Empirical Analysis of the Impact of Urbanization Development on Food Production

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Abstract　In order to clarify the impact of urbanization development on food production，based on panel data from 31 provinces（municipalities，autonomous regions）in China from 2005 to 2015，using a fixed effect model，the paper found that the urbanization rate has a negative impact on per capita food production，and finally made the related policy recommendations. The above research is of significance for promoting the development of urbanization and ensuring food security.

Key words　Urbanization，Food production，Fixed effect model

1　Introduction

　　Food is not only an important material for people's lives，but also related to social stability and sustainable economic development. In the context of continuous urbanization，it is of great significance to ensuring the supply of food markets. The development of urbanization is a "double-edged sword" for food production. On the one hand，the development of urbanization has promoted the progress of food production technology，the accumulation of production factors and the transfer of rural surplus labor；on the other hand，the development of urbanization has also caused certain adverse effects such as increasing deagriculturalization of rural population，non-grain orientation of cultivated land and other phenomena. In the process of promoting urbanization，how to ensure food security is an issue worthy of attention.

2　Literature review

　　At present，there are two opposing views on the impact of urbanization on food security in academia. Some scholars believe that the development of urbanization is conducive to food production. Chen Xiwen *et al.* （2011）believe that urbanization can promote capital，technology and other production factors into the agricultural space，thereby increasing agricultural labor productivity，achieving agricultural scale operations，and benefiting China's food security [1]. Li Fuduo and Yang Xinghong（2016）used statistical data from 1994 to 2013 and conducted a correlation test by constructing a model to make an empirical analysis of the relationship between the two. The promotion of urbanization in China does not have a negative impact on food safety as most people think，on the contrary，there is a long-term equilibrium relationship between the two[2]. However，other scholars believe that urbanization will weaken the capacity of food production，which is mainly manifested in the following two aspects. First，the development of urbanization has occupied a large amount of cultivated land，thereby affecting food security，and the studies by Tim（2012）support this view [3]. Second，the large outflow of young and strong laborers with a high level of education during the transfer of rural labor to cities not only reduced the labor input for food production，but also reduced the overall quality of the agricultural labor force，which affected the use of agricultural technology and led to extensive land management and production decline. Fan Dongjun and Zhu Youzhi （2012）believe that the transfer of a large number of effective agricultural labor forces to cities and towns has affected the progress and extension of agricultural technology，and is prone to the abandonment of arable land，which has affected food production to a certain extent [4]. The research of Tu Taotao and Li Gucheng （2017）found that with the aging of the population and the advancement of population urbanization，China's food security is subject to persistent negative impacts on both the supply and demand levels [5]. From the existing research，there is some controversy about the impact of urbanization on food security by domestic and foreign scholars. The research on the food supply of urbanization is mainly concentrated in the main production areas and the main sales areas. To discuss the relationship between the two，this paper uses panel data from 31 provinces（municipalities，autonomous regions）in China from 2005 to 2015，and uses a fixed effect model to demonstrate the relationship between the urbanization rate and per capita food supply.

3　Theoretical analysis and research hypothesis

　　The land factor（G）is introduced on the basis of the Cobb-Douglas production function. Assuming its elastic coefficient is γ，the C-D production model is extended as：

$$Q = f（L，K，G）= AL^{\alpha}K^{\beta}G^{\gamma}（A，\alpha，\beta，\gamma > 0）\tag{1}$$

　　From the extended Cobb Douglas function，it can be seen that the output depends on the size of labor，capital，and land. With the

advancement of urbanization, a large number of rural people move to cities, and the labor force engaged in food cultivation is reduced. The above analysis makes the following hypothesis: the urbanization rate has a negative impact on per capita food production.

4 Research design

In order to test the impact of urbanization development on food production, the regression model is set as follows:

$$\mathrm{Ln}Q_{pt} = a_0 + a_1 urban_{pt} + \alpha_2 X_{pt} + \varepsilon_{pt} \qquad (2)$$

where $\mathrm{Ln}Q_{pt}$ represents the logarithm of per capita food production in province p in year t; $urban_{pt}$ represents the urbanization rate of province p in year t; X_{pt} represents the control variable; ε_{pt} represents the disturbance term.

To reduce heteroscedasticity, the dependent and control variables are logarithmic. Dependent variable: logarithm of per capita food production. Independent variable: urbanization rate, the proportion of urban population to the total population. Control variables: logarithm of chemical fertilizer application, logarithm of grain sown area, logarithm of pesticide use, logarithm of total mechanical power, logarithm of financial support for agriculture. The data come from China's Agriculture, Forestry, and Forestry Database, and China's Macroeconomic Database.

5 Empirical results and analysis

In order to determine which panel regression method is more effective, the Hausman test is used. The test results show that the fixed effect model is better than the random effect model. Therefore, the fixed effect model is used. The regression results are shown in Table 1. From the regression results, it can be seen that the urbanization rate is significantly negative for per capita food production. With the advancement of urbanization and industrialization, the economy is developed and the cultivated land is scarce. The transfer of labor force to cities leads to a decrease in agricultural labor force and a decline in per capita food production. The amount of fertilizer applied is significantly positive for per capita food production, indicating that more materials need to be invested in food production, and the amount of financial support for agriculture is significantly positive for per capita food production, indicating that China's fiscal support for agriculture policy has given a good incentive to food production effect.

Table 1 Regression results of the impact of urbanization rate on per capita food production

Independent variable	Regression results
Urbanization rate	$-4.612\ 0^{***}\ (0.476\ 1)$
Fertilizer application	$0.963\ 3^{**}\ (0.183\ 9)$
Grain sown area	$-0.030\ 1\ (0.285\ 7)$
Amount of pesticide used	$-0.806\ 2^{***}\ (0.078\ 2)$
Mechanization level	$-0.545\ 3\ (0.291\ 3)$
Amount of financial support for agriculture	$0.157\ 5^{*}\ (0.060\ 1)$

Note: ***, **, * mean significant at the levels of 1%, 5%, and 10%, respectively, and the values in parentheses indicate standard error.

