An Analysis of the Effect of Population Structure on Fiscal Revenue and Expenditure

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ABSTRACT

Finance is the foundation and important pillar of national governance. This paper uses a linear regression model to conduct research based on the total dependency ratio and fiscal revenue and expenditure data in China's inter-provincial panel data from 2002 to 2019, explore the impact of changes in the dependency ratio on China's fiscal revenue and expenditure, and further adopt a heterogeneous analysis method，through the dependency ratio and regional heterogeneity analysis perspective to carry out group regression. In this paper, the results of this study are as follows: (1) the total dependency ratio has an inverse relationship with China's fiscal revenue and expenditure. (2) There is a positive relationship between the dependency ratio of the elderly population and the fiscal revenue and expenditure of China, while the dependency ratio of children and adolescents has a reverse relationship with the fiscal revenue and expenditure of China. (3) There is also a reverse relationship between the total dependency ratio of the eastern and western regions of China, while the change of the total dependency ratio of the central and northeastern regions has no significant impact on the fiscal revenue and expenditure.

Keywords: population structure, the dependency ratio, fiscal revenue and expenditure, linear regression, heterogeneity analysis.

1.INTRODUCTION

Finance, also known as the government's "financial management", is an economic behavior or economic phenomenon accompanying the emergence of a country. It is a distribution behavior implemented by a government to obtain a part of national income in some form (real goods, labor, or currency) in order to realize its functions. Finance occupies a very important position and role in a country's economic development and distribution system, and it is the foundation and important pillar of national governance. At the same time, in recent years, demographic changes have also attracted much attention. Population structure, also known as population composition, refers to a result obtained by dividing the population according to different standards. The dependency ratio is also a manifestation of the population structure. The dependency ratio, also known as the dependency coefficient, refers to the ratio of the non-working-age population to the working-age population in the population. The larger the dependency ratio is, the greater the number of dependents per labor force, which

means that the labor force's support burden is more serious. Nowadays, the phenomenon of population aging is widespread, and this trend is getting worse, which also makes the dependency ratio further increase. The fiscal revenue and expenditure cannot be separated from the promotion of labor, so the demographic structure is very important to finance. This paper uses China's inter-provincial panel data from 2002 to 2019, and uses unary linear regression and heterogeneity analysis to conduct an empirical analysis of the relationship between dependency ratio and finance, and provides China cases and China strategies for research on population structure and fiscal revenue and expenditure.

2.LITERATURE REVIEW

In recent years, population structure is changing constantly, and population aging has become a major feature of China's population structure. Luo Liheng [1] analyzed the current situation and development trend of population aging, and he explained that the trend of population aging is irreversible, and the disappearance of demographic dividend is not conducive to economic

growth, which also leads to the dilemma of "decreasing income and increasing expenditure" in finance. Demographic structure change has an important impact on fiscal revenue and expenditure. Many scholars have studied and discussed this topic from the two aspects of revenue and expenditure by using various mathematical models and economic data. Li Chenqi [2] discussed whether China should carry out tax reform and the universal two-child policy to maintain economic growth in the future through the econometric model and OLS analysis. Liu Dejun [3], by compiling a discrete population prediction model, predicted the population development trend and combined with the results, simulated and analyzed the impact of population size change, population structure change, urbanization level change, and floating population size change on future fiscal revenue.

At the same time, the change of population structure has promoted the change of fiscal expenditure burden, bias, scale, and rigidity from all angles. Li Ting and Zhang Yali [4] point out that the squeezing effect of regional fiscal expenditure on consumption is also different under different levels of residents' income and population age structure. Liu Lvji et al. [5] comprehensively used static panel model and dynamic panel model as well as fixed effects and system Generalized moment estimation (SYS-GMM) method for empirical analysis and obtained the results: aging is the cause of pressure on fiscal and social security expenditure; while there is a significant negative correlation between the child support ratio and the per capital fiscal social security expenditure. Qi Hongqian et al. [6] empirically studied the nonlinear characteristics of the impact of population dependency ratio on local financial burden based on the three-stage overlapping generation model, and the results showed that the child dependency ratio showed an inverted L-shaped relationship from negative to positive, while the elderly dependency ratio showed an L-shaped relationship from positive to negative. Li Chengyou et al. [7] established a dynamic general equilibrium model of the urban-rural income gap and found that demographic dividend is conducive to further narrowing the urban-rural income gap and negatively affects the urban-rural income gap through its moderating effect on fiscal expenditure bias. Zhang Qun and Sun Zhiyan [8] made use of multiple regression analysis methods to forecast and analyze the scale of future fiscal expenditure and put forward relevant policy suggestions for optimizing future fiscal expenditure policies. Zhong Fan and Yang Shenggang [9], based on the government debt data and the panel data of debt level, studied and concluded that the higher the proportion of population outflow, the higher the dependency ratio of the elderly population, the higher the rigidity of fiscal expenditure and the higher the debt ratio of local government.

