A Study on the Main Income Affecting the Distribution of Pension Income in China: A Case Study of Beijing

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Abstract. In the past few years, a large number of laborers in China have withdrawn from the market, resulting in a slowing down in the growth rate of the current economy as well as the total economic volume. In this context, the total scale of pension income distribution will therefore enter a state of slow growth even if the level of pension income distribution has improved. In the long run, a "contradictory" phenomenon will inevitably appear between the slow growth of pension income distribution and the rapid growth of pension demand, that is, the level of pension income distribution will not be able to meet pension needs. Accordingly, this paper aims to identify the main factors that affect the level of pension income in China, and to discuss how to optimize the level of pension income. Results show that the growth rate of the dependency ratio of the elderly has been in negative numbers for a long time, which indicates a shortage of available labor in China, and on the other hand, it reflects the stabilization and deepening of China's aging. What is more, there is a causal relationship between the growth rate of residents' disposable income and the growth rate of the dependency ratio of the elderly and the growth rate of China's pension fund expenditure. In addition, the impact of local fiscal revenue on pension fund expenditure is not significant, so there is no explanatory significance for this work.

1 Introduction

With the social and economic progress, people's living standards are improved, the social system is perfected, and the pension issue has attracted widespread attention. The solution to the pension problem is of great significance to promoting national economic progress and social stability, as well as improving people's happiness. At the same time, it is also a symbol of civil society progress [1]. In the past few years, a series of serious consequences such as lower savings rate, lower labor supply, and lower consumption, have caused the economic downturn. However, economic fluctuations are also closely related to aging. In addition, this also affects the level of pension income distribution, a key social distribution link. To some extent, the income scale of pension fund reflects the scale of the transfer of social wealth from the younger generation to the older generation, while its expenditure level directly reflects the scale of social wealth used for the elderly. Based on this, the purpose of this paper is to determine the factors that affect the level of pension expenditure, so as to put forward feasible suggestions for the distribution of social pension.

2 Background Information

The changes in the income and expenditure levels of the basic pension fund directly reflect the changes in the distribution of pension income. The income and expenditure levels of China's basic pension fund are shown in Figure 1 [2].

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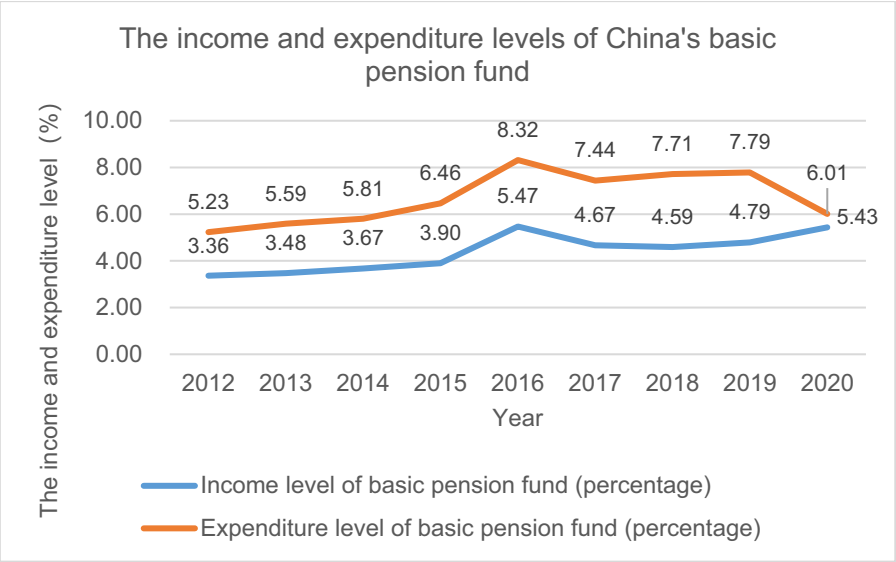

Fig. 1. The income and expenditure levels of pension fund (original, compiled and calculated from the data of China Statistical Yearbook -Calendar Years).

