The impact of population aging on economic growth

Qianhui You[*]

Sun Yat-sen University, Guangzhou, Guangdong, 510000, China

*Corresponding author. Email: 2305962044@qq.com

ABSTRACT. The purpose of this paper is to study the impact of population aging on economic growth rate and whether the impact is through
The transmission is carried out by the way that affects the consumption level of residents and the consumption expenditure of the government. Based on the econometrics research method, this paper uses the comprehensive data of regional economy in CSMAR database to explore the role of the elderly population dependency ratio, which reflects the degree of aging, in economic growth. This paper will use relevant statistical data, set up a panel model based on six provinces and cities for fixed-effect regression, quantify the impact degree, and finally get the conclusion that population aging will significantly affect the local economic growth rate.
By studying the relationship between population aging and economic growth, we can have a deeper understanding of the factors affecting economic growth, and provide empirical basis for the formulation of population policies and education policies.

Keywords: population aging; economic growth; household consumption

1   Introduction

With population growth, economic growth, and ever-changing attitudes to life, the worldwide problem of aging is increasing. China has experienced a series of stages such as population explosion and family planning, and the problem of population aging has gradually become prominent. [1]According to international standards, China is actually in the stage of population aging and showing a trend of continuous deepening.

In 2022, China's total population will decrease slightly, the number of births will continue to decrease, and the natural growth rate will be reduced to negative. The intensification of population aging means that the model of demographic dividend can no longer be maintained, and the reduction of the working-age population will greatly affect the economic growth rate. How to promote high-quality development and maintain economic growth rate has been called one of the key issues to be solved urgently in China.

2   Review of relevant research

In Chinese academic circles, Mu Guangzong (2011) put forward three characteristics of China's aging population, namely, getting old before getting rich, getting old without preparation, and dying alone.   Compared with the per capita GDP of developed countries entering the aging population stage, China's per capita GDP is only less than one-fifth of that of the developed countries, and the economic strength to cope with the aging population is relatively weak. [2] At the same time, China's aging industry has not made full development, in many aspects of social security systems are lacking.

On the other hand, there are regional differences in aging. Loh Jiehua and Lam Jiaqi (2021) conclude that by the influence of regional growth centers and urban agglomerations, China's aging has obvious regional imbalance characteristics. According to the report of the seventh population census, all administrative provinces in the mainland, except Tibet, have entered the aging society in 2020, and the distribution features are rising from the west to the east. Some areas in Northeast China have even begun to bear the dual pressure of negative population growth and accelerated population aging. [3]

In recent years, a number of scholars have explored the impact of population aging on the economy. Some scholars believe that aging will inhibit economic growth, Gai Xiaomin, Zhang Shuangshuang (2018) proposed that population aging would affect a country's economic growth by influencing factors such as labor supply, savings and capital investment. [4] Zhang Zixuan (2021) showed that while population aging inhibits economic growth, it has a significant promoting effect on human capital, and the influence of human capital can reverse reduce the inhibiting effect.   At the same time, some scholars believe that aging will positively promote economic growth by increasing the time spent in education. To some extent, I personally believe that this will also have an impact on the economy by affecting human capital.

This paper will test the inhibitory effect of aging on economic growth through empirical study, explore whether there is an influence mechanism on consumption, and explore the research direction other than expanding human capital. re way to let you spend money and play more time.

3   Data and sample selection

The data in this paper are from regional economy and population aging data in CSMAR database. We obtained the data from From 1995 to 2021, we extracted the GDP data by province, population data by province, per capita consumption data by province, as well as the age composition and dependency ratio of the population by region. According to the characteristics of regional imbalance of population aging proposed in the previous article, this paper is based on geographical location. Six provinces and cities were selected, including Anhui province, a populous province, Zhejiang province, a coastal province with rising economic development, Heilongjiang province, an old industrial province in the northeast, Beijing

Municipality, Hunan province in the central region, and Guizhou Province in the southwest.

4   Empirical model

4.1   Descriptive Statistics

Table 1. shows the general descriptive statistics.

