A Study of Regional Economic Convergence base on Multiple Linear Regression

A Case Study of Zhejiang Province in China

Yin Ping[1, a]
[a]e-mail: py153250@163.com

[1]dept. College of Financial Accounting, Zhejiang Institute of Economics and Trade, Hangzhou, Zhejiang, China

Abstract—During the 14th Five-Year Plan period (2021-2025), Zhejiang Province aims for significant progress in building itself into a pilot zone for shared prosperity by 2025 through high-quality development. This paper selects relevant data from the *Zhejiang Statistical Yearbook* from 2007 to 2019 to construct panel data. Since the data of some individual years are not available, this paper ignored these data and only selected data suitable for empirical analysis, and the observation sample is 797. Through mixed regression, fixed-effect regression and random-effect regression, this paper empirically analyzes the relationship between fiscal expenditure and regional economic convergence, hoping to provide feasible policy suggestions for Zhejiang Province to promote the construction of the pilot zone for common prosperity in the later period. The mixed regression and fixed-effect regression results in the time-lapse analysis show that the total fiscal expenditure after 2016 has a more significant impact on regional economic convergence. Meanwhile, mixed regression and fixed-effect regression results in the item-lapse analysis show that the effect of education expenditure on regional economic convergence is more significant than other fiscal expenditures.

Keywords- total fiscal expenditure; public budget expenditure; education expenditure; convergence

1. INTRODUCTION

The theory of endogenous growth indicates that fiscal expenditure plays an important role in regional economic growth, but the promotion system of horizontal competition may lead to the adoption of a short-term growth maximization strategy, which is not conducive to regional economic convergence. The relationship between fiscal expenditure and regional economic convergence in Zhejiang Province in recent years requires further empirical analysis. The research contents related to this theory mainly focus on two aspects: the relationship between total fiscal expenditure and regional economic convergence; and the relationship between different fiscal expenditure items and regional economic convergence.

1.1 The relationship between total fiscal expenditure and regional economic convergence

Adam Smith first argued that the main functions of government included providing public infrastructure, national defense and compensating for market failures. The market focuses on

efficiency and the government pays more attention to fairness. Therefore, fiscal expenditure should pay more attention to regional economic convergence than regional economic growth. Chen Zhiguo [1] used the local budgetary expenditure as a control variable, empirical analysis: Local fiscal expenditure does not promote regional economic convergence. Han Junfei and Wang Ling [2] further proposed that fiscal expenditure has a nonlinear effect on economic growth by examining the economic convergence in western China. Zhao Jiajia [3] comprehensively analyzed the σ and β convergence of China's provincial economies, and found that after 2003, the convergence occurred, and the change of this convergence is related to the changes in the scale and structure of fiscal expenditure. Tian Fengping [4] studies the convergence of economic development in three major urban agglomerations in China and uses the Gini Coefficient and sub-group decomposition method to study the source of the difference, which shows the difference between urban areas agglomerations is the primary source of the difference. Previous studies have mainly focused on the provincial level, and there have been few studies on the relationship between the total fiscal expenditure and regional economic convergence from the city and county levels. Based on the above, this paper puts forward the theoretical hypothesis that the total budgetary expenditure of the cities and counties in Zhejiang Province has a positive effect on regional economic convergence.

1.2 The relationship between different fiscal expenditure items and regional economic convergence

Even if the total fiscal expenditure has a positive impact on economic convergence, the fiscal expenditure of cities and counties can also be divided into public budget expenditure, education expenditure, and so on. Zhang Mingxi [5], through the empirical analysis of the relationship between different financial expenditure items and regional economic convergence, proposes that the increase of the proportion of local expenditure on science, education, culture, health and social security is beneficial to regional economic convergence, the cost of local administration should be reduced. Gan Jiawu [6] studies the effects of the capital construction expenditure, science, education, culture and health expenditure and social security expenditure on economic convergence in China from 1986 to 2007. Wang Baoshun and Xu Qishuang [7] through the empirical analysis of the provincial panel data from 1991 to 2018 in China, it is concluded that fiscal expenditure only contributes to economic growth in the short term; however, fiscal welfare expenditure significantly promotes economic growth and contributes to both short-term and long-term economic convergence. There are many studies on the economic convergence effect of different fiscal expenditure items, but no consensus has been reached yet. Since the promotion system of horizontal competition will inevitably lead to the adoption of short-term growth maximization strategies in various regions, ignoring the balance of regional economic development, theoretical hypothesis 2 is put forward: the impact of general public budget expenditure on economic convergence is not significant, and the education expenditure has a remarkable effect on the economic convergence.