Based on the changes in fiscal revenue and

expenditure, fiscal policies are constantly adjusting to adapt to new changes and challenges. Qin Shuhan [10] pointed out that the existing fiscal and tax policies could not meet the needs of economic and social development; therefore, the country should continuously adjust and improve fiscal and tax policies, give full play to the role of fiscal and tax policies as an important economic lever, in order to better reduce the negative impact of aging. The research results of Li Jianqiang and Zhang Shucui [11] found that compared with increasing the fertility rate of the population, increasing the labor participation rate is not only the key to alleviating the short-term financial pension burden and ensuring the sustainability of pension financing, but also effectively increasing labor supply, improving policies, and playing the ecological environment, it's really a stopgap measure to further improve the effectiveness of fiscal policy and monetary policy. Yang Aiyun et al. [12] took the relationship between population aging and financial risks in China as the research object, through qualitative and quantitative analysis, tried to establish a model of the relationship between population aging and financial risks.

The stability of the financial system is also attracting attention due to the ongoing restructuring. Huang Chunyuan [13] clearly pointed out that the deepening of the degree of aging will gradually lead to the decrease and aging of China's working-age population, inhibit the improvement of labor productivity, lead to the decrease of social output, and reduce the government's tax source; at the same time, it will continue to increase the Chinese government's spending responsibility for pension and health care, and thus bring fiscal risks. The research results of Sun Zheng [14] show that: the dependency ratio of middle-aged and old people is negatively correlated with fiscal sustainability, while the dependency ratio of young people is positively correlated with fiscal sustainability; In addition, the variables of population natural structure and population economic and social structure have obvious "spillover effect".

Based on the above-mentioned literature, the paper may have the following four contributions. First, in terms of research methods, this paper will conduct two kinds of heterogeneity analysis, namely, dependency ratio heterogeneity regression and regional heterogeneity regression to compare the dependency ratio of the elderly population. Compared with the different influence trends of the child dependency ratio on the fiscal revenue and expenditure, the research sample is divided into four major regions in the east, west, central, and northeast according to the division of China's regions, and further study the impact of changes in the total dependency ratio in different regions on the fiscal revenue and expenditure. And put forward targeted and personalized policy recommendations focusing on the two types of dependency ratios and the

dependency ratios and fiscal revenues and expenditures of the four major regions in China. Second, in terms of themes, few articles focus on the analysis of the effect of population structure on fiscal revenue and expenditure. This article uses the dependency ratio as a representative of the population structure to explore its impact on China's fiscal revenue and expenditure and countermeasures. Third, this article uses the data of the National Bureau of Statistics of China from 2002 to 2019. The data is comprehensive, relatively new, and close to reality, which is conducive to reflecting the overall problems of China in the past two decades and helps to draw more accurate and time-sensitive economic conclusions. Fourth, in the context of the increasingly aging trend of the world, research on population structure and its impact on fiscal revenue and expenditure are particularly important. Therefore, the conclusions and policy recommendations of this article have important theoretical significance and practical values, and they can serve the other developing countries in the world, to provide them with valuable Chinese cases, Chinese experience, and Chinese solutions.

3. EMPIRICAL DESIGN

3.1. Variable Selection

On the basis of summarizing the previous research experience, combined with the characteristics and availability of China's economic data, this article selects the total dependency ratio (dr), the elderly dependency ratio (dro), and the young child dependency ratio (dry) to measure and explain population structure, the explanatory variables, and select general budget revenue (gbr) and general budget expenditure (gbe) to measure the explained variable, financial revenue and expenditure.

