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An Empirical Study on the Relationship between Farmers' Income Increase and Primary Industry in Zhanjiang City

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Abstract

This article briefly introduces the 25 themes of the "No. 1 Document" of the CPC Central Committee. Based on the data of farmers' income, agriculture, forestry, animal husbandry and fishery, and agriculture, animal husbandry and fishery service in Zhanjiang City, Guangdong Province from 1978 to 2021, this paper conducted an empirical study on the relationship between the primary industry and farmers' income in Zhanjiang City. In the empirical analysis, first of all, the stationarity test of the data was carried out, the EG co-integration modeling was carried out, the stepwise regression method was used to eliminate multicollinearity, and the generalized difference method was used to eliminate sequence correlation, and the optimized model was obtained. The results show that the total output value of agriculture and fishery has no significant effect on the increase of farmers' income in Zhanjiang City. Forestry, animal husbandry, agriculture, forestry, animal husbandry and fishery services have a significant impact on farmers' income. The total output value of forestry, animal husbandry and agriculture and the service industry of forestry, animal husbandry and fishery increased by 1%, and the income of farmers increased by 0.429%, 0.240% and 0.619%, respectively. The impact of agriculture and fishery on per capita disposable income in Zhanjiang rural areas is lagging, with a maximum lag of 9 years. Accordingly, the corresponding policy suggestions are put forward.

Keywords: "No. 1 Document" of the Central Committee of the Communist Party of China, "Three rural" problems, EG co-integration modeling, step-up regression method, generalized difference method

1. Introduction

Since 1982, the Central Committee of the Communist Party of China has continuously issued the "No. 1 Document" to address the development challenges faced by "three rural areas" (agriculture, rural areas, and farmers). This initiative has been implemented for five consecutive years and has significantly influenced policies aimed at improving the livelihoods of rural residents and promoting sustainable agricultural development.

In 1982, the Central Committee adopted the Minutes of the National Rural Work Conference, which officially recognized the legality of household contract production. In 1983, the Central

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government issued Document No. 1 entitled "Some Issues in the Current Rural Economic Policy" with the aim of revitalizing rural industry and commerce.1984: The first document of the Central Committee in 1984 was the Notice on Rural Work, which focused on developing rural commodity production. In 1985, the first document of the Central government, "Ten Policies for Further invigorating the Rural Economy," proposed the abolition of the unified purchase and marketing system. The first central document in 1986 was "On the Deployment of Rural Work in 1986", which aimed to increase agricultural inputs and adjust the relationship between industry, agriculture and urban and rural areas.

Since 2004, the CPC Central Committee has issued Document No. 1 for 19 consecutive years. These documents elaborated major measures and strategies for agricultural and rural development, and stressed the central government's firm determination to promote agricultural and rural work in the new development stage.

In 2004, the "No. 1 Document" of the Central Committee made increasing farmers' income a priority. The following year, the "No. 1 Document" shifted the policy focus to improving the overall agricultural production capacity. In 2006, the "No. 1 document" of the Central Committee emphasized the promotion of the construction of a new socialist countryside. In 2007, the "No. 1 Document" of the Central Committee emphasized the active development of modern agriculture.

In 2008, the central "No. 1 document" put agricultural infrastructure construction in the first place, increased investment in "agriculture, rural areas and farmers", and consolidated the agricultural foundation. In 2009, the "No. 1 document" of the Central Committee proposed to stabilize agricultural development, increase farmers' income, and ensure food security and effective supply of major agricultural products. In 2010, the Central "No. 1 Document" mainly focused on improving people's livelihood and strengthening rural and urban agriculture as part of overall development efforts. In 2011, the "No. 1 Document" of the Central Committee stressed the importance of water conservancy and its impact on agriculture.

In 2012, the central "No. 1 document" emphasized the development of agriculture by science and technology and accelerated scientific and technological innovation. In 2013, the document aims to promote rural development, increase policies conducive to agriculture, and strengthen food supply. In 2014, the Central "No. 1 Document" emphasized sustainable agricultural development, national food security, and deepening the reform of the rural land system.

The theme of the "No. 1 Document" of the Central Committee in 2015 is: understanding the new normal, adapting to the new normal, leading the new normal, comprehensively promoting the construction of the rule of law in rural areas, and the simultaneous development of new industrialization, information technology, urbanization and agricultural modernization. In 2016, the theme of the "No. 1 Document" of the Central Committee is to respond to the new challenges faced by "agriculture, rural areas and farmers" with new development concepts. The theme of the Central "No. 1 Document" in 2017 is to further promote the structural reform of the agricultural supply side.

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In 2018, the central "No. 1 document" focused on the strategic deployment of rural revitalization. In 2019, the theme was changed to give priority to development and do a good job in "agriculture, rural areas and farmers". In 2020, the focus will be on "agriculture, rural areas and farmers" to ensure the building of a moderately prosperous society in an all-round way. In 2021, the theme of the document is to focus on poverty alleviation and comprehensively promote rural revitalization. The core highlights include consolidating poverty alleviation achievements, promoting the seed industry and agricultural scientific and technological equipment, encouraging green agricultural development, and implementing rural construction actions.

The focus of the 2022 Central "No. 1 document" is to make progress while maintaining stability, ensure food security, and implement a number of measures for rural revitalization. In 2023, the central government's "No. 1 document" aims to strengthen agriculture, stabilize production, ensure supply, prevent poverty and promote rural harmony.

This paper conducts an empirical study on the relationship between farmers' income growth and the primary industry in Zhanjiang City, Guangdong Province from 1978 to 2021.The study aimed to determine the actual impact of the 25 Central No. 1 documents issued by the Communist Party of China (CPC) Central Committee on farmers' incomes. The data collected include information on farmers' income, information on agriculture, forestry, animal husbandry and fishery, and information on agriculture, forestry, animal husbandry and fishery services.