6 Policy recommendations

6.1 Speeding up agricultural science and technology innovation and improving the level of agricultural modernization Given that China has a limited arable land area and even the development of urbanization may reduce the area of arable land, increasing grain yield is the most effective way to increase grain production and ensure China's food security. If we want to increase the yield per unit of grain, we must accelerate innovation in agricultural science and technology, increase the scientific and technological content of grain production, and realize agricultural modernization. To this end, the following measures can be taken. First, it is necessary to consider the selection and breeding of excellent food crop varieties suitable for growth in different regions of our country, improve the application capacity of biotechnology, expand the scope of biotechnology application, develop new green fertilizers that will not damage the soil structure, improve the structure of fertilization and increase the efficiency of fertilizer use. Second, it is necessary to establish and improve the scientific and technological support system for food production by strengthening the input of agricultural credit, increasing investment in agricultural research, constructing new business models for food crops, innovating food product business concepts and improving food product added value, thereby increasing farmers' income and ensuring the security of food supply. Finally, it is necessary to increase the level of mechanization of food production. The government can stimulate the level of agricultural mechanization by further increasing the direct subsidy for the purchase of agricultural machinery by grain farmers.

6.2 Implementing agricultural protection policies and increasing grain subsidies With the rapid advancement of industrialization and urbanization, the comparative advantage of agriculture is losing more and more rapidly. In this case, if we still adhere to free trade, farmers will inevitably compete against other countries with lower food production costs. The producers and operators of other industries in their country, even if their income does not fall, cannot keep up with the income growth rate of other industries, which will lead to a decline in farmers' enthusiasm for grain production and a significant decrease in grain output. And when farmers' income is all or mainly from grain cultivation, the protection of agriculture is not only related to the development of the national economy, but also related to the survival of farmers. This is the fundamental reason for implementing agricultural protection policies. On the one hand, the government must take measures to stabilize food prices, reduce food price fluctuations, and implement a supportive price policy (minimum price) on food to keep it stable at a relatively high level. Only in this way can farmers benefit from food production. There will be some guarantees to increase their enthusiasm for growing grain. On the other hand, in accordance with the principles of efficiency, fairness, stability, and sustainability, it is necessary to further increase the

investment of agricultural funds, increase the subsidy standards for grain cultivation, and explore new subsidy mechanisms (differentiated subsidies, *etc.*), to improve the efficiency of capital use, promote production, increase income, and protect the interests of grain and farmers. Finally, in order to actively and steadily advance and establish a sound social security system in the process of urbanization, it is necessary to ensure food security, we must consider the social security issues of low-income groups in rural society. Along with the process of urbanization, some farmers will lose their arable land and become landless farmers. In addition, women, the elderly and children are left behind in the countryside, and the main problem faced by these people is that "they cannot afford food", which requires the government to take active measures to improve the rural social security system and guarantee their basic living conditions.

6. 3   Standardizing the use of cultivated land and strengthening the protection of cultivated land   With the development of urbanization, non-agricultural construction takes up more and more cultivated land. However, cultivated land is a scarce resource that is non-renewable or difficult to regenerate, and food is a cultivated land-intensive product. It has not been developed and used by humans. Before cultivated land can be used for large-scale food production technology, it is necessary to standardize the use of cultivated land, strengthen the protection of existing cultivated land, and ensure a certain area of cultivated land. Specifically, the following three aspects need to be done. First, it is necessary to continue to adhere to China's 1. 8 billion acres of arable land red line, no matter how much urbanization and industrialization develop, this part of arable land cannot be occupied, thereby providing a strategy for China's food security protection. In urbanization construction, it is necessary to make a plan, strive for reconstruction and construction on the original homestead, and try not to occupy cultivated land. If part of the cultivated land must be occupied during the urbanization process, reasonable planning is also required. Starting from the lowest level of cultivated land, we will improve the reward and punishment mechanism for graded cultivated land occupation, and strictly restrict or even eliminate the occupation of high-grade cultivated land by non-agricultural construction. Second, it is necessary to formulate a cultivated land compensation mechanism to ensure the stability of the total cultivated land area through the appropriate development of reserve cultivated land resources and strengthening the consolidation of existing "abandoned" land. Third, we must regulate the farmer's transfer of farmland, prohibit the private sale of farmland, protect the existing farmland to the greatest extent, and limit its conversion to non-agricultural use.

6. 4   Implementing moderate scale management and intensive management of grain production   At present, a prominent agricultural problem in China's food production is the small size of farmland and fragmented land. This situation has led to high cost of food cultivation, poor competitiveness, and extremely uneconomical scale, which has affected the development of agricultural modernization. The implementation of moderate scale and intensive management of grain crops is conducive to the more adequate and rational use of agricultural machinery and equipment, the use of advanced agricultural technology and advanced management methods. It can improve agricultural labor productivity and reduce the cost of food production, thereby stabilizing food production and improving the quality of market competitiveness and agricultural economic benefits. With the development of urbanization, China's rural population will be reduced to 518 million by 2026. The development of urbanization will become an opportunity to gradually expand the scale of food production. By encouraging the internal transfer of cultivated land for agricultural purposes, there is a need to gradually guide farmers to take the road of large-scale and intensive agricultural operation, promote the industrialization of grain operation, increase overall scale benefits, increase farmers' income, and strive to increase farmers' enthusiasm for growing grain.

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