In Fig. 1, the percentage of basic pension income and expenditure is the ratio between the total fund income and expenditure and the GDP. As shown in Fig.1, Beijing's basic pension fund income level showed a sustained growth trend from 2012 to 2019, from 5.23% in 2012 to 8.32% in 2016. There was a significant downward trend in the basic pension fund income level from 2012 to 2016 and from 2012 to 2020. The reason for this trend may be that in May 2016, the Notice on Staged Reduction of Social Insurance Rates in the Beijing jointly issued by the Beijing Municipal Bureau of People and Society and the Bureau of Finance decided to reduce Beijing's social insurance rates in stages. The basic pension insurance rate and unemployment insurance rate for enterprise employees will be adjusted from the original 28% and 1.2% to 27% and 1%, respectively. At the same time, in May 2019, China lowered the enterprise contribution rate of urban employee endowment insurance from 20% to 16%. The expenditure level of the basic pension fund shows a similar growth trend to its income level. However, compared with the income of the basic pension fund, the expenditure level of the basic pension fund has grown more slowly from 2012 to 2015, 1.23% higher than the basic pension fund income level, and only 0.54% higher than the basic pension fund expenditure level. But in the three years from 2018 to 2020, the expenditure level of the basic pension fund increased, from 4.59% in 2018 to 5.43% in 2020, an increase of 1.44%. This growth trend of income and expenditure level reflects the improvement in pension distribution levels in Beijing, which is consistent with the rapid growth of aging in China.

3 Methodology

3.1 Selection of Data and Variables

From the China Statistical Yearbook Selection, the disposable income of residents (Beijing), Beijing government's fiscal revenue, and elderly dependency ratio (Beijing) from 2012 to 2020 were selected as explanatory variables, and Beijing's basic pension fund expenditure level was selected as the explained variable.

(1) The dependency ratio of the elderly population. This figure refers to the ratio of the elderly population to the labor force population.

(2) Disposable income of residents. It refers to the sum of final consumption expenditure and other non-obligatory expenditures and savings of urban and rural households, that is, the income that households can use freely.

(3) Basic pension fund expenditure. It refers to the expenditures of the basic pension insurance fund.

(4) Local fiscal revenue. It refers to the local fiscal annual revenue, including local level revenue, central tax rebates and transfer payments.

3.2 Model Construction

According to the setting of the above variables and examining the actual economic significance, the following model is constructed:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + U_i \quad (1)$$

Where Y represents the expenditure level of the basic pension fund in Beijing in that year (RMB 100 million), X_1 represents the disposable income of residents in Beijing in that year (RMB), X_2 represents the level of government revenue in Beijing in that year (RMB 100 million), AND X_3 represents the dependency ratio of the elderly population in Beijing in that year.

3.3 OLS Parameter Estimation

The simulation results are as follows:

$$\hat{y} = -937.7751 + 0.031486X_1 - 0.06851X_2 + 60.97683X_3 \quad (2)$$

$$t=(-4.468626)\ (3.112385)\ (-0.545423)\ (2.086043) \quad (3)$$

$$t_{\alpha/2}(6)=1.943 \quad (4)$$

$$R^2=0.966544\ \overline{R^2}=0.946470 \quad F=0.000412<0.05 \quad (5)$$

The results show that when the significance level is α=0.05, the increase of disposable income of residents increases the basic pension level by an average of 0.031486 billion yuan per year, R^2 =0.966544, indicating that the model has a high goodness of fit, and the F test is highly significant. According to Fig. 1-1, the t-statistics of the explanatory variables X_1 and X_3 are 3.112385 and 2.086043, respectively, indicating that the disposable income of residents and the dependency ratio of the elderly population have significant effects on the expenditure level of the basic pension fund. However, the t value of X_2 (local government fiscal revenue) failed the test, and the economic significance was unreasonable. On the other hand, for the hypothesis: $H_0=\beta_1=\beta_2=\beta_3=0$, the F critical value is 5.41 at the significance level α=0.05. The model has passed the overall significance test, that is, the three explanatory variables identified have a significant impact on the expenditure level of basic pension funds in Beijing in that year. Therefore, there is multicollinearity in the model.