2. MATERIALS AND METHODS

The 14th five-year plan for Economic and Social Development and the *Outline of the 2035 Nationality Law of the People's Republic of China* clearly states that "Zhejiang is expected to make substantial progress in building a demonstration zone for common prosperity through

high-quality development." Why did the demonstration zone of common prosperity choose Zhejiang? Is fiscal expenditure one of the means for the government to narrow the gap between the rich and the poor and achieve common prosperity through the redistribution of wealth? What experience can be extended nationally at a later stage? This paper hopes to answer these questions by studying the relationship between fiscal expenditure and regional economic convergence in Zhejiang Province.

2.1 Data description

This paper hopes to further clarify the influencing mechanism of fiscal expenditure on regional economic convergence by studying the total fiscal expenditure and the relationship between fiscal expenditure items and regional economic convergence in Zhejiang Province. Given the fact that the budget classification of fiscal expenditure in 2006 is different from other years, and some data in 2020 are not available, this paper selects all the cities and counties in the *Statistical Yearbook of Zhejiang Province* from 2007 to 2019 as samples. It mainly includes per capita GDP, general public budget expenditure, general public budget expenditure and education expenditure.

2.2 Model setup

Economic convergence can be divided into σ convergence and β convergence. σ convergence means that the deviation of per capita income between different systems decreases over time. β convergence refers to the fact that economic entities with lower initial per capita output tend to grow faster than those with higher initial per capita output in terms of the growth rate of per capita output, the growth rate of per capita capital and other per capita items. σ convergence comes from the stock study of economic convergence status, β convergence comes from the flow study of economic convergence status. In the analysis of the relationship between fiscal expenditure and regional economic convergence, β convergence is generally adopted, which is directly referred to as β convergence below:

$$\frac{1}{T}(gdpper_{it} - gdpper_{i0}) = \alpha_0 + \alpha_1 gdpper_{i0} + \alpha_2 government\,total_{it} \tag{1}$$

$$+\alpha_3 industry_{it} + \alpha_4 finance_{it} + \varepsilon_i$$

In Formula (1), T is the time span, $gdpper_{i0}$ is the logarithm of per capita GDP for 2007, $gdpper_{it}$ is the logarithm of per capita GDP for the T period, and $governmenttotal_{it}$ is the logarithm of general public budget expenditure for the T period, representing the regional financial expenditure. $Industry_{it}$ means the logarithm of the total industrial production value for the T period, representing the regional industrial development level. $Finance_{it}$ means the logarithm of the balance of loans at the end of the year for the T period, representing the regional financial development level, if $\alpha = (1-e^{\beta t})$, β is the convergence rate.

3. RESULTS & DISCUSSION

3.1 Descriptive statistics

Since the data of some individual years are not available, this paper ignored these data and only selected data suitable for empirical analysis, and the observation sample is 797 (see Table 1).

The average value of per capita GDP of Zhejiang Province is 10.88, the standard deviation is 0.55, the average value of general public budget expenditure is 3.7, the standard deviation is 0.85, the average value of industrial GDP is 4.74, the standard deviation is 1.21. The average year-end loan balance of financial institutions is 5.83, and the standard deviation is 1.26. The change in the gross industrial product value and the year-end loan balance of financial institutions is more significant than general public budget expenditure.

TABLE 1.   DESCRIPTIVE STATISTICS OF MAJOR VARIABLES

Variable	Observed	Mean	Standard Deviation	Min	Max
gdpper	797	10.88	0.55	9.03	12.01
governmenttotal	797	3.70	0.85	1.74	7.48
industry	797	4.74	1.21	1.25	8.28
finance	797	5.83	1.26	2.67	10.59

3.2 Benchmark regression

Firstly, the short panel with "N = 67, T = 12" is analyzed by mixed regression, fixed effect regression and random effect regression.

As for the choice of mixed regression model and fixed-effect model, the F test is used, the test statistic is 3.95 and the p-value is 0.00, indicating that the fixed-effect model is better than the mixed regression model. However, the standard error of clustering robustness is not considered in the F test. Therefore, the LSDV test shows that although the individual effect is significant in a few cities and counties, the mixed regression model cannot be completely excluded. When choosing the fixed-effect model and random-effect model, the Housman test is used. The statistic is 47.17, and the p-value is 0.00, which completely excluded the original hypothesis of the random-effect model, and the fixed-effect model is better.

