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Aging and income inequality: An empirical analysis of the Chinese context,1995–2016

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Abstract. China's rapid economic growth is accompanied by an aging population and rising income inequality. Although both developed and some developing countries are faced with the challenge of population aging, but the transmission mechanism of aging-to-income inequality has been lacking. With Gini coefficient as measurement of the income inequality, and use the provincial level panel data of China from 1995-2016, the paper confirms the empirical relationship between aging and inequality, an econometric model will be used to prove that aging has a significant impact on income inequality in China.

1. Introduction

Forty years since the reform and opening up, China's economy has gained remarkable achievements, with a continuously improved, and people's have been continuously improving. However, the problem of population aging is gradually emerging. China's society has gradually entered an aging society. According to the "Statistical Bulletin of National Economic and Social Development in 2017", by the end of 2017, the number of elderly people over the age of 60 in China has reached 17.3%. The aging process seriously threatens the increase in the number of labor force in China, and it also promotes the change in the income structure of households.

In terms of income distribution, in the process of China's aging process, China's income inequality is also becoming more and more serious. According to the data released by the National Bureau of Statistics, China's Gini coefficient of national income at the end of 2017 was 0.452, far exceeding the internationally recognized Gini coefficient warning line of 0.4, which is also higher than the countries with the same level of economic development. The high level of income inequality poses great challenges to China's sustained and healthy growth of macroeconomics, social justice and stability, leading to serious problems such as economic efficiency decline, rising class conflicts and social welfare losses. Factors such as the decline in the social labor force and changes in the family income structure caused by changes in age structure also appear to be the cause of changes in the structure of income distribution. Studying the intrinsic link between China's aging and income inequality will help to explore the mechanism of income inequality in China and provide an effective policy reference for China's policy-making authorities.

2. Data variables and models

In order to verify the relationship between the theoretical mechanism and age structure mentioned above and social income gap, the following empirical model was set up to test its macro effect by referring to the research of Dong et al. (2012) [1].

$$\mathrm{Gini}_{i,t} = \alpha + \beta_1 \mathrm{Ydep}_{i,t} + \beta_2 \mathrm{Odep}_{i,t} + \gamma \mathrm{Contrl}_{i,t} + \varepsilon_{i,t}$$

The index i and t represent the region and time respectively, and epsilon and epsilon (i,t) represents the random disturbance term. Gini(i,t) stands for Gini coefficient, which is used to represent income gap. In order to measure the change of population age structure, two indicators are uesed, namely, young dependency ratio (and elderly dependency ratio). Ydep and Odep are the core explanatory variables that this paper focuses on. Among them, Ydep is the dependency ratio of

children, and the calculation index is the ratio of the population under the age of 15 and the population aged between 15 and 64 (%). Odep is the old-age dependency ratio (%), which is calculated as the ratio between the population aged 65 and above and the population aged 15-64. The changes of Ydep and Odep over time reflect the changes of population age structure. Aging is manifested in the increase of the elderly dependency ratio and the decrease of the children's dependency ratio, which is exactly the obvious trend of the population changes in contemporary China. In the empirical study, natural logarithms of Ydep and Odep were taken. According to the previous theoretical analysis, we expect the coefficient of Ydep to be negative, while the coefficient of Odep is positive, that is, aging (declining dependency ratio of children and rising dependency ratio of old age) will aggravate income inequality.

Table 1. Variable definition and data source

Variable	Definiton	Source
Gini	The Gini coefficient	The gini coefficients of 31 provinces in China were calculated by referring to Tian(2012) algorithm
Ydep	Children's dependency ratio	Data from China's National Bureau of Statistics
Odep	Elderly dependency ratio	Data from China's National Bureau of Statistics
BC	Bussiness Cycle	The growth rate of per capita income by referring to Evans（2004）[2]
FIR	Financial Interrelation Ratio	Compilation of statistics on the 60 years of new Chi
FDI	Foreign direct investment	Wind Database
URB	Urbanization rate	Wind Database
INF	Inflation	The rate of change in the consumer price index

To test the impact of aging on income inequality at the macro level, this excerpt USES macro statistics from 1995 to 2016.Among them, the young dependency ratio and the elderly dependency ratio calculation from China statistical yearbook of population situation, level of financial development and urbanization rate data from the new China sixty years of statistical data collection and vendors database, foreign open degree of the data from China statistical yearbook and vendors database common calculation, the Gini coefficient reference Tian (2012) [3]of the algorithm to calculate the Gini coefficient of 31 provinces in China. Sample descriptive statistics are shown in the table 2 below.