Table 1. OLS Parameter Estimation (original).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-937.7751	209.8576	-4.468626	0.0066
X1	0.031486	0.010116	3.112385	0.0265
X2	-0.068510	0.125609	-0.545423	0.6089
X3	60.97683	29.23086	2.086043	0.0914
R-squared	0.966544	Mean dependent var		1247.388
Adjusted R-squared	0.946470	S.D. dependent var		464.5394
S.E. of regression	107.4784	Akaike info criterion		12.49356
Sum squared resid	57758.04	Schwarz criterion		12.58121
Log likelihood	-52.22102	Hannan-Quinn criter.		12.30440
F-statistic	48.14961	Durbin-Watson stat		3.462927
Prob(F-statistic)	0.000412			

4 Model Check and Correction

4.1 Check and Correction of Multicollinearity

According to Table 2, the minimum correlation coefficient between the two explanatory variables is 0.862463, and the others are all above 0.90, indicating that there is a serious multicollinearity problem in the model.

Table 2. Correlation Coefficient (original).

	X1	X2	X3
X1	1.000000	0.941654	0.863549
X2	0.941654	1.000000	0.862463
X3	0.863549	0.862463	1.000000

According to the regression results, the determinable coefficient of the regression equation is very high, but the symbol is opposite to the expectation in the economic sense, and the regression coefficient of X2 local fiscal revenue level is not significant at a given significant level. The correlation between the variables of the model is further calculated. Using the stepwise regression function of EViews, the final results are as follows. As shown in Table 3, after the stepwise regression, there are two explanatory variables, X1 and X3.

Table 3. Stepwise Regression Results (original).

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-977.1468	185.1569	-5.277400	0.0019
X1	0.027230	0.006050	4.500608	0.0041
X3	56.34464	26.28150	2.143890	0.0757
R-squared	0.964553	Mean dependent var		1247.388
Adjusted R-squared	0.952738	S.D. dependent var		464.5394
S.E. of regression	100.9905	Akaike info criterion		12.32913
Sum squared resid	61194.49	Schwarz criterion		12.39487
Log likelihood	-52.48109	Hannan-Quinn criter.		12.18726
F-statistic	81.63382	Durbin-Watson stat		3.329242
Prob(F-statistic)	0.000045			

$$\hat{y}=-977.1468+0.027230X\_1+56.34464X\_3 \quad (6)$$

$$t=(-5.277400)\ (4.500608)\ (2.143890) \quad (7)$$

$$R^2=0.964553\ (\bar{R}^2)=0.952738 \quad F=81.63382$$
$$t_{(\alpha/2)}(6)=1.895 \quad (8)$$

According to Table 3, the symbols and values of the regression coefficient are reasonable. The goodness of fit of Model 2 does not change much compared with the model, the F test value far exceeds the critical value, and Model 2 is more reasonable than Model 1.

4.2 Stationarity Test

The classical econometric structure model is based on the stationarity model of time series, and the stationary time series can effectively reduce false regression. In this study, EViews software is employed to test the stationarity of the variables of the model. The results of ADF inspection are shown in Table 4.

Then the regression model $\hat{y}=-977.1468+0.027230X\_1+56.34464X\_3$ is a non-stationary time series model. Using X3 : elderly dependency ratio (Beijing) time series data, the annual growth rate of the dependency ratio of the elderly population can be calculated, which is $(X3/(X3-1)-1)$. Further, take the logarithm of it, and denoted by DGX_3. The ADF unit root test is performed on DGX_1 to check its stationarity. First, the GX_1 level sequence is tested, and the test result is obtained at the 5% significance level. The t statistic -2.006292 is less than the critical value -1.495178, so the null hypothesis of the existence of a unit root is rejected. Then the first-order difference is performed on the DGX_3 level sequence. At the 5% significance level, the test result t statistic -2.021193 is less than the critical value -2.378723, so the null hypothesis of the existence of a unit root is rejected. That is, the first-order difference series of the annual growth rate of the dependency ratio of the elderly population in Beijing is stationary, DGX_3~I(1).

Table 4. Results of ADF Inspection (original).

Null Hypothesis: DGX3 has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.495178	0.1191
Test critical values:	1% level	-2.937216	
	5% level	-2.006292	
	10% level	-1.598068	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 7

Table 5. First Difference Results of DGX_3 (original).

Null Hypothesis: D(DGX3) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.378723	0.0274
Test critical values:	1% level	-3.007406	
	5% level	-2.021193	
	10% level	-1.597291	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 6

From the ADF test results, it can be obtained:

Table 6. ADF Test Results (original).