As can be seen from Table 2 below, the results of the mixed regression model show that the impact of per capita GDP on regional economic growth in 2007 is -0.017, which is significant, indicating that the initial regional economic conditions have a negative impact on regional economic growth, the regional economy converges remarkably. The total fiscal expenditure has a positive effect on regional economic growth and can promote regional economic convergence. The results of the fixed effect model show that the per capita GDP had a significant impact of 0.028 on the regional economic growth in 2007, indicating that the initial regional economic conditions have a positive effect on the regional economic growth and the regional economy is in a divergent state. In addition, the total fiscal expenditure has a negative impact on regional economic growth and hinders regional economic convergence. From other analysis results, in the mixed regression model, the regional industrial development level and the financial development level also promote regional economic convergence. The significance is very strong, and the goodness of fit is also better.

TABLE 2. THE RELATIONSHIP BETWEEN FISCAL EXPENDITURE AND REGIONAL ECONOMIC CONVERGENCE IN ZHEJIANG PROVINCE FROM 2007 TO 2019

Explanatory variable	Dependent variable		
	Mixed regression	*fixed effect*	*random effect*
$gdpper_{i0}$	-0.017*** （-2.65）	0.028*** （3.23）	-0.008 （-1.17）
governmenttotal	0.0132** （2.2）	-0.034*** （-3.98）	-0.001 （-0.16）
industry	0.008 （1.33）	0.015 （1.61）	0.003 （0.58）
finance	-0.023*** （-3.09）	-0.010 （-1.01）	-0.014 （-2.19）
constant	0.0347*** （6.11）	-0.079 （-0.95）	0.026*** （4.57）
N	797	797	797
R^2	23.34%	11.98%	21.9%

a: Figures in brackets denote t statistics, *, ** And *** Denote significant at 10%, 5% and 1% levels, respectively. (The same below)

3.3 Time-lapse regression

As can be seen from Figure 1 below, the per capita GDP gap between cities and counties in Zhejiang Province has been significantly reduced after 2016. The regression is divided into two periods: 2007-2015 and 2016-2019.
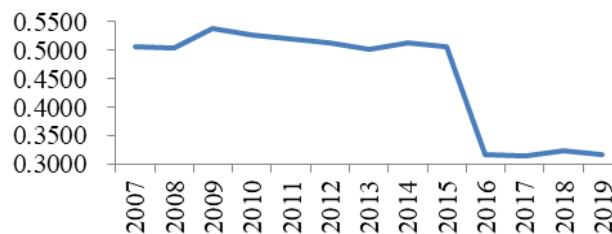
Figure 1. Distribution of logarithmic standard deviation of per capita GDP of cities and counties in Zhejiang Province

From the results of 2007-2015 in Table 3 below, it can be seen that the impact of per capita GDP on regional economic growth in 2007 in mixed regression is -0.017, which is significant, indicating that the initial regional economic conditions have a certain negative impact on regional economic growth, and the regional economy is in a state of convergence. The total fiscal expenditure has a significant positive effect on regional economic growth and can promote regional economic convergence. The level of regional industrial development and financial development also has a significant positive effect on economic growth. In the fixed effect regression, the impact of per capita GDP on the regional economic growth in 2007 is -0.051, which indicates that the initial regional economic conditions have a certain negative impact on the regional economic growth, and the regional economy is in the state of convergence. Besides, the total fiscal expenditure has no significant effect on regional

economic growth, while the level of regional industrial development has a significant positive effect on economic growth. Through the investigation of LSDV, compared with previous articles, the fixed-effect model is more preferred.

From the results of 2016-2019, it can be seen that in the mixed regression, the impact of per capita GDP on regional economic growth in 2007 is -0.029, which is significant, indicating that the initial regional economic conditions have a strong negative impact on regional economic growth, the regional economy is in a state of convergence. Meanwhile, the total fiscal expenditure has a positive effect on regional economic growth. It can promote regional economic convergence, and the level of regional financial development has a significant positive effect on economic growth. In the fixed effect regression, the influence of per capita GDP on regional economic growth in 2007 is -0.022, which shows that the initial regional economic conditions have a strong negative impact on regional economic growth, and the regional economy is in a convergent state. Moreover, the total fiscal expenditure has a significant positive effect on regional economic growth and can promote regional economic convergence. Besides, the level of regional industrial development has a significant positive effect on economic growth, while the level of regional financial development has a significant negative impact on economic growth. However, in this LSDV investigation, most cities and counties have significant individual effects, so it is strongly recommended to adopt the fixed effect model.