2. Literature review

2.1 Scholars' basic views on the development of industries in the Beibu Gulf area, including Zhanjiang

Zhou Zhongjian (1991) proposed six industries suitable for development in the Beibu Gulf: aquatic products and processing industry, tropical and subtropical crop processing industry, petrochemical industry, iron and steel industry, shipbuilding industry, and tourism [1]. Zhang Ben (1998) proposed two industries suitable for the development of coastal provinces and cities in the South China Sea: fishery and Marine resources industry in the South China Sea [2]. Xu Jin (2005) proposed four industries suitable for the development of the Beibu Gulf region: coastal industry, Marine resource industry, tropical and subtropical resource processing industry, and coastal tourism [3]. Zhu Jianzhen (2007) proposed five industries suitable for the development of the Beibu Gulf region: Marine biological industry, Marine transportation industry, port system, Marine oil and gas industry, and coastal tourism [4]. Zhu Jianzhen et al. (2010) proposed the integrated development of the South China Sea International Corridor and the Marine and land industries [5].

2.2 Scholars' basic views on natural disasters in the Beibu Gulf area, including Zhanjiang

The Beibu Gulf, including Zhanjiang, is an area prone to natural disasters. Luo Fu et al. (1989) analyzed natural disasters and their impact on economic development in Guangxi [6]. Tang Changhan et al. (1994) analyzed the geological environment and the current situation of geological disasters in the coastal area of Beibu Gulf in Guangxi [7]. Fu Changhong (1996) proposed that the probability of recent strong earthquakes occurring in Hainan Island and its adjacent areas was a potential source [8]. The National Development and Reform Commission

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(2017) pointed out that it is necessary to improve the prevention and control system of meteorological disasters, flood and drought disasters, earthquake prevention and reduction, and geological disasters [9].

2.3 Scholars' views on the issues of "agriculture, rural areas"

Du Runsheng (1999) believed that solving urban problems should rely on rural areas; Solving rural problems depends on cities; The solution to the problem of farmers is to stop them being farmers[10]. Hong Yinxing (2019) divided the urbanization roads after China's reform and opening up into the roads where farmers leave their land but not their homes, the roads where farmers leave their homes, and the new urbanization in the new era [11]. Yin Zhaojing (2019) estimated the change of agricultural total factor productivity in Chongqing from 2000 to 2016 by using sequential DEA method, and the result showed that the agricultural total factor productivity of Chongqing showed an upward trend, and urbanization and industrialization had a significant positive impact on the growth of agricultural total factor productivity [12]. Using the spatial panel model and panel data of 31 provinces in China from 2005 to 2017, Zhu Dongyuan et al. (2019) studied the multidimensional poverty reduction effects of urbanization on residents' income poverty, education poverty and medical poverty, and the results showed that urbanization development had significant poverty reduction effects on income poverty and medical poverty [13].

2.4 Agriculture becomes a primary industry

Wen Tiejun pointed out: China's agriculture has always been "three lives in one", that is, the unity of ecology, life and production, that is, the way of life under certain ecological environment conditions; Since modern times, the government, as an institutional arrangement, transformed agricultural surplus into industrial primitive accumulation, making agriculture an industry [14]. Li Deshui (2002), former director of the National Bureau of Statistics, pointed out that in the new Regulations on the Division of Three Industries, the primary industry includes agriculture, forestry, animal husbandry and fishery and agriculture, forestry, animal husbandry and fishery service [15].

3. Data source and data processing

3.1 Data Sources

The total output value of agriculture, forestry, animal husbandry and fishery and the service industry data of agriculture, forestry, animal husbandry and fishery during 1978-2021 were obtained from Zhanjiang Statistical Yearbook 2022 Agricultural Yearbook. The disposable income of Zhanjiang farmers from 1978 to 2021 was obtained from the Zhanjiang Statistical Yearbook "Agriculture Yearbook 2022", and the index was calculated according to the price of the current year. The total output value index of agriculture, forestry, animal husbandry and fishery industry and the total output value index of agriculture, forestry, animal husbandry and fishery service industry from 1978 to 2021 were obtained from Zhanjiang Statistical Yearbook 2022, which was set at 100 on the basis of 1949. The CPI index is derived from the State Statistical Yearbook. The CPI index is based on 1978, and there is no CPI data before 1978 in the Statistical Yearbook.

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3.2 Data Processing

On the one hand, the total output value of agriculture, forestry, animal husbandry and fishery industry and the nominal data of agriculture, forestry, animal husbandry and fishery service industry of Zhanjiang City were processed respectively, and the actual total output value of the above indicators was obtained. On the other hand, using CPI index to process the nominal disposable income of Zhanjiang farmers can get the real disposable income of Zhanjiang farmers. In this way, the actual disposable income of Zhanjiang farmers and the actual total output value of Zhanjiang agriculture, forestry, animal husbandry and fishery and agriculture, forestry, animal husbandry and fishery service industries are formed into a table, which is the data used in modeling.

4. The basic situation of Zhanjiang farmers' income and the total output value of each component of the primary industry

4.1 The overall increase of Zhanjiang farmers' income

In the period 1978-2020, the nominal income of Zhanjiang farmers increased from 120 yuan in 1978 to 20,693 yuan in 2021, an increase of 171.4 times. Using cpi index to adjust the actual income of Zhanjiang farmers. The actual income of farmers in Zhanjiang increased from 120 yuan in 1978 to 3007.7 yuan in 2021, an increase of 24.1 times.

Figure 1 shows that from 1978 to 2021, the nominal income of farmers in Zhanjiang has an obvious growth trend. In the same period, the real income of farmers in Zhanjiang City has the same growth trend, but the range of change is smaller.