Variables	ADF statistic	1% critical value	5% critical value	10% critical value	Stationarity	Conclusion
Y	-2.4033	-6.2921	-4.4504	-3.7015	non-stationary	—
X1	-3.1550	-6.2920	-4.4504	-3.7015	non-stationary	—
X3	-3.2991	-6.2921	-4.4504	-3.7015	non-stationary	—
DY	-3.4942	-4.8035	-3.4033	-2.8418	stationary	I（1）**
DX1	-2.0104	-2.8861	-1.9959	-1.5991	stationary	I（1）**
DGX3	-2.378723	-3.00406	-2.021193	-1.597291	stationary	I（1）**

I(n)**indicates that the variable passes the ADF stationarity test at the 5% significance level after the n-order difference. There is a cointegration relationship between DX_1, DY and DGX_3.

4.3 Cointegration Test

Since both the explanatory variables and the explained variables are non-stationary, and the cointegration relationship can be interpreted as a long-term stable relationship between the first-order difference of DX1: disposable income of residents (Beijing), the first-order difference of the annual growth rate of the dependency ratio of the elderly population, and DY: the first-order difference of the basic pension fund expenditure level. First, DY and D are tested for causality, and the results are as follows:

Table 7. Causality test for DY and DX_1 (original).

Date: 06/26/22 Time: 21:25
Series: DY DX1
Sample (adjusted): 2013 2020
Included observations: 8 after adjustments
Null hypothesis: Series are not cointegrated
Automatic lags specification based on Schwarz criterion (maxlag=1)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
DY	-3.445661	0.0379	-9.880440	0.0087
DX1	-1.878848	0.2975	-4.887419	0.2675

*MacKinnon (1996) p-values.
Warning: p-values may not be accurate for fewer than 20 observations.

A causal relationship test was performed on DY and lnGX3, and the results are as follows. The corresponding p=0.0379<0.05 of the t-test indicates that when the explained variable is DY and the explanatory variable is DX_1, there is a causal relationship between DX_1 and DY. But when p=0.2.2975>0.05, it indicates that the explanatory variable is DX_1, and there is no causal relationship between DX1 and DY when the explanatory variable is DY.

Table 8. Correction Factor (original).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-1.561996	0.333363	-4.685576	0.0034

R-squared	0.785196	Mean dependent var	8.098618
Adjusted R-squared	0.785196	S.D. dependent var	310.6883
S.E. of regression	143.9944	Akaike info criterion	12.90899
Sum squared resid	124406.4	Schwarz criterion	12.90126
Log likelihood	-44.18146	Hannan-Quinn criter.	12.81348
Durbin-Watson stat	2.523286		

The short-term correction coefficient is -1.561996, P=0.0034<0.05, $R^2 = 0.785196$, and the significance level is significant.

Table 9. t-test for DGX3 (original).

Series: DY DGX3
Sample (adjusted): 2013 2020
Included observations: 8 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=1)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
DY	-5.116815	0.0224	-11.39103	0.0368
DGX3	-2.809737	0.2637	-8.303977	0.1735

*MacKinnon (1996) p-values.
Warning: p-values may not be accurate for fewer than 20 observations.

The corresponding p=0.0224<0.05 of the t-test indicates that when the explained variable is DY and the explanatory variable is DGX3, there is a causal relationship between DGX3 and DY. But when p=0.2637 >0.05, it means that there is no causal relationship between DGX_3 and DY when the explained variable is DGX_3 and the explanatory variable is DY.

4.4 Error Correction

In order to examine the dynamic relationship between China's disposable income of residents (Beijing), Beijing government's fiscal revenue, elderly dependency ratio (Beijing) and Beijing's basic pension fund expenditure level, an error correction model needs to be established to consider how strong the short-term fluctuations can be to pull the non-equilibrium state back to the equilibrium state when the short-term fluctuation is out of the long-term equilibrium.