3.2. Data Sources

The empirical part of this paper uses China's provincial panel data from 2002 to 2019 for research, all of which are from the National Bureau of Statistics. The data of total dependency ratio, elderly population dependency ratio and children dependency ratio in 2010 were supplemented one by one by linear interpolation method. The specific statistical description of related variables is shown in Table 1.

3.3. Model selection

The research method selected in this paper is empirical analysis, the research model is a linear regression model, and the specific econometric model is:

$$Y_i = \alpha + \beta X_i + \varepsilon_i \tag{1}$$

Among them, Y_i is the fiscal revenue and expenditure of the explained variable, X_i is the explanatory variable population structure, and ε_i is the random error term.

Table 1. Statistical description of variables

| Variable	Unit	Obs	Mean	Std.Dev.	Min	Max
dr	%	527	37.64	6.802	19.30	57.60
dro	%	527	13.05	3.099	6.700	23.80
dry	%	527	24.59	7.188	9.600	44.60
gbr	100 million yuan	558	1627	1874	7.310	12655
gbe	100 million yuan	558	2968	2686	92.26	17298

4. EMPIRICAL ANALYSIS

4.1. Correlation Analysis

Figure 1 and Figure 2 respectively depict the relationship between China's general budget revenue and expenditure and the total dependency ratio of the population structure. From the preliminary point of the trend on the graph, the general budget revenue decreases with the increase of the total dependency ratio, and the general fiscal budget expenditure also decreases with the increase of the total dependency ratio. The relationship between the two types of fiscal budget indicators and the population structure needs to be further confirmed by regression analysis in this article.
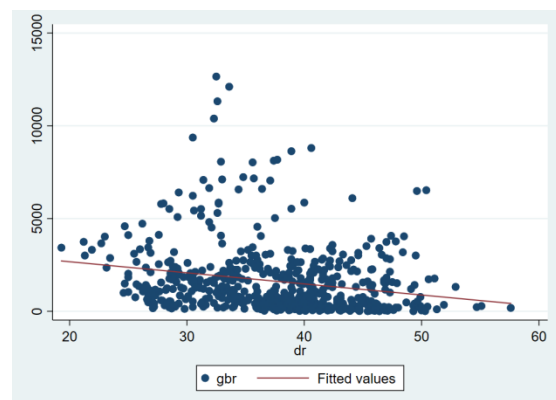
Figure 1 Correlation between general fiscal budget revenue and total dependency ratio
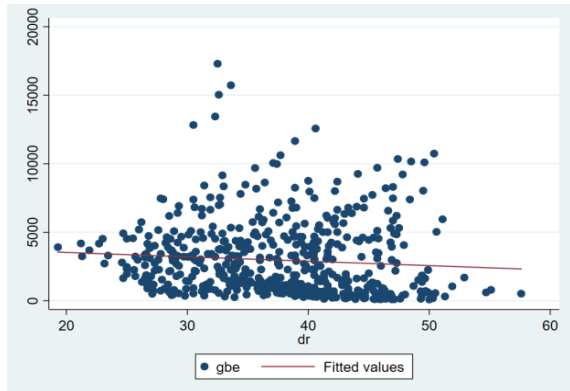
Figure 2 Correlation between general fiscal budget expenditure and total dependency ratio

4.2 Analysis of Baseline Regression Results

Model (1) and model (2) in Table 2 respectively report the main regression results of the effect of total dependency ratio on financial general budget revenue and financial general budget expenditure, in which the

financial general budget revenue and expenditure have been logarithmic processing. Specifically, the estimated coefficient of the core explanatory variable of model (1) is -0.0801, which is significantly negative at the significance level of 1%; The estimated coefficient of the core explanatory variable in model (2) is -0.0629, which is significantly negative at the significance level of 1%. The regression results preliminarily show that for China's finance, the current total dependency ratio has a reverse impact on the revenue and expenditure of the general fiscal budget, that is, with the increase of the total dependency ratio, the revenue and expenditure of the general fiscal budget will gradually decrease. The formation of this negative correlation is due to the increase of dependency ratio, which marks the increasing proportion of non-working age population in China and the rapid decline of social wealth creation ability, leading to the decline of government fiscal revenue. In order to prevent the deterioration of income and expenditure, local governments then reduce government fiscal expenditure.