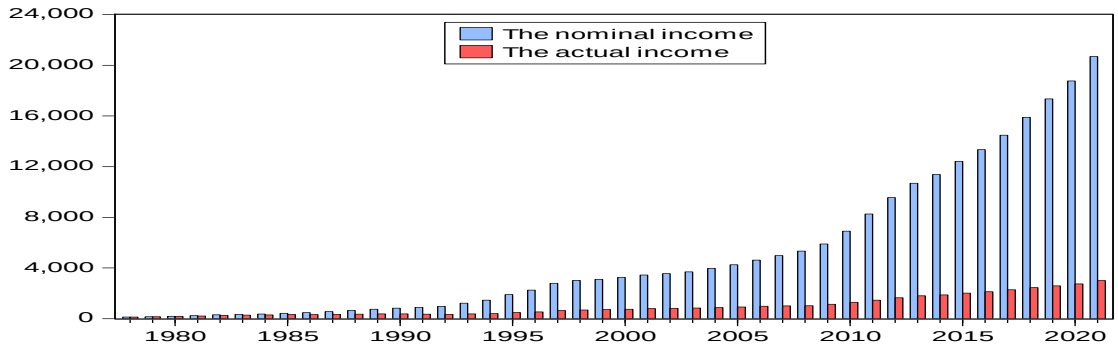

Figure 1 Farmers' income in Zhanjiang City, Guangdong Province, 1978-2021(Unit: yuan)

4.2 Total agricultural output value of Zhanjiang increased basically

The total nominal output value of Zhanjiang's agriculture increased from 466.78 million yuan in 1978 to 553.5825 million yuan in 2021, an increase of 117.6 times. The actual total agricultural output value of Zhanjiang was obtained by adjusting the agricultural production price index. The actual total agricultural output value of Zhanjiang increased from 153.34 million yuan in 1978 to 1682.57 million yuan in 2021, an increase of 9.97 times.

As can be seen from Figure 2, although the annual growth rate is different from 1978 to 2021, the nominal gross agricultural output value of Zhanjiang City is basically growing. In the past 44

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years, the actual total agricultural output value of Zhanjiang City also showed the same trend of change, but the change range was smaller.

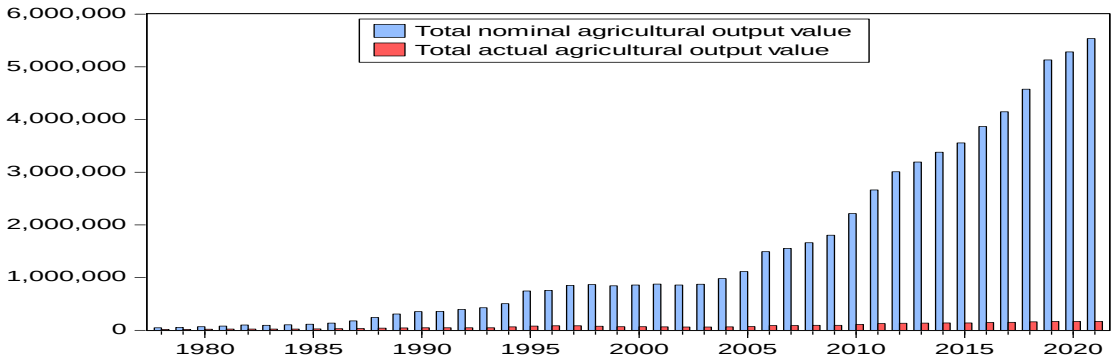

Figure 2 Total agricultural output value of Zhanjiang City, Guangdong Province, 1978-2021(Unit: ten thousand yuan)

4.3 The total output value of forestry in Zhanjiang City increased in a fluctuating manner

The total nominal output value of Zhanjiang forestry increased from 80.45 million yuan in 1978 to 1984.65 million yuan in 2021, an increase of 23.67 times. The actual total output value of Zhanjiang forestry was obtained by adjusting the forestry production price index. The actual total output value of Zhanjiang forestry increased from 1.628 million yuan in 1978 to 21.3099 million yuan in 2021, an increase of 12.09 times.

It can be seen from Figure 3 that the growth of the nominal gross forestry output value of Zhanjiang City from 1978 to 2021 is characterized by volatility. In 1988, 2007, 2010 and 2017, the year-on-year growth rate is very high, while in 1989 and 2020, the year-on-year decline rate is also very high. In the same period, the actual total output value of forestry in Zhanjiang City also showed the same trend of change, but the range of change was smaller.

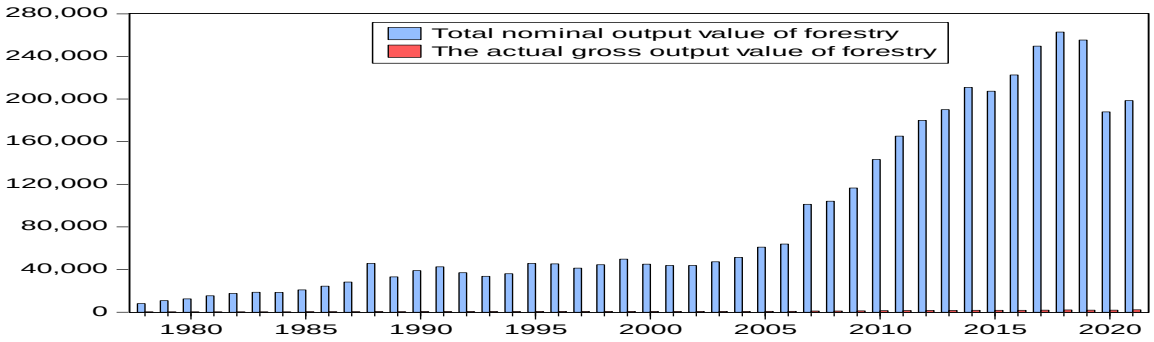

Figure 3 Total output value of forestry in Zhanjiang City, Guangdong Province from 1978 to 2021(Unit: ten thousand yuan)

4.4 Total output value of animal husbandry in Zhanjiang increased basically

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The nominal gross output value of animal husbandry in Zhanjiang increased from 115.83 million yuan in 1978 to 1710.905 million yuan in 2021, an increase of 146.71 times. The actual total output value of Zhanjiang animal husbandry was obtained by adjusting the index of animal husbandry production price. The actual total output value of animal husbandry in Zhanjiang increased from 41.177 million yuan in 1978 to 852.0868 million yuan in 2021, an increase of 19.69 times.