First of all, there is a co-integration relationship among DX_1, DY, and $\ln DGX_3$ after analysis, that is, the long-term equilibrium relationship constitutes the error correction term with this relationship. Subsequently, a short-term model, an error correction model is established.

$$\Delta DY = c(1)DX1(-1) + c(2)DGX3(-1) + c(3)DY(-2) + C + ecm(-1) + v_t \quad (9)$$

$$R^2 = 0.988834 \quad \bar{R}^2 = 0.944172 \quad LM=nR^2=3.548469 \ (p=0.4134>0.05) \quad (10)$$

The goodness of fit of the model is very high, and the effect is good. It can be obtained from p=0.4134>0.05 that the sequence has no sequence correlation. The coefficient of ecm (-1) is -0.952629, which reflects the extent to which the short-term fluctuation of the data deviates from the long-term equilibrium, which is interpreted as that when the short-term fluctuation deviates from the long-term equilibrium, the non-equilibrium will be pulled to equilibrium with an adjustment of-0.952629.

In conclusion, the first-order difference of DX_1: the disposable income of residents (yuan) in Beijing in that year, and the first-order difference of DGX_3: the growth rate of the dependency ratio of the elderly population in Beijing in that year have causal effects on the first-order difference of DY_t: the pension fund expenditure level in both the long and short term.

Table 10. Error Correction Model (original).

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.480094	Prob. F(4,1)	0.7776
Obs*R-squared	3.945469	Prob. Chi-Square(4)	0.4134
Scaled explained SS	0.040934	Prob. Chi-Square(4)	0.9998

Table 11. Modified Model Test (original).

Dependent Variable: DY
Method: Least Squares
Date: 06/27/22 Time: 15:43
Sample (adjusted): 2015 2020
Included observations: 6 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DX1(-1)	0.131576	0.035552	3.700967	0.1680
DGX3(-1)	-1307.119	194.0718	-6.735231	0.0938
DY(-2)	-0.886815	0.133383	-6.648648	0.0950
C	-345.9696	164.7386	-2.100113	0.2829
ECM(-1)	-0.952629	0.128063	-7.438783	0.0851

R-squared	0.988834	Mean dependent var	185.2602
Adjusted R-squared	0.944172	S.D. dependent var	196.6687
S.E. of regression	46.46886	Akaike info criterion	10.39035
Sum squared resid	2159.355	Schwarz criterion	10.21682
Log likelihood	-26.17105	Hannan-Quinn criter.	9.695679
F-statistic	22.14013	Durbin-Watson stat	1.755328
Prob(F-statistic)	0.157911		

4.5 Heteroskedasticity Test

After constructing the auxiliary function using the White test, the results are shown in Table 12. Obs*R-squard=7.072067. Take the significance level α=0.05, since $x^2(2)=11.07>7.072067$, and p=0.2153>0.53, the model does not have heteroscedasticity.

Table 12. White Test (original).

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	3.048523	Prob. F(5,2)	0.2652
Obs*R-squared	7.072067	Prob. Chi-Square(5)	0.2153
Scaled explained SS	3.741890	Prob. Chi-Square(5)	0.5871

5 Recommendations

In the new era, population aging is closely related to the interests of the people, so it is proposed to deal with the problem of population aging scientifically and rationally. Through the empirical study on the relationship between population aging and the disposable income of residents, and local revenue and the dependency ratio of the elderly population, the following suggestions on how to regulate the income and expenditure distribution of pension funds in China are put forward.

5.1 Extending the Premium Payment Period of the Pension Fund

The pace of aging in China has become faster. According to the Ministry of Human Resources and Social Affairs, compared to 2015, China has 8.86 million more people aged 60 and over in 2016. It can be said that aging poses more and more challenges to people. At present, the total number of people aged 60 and above in China is more than 830 million, and the dependency ratio is gradually increasing. In order to better deal with a series of problems caused by the aging population, it is a general trend to extend the number of years of insurance contributions and delay the retirement age. In the light of China's national conditions, it is suggested that the insurance method for flexible employment should be gradually extended and the proportion of contributions should be reduced appropriately. This low-level and long-term contribution method not only allows flexible workers to accumulate a pension for their old age, but also enables pension fund to make ends meet in the long run (flexible employment is a new form of employment, in which working hours, income, social insurance are not fixed, labor relations are unstable, employment types and forms are more diverse, and employment flexibility is greater).

5.2 Raising Personal Awareness of Pension Security

Before the arrival of the aging society, a better standard of living for the elderly can be achieved by relying on the state and family members to provide for the aged. After the arrival of the aging society, the function of national

pension and family children for the aged is gradually weakened, the responsibility of personal pension security is gradually enhanced, and the level of personal pension security is also gradually improved, which is a historical trend. In order to adapt to this historical trend, it is necessary to establish the consciousness of pension security dominated by individual pension security as soon as possible, and change the concept of relying on the state and family members to provide for the aged [3].