Table 2 Description Statistics of Variables

Variable name	Mean value	Standard deviation	Least value	Median value	Maximum value
Gini Conefficient	0.377	0.059	0.228	0.381	0.571
Ydep	28.355	9.295	9.600	28.000	57.780
Odep	11.675	2.702	5.840	11.400	21.900
BC	1.128	0.064	0.777	1.119	1.425
FIR	2.477	0.936	0.813	2.366	7.575
FDI	2.982	3.050	0.001	1.950	24.253
URB	46.284	16.533	17.190	44.900	89.600
INF	2.956	3.959	-3.600	2.130	21.400

It is worth noting that the mean value of Gini coefficient is 0.377, and the maximum value is 0.571, which is much higher than the international warning line, indicating that income inequality in some regions of China is serious. The mean child dependency ratio is 28.355, and the minimum value of 9.295 indicates that the proportion of children in the total population is very low in some regions and time, which indicates that the birth rate of children in China is at a low level. The mean value of the old-age dependency ratio is 11.675, and the maximum value is 21.900, indicating that the population

proportion of the elderly in China is at a high level, and the level of population aging is at a high potential level.

3. Empirical analysis

3.1 Aggregate analysis

According to the preliminary regression results of column (1), both the dependency ratio index of the elderly and the dependency ratio index of the young children show a certain correlation with the formation of income gap, and from the R square in the regression group, the two have certain explanatory power for the formation of income gap. Specifically, the higher the degree of social "aging", the greater the income gap, the higher the degree of social "less children", the lower the dependency ratio of children, the greater the income gap. Control variables are further introduced to conduct regression of the model. Column (2) and column (3) show the regression results of panel data under the assumption of fixed effect and random effect. Both of them can reject the assumption of model setting bias by using F statistic and Wald statistic at the significance level of 10%. In order to establish the specific form of the model, the Hausman test is used to identify the reliability of the random effect of the model.

The goodness of fitting of fixed effect panel data model is 0.38, which indicates that the data can be well fitted. From the parameter estimation results, the influence coefficient of aging on income inequality is significant at the level of 1%. The influence coefficient of the dependency ratio of children to income inequality is negative, that is, less children will aggravate the degree of income inequality or the aging at the bottom will enlarge income inequality. The old-age dependency ratio has a positive impact on income inequality, which is significant at the 1% level, that is, the aging of the top has a positive impact on income inequality. The above research conclusions have a strong consistency with existing academic literature, which indicates that the research conclusions of this section have a strong robustness.

To avoid endogenous problems caused by bidirectional causality of panel data, column (4) reports the estimation results of problems using dynamic panel data model. According to the Arellano-bond test results, the first-order autoregression results of regression residuals are significant at 10%, while the second-order autoregression results are not significant at 10%, indicating that the first-order difference terms of model regression residuals do not have autocorrelation. Hansen tested the statistic of 19.29, and could not reject the assumption that "all instrumental variables are valid" under the significance of 10%, indicating that the model instrumental variables did not produce excessive identification problem, which indicated that there was no error in the model setting. Further analysis of the estimated parameters of the dynamic panel model shows that the estimated results are similar to those of the fixed effect panel data model, which indicates that the regression estimation results in this paper are relatively robust.[4]

Table 3 Empirical Results (Gini Coefficient as Explained Variable)

Variable name	(1)	(2) FE	(3) RE	(4)
Log(Ydep)	-0.0023***	-0.0034***	-0.0030***	-0.0031***
	(0.0002)	(0.0004)	(0.0004)	(0.0006)
Log(Odep)	0.0018**	0.0026***	0.0029***	0.0030***
	(0.0009)	(0.0010)	(0.0010)	(0.0007)
BC		0.2047***	0.2176***	0.0464***
		(0.0257)	(0.0270)	(0.0142)
FIR		0.0034	0.0013	-0.0058***
		(0.0024)	(0.0024)	(0.0018)
FDI		0.0017	-0.0018*	-0.0013