The following conclusion can be drawn from the information in Figure 4: from 1979 to 1995, from 1996 to 2008, from 2009 to 2012, from 2014 to 2016, and from 2018 to 2020, the nominal gross output value of animal husbandry in Zhanjiang City continued to increase; In 1979, 1996, 2009, 2013, 2014, 2018 and 2021, the nominal total output value of Zhanjiang animal husbandry declined year on year. In the same period, the actual total output value of animal husbandry in Zhanjiang City also has the characteristics of change, but the change range is smaller.

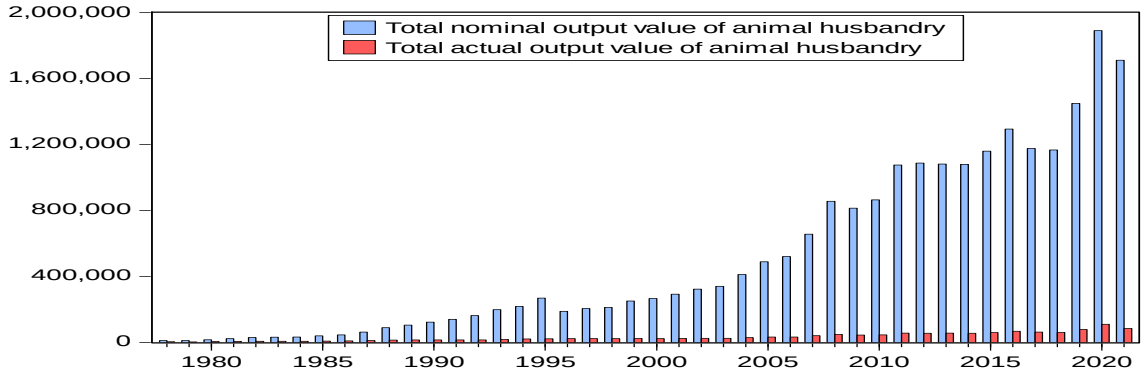

Figure 4 Total output value of animal husbandry in Zhanjiang City, Guangdong Province from 1978 to 2021(Unit: ten thousand yuan)

4.5 The total fishery output value of Zhanjiang has increased

The total nominal output value of Zhanjiang fishery increased from 65.42 million yuan in 1978 to 2.548.101 million yuan in 2021, an increase of 388.5 times. The actual total output value of Zhanjiang fishery is obtained by adjusting the fishery production price index. The actual gross fishery output value of Zhanjiang increased from 10.1 million yuan in 1978 to 13500.66 million yuan in 2021, an increase of 12.37 times.

The information in Figure 5 tells us that the total nominal fishery output value of Zhanjiang City declined year-on-year in 1979, 1990 and 2020. In other years, the total nominal fishery output value of Zhanjiang City is increasing. In these 44 years, the actual total fishery output value of Zhanjiang City also has the same change characteristics, only the change range is small.

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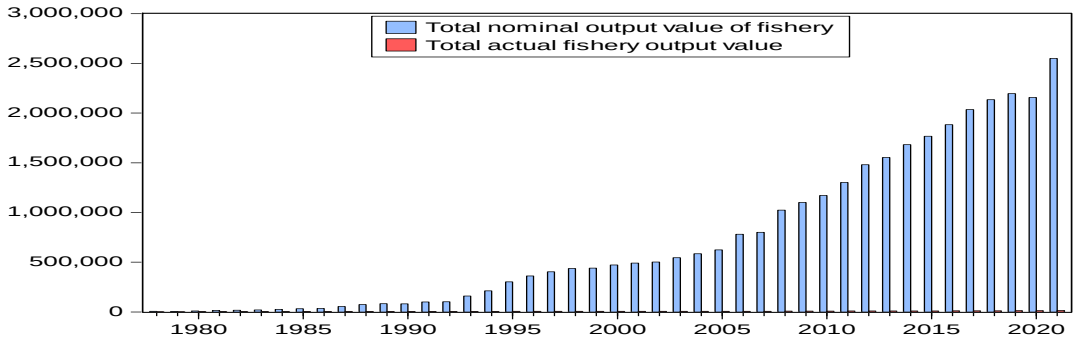

Figure 5 Total fishery output value of Zhanjiang City, Guangdong Province, 1978-2021(Unit: ten thousand yuan)

4.6 The total output value of Zhanjiang's agriculture, forestry, husbandry and fishery service industry increased as a whole

The total nominal output value of Zhanjiang's agriculture, forestry, animal husbandry and fishery services increased from 6.38 million yuan in 1978 to 439.132 million yuan in 2021, an increase of 687.29 times. The actual total output value of Zhanjiang agriculture, forestry, husbandry and fishery service industry is obtained by adjusting the production price index of agriculture, forestry, husbandry and fishery service industry. The actual total output value of Zhanjiang's agriculture, forestry, animal husbandry and fishery service industry increased from 282,000 yuan in 1978 to 2.024 million yuan in 2021, an increase of 6.18 times.