Table 2. Baseline regression results

	(1)	(2)
	gbr	gbe
dr	-0.0801***	-0.0629***
	(-7.9579)	(-6.7120)
_cons	9.7290***	9.8890***
	(23.4719)	(26.9343)
N	558	558
R^2	0.1208	0.0870

Note: ***, **, * indicates that the statistical values are significant at the significance level of 1%, 5% and 10%, and the z-values are in parentheses. The same below.

4.3. Heterogeneity Analysis

4.3.1. Heterogeneity Analysis of Dependency Ratio

Since in the real economy, the population can be roughly divided into three categories: minor population, labor force population, and elderly population, this article will conduct a heterogeneous analysis based on the influence of the dependency ratio of the elderly population and the child dependency ratio on the financial revenue and expenditure of the dependency ratio. Table 3 Model (1) and Model (2) report the regression results of the dependency ratio of the elderly population affecting fiscal revenue and expenditure. The estimated coefficients of the explanatory variables are 0.2280 and 0.2277, respectively, which are significantly positive at the 1% significance level. Table 3 Model (3) and Model (4) report the regression results of the child dependency ratio on fiscal revenue and expenditure. The estimated coefficients of the explanatory variables are

-0.1760 and -0.1499, respectively, which are significantly negative at the 1% significance level.

The regression results show that for China's finance, the dependency ratio of the elderly population has a positive relationship with the fiscal revenue and expenditure, that is, the fiscal income and expenditure will increase with the increase of the dependency ratio of the elderly population. As the aging trend is inevitable and getting worse, local government's spending on dealing with the elderly is rising. The phenomenon of the increase of the income is due to the significant changes in social consumption demand caused by the dependency ratio of the elderly population. The elderly population pay more attention to health, and their demand for medical services and health care services is constantly improving. In order to meet the changes in the needs of the elderly, the pension industry known as the "Silver Economy" arises at the historic moment. In 2006, the consumption capacity of products for the elderly in China reached 600 billion yuan, but the market could only provide 100 billion yuan of

products [15]. The special physiological and psychological characteristics of the elderly determine the broad nature of the industries related to the elderly. The elderly group is a heterogeneous consumer group with diversified and multi-level consumer needs. It covers many fields, such as service homemaker services and social pension services. There are medical health care, fitness equipment; clothing and articles of daily use; education, travel, toys, food and so on. The increase of the aging population has created unlimited business opportunities for the production enterprises of aging products. Therefore, the continuous expansion of the elderly market has led to a continuous increase in fiscal revenue. Wang Xiaolin and Feng Hexia [16] pointed out that Japan pays great attention to the special needs of the elderly and implements specialized division of labor in the elderly care industry, so a large number of excellent enterprises such as elderly supplies, elderly catering, management consulting, and elderly service personnel training have been constructed, it also formed a silver economic industrial chain centered on elderly service institutions.

In contrast, the child dependency ratio has an inverse relationship with fiscal revenue and expenditure, that is, fiscal revenue and expenditure will decrease as the child dependency ratio increases. This is because the increase in the dependency ratio of children indicates that the proportion of children in China has increased, and the ability to create social wealth has declined, which has led to a decline in government revenue. In order to prevent the deterioration of revenue and expenditure, local governments have reduced government expenditures. However, the increase in the juvenile dependency ratio will generate a demographic dividend, increase the society's ability to create wealth in the future, give potential for economic development, and help increase fiscal revenue in the future.

Table 3. Results of dependency ratio heterogeneity analysis

	(1)	(2)	(3)	(4)
	gbr	gbe	gbr	gbe
dro	0.2280***	0.2277***		
	(14.2100)	(15.1065)		
dry			-0.1760***	-0.1499***
			(-20.3832)	(-17.8743)
_cons	3.7617***	4.5711***	11.0358***	11.2019***
	(14.8886)	(21.1715)	(42.0329)	(48.5280)
N	558	558	558	558
R^2	0.2583	0.2963	0.4512	0.4455