		(0.0011)	(0.0011)	(0.0016)
URB		-0.0013***	-0.0015***	-0.0023***
		(0.0002)	(0.0002)	(0.0004)
INF		-0.0030***	-0.0030***	-0.0021***
		(0.0006)	(0.0007)	(0.0003)
Explained variable				0.5932***
First-order lag				(0.0625)
constant	0.4219***	0.2685***	0.2583***	
	(0.0152)	(0.0412)	(0.0432)	
Fixed effects regression	control	control	uncontrol	uncontrol
Within R^2	0.23	0.38	0.36	
F-stat.	77.78	39.06		
P values(F-stat.)	0.00	0.00		
Fixedv.s. Pooled	50.73	30.74		
P values(effects regression)	0.00	0.00		
Wald-stat.			230.7	1633
P values(Wald-stat.)			0.00	0.00
Arellano-Bond testforar(1)				-1.72
P values[ar(1)]				0.08
Arellano-Bondtestforar(1)				1.13
P values[ar(2)]				0.26
Hansen-stat.				19.29
P values(Hansen-stat.)				1.00
Hausman Test		45.33		
P values(Hausman Test)		0.00		

Note: See table 3 for definitions of variables. Robust standard errors in parentheses. *p＜0.1;**p＜0.05;***p＜0.01

3.2 Spatial effect analysis

In order to further distinguish the difference and agglomeration effect between different regions of the influence of aging on income gap. This paper further constructs the panel data model with variable coefficient and fixed effect as follows.

$$Gini_{i,t} = \alpha + \beta_1 Ydep_{i,t} + \sum D_i \times \beta_{2,i} Odep_{i,t} + \gamma \mathrm{Contrl}_{i,t} + \mu_i + \varepsilon_{i,t}$$

On behalf of the virtual variable $D_i$type, by introducing virtual variables get every province ageing effect coefficient of income inequality, after get the influence coefficient of various provinces and cities, the drawing for below scatterplot, through to the scatterplot fitting regression, can see clearly in the different levels of economic development under the influence of population aging on income inequality shows the characteristics of the influence of the time-varying.Specifically, the income level is ranked from high to low, that is, the closer the horizontal axis is to the origin, the higher the economic development level is; the closer the vertical axis is to the origin, the greater the impact of aging on income inequality is.It can be observed from figure 1 that the influence of aging on income inequality in both low-income and high-income groups is smaller than that in middle-income groups.In income level, due to the low level of income, the elderly may need to continue to work to meet their demand, and the low-income groups, the young compared to the old has strong advantages, thus lead to smaller gap between groups, performance in low income is the stage on the regression results aging effects on the income inequality is smaller.In high-income stage, because the welfare and family income are high, so this group stage production efficiency may be higher than other income groups, and may rely mainly on capital income and the advantage of education and experience to generate income, therefore in the stage of high income does not show the aging effect

on income inequality has stronger effect.For the middle-income group, it is better than the low-income group but does not have the advantage of the high-income group. Therefore, aging has a very strong effect on income inequality in this stage.

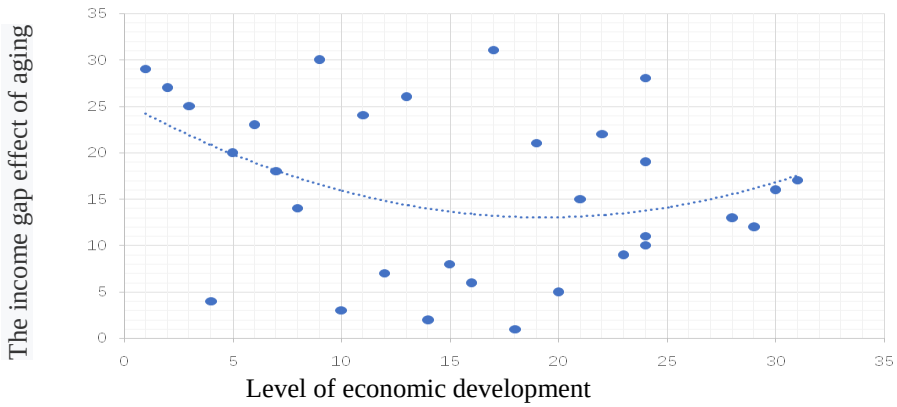

Fig. 1. The spatial effect of aging on income inequality

4. Concluding remarks

This paper discusses the mechanism of aging on income inequality, and then discusses the relevant theoretical context, and then, based on the existing research, the analysis of the provincial panel data of 1995 to 2016 is tested, and the effect of aging on the income inequality of our country is tested.

It is found in the research results of population age structure on income inequality that while economic factors affect distribution policies, population policies also have an impact on inequality, which provides more reasonable policy governance ideas for the formulation of population policies in China. It is necessary to comprehensively analyze various factors such as economic development level, economic cycle and aging society evolution stage, so as to formulate relatively appropriate policies and adjust the policies with The Times, so as to ensure the stability of policy effectiveness.

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