

The Impact of Aging Population on Industrial Structure Upgrading-- Empirical Test Based on Provincial Panel Threshold Effect

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Abstract. In this paper, panel data of 30 provinces from 2006 to 2016 in China were used to study the impact of population aging on industrial structure upgrading. The empirical results show that, on the whole, the aging population is not conducive to the upgrading of a country's industrial structure. However, this effect is limited by the level of regional economic urbanization and population urbanization. Research shows that when the level of economic urbanization of a region exceeds the threshold value of 2.2785, or the level of population urbanization exceeds the threshold value of 2.2788, the aging population will promote the transformation of domestic industrial structure. But so far, only Shanghai, Beijing and Tianjin have exceeded the threshold level of economic and population urbanization. In order to adapt to the aging of the social population, we should first accelerate the tax reform to narrow the social income gap. Then, speeds up the educational reform. Finally, while increasing the social security for the aging population, we should not reduce R&D investment.

Introduction

With the rapid development of social economy and the improvement of people's living standards, aging has become a very serious problem in China. By the end of 2016, the number of people over 65 in China had reached 150 million, accounting for 10.85 percent of the total population. Economists predict that by 2025, China will have 300 million people over the age of 60, making China a super-aged country. At the same time, with the promotion of "new normal" goal, promoting industrial upgrading has become an important task for all provinces. So it is urgent to study the influence of aging on industrial structure upgrading.

At present, scholars' researches on this aspect mainly focus on two aspects: the first view is that the aging of population hinders the upgrading of industrial structure. On the one hand, the aging of the population will reduce the quantity and quality of labor supply. At the same time, the government's social expenditure on the aging population will not only force the government to increase tax burden, but also crowd out the funds used by enterprises for research and development, that will hinder the upgrading of industrial structure^[1]. The second view is that the aging population is conducive to the upgrading of industrial structure. First, as most of the aging industries belong to the tertiary industry, the increase in the number of elderly people will drive the development of the relevant tertiary industry^[2]. Second, the aging of the population will accelerate the arrival of the "lewis turning point"^[3], and the gradual rise of labor costs will force the upgrading of the industrial structure.

Through to the related literature in recent years, most literatures are directly observed correlation of aging population and the industrial structure. But that correlation also will be affected by different economic development level and different human capital level, Therefore, introducing these factors into the empirical model as threshold variables can improve the current research.

Empirical Model Design

Basic Model. Considering the heterogeneity of regions and the influence of time on population structure and industrial structure, panel model was selected for empirical analysis, and the established basic regression model is shown in equation (1).

$$ins_{it} = \alpha_1 old_{it} + \chi Y + \eta_t + \vartheta_i + \mu_{it} \quad (1)$$

Panel Threshold Model. Considering that the level of urbanization in a country can comprehensively reflect the economic development, consumer demand and human capital of the place. In this paper, urbanization level difference is cited as the threshold variable, and the urbanization level is divided into economic urbanization and population urbanization level which refers to Zhao Chunyan^[4]. The specific analysis hypothesis is as follows.

Firstly, the demand of the elderly for the tertiary industry depends on the level of economic development and per capita income of a region. When the income of the elderly increases, they will spend their spare money on the investment and consumption of the tertiary industry, so as to promote the development of related industries. Therefore, this paper proposes the first hypothesis: the level of economic urbanization plays a role of threshold effect in the impact of aging on the upgrading of industrial structure. When the level of economic urbanization of a region exceeds the threshold value, aging will significantly promote the upgrading of industrial structure.

Secondly: the agglomeration of population in cities will firstly increase the supply of labor, secondly bring about the agglomeration of consumption and human capital. All these are important factors to promote the upgrading of industrial structure. Therefore, this paper proposes the second hypothesis: the level of population urbanization plays a role of threshold effect in the impact of aging on industrial structure upgrading. When the level of economic urbanization of a region exceeds the threshold value, aging will significantly promote the upgrading of industrial structure.

The threshold model in this paper is based on the panel data threshold model of Hansen (1999). The specific setting is shown in equation (2-3):

$$ins_{it} = \beta_1 + \beta_2 old_{it}(purb_{it} \leq \gamma_1) + \beta_3 old_{it}(purb_{it} > \gamma_1) + \eta_1 X_{it} + \varepsilon_{it} \quad (2)$$

$$ins_{it} = \beta_1 + \beta_2 old_{it}(eurb_{it} \leq \gamma_2) + \beta_3 old_{it}(eurb_{it} > \gamma_2) + \eta_1 X_{it} + \varepsilon_{it} \quad (3)$$

Variable Declaration

The explained variable in this paper is the industrial structure upgrading index (ins), which is measured by the ratio between the added value of the tertiary industry and the added value of the secondary industry. The core explanatory variable is the degree of population aging (old), which is measured by the dependency ratio of elderly. Threshold variables were synthesized by factor analysis. Among them, the measurement index of population urban rate (purb) includes Labor force (emp) which measured by the logarithm of total employment in the three industries, population urbanization rate (urb), which measured by the proportion of urban population in the total population, and human capital accumulation (edu), which measured by the average years of education for people over 6 years old. The measurement index of economic urban rate (eurb) includes real per GDP (gdpi), which measured after adjustment for the base period of 2000, and urban disposable income (urdi), which measured by the annual household income of the average urban resident. The control variables in this paper include child support ratio (edr), level of opening-up (fdi), level of financial development (fin). These indicators also impact on the upgrading of the industrial structure.

