity consumption and urbanization on carbon dioxide

emissions in ghana. J. Management of Environmental Quality (3), 33.

16. SONG, Z., & ZHU, Q. (2020). Spatio-temporal pattern and driving forces of urbanization in China's border areas. J. Journal of Geographical Sciences, 30(5), 775-793.
17. Su, B. (2013). Developing rural tourism: The PAT program and 'Nong jia le' tourism in China. J. International Journal of Tourism Research, 15(6), 611-619.
18. Wei, Y. D., Li, H., & Yue, W. (2017). Urban land expansion and regional inequality in transitional China. J. Landscape and Urban Planning, 163, 17-31.
19. Zhang, F., Chung, C. K. L., & Yin, Z. (2020). Green infrastructure for China's new urbanisation: A case study of greenway development in Maanshan. J. Urban Studies, 57(3), 508-524.
20. Zhang, M., Tan, S., Zhang, Y., He, J., & Ni, Q. (2022). Does land transfer promote the development of new-type urbanization? new evidence from urban agglomerations in the middle reaches of the yangtze river. J. Ecological Indicators, 136, 108705.
21. Zhou, T., Jiang, G., Zhang, R., Zheng, Q., Ma, W., Zhao, Q., & Li, Y. (2018). Addressing the rural in situ urbanization (RISU) in the Beijing–Tianjin–Hebei region: Spatio-temporal pattern and driving mechanism. J. Cities, 75, 59-71.