According to Figure 6, from 1978 to 2021, the nominal GDP of the agriculture, forestry, animal husbandry and fishery service industry in Zhanjiang City decreased only in 1993, 1995, 2002 and 2001. In other years, the nominal GDP of Zhanjiang's agriculture, forestry, animal husbandry and fishery services increased. In the past 44 years, the actual GDP of the agriculture, forestry, animal husbandry and fishery service industry in Zhanjiang City has the same trend of change, but the change range is smaller.

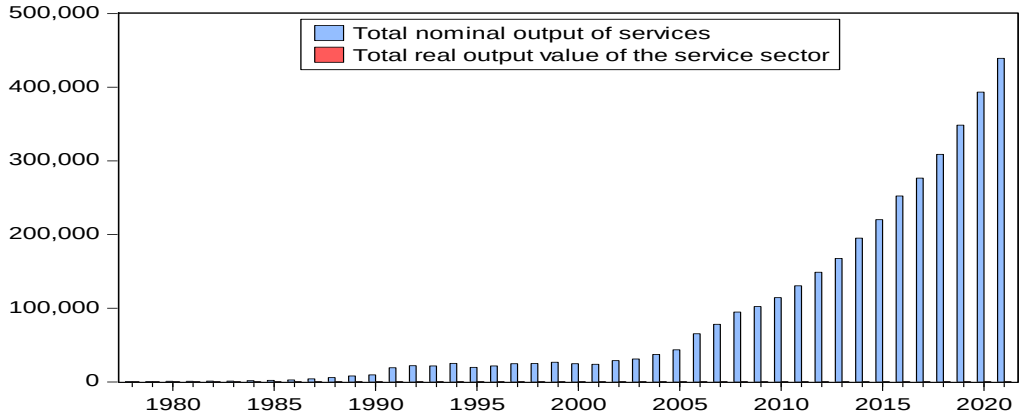

Figure 6 Total output value of agriculture, forestry, animal husbandry and fishery services in Zhanjiang, Guangdong Province, 1978-2021(Unit: ten thousand yuan)

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5. Empirical analysis

5.1 Graphical analysis of data

5.1.1 Graphics of raw data

For the convenience of drawing and modeling, the actual disposable income of farmers in Zhanjiang City is expressed as Y, and the actual total output value of agriculture, forestry, animal husbandry, fishery and agriculture, forestry, animal husbandry and fishery services in Zhanjiang City is expressed as X1, X2, X3, X4 and X5 respectively. Use Eviews 10 to make their timing diagram, as shown in Figure 7. It can be seen from the time series diagram that these 6 variables all have upward time trends, and they are all unstable and cannot be directly used for modeling.

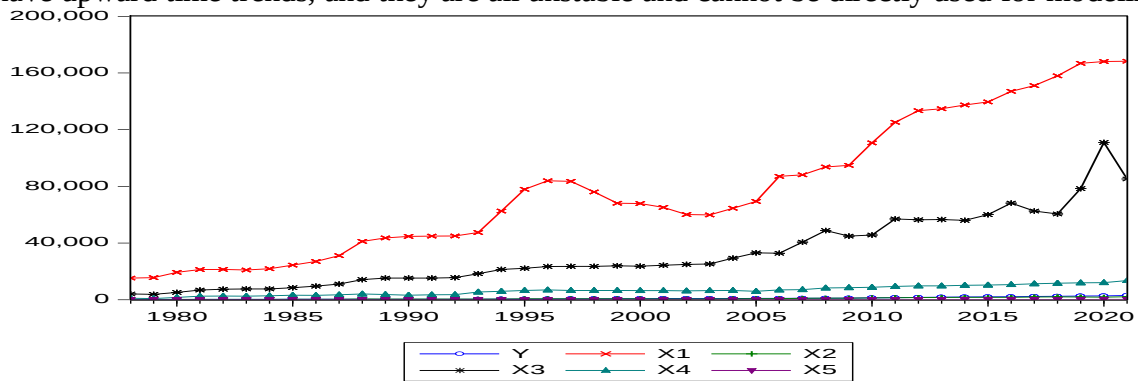

Figure 7: Farmers' income and total output value of primary industries in Zhanjiang, Guangdong Province, 1978-2021

5.1.2 Graph of the logarithm of raw data

In order to reduce the volatility of data and the order of data stability, logarithms of the above six variables are taken. The logarithm of y is represented as lnY, while the logarithm of X1, X2, X3, X4 and X5 are represented as lnX1, lnX2, lnX3, lnX4 and lnX5 respectively. Make a time sequence diagram of these logarithmic sequences, as shown in Figure 8. It can be seen from the graph that these 6 logarithmic sequences still have an upward trend of change and are not yet a stationary sequence. However, compared to the six sequences in Figure 1, the changes are more gradual.

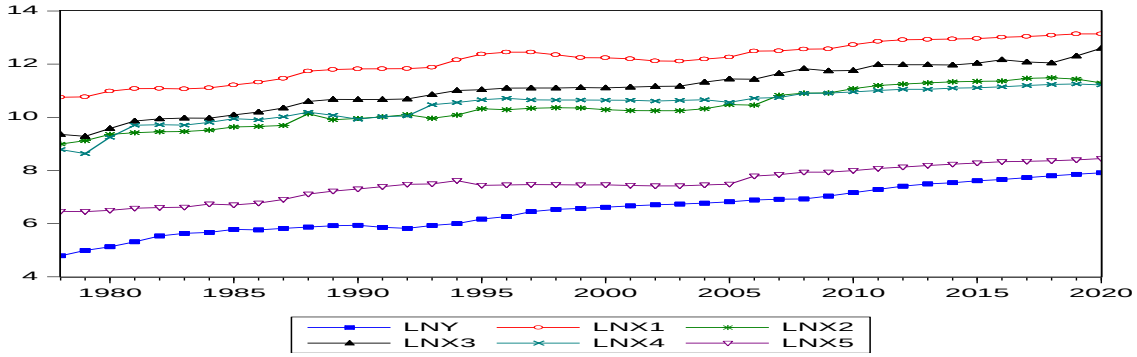

Figure 8: Logarithms of farmers' income and total output value of primary industries in Zhanjiang City, Guangdong Province from 1978 to 2021