Table 1. General descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Total dependency ratio	156	38.88	9.46	20.95	57.58
Juvenile/child support ratio	156	25.318	9.458	10.41	47.74
Elderly population dependency ratio	156	13.562	3.437	6.27	23.55
Gross regional product	162	14488.557	14518.979	630.07	73515.758
Gross regional product per capita	162	34937.898	34983.57	1826	183980
Gross regional Product index (previous year = 100).	162	109.938	2.818	101	116.7
Year end population (tens of thousands)	162	4510.512	1689.713	1240	7246.258
Birth rate (per thousand)	154	11.115	3.538	3.59	22.15
Fixed asset investment	138	6598.192	7826.027	161.79	31959.227
Growth rate of fixed asset investment	132	1.179	0.103	0.858	1.44
Residents' consumption level	132	10481.907	9751.353	1258	52912

Household consumption level index	132	108.613	4.301	98	126.7
Government consumption spending	132	1641.168	1503.043	85.8	6442.65
Government consumption spending on a month-onmonth basis	126	1.146	0.091	0.793	1.419
Population aged 15-64	162	32335136	11612622	8998846.2	48937888
Employment numbers	153	2564.867	1139.29	618.6	4385.3
Employment rate	152	0.77	0.111	0.524	1.028

Descriptive statistics of panel data.

area: 1, 2, ..., 6   n=6

year: 1, 2, ...,27   T=27

Delta(year)=1 unit
Span(year)=27 periods
(area*year uniquely identifies each observation)

Distribution of max	T_i:	min	5%	25%	50%	75%	95%
	27	27	27	27	27	27	27

Freq.	Percent	Cum.	Pattern
6	100.00	100.00	111111111111111111111111111
6	100.00		XXXXXXXXXXXXXXXXXXXXXXX XXXXX

4.2   Basic Model

Establishment of identification hypothesis and model.
Hypothesis: Population aging will reduce economic growth.
Model: The panel is built with province as individual identifier and year as time identifier.
After the preliminary F test on the panel data, we get Prob > F = 0.0000; At the same time, the Hausmann test showed that the individual random effects were the

same as the Pooled OLS regression results. [5]Therefore, it can be concluded that the individual solid effects exist and the individual fixed effects model should be used for regression.

Therefore, the basic model is set as follows:

Further develop high-quality game products.

$$GDPrate_{it}, = \alpha + \beta_1 \ Old \ DependencyRatio_{it}, + \theta X_{it}, + \mu_i + \epsilon_{i,t}$$

Table 2 shows the regression results.

<div align="center">Table 2. Basic Model</div>

VARIABLES	(1) m1 Gdp0126	(2) m2 Gdp0126	(3) m3 Gdp0126	(4) m4 Gdp0126
OldDependencyRatio	-0.283***	-0.385***	-0.728***	-0.256**
	（0.0351）	（0.0642）	（0.128）	（0.0767）
Inco1005				0.213
				（0.0285）
gov				5.839***
				(1.118)
IfaRate				11.23***
				(1.533)
employrate			15.91*	10.46*
			(6.643)	(4.981)
birthrate			-0.664*	-0.206*
			(0.272)	(0.0888)
ChildrenDependencyRatio			-0.00660	
			(0.130)	
Constant	113.8***	115.2***	115.1***	65.08***
	（0.662）	（0.871）	（7.804）	（4.986）
Observations	156	156	144	117
R-squared		0.196	0.284	0.608
Number of area	6	6	6	6

Robusts standard errors in parentheses
   ***p<0.01, **p<0.05, *p<0.1

Column (1) was Pooled OLS regression, and the results were significant. Individual fixed effect regression was performed starting from column (2), and multiple control variables were added to column (3) and (4). From the results, we can conclude that in controlling the birth rate, employment rate, growth rate of government consumption expenditure, The old-age dependency ratio always has a

significant negative impact on economic growth, and this effect is still valid even after excluding the interference of individual effects. In regression (3) and (4), STATA regression all showed obvious individual fixed effects.