The data of each index in the panel threshold model in this paper are provincial-level data of 30 provinces (excluding Tibet) in China from 2006 to 2016.

Empirical Analysis

Basic Regression Results. This paper uses stata15 to realize regression. The estimated results are shown in Table 1. As the result, the deepening of population aging will hinder the upgrading of industrial structure. This may be because the economic development level of many provinces in China is still not very high, and the old age group's thrifty consumption thought is very serious. Secondly, as the retirement age of the elderly population is delayed, the employment opportunities of young group are squeezed out. And the government's subsidies to elder will reduce the amount of R&D funds. These all reduced the level of human capital, which will hinder the upgrading of industrial structure.

In order to verify the robustness of the results, this paper redefines the aging level according to the new UN standard. The new standard indicates that only when the proportion of elder, which over 65 years, exceeds 7% can define the stage of aging. So use this new standard, we build the new index of aging. The regression results are shown in table 2 (5). The relationship between the degree of aging, which measured by the new index, and the upgrading of industrial structure is more significant, which may be because the degree of aging reflected by this index is deeper, and the hindering effect on the upgrading of industrial structure is more obvious.

Table 1 Regression results of basic model

	(1)	(2)	(3)	(4)	(5)
aging of population	-1.2217** (0.5325)	-1.2115** (0.5277)	-1.3099** (0.5918)	-1.2153** (0.5137)	-1.2153** (0.3373)
control variable	no	no	yes	yes	yes
year fixing effect	yes	yes	yes	yes	yes
province fixing effect	no	yes	no	yes	yes
Number of observations	330	330	330	330	330

Note: the brackets are robust standard errors. ***, ** and * represent the significance levels of 1%, 5% and 10% respectively.

Threshold Regression Results. The estimated results are shown in Table 2.

Table 2 Regression results of panel threshold model

variable	Panel Threshold Model (1)	Panel Threshold Model (2)
Threshold variable	eurb	pueb
fdi	-0.0375 (0.0234)	-0.0401* (0.0237)
fin	0.3361*** (0.0359)	0.3192*** (0.0366)
edr	0.01263*** (0.0034)	0.0112*** (0.0035)
old(eurb ≤ 2.2785)	0.4863** (0.086)	
old(eurb > 2.2785)	4.0042*** (0.4907)	
old(pueb ≤ 2.2788)		0.5100** (0.2406)
old(eurb > 2.2788)		4.9928*** (0.6197)
Observations	330	330

Note: standard error in brackets.***, ** and * represent the significance levels of 1%, 5% and 10% respectively.

The first column shows that: the impact of aging on the upgrading of industrial structure has a significant threshold feature, which means that the level of economic urbanization can play a positive regulating role in the relationship between aging and industrial structure. However, when the level of economic urbanization is lower than the threshold value of 2.2785, its role is very small. However, when the level of economic urbanization is higher than the value of 2.2785, aging has a significant positive effect on the upgrading of industrial structure, and the effect coefficient is 4.0042. Secondly, the results in column (2) show that the impact of aging on the upgrading of industrial structure has a significant threshold feature, which shows that the level of population urbanization can also play a positive regulating role in the relationship between aging and industrial structure. However, when the level of population urbanization is lower than the threshold value of 2.2788, its regulating effect is very small. However, when the level of economic urbanization is higher than the threshold value of 2.2788, aging has a significant positive effect on the upgrading of industrial structure, with an action coefficient of 4.9928^[5, 6].

Conclusion and Suggestion

This paper uses panel data of 30 provinces from 2006 to 2016 to research the impact of population aging on industrial structure upgrading. The empirical results show that, on the whole, China's aging population hinders the upgrading of industrial structure, which can be analyzed from three aspects: consumption, supply and social burden. In terms of consumption, the per capita income of the elderly population is low, and the solidified consumption thinking is serious, which will not conducive to the consumption transfer of elderly population. In terms of supply, the increase of the elderly population has squeezed the employment resources of the society and forced newly employed population to move towards labour intensive industry, which is not conducive to the upgrading of the industrial structure. In terms of social burden, the increase of aging population means that the government needs to spend more social welfare amount, which will crowd out the government expenditure on R&D funds. In order to further study whether the aging of economy and human capital will promote the upgrading of industrial structure after a certain stage of development. In this paper, the index of population urbanization rate and economic urbanization rate are taken as the threshold variable to construct the panel threshold model.

The empirical results of the threshold model show that when the comprehensive index of economic urbanization exceeds the threshold value of 2.2785, and the comprehensive index of population urbanization exceeds the threshold value of 2.2788, the aging of population will significantly promote the upgrading of industrial structure. Among the 30 provinces in China, only Beijing, Shanghai and Tianjin have passed the threshold value in recent years, while the remaining 27 provinces have not crossed the threshold value during the observation period.

Based on the above empirical results, this paper proposes the following Suggestions:

First, increase per capita disposable income and promote economic urbanization. Mean while accelerate the reform of taxes and fees to narrow the income gap in society. China should work hard to achieve common prosperity for all

social groups.

Secondly, while reforming the household registration system, we should increase the accumulation of human capital, actively implement the education of the youth in rural areas, and improve the level and quality of compulsory education. At the same time, the re-education and training of the elderly population should be strengthened so that the elderly population can also adapt to the economic upgrading and development.

Third, we should reasonably allocate government expenditure and income. While strengthening the investment in social security and medical insurance for the elderly, we should not neglect the investment in scientific research.

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