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5.1.3 Graph of the first difference of the logarithm of the original data

The first-order difference operation is taken for the above 6 logarithmic sequences, and the first-order difference of LNY is represented as DLNY, while the first-order difference of lnX1, lnX2, lnX3, lnX4 and lnX5 is represented as dlnX1, dlnX2, dlnX3, dlnX4 and dlnX5, respectively. These 6 log-difference sequences are made into a time sequence diagram, as shown in Figure 9. Judging by the graph, they all fluctuate around a certain horizontal line, and they can be preliminarily judged to be stable.

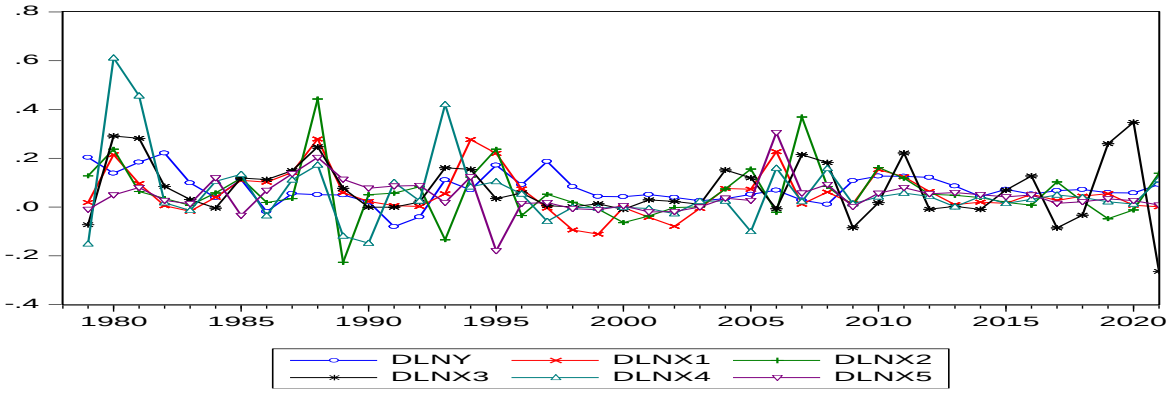

Figure 9 First-order difference of logarithms of farmers' income and gross output value of primary industries in Zhanjiang City, Guangdong Province from 1978 to 2021

5.2 Stationarity test of data

In order to accurately judge the stationarity of data, we use ADF test.ADF tests are performed on the above 6 logarithmic sequences and the 6 log-difference sequences. The test results are shown in Table 1. The results show that the 6 logarithmic sequences are all unstable at the significance level of 5%. The six log-difference sequences are all stationary at the significance level of 5%, and they are all first-order stationary, i.e. they are all I (1).

Table 1 ADF test results of each variable

Test variable	**Check type** （C, T, *）	**ADF statistic**	**5% threshold**	**D.W value**	**Test conclusion**
lnY	（C, T, 1）	-3.1464	-3.5208	2.3096	unstable
dlnY	（C, 0, 0）	-4.0692	-2.9332	2.1405	stable
lnX_1	（C, T, 1）	-2.8969	-3.5208	1.8180	unstable
$dlnX_1$	（C, 0, 0）	-3.9148	-2.9332	1.6913	stable
lnX_2	（C, T, 0）	-2.8464	-3.5181	2.1114	unstable
$dlnX_2$	（C, 0, 0）	-7.7912	-2.9332	2.0195	stable
lnX_3	（C, T, 3）	-2.6671	-3.5266	1.8267	unstable

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$dlnX_3$	(C, 0, 1)	-7.2417	-2.9350	1.7042	stable
lnX_4	(C, T, 0)	-3.3672	-3.5181	1.7726	unstable
$dlnX_4$	(C, 0, 0)	-5.7790	-2.9332	1.2454	stable
lnX_5	(C, T, 2)	-2.4403	-3.5236	2.0833	unstable
$dlnX_5$	(C, 0, 0)	-5.6516	-2.9332	2.0405	stable

5.3 Data modeling

5.3.1 Modeling roadmap

According to the characteristics of these data, there are two basic ideas: one is to model according to the stationary sequence; The other one is based on the modeling idea of cointegration. The advantage of the former is that it meets the basic conditions of classical econometrics, but the disadvantage is that the economic significance of the model is not clear. The disadvantage of the latter is that it does not meet the basic conditions of classical econometric modeling, but the advantage is that the economic significance of the model is clear. This paper uses the modeling idea of cointegration to build a model.

5.3.2 Model construction

As can be seen from Table 1, lnY is a first-order single integer, and lnX_1, lnX_2, lnX_3, lnX_4 and lnX_5 are also first-order single integer, which is the condition of full modeling. With lnY as the explained variable, and lnX_1, lnX_2, lnX_3, lnX_4 and lnX_5 as the explanatory variables, the following cointegration equation is established:

$$lnY=\beta_0+\beta_1 lnX_1+\beta_2 lnX_2+\beta_3 lnX_3+ \beta_4 lnX_4+\beta_5 lnX_5+\varepsilon t \quad (1)$$

Among them, lnY represents the logarithm of the actual disposable income of Zhanjiang farmers; lnX_1, lnX_2, lnX_3, lnX_4 and lnX_5 respectively represent the logarithm of the actual total output value of Zhanjiang's agriculture, forestry, animal husbandry, fishery and agriculture, husbandry and fishery services. Beta 0 represents the constant term, beta 1, beta 2, beta 3, beta 4, and beta 5 represent their respective parameters to be estimated, and εt represents the random disturbance term.