In summary, the regional economy was in a convergence state around 2016. But after 2016, the total fiscal expenditure has a stronger impact on the regional economic convergence than before 2016.

TABLE 3. THE RELATIONSHIP BETWEEN ZHEJIANG FISCAL EXPENDITURE AND REGIONAL ECONOMIC CONVERGENCE IN 2007-2015 AND 2016-2019

Explanatory variable	Dependent variable			
	2007-2015		*2016-2019*	
	Mixed regression	*fixed effect*	*Mixed regression*	*fixed effect*
$gdpper_{i0}$	-0.017** （-2.34）	-0.051** （-1.53）	-0.029*** （-3.34）	-0.022*** （-9.11）
governmenttotal	0.026*** （3.15）	0.002 （0.14）	0.015* （1.71）	0.011** （2.57）
industry	0.018** （2.55）	0.053*** （3.2）	-0.001 （-0.24）	0.028*** （8.83）
finance	-0.035*** （-3.39）	-0.014 （-1.25）	-0.022** （-2.57）	-0.024*** （-5.63）
constant	0.32*** （5.06）	0.485*** （1.93）	0.5*** （6.33）	0.308*** （11.87）
N	530	530	266	266
R^2	14.08%	6.61%	65.87%	57.45%

3.4 Item-lapse regression

In the *Statistical Yearbook of Zhejiang Province* from 2007 to 2019, public budget expenditure is divided into general public budget expenditure and education expenditure. The following are the impacts of different fiscal expenditure items on regional economic convergence in 2007 - 2015 and 2016 - 2019:

$$\frac{1}{T}\left(gdpper_{it} - gdpper_{i0}\right) = \alpha_0 + \alpha_1 gdpper_{i0} + \alpha_2 government_{it} \tag{2}$$
$$+\alpha_3 industry_{it} + \alpha_4 finance_{it} + \varepsilon_i$$

$$\frac{1}{T}\left(gdpper_{it} - gdpper_{i0}\right) = \alpha_0 + \alpha_1 gdpper_{i0} + \alpha_2 education_{it} \tag{3}$$
$$+\alpha_3 industry_{it} + \alpha_4 finance_{it} + \varepsilon_i$$

In Formula (2), the government is the logarithm of general public budget expenditure for the T period; In Formula (3), education is the logarithm of education expenditure for the T period; the other variables are the same.

From 2007 to 2015, both the F test and the LSDV test recommended that the fixed-effect model should be used when examining general public budget expenditure, but the mixed regression model is not completely excluded when investigating education expenditure. General public budget expenditure should adopt the fixed-effect model. The mixed regression model and fixed-effect model are used in education expenditure. It can be seen from Table 4 that when examining the general public budget expenditure, the impact of per capita GDP on regional economic growth in 2007 is -0.074, which is significant, indicating that the initial regional economic conditions have a certain negative impact on regional economic growth, and regional economy is in a state of convergence. It also shows that the public budget expenditure has a significant positive effect on regional economic growth and can promote regional economic convergence. The level of regional financial development has a significant negative impact on economic growth. In the mixed regression, the impact of per capita GDP on regional economic growth in 2007 is -0.012, which shows that the initial regional economic conditions have a negative impact on regional economic growth, and the regional economy is in a state of convergence. At the same time, the education expenditure has no significant impact on the regional economic growth, and the regional financial development level has a significant negative impact on the economic growth. In the fixed effect regression, the influence of per capita GDP on regional economic growth in 2007 is -0.074, but it is not significant; the development level of regional industry has a significant positive effect on economic growth.