5.3 Promoting the Reemployment of the Elderly Population

At the same time, the government can introduce relevant policies to encourage the re-employment of the elderly population, so as to increase jobs, absorb the employment of the labor force, and achieve the overall improvement of the labor force participation rate. On the other hand, it can also make use of the rich professional experience and high technical level accumulated by the elderly population over the years to promote scientific and technological innovation, provide power for the optimization and upgrading of the industrial structure, and provide a guarantee for long-term sustainable economic growth, so as to mitigate the adverse impact of population aging on social stability and economic development to a certain extent [2]. The implementation of the silver economic development strategy can improve the human capital of the working population, increase labor productivity, change the knowledge structure of the elderly, and improve their physical quality. On the other hand, it can improve the asset structure of the elderly population, increase their purchasing power, promote the consumption of the elderly population, develop the elderly finance business, as well as realizing the rational planning and operation of the rights and interests assets, labor management assets, and capital gains of the elderly population [4]. In a word, the strategies of flexibly delaying the retirement age and promoting the development of elderly finance business can increase the labor force participation rate, expand the scale of labor force, enhance the level of labor supply, and realize the coordinated growth of population aging, pension income distribution, and economy [5].

5.4 Actively Giving Play to the Country's Supervision and Review Function

Pensions and benefits under the National Pension Insurance will increase along with the rise in consumer price index starting January 2016. Building a robust social security network has always been an important policy and objective of the government. The Ministry of Health and Welfare will continue to implement related affairs and review insurance disputes in hopes of looking after all citizens. The government will collaborate with the Bureau of Labor Insurance and Bureau of Labor Funds in providing satisfactory, rapid, and thoughtful national pension services, so as to achieve the mission of “promoting national health and well-being,” ensure the sustainable operation of the National Pension system, and safeguard the basic economic security of all citizens in their late years looking after all citizens [6].

5.5 Development Trend of China's Pension Fund

The first is to make a clear position. The orientation of basic pension insurance is "basic" and there is no need to bear the overall responsibility of the three pillars of pension insurance, so it is necessary to gradually change the current situation of "one pillar dominant" with the goal of ensuring basic insurance in a planned, active, and steady manner. The second is to gradually weaken the financial responsibility. At present, the overall stable operation of pension insurance in China is mainly due to the financial responsibility of the government. Therefore, governments at all levels should bear the responsibility of "gap", and at the same time, gradually weaken the direct responsibility of the government to the enterprise pension. Third is to speed up the overall planning of basic pension insurance at the provincial level. At present, the endowment insurance in most provinces has not achieved overall planning at the provincial level, and the pension is still managed by counties and cities. Therefore, it is necessary to clean up and standardize the relevant policies of pension insurance, such as promoting the same treatment in the same province and the same rate, and speeding up the construction of the provincial pension insurance system, so as to create conditions for the realization of national overall planning in the future [7].

6 Conclusion

The degree of population aging has a significant positive impact on the change of the pension fund expenditure level. On the basis of the establishment of the econometric model, the dependency ratio of the elderly population and basic pension fund expenditure levels are selected as indicators to measure the degree of population aging and pension income distribution. Besides, two control variables, local government revenue, and the disposable income of residents level are selected to estimate the econometric model. Combined with the trend of x3 and Y and the trend of X1 and Y, it is obvious that with the deepening of the aging degree of the population and the deepening of disposable income of the residents level, the level of pension fund will continue to improve. In the model estimation, X2: local fiscal revenue has multiple collinearity, and the excluded model accords with economic significance. After the stationarity test, it is found that the model is unstable and cointegrated. In a short term and long term, both DX1 and DGX3 have causality to DY, and there is no heteroscedasticity. There are more extensive studies on the effect of public pension insurance system on income distribution both at home and abroad, which fully proves the importance of its role in social equity. The factors that affect the public pension insurance system in playing a role in reality are very complex. In the research process, different systems, different research perspectives, different research methods, different hypotheses, and even different basic

data may lead to completely different results. However, it is worth noting that the main reason why there is no significant difference between local revenue and pension fund has not been found in this work, and the model still needs to be further improved [8].

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