5.3.3 E-G two-step method was used for co-integration analysis

The E-G two-step method is to first estimate the parameters and residuals of the model by the least square method. Then check the stationarity of the residual. As long as the residual is stable, it can be judged that there is a cointegration relationship between the explained variable and the explained variable, that is, there is a long-term equilibrium relationship between the two.

The first step is to estimate the sample regression equation. Using the time series data of Zhanjiang's farmers' actual disposable income and the actual total output value of agriculture, forestry, animal husbandry, fishery and agriculture, forestry, animal husbandry and fishery services from 1978 to 2021, the following regression equation (2) is estimated by using the least square method.

$\ln Y = -2.3721-0.2668\ln X_1+0.9041\ln X_2 + 0.7366\ln X_3 +0.1014\ln X_4 - 0.5265\ln X_5$
T = (-2.141) (-1.119) (4.921) (3.274) (0.606) (-1.954)
R^2=0.9708, F=253, DW=0.9641, N=44. (2)

The second step is to judge the stationarity of the residual. The residual sequence of the above equation is extracted and denoting as e=resid. Then, the stationarity test is performed on the residual sequence e. The ADF unit root test results of the residual sequence e are shown in Table 2, indicating that e is stable at the significance level of 1%. Therefore, lnY has a cointegration relationship with $\ln X_1$, $\ln X_2$, $\ln X_3$, $\ln X_4$ and $\ln X_5$, that is to say, lnY has a long-term equilibrium relationship with $\ln X_1$, $\ln X_2$, $\ln X_3$, $\ln X_4$ and $\ln X_5$.

Table 2 Results of ADF unit root test for residual e

Test variable	**Check type (C, T, K)**	**ADF statistic**	**D.W value**	**ADF critical value at a significant level**			**P value**	**Test conclusion**
				1%	5%	10%		
e	(0, 0, 0)	-3.6191	1.9730	-2.6199	-1.9487	-1.6120	0.0006	stable

5.3.4 Using stepwise regression method to eliminate multicollinearity
As can be seen from the above cointegration equation, R^2 = 0.9688, the model can pass the goodness of fit test; F = 229.5305, the model can also pass the significance test of the equation; However, the absolute values of T statistics of lnx1 and lnx4 in the model are too small to pass the significance test of variables. Therefore, there may be multicollinearity and the model needs to be improved. We use stepwise regression to eliminate multicollinearity.

(1) Find out the most basic form of regression

lnY's unitary linear regression models for $\ln X_1$, $\ln X_2$, $\ln X_3$, $\ln X_4$ and $\ln X_5$ were respectively made, and the results were shown in Table 3. It is found that lnY regression with respect to $\ln X_2$ has the largest coefficient of determination. Therefore, the unitary linear regression model $\ln Y=f(\ln X_2)$ is the most basic regression form.

Table 3 Finds the most basic regression form in stepwise regression method

Model form	$\ln Y=f(\ln X_1)$	$\ln Y=f(\ln X_2)$	$\ln Y=f(\ln X_3)$	$\ln Y=f(\ln X_4)$	$\ln Y=f(\ln X_5)$
R^2	0.9163	0.9539	0.9518	0.8886	0.9092

(2) Gradual regression

Other explanatory variables were introduced into the most basic regression model and the best regression equation was found, as shown in Table 4.

Table 4 In the most basic regression form, gradually increase the variables for regression

	C	$\ln X_2$	$\ln X_1$	$\ln X_3$	$\ln X_4$	$\ln X_5$	Adjusted R^2
$\ln Y=f(\ln X_2)$	-0.9761	1.156					
T-value	(-3.812)	(29.49)					0.9528
$\ln Y=f(\ln X_2,\ln X_1)$	-1.6779	1.017	0.1453				
T-value	(-1.894)	(5.896)	(0.828)				0.9525
$\ln Y=f(\ln X_2,\ln X_3)$	-2.1716	0.6138		0.4684			
T-value	(-5.002)	(3.602)		(3.253)			0.9616
$\ln Y=f(\ln X_2,\ln X_3,\ln X_4)$	-2.2772	0.6390		0.3623	0.1174		0.9612
T-value	(-4.963)	(3.660)		(1.786)	(0.747)		
$\ln Y=f(\ln X_2,\ln X_3,\ln X_5)$	-3.4190	0.8757		0.7170		-0.6731	0.9676
T-value	(-5.866)	(4.861)		(4.565)		(-2.934)	

In the first step, lnx1 was introduced into the basic unitary linear regression model $\ln Y=f(\ln X_2)$ to obtain the binary linear regression model $\ln Y=f(\ln X_2, \ln X_1)$, and the modified R^2 of the model was 0.9525, which was reduced compared with the original, and the variable did not pass the T-test with a significance level of 5%, so $\ln X_1$ was removed.

In the second step, $\ln X_3$ was introduced into the basic unitary linear regression model $\ln Y=f(\ln X_2)$, and the modified R^2 of the model was 0.9616, which was improved compared with the original. Each variable also passed the T-test with a significance level of 5%, so the most basic model became the optimal model $\ln Y=f(\ln X_2,\ln X_3)$ with $\ln X_3$ retained.