4.3   Identifying Problems

After reaching the conclusion that population aging does reduce economic growth, there are still several problems:

1.Mediating effect: Does it exist when factors such as control variables significantly affect the explained variables

2.Intermediate effect, that is, the old-age dependency ratio of the explanatory variable acts on the gross product index of the explained variable by influencing the intermediate variables such as the consumption level index and the employment rate. [6]

3.Endogenous problem: This experiment adopts a fixed effect regression model, which can be controlled within to a certain extent The effect of endogeneity solves the endogeneity problem caused by the correlation between individual characteristics and explanatory variables. [7]However, there may still be some problems in the model, such as missing variables, measurement errors, two-way causality, etc., which will lead to inaccurate model estimation.

4.4   Mediating effect

In order to explore the mediating effect, that is, the transmission mechanism of population aging, we will conduct further research Investigate. From the fixed effect regression of the previous article, we get that the consumer consumption level index and government consumption expenditure have a significant impact on economic growth rate. Government consumption refers to the government's expenditure for the provision of public services and social welfare, including education, medical care, social security, etc. [8]The acceleration of population aging may lead to the increase of government welfare expenditure. Population aging may also cause the change of residents' consumption concept, which will affect the consumption level of residents and ultimately affect the GDP growth rate. Therefore, we will study the influence of these two intermediary effects.

Model setup.

$$GDPrate_{it},\, = \alpha_1 + \beta_1\; Median_{it} + \gamma \times Median_{it}\; \times Old\; DependencyRatio_{it},\, + \delta X_{it},\, +$$

$$\mu_i\; + \epsilon_{i,t}$$

$$Median_{it} = \alpha_2 + \beta_2\; Old\; DependencyRatio_{it} + \sigma_{i,t}$$

Table 3 shows the regression results

Table 3. Mediating effect

	(1) a1 Gdp0126	(2) a2 Gdp0126	(3) a3 gov	(4) a4 Gdp0126	(5) a5 Gdp0126
VARIABLES					
OldDependencyRatio	0.660* (0.307)	-0.0185 (0.153)	-0.00937** （0.00265)	-0.502 （0.943）	-0.0470 (0.620)
Inco1005		0.2000*** (0.0301)		0.211*** （0.0329）	0.199*** (0.0317)
depencycost		-6.71e-06* (2.84e-06)			-6.71e-06* (2.84e-06)
govdepency				0.218 (0.880)	0.0579 (0.568)
gov		3.267** (1.141)		2.907 (11.18)	2.491 (7449)
IfaRate		10.07*** (1.854)		11.27*** (1.451)	10.08*** (1.810)
employrate		9.767* (4.324)		10.47* (4.989)	9.770* (4.326)
birthrate		-0.0754 (0.119)		-0.203* (0.0919)	-0.0746 (0.120)
Constant	100.2*** （3.886）	67.34*** （4.451）	1.264*** （0.0339）	68.48** （17.74）	68.24*** （12.50
Observations	126	117	120	117	117
R-squared	0.112	0.677	0.042	0.608	0.677
Number of area	6	6	6	6	6

Robusts standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1

Regression (1) and (3) were respectively regression with dependency ratio of mediating variables, and the results were significant but had no explanatory strong effect. Regression (2) and (4) respectively test the influence of intermediary variables, in which the intermediary variable of household consumption level and its cross-pollination terms are significant, while the government consumption expenditure does not show further effective regression results.

According to the above results, we can preliminarily draw a conclusion that residents' consumption level is the transmission mechanism of the influence of population aging on economic growth, while government consumption expenditure does not play an intermediary role.

5 Conclusions and suggestions

Population aging has a significant inhibitory effect on economic growth and a certain promotion of residents' consumption level. And the improvement of residents' consumption level can partially inhibit the negative impact of population aging on economic growth. [9]

According to the above conclusions, the following suggestions are put forward:

First, the government should strengthen the construction of the oldage security system to ensure the living standards of the elderly. In the meantime, we should seize the new opportunities arising from the gradual rise of emerging industries for the elderly to stimulate economic development.

Secondly, increasing investment in human capital and technological innovation is the inevitable choice of the future economic transformation of our country, and we must strengthen innovation;.

Finally, while vigorously exerting the role of the market, the government should stimulate the consumption level of residents through various ways to mitigate the impact of population aging on economic growth.

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