Analysis of The Impact Between the Income Distribution Gap and Economic Growth Based on Individual Fixed Effect Variable Intercept Models

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Abstract—To explore the interaction between the income distribution gap and economic growth, the difference between per capita disposable income and per capita GDP of urban and rural residents in 31 provinces and cities in China from 2013 to 2019 is selected as the data. Through the unit root test and cointegration test, the type of model is distinguished. Finally, an individual fixed effect variable intercept model was established to analyze the influence direction and trend between the two variables. The results show a positive interaction between the income distribution gap and economic growth. That is, the income distribution gap will promote economic growth. Similarly, economic growth will also expand the income distribution gap. Although the impact trend of the two is the same between different provinces and cities, there are significant differences in the intercept term of with individuals, indicating that the economic development differences between different regions may impact the relationship between the two. The research results can provide a reference basis for regional economic development and reducing the income gap.

Keywords-the income distribution gap; economic growth; fixed effect

1 INTRODUCTION

With the advent of the all-around well-off era, the problem of income distribution gap and economic growth has become a hot topic again. In economic development, we should take into account the fair distribution of income. While solving the dilemma of the income distribution gap, we also need to pay attention to sustainable economic growth. The balanced and steady development between the two can be conducive to social stability and prosperity. Therefore, it is of great practical significance to explore the relationship between them.

Economic growth and income distribution run through the development of economics and have always been two vital aspects of economic theory. Sustain economic growth, and rational income distribution are the premise of national and social stability and the basis of prosperity and development. Therefore, they have been paid long-term attention and universal attention by national and regional governments. The relationship between the two is mainly divided into three aspects.

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The first is mutual promotion. Kaldor (1956) [6] proposed that the increase of income gap enables the rich to accumulate capital to promote economic development. Sabot (1996) [7] believes that the income gap will stimulate the work enthusiasm of low-income people, which will promote economic growth to some extent. Foellmi & zweimuller (2006) [8] compared the degree of income distribution inequality between the United States and some other E.U. countries and believed that the income gap played a positive role. Jiang Tao (2014) [1] based on the E-G two-step analysis, it is concluded that economic growth leads to the expansion of the income gap. In turn, the widening income gap has promoted economic growth.

The second is mutual inhibition. Alesina (1996) [9] demonstrated that excessive the income gap hinders economic growth by considering the factors of labor and capital. Benabou R (1996) [10] further demonstrated that excessive the income gap leads to social instability and affects economic growth from a social perspective. Tu Pingping (2018) [2] believes that uneven the income distribution will damage the interests of low-income people, thus affecting investment, and affect the people's preferences of investors due to lack of consumption power, thus affecting economic growth.

The third is the inverted “U” curve with the time change, which first rises and decreases. Kuznets (1955) [11] first put forward the inverted “U” hypothesis on the relationship between them. The research of Paukert (1973) and Ahluwalia (1976) concluded similarly to Kuznets. Wang Xiuyun (2019) [3] through the research on the Gini coefficient and the actual GDP trends trended chart calculated at constant prices in the past 40 years of reform and opening up, it is found that so far, from the correlation between China's economic growth and income gap, it is basically consistent with the inverted “U” curve. Hua Ning (2019) [4] believes that the income gap can improve workers' enthusiasm and promote economic growth. But in the long-term, the speed and quality of economic growth will decline with the continuous expansion of the income distribution gap. Yu Yang (2019) [5] divided space into different regions and studied the imbalance of economic growth and income distribution gap. The results show that the manifestations under the conditions of space and time have doubled inverted “U” shaped coordinated changes.

2 RESEARCH METHODS

2.1 Panel data regression model

$$y_{it} = \alpha + \sum \beta X_{it} + \lambda_i D_i + \mu_{it} \tag{1}$$

Here, i represent the individual, t represents the time, and μ represents a random error term.