In the third step, $\ln X_4$ was introduced into the better model to become a terial linear regression model $\ln Y=f(\ln X_2,\ln X_3,\ln X_4)$, and the modified R^2 of the model was 0.9612, which was reduced relative to the better model. The variable $\ln X_4$ also failed to pass the T-test with a significance level of 5%, so $\ln X_4$ was removed.

In the fourth step, $\ln X_5$ was introduced into the better model to become a terial linear regression model $\ln Y=f(\ln X_2,\ln X_3,\ln X_5)$, and the modified R^2 of the model was 0.9676, which was improved relative to the better model. All variables also passed the T-test with a significance level of 5%, so $\ln X_5$ was retained.

The ternary linear regression model $\ln Y=f(\ln X_3,\ln X_2,\ln X_5)$ becomes a better model. The results of the regression model after eliminating multicollinearity are the regression model (3).

$$\ln Y = -3.4190 + 0.8757\ln X_2 + 0.7170\ln X_3 - 0.6731\ln X_5$$
$$T = (-5.866)\quad (4.861)\quad (4.565)\quad (-2.934)$$
$$R^2=0.9699,\ F=429.2,\ DW=0.9277,\ n=44. \qquad (3)$$

As can be seen from the above model, the absolute values of T statistics of $\ln X_2$, $\ln X_3$ and $\ln X_5$ are all greater than 2, and they can pass the significance test of variables at the significance level

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of 5%. All three variables are significant and independent, and multicollinearity has been eliminated.

5.3.5 Autocorrelation Test and Correction for Sequences

According to the Durbin-Watson statistic, which has a value of 0.9277, the model (3) may have positive first-order autocorrelation as the statistic is less than 1. To further investigate this, the LM test was conducted. The P-values of Obs* R^2 for orders 1-14 were all found to be less than 0.05, leading to the rejection of the null hypothesis at a significance level of 5%. However, for order 15, the p-value of Obs* R^2 was greater than 0.05, indicating that the null hypothesis is accepted at a significance level of 5%. Therefore, it can be concluded that at a significance level of 5%, the model (3) exhibits the largest 14-order autocorrelation.

After confirming the presence of autocorrelation in the sequence, we utilized the generalized least squares (GLS) method in Eviews 10 to eliminate the correlation in model (3). To correct for autocorrelation, we incorporated random disturbances AR(1), AR(2), ..., AR(k) into the model. The results indicate that only AR(1), AR(5), and AR(9) are significant at the 5% significance level when compared to the original model. Furthermore, the Durbin-Watson statistic (D.W) is 1.9659, suggesting that sequence correlation is no longer present in model (4) after multiple iterations of GLS.

$$\begin{aligned}&\ln Y = -1.407 + 0.429\ln X_2 + 0.240\ln X_3 + 0.619\ln X_5 + 0.684AR(1) - 0.204AR(5) - 0.286AR(9)\\&T = \quad (-3.33)\ (4.20)\qquad (2.04)\qquad (3.40)\qquad (5.85)\qquad (-3.12)\qquad (-2.35)\\&R^2 = 0.9931,\ F = 740,\ \ DW = 1.9659,\ \ n = 44.\end{aligned} \tag{4}$$

The optimal model (4) can be observed from the fact that the absolute value of the T statistics for each variable is greater than 2, indicating that all variables pass the significance test. Additionally, all variables are found to be significant and independent, with no evidence of multicollinearity. The Durbin-Watson statistic (DW) is calculated to be 1.9659, which is close to 2. This suggests that there is no valuable information remaining in the residual and any sequence correlation in the residual has been eliminated. Therefore, the above model (4) can be considered as the optimal model.

6. Research conclusions and suggestions

6.1 Research Conclusions

According to the optimal model, the following conclusions can be obtained:

(1) The increase in the total output value of agriculture ($\ln X_1$) and the increase in the total output value of fishery ($\ln X_4$) had no significant impact on the increase in the actual income (lnY) of farmers in Zhanjiang City in the current period, that is, in the two industries of agriculture and fishery, the increase in production did not increase income.

(2) The increase of the total output value of forestry ($\ln X_2$), the increase of the total output value of animal husbandry ($\ln X_3$) and the increase of the total output value of agriculture, forestry, animal husbandry and fishery service ($\ln X_5$) had a significant impact on the increase of farmers' actual income (lnY) in Zhanjiang City, and the effects of the three were all positive; Among them, every 1% increase in the total output value of Zhanjiang forestry, on average, the per

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capita disposable income of Zhanjiang rural areas increased by 0.429%; When the total output value of Zhanjiang animal husbandry increases by 1%, on average, the per capita disposable income in Zhanjiang rural areas increases by 0.240%; Every 1% increase in the total output value of Zhanjiang's agriculture, forestry, animal husbandry and fishery services, on average, the per capita disposable income of Zhanjiang's rural areas will increase by 0.619%.

(3) The impact of agriculture and fishery on the per capita disposable income in rural areas of Zhanjiang is lagging, with the longest impact lagging behind by 15 years; Among them, the effect of one-year lag [AR(1)] is positive, but the effect of 5-year lag [AR(5)] and 9-year lag [AR(9)] are all negative.

6.2 Policy Recommendations

First of all, in order to increase the per capita disposable income in Zhanjiang rural areas, vigorously develop Zhanjiang agriculture, forestry, animal husbandry and fishery service industry, because it has the best effect on increasing the income of Zhanjiang farmers.

Secondly, vigorously develop Zhanjiang forestry, because it is the second best effect on Zhanjiang farmers' income, at the same time, it is also extremely important to the ecological environment of Zhanjiang.

Thirdly, the moderate development of Zhanjiang animal husbandry, its impact on Zhanjiang farmers' income is the third.

Finally, we should also pay attention to the development of agriculture and fisheries in Zhanjiang, if we do not pay attention to them, it will have a negative impact for up to 15 years.

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