In 2016-2019, in the F test and the LSDV test, the fixed-effect model was recommended for both general public budget expenditure and education expenditure. As can be seen from Table 5, when examining the general public budget expenditure, the impact of per capita GDP on regional economic growth in 2007 is -0.021, which is significant, indicating that the initial regional economic conditions have a strong negative impact on regional economic growth, and regional economy is in a state of convergence. Meanwhile, the general public budget expenditure has no significant impact on regional economic growth. It also shows that regional industrial development level has a significant positive effect on economic growth. In contrast, the level of regional financial development has a significant negative impact on economic growth. The impact of per capita GDP in 2007 is -0.02, which shows that the initial regional

economic situation has a strong negative impact on the regional economic growth, and the regional economy is in a convergent state. Besides, the education expenditure also has a significant positive effect on regional economic growth and can promote regional economic convergence; the level of regional industrial development has a significant positive effect on economic growth, while the level of regional financial development has a significant negative impact on economic growth.

TABLE 4. THE RELATIONSHIP BETWEEN DIFFERENT FISCAL EXPENDITURE ITEMS AND REGIONAL ECONOMIC CONVERGENCE IN ZHEJIANG PROVINCE FROM 2007 TO 2015

Explanatory variable	Dependent variable		
	fixed effect	*Mixed regression*	*fixed effect*
gdpper$_{i0}$	-0.074** （-3.71）	-0.012* （-1.67）	-0.074 （-1.6）
government	0.033** （2.21）		
education		0.006 （0.58）	0.033 （1.06）
industry	0.045*** （2.71）	0.01 （1.62）	0.045** （2.09）
finance	-0.021** （-2.08）	-0.018** （-2.35）	-0.021 （-1.54）
constant	0.749*** （4.47）	0.285*** （4.14）	0.749* （1.88）
N	530	530	530
R^2	7.6%	11.46%	7.59%

TABLE 5. THE RELATIONSHIP BETWEEN DIFFERENT FISCAL EXPENDITURE ITEMS AND REGIONAL ECONOMIC CONVERGENCE IN ZHEJIANG PROVINCE FROM 2016 TO 2019

Explanatory variable	Dependent variable	
	fixed effect	*fixed effect*
gdpper$_{i0}$	-0.021*** （-8.6）	-0.02*** （-8.51）
government	0.0005 （0.15）	
education		0.014*** （3.06）
industry	0.03*** （9.54）	0.029*** （9.1）
finance	-0.016*** （-3.89）	-0.024*** （-6.3）
constant	0.281*** （9.56）	0.291*** （12.43）
N	266	266
R^2	56.01%	58.03%

4. CONCLUSIONS

From the perspective of the relationship between fiscal expenditure and regional economic convergence, the regional economy around 2016 is in a state of convergence, but after 2016, the total fiscal expenditure has a more substantial impact on regional economic convergence than before 2016. If Zhejiang Province wants to sum up its advanced experience in the early stage, promote "common prosperity" in the later stage, and spread it to the whole country, it can pay more attention to the relevant policies of Zhejiang Province after 2016.

At the level of the relationship between different fiscal expenditure items and regional economic convergence, after 2016, the regional economy is in a state of convergence, education has a significant positive impact on regional economic convergence, while public budget expenditure has no significant effect on regional economic convergence.

In general, the level of industrial development and financial development have different effects on regional economic growth. The level of regional industrial development has a positive impact on economic growth, while the regional financial development level has a negative impact on economic growth. In the later stage, the relationship between the two items and regional economic convergence can be examined in detail to clarify the influencing mechanism, so as to determine the reform plan.

REFERENCES

[1]   Chen Z.G, Zhang J, Chen G.X. (2018) Analysis on the influence of local fiscal expenditure on the convergence of regional economic growth club. Financial Research,12: 54-57.

[2]   Han J.F, Wang L. (2010) An empirical analysis of the relationship between fiscal expenditure and regional economic convergence. Modern Economic Information,08:194,196.

[3]   Zhao J. J. (2010) An empirical analysis of the effect of local fiscal expenditure on inter-provincial economic convergence in China. Journal of Lanzhou Commercial College, 26(04):93-98.

[4]   Tian F.P, Qin J.L, Yang K. (2020) Study on regional difference and convergence of economic development of three urban agglomerations in China. Systems engineering, 10:16.

[5]   Zhang M.X. (2007) Local fiscal expenditure and regional economic convergence. Economic Latitude,01: 68–73.

[6]   Gan J. W. (2010) An empirical study on the relationship between fiscal expenditure and economic convergence. Journal of Central South University (Social Sciences Edition), 16(04):79-83.

[7]   Wang B.S, Xu Q. S. (2021) Fiscal expenditure, regional economic disparity and convergence of dynamic growth. Journal of the Zhongnan University of Economics and Law,03: 48–90.