2.2 The individual fixed effect regression model

The individual fixed effect model is a model with only different intercept terms for different longitudinal time series. From the individual point of view, the editorial impact of the model's explanatory variables on the explained variables is the same, while the effects of other deterministic variables affecting the explained variables only change with the individual.

$$y_{it} = \alpha + \sum \beta X_{it} + \lambda_i D_i + \mu_{it}$$

$$D = \begin{cases} 1 & \text{if it belongs to the i-th}, \ i = 1, \cdots, N \\ 0 & \text{else} \end{cases} \tag{2}$$

3 EMPIRICAL ANALYSIS

3.1 Selection of indicators

Income distribution shows differences in many aspects, which can be analyzed specifically for the income gap between urban and rural residents. Since the indicators involved are divided into distribution gap and economic growth, per capita GDP is selected as the indicator to measure economic growth, expressed in GDP. The gap of the income distribution can be measured by the difference between the per capita disposable income of urban and rural residents, expressed in CJ. The data of each indicator comes from the State Statistical Bureau.

3.2 Unit root test

This paper selects the panel data of 31 provinces and cities in China from 2013 to 2019. In order to avoid the phenomenon of pseudo regression, the stationarity test is carried out on the original data, and the results are shown in Table 1. Both variables accept the original hypothesis at the significance level of 5%, and GDP and CJ are non-stationary series. Therefore, after the first-order difference of the original data, the stationarity test is carried out. The results show that the P-value of GDP and CJ after the first-order difference is less than 0.05, indicating that the first-order difference sequence is stable. They are single integer sequences of the same order, and there may be a cointegration relationship.

Table 1 Stability test of variables

test variable	LLC inspection		IPS inspection	
	statistic	*P-value*	*statistic*	*P-value*
GDP	7.13	1	7.39	1
CJ	31.57	1	21.91	1
	ADF test		P.P. inspection	
	statistic	*P-value*	*statistic*	*P-value*
GDP	10.88	1	11.38	1
CJ	4.81	1	8.44	1
	After first-order difference			
	statistic	*P-value*		
GDP	-7.71	0.00		
CJ	-6.56	0.00		

3.3 Cointegration Cointegration test

The cointegration test is conducted for the two variables, as shown in Table 2. The statistic is -3.5748, and the corresponding P-value is less than 0.05. The original assumption that there is no cointegration relationship is rejected. Through cointegration test, it shows that there is a long-term equilibrium relationship between per capita regional GDP and the urban-rural income gap.

Table 2 Cointegration test

ADF	t-Statistic	Prob.
	-3.5748	0.0002

3.4 Model selection

There are many kinds of panel data models, roughly divided into the following types, as shown in the figure below. In order to avoid the deviation caused by the model set, the conforming panel design model form shall be judged through relevant inspection. Firstly, the F-test selects the constant coefficient model, variable intercept model, or variable coefficient model. Secondly, the fixed-effect model or random effect model is selected by the Hausman test.

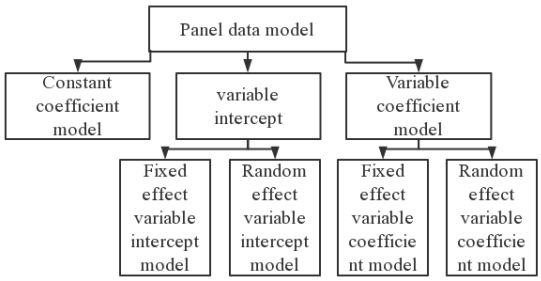

Figure 1 panel data model classification

1)F inspection

H_0: The intercept of different individuals in the model is the same.

H_1: The intercept items of different individuals in the model are different.

$$F_1 = \frac{(SSE_1 - SSE_2)/[(N-1)(k+1)]}{SSE_2/(NT - N(k+1))} \sim F[(N-1)(k+1), N(T-k-1)] \quad (3)$$

SSE_1 is the sum of squares of the invariant parameter model. SSE_2 is the sum of squares of the residuals of the variable intercept model. N is the number of sections, T is the number of periods, and K is the number of explanatory variables. When the value of F_1 is greater than or equal to the critical value under the given set information interval, continue to calculate F_2. Otherwise, the constant coefficient model is selected.

H_0: The coefficients of different individuals in the model are the same.