4.3.2. Regional Heterogeneity Analysis

This article divides all provinces in China into four major regions: Eastern, Central, Western, and Northeast China according to the 2011 National Bureau of Statistics of China (Eastern areas include Beijing, Hebei, Tianjin, Shandong, Shanghai, Jiangsu, Zhejiang Province, Guangdong Province, Hainan Province, Fujian Province, a total of 10 provinces; the central region includes Shanxi Province, Henan Province, Anhui Province, Jiangxi Province, Hubei Province, Hunan Province a total of 6 provinces; the western region includes Inner Mongolia Autonomous Region, Xinjiang Uygur Autonomous Region, Gansu Province, Qinghai Province, Sichuan Province, Yunnan Province, Tibet Autonomous Region, Guangxi Zhuang Autonomous Region, Ningxia Hui Autonomous Region, Guizhou Province, Chongqing City, Shaanxi Province, a total of 12 provinces; Northeast China includes Heilongjiang Province, Jilin Province and Liaoning Province, a total of 3 provinces province.). To reveal the geographic characteristics of China's dependency ratio on fiscal revenues and expenditures, Table 4 models (1) (2) and (5) (6) respectively report the regression results of the total dependency ratio on fiscal revenue and expenditure in the eastern and western regions. The estimated coefficients of the explanatory variables are -0.0533, -0.0458, -0.1448, and -0.1223 are significantly negative at the 1% significance level. Table 4 models (3) (4) and (7) (8) respectively report the regression results of the total dependency ratio in the central and northeastern regions on fiscal revenue and expenditure. The estimated coefficients of the explanatory variables are -0.0237, -0.0174, -0.0030, and -0.0293 are all not significant. The regression results show that for China's fiscal revenue and expenditure, the increase in the total dependency ratio in the eastern and western regions will lead to a decrease in the fiscal revenue and expenditure, while the changes in the total dependency ratio in the central and northeastern regions have no significant impact on the fiscal revenue and expenditure for the time being.

5.CONCLUSIONS

According to the above empirical results, this paper believes that the total dependency ratio has a reverse

relationship with the fiscal revenue and expenditure of China；according to the four regions of China, the fiscal revenue and expenditure of the eastern and western regions decrease with the increase of the total dependency ratio, while the change of the total dependency ratio in the central and northeastern regions has no significant impact on the fiscal revenue and expenditure; the dependency ratio of the elderly population has a positive relationship with China's fiscal revenue and expenditure, and there is an inverse relationship between the child support ratio and China's fiscal revenue and expenditure. The enlightenment of the above conclusion lies in the following three points. First, governments in eastern and western regions should actively establish a comprehensive social security system, expand the coverage of medical insurance and pension insurance, gradually delay the retirement age to increase the contribution rate of the elderly to fiscal revenue and expenditure. The central

and northeastern regions should be alert to the possible reverse impact of the future increase of dependency ratio on fiscal revenue and expenditure. Second, the government should actively expand the market for the elderly, attract and encourage the investment in the elderly industry through preferential policies, and develop the silver economy, so as to develop the elderly consumption and welfare industry and improve the fiscal revenue brought by the increase of the dependency ratio of the elderly population. Third, the government should appropriately adjust the childbirth policy, actively promote the two-child and three-child policy, increase the birth rate to reduce the proportion of the elderly, maintain and increase the child support ratio, and increase the proportion of the young and middle-aged population in the total population in the later period to ensure that the more demographic dividends will lay a good foundation for future fiscal revenue.

Table 4. Results of regional heterogeneity analysis

	(1)	(2)	(3)	(4)
	gbr	gbe	gbr	gbe
dr	-0.0533***	-0.0458***	-0.0237	-0.0174
	(-3.6148)	(-3.0841)	(-1.2694)	(-0.8753)
_cons	9.2588***	9.3506***	7.8853***	8.4180***
	(16.2440)	(16.8396)	(10.3222)	(10.3562)
N	180	180	108	108
R^2	0.0652	0.0516	0.0355	0.0307
	(5)	(6)	(7)	(8)
	gbr	gbe	gbr	gbe
dr	-0.1448***	-0.1223***	0.0030	0.0293
	(-8.0172)	(-7.0987)	(0.0638)	(0.6051)
_cons	11.9501***	12.2032***	6.6353***	6.7577***
	(14.8957)	(16.7706)	(4.7188)	(4.7817)
N	216	216	54	54
R^2	0.2553	0.2399	0.0012	0.0025

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