H_1: The coefficients of different individuals in the model are different.

$$F_2 = \frac{(SSE_3 - SSE_2)/[(N-1)k]}{SSE_2/(NT - N(k+1))} \sim F[(N-1)k, N(T-k-1)] \quad (4)$$

SSE_3 is the sum of squares of residuals of the variable intercept model. When the value of F_2 is greater than or equal to the critical value under a given set information interval, the variable coefficient model is adopted. Otherwise, the variable intercept model is adopted.

Considering the impact of economic growth on the income gap, according to table 3, F_1=6.3329 is calculated from N=31, T=7, and K=1, which is greater than its critical value $F_{0.05}(60155)$=1.404. The original assumption is rejected. Similarly, it is calculated that F_2=0.0483, which is less than its critical value $F_{0.05}(30155)$=1.5329. Therefore, the original hypothesis is accepted, and the variable intercept model is finally selected.

Table 3 Estimation results of each model

	SSE	Adjusted R^2	D.W.
Invariant parameter model	2.44×109	0.6143	0.1068
Variable intercept	6.49×108	0.8807	0.4624
Variable coefficient model	8.11×108	0.6389	0.3391

2)Hausman test

The Hausman test tests the proper estimation of the random effect model of panel data, and the test results are shown in Table 4. The P-value in the table is less than 0.05, and the fixed-effect model shall be established.

Table 4 Hausman test results

Test Summary Cross-section random	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
	17.2210	1	0.0000

3.5 Model results

According to the F test and Hausman test, it is most reasonable to establish the fixed effect variable intercept model. The model is regressed and the results are shown in Table 5.

Table 5 Model results of the impact of economic growth on income gap

	GDP	c
Anhui Province	0.2410	7427.54
Beijing City	0.2410	5758.0750
Chongqing City	0.2410	4200.027
Fujian Province	0.2410	2163.289

Guangdong Province	0.2410	5343.7305
Gansu Province	0.2410	11558.722
Guangxi Zhuang Autonomous Region	0.2410	9117.521
Guizhou Province	0.2410	10615.92
Hainan Province	0.2410	5991.6738
Hebei Province	0.2410	6257.0837
Heilongjiang Province	0.2410	4566.056
Henan Province	0.2410	5196.454
Hubei province	0.2410	2855.936
Hunan Province	0.2410	8350.55
Jilin Province	0.2410	2656.801
Jiangsu Province	0.2410	6777.607
Jiangxi Province	0.2410	6108.5895
Liaoning Province	0.2410	-845.592
Inner Mongolia Autonomous Region	0.2410	4939.8431
Ningxia Hui Autonomous Region	0.2410	6183.659
Qinghai Province	0.2410	7776.825
Shaanxi Province	0.2410	6363.262
Sichuan Province	0.2410	7174.28
Shandong Province	0.2410	4380.017
Shanghai City	0.2410	3612.123
Shanxi Province	0.2410	7972.201
Tianjin City	0.2410	-7693.841
Xinjiang Uygur Autonomous Region	0.2410	7172.484
Tibet Autonomous Region	0.2410	9965.781
Yunnan Province	0.2410	11588.132
Zhejiang Province	0.2410	3772.504

It can be seen from Table 5 that the coefficient of GDP is 0.2410, which shows that the per capita regional GDP has had a positive impact on the urban-rural disposable income gap in recent years. That is, economic growth has promoted the expansion of the income gap. Gansu Province and Yunnan Province have more than 10000 intercept terms, the most negligible intercept term is -7693.841 of Tianjin, and most of the other cities fluctuate between 6000 and 9000. According to the different intercept terms of provinces and cities, the impact of economic growth on the income gap is different for different regions. For example, in Gansu, Yunnan, and other places, the intercept term is more significant, indicating that the impact of economic growth on the income gap is not as good as that in Fujian, Shanghai, and other places with nominal intercept terms.

In addition to considering the positive impact of economic growth on the income gap, the negative impact of the income gap on economic growth should also be considered. Therefore, taking GDP as the explained variable and CJ as the explanatory variable, test again, determine the regression model, and calculate. The results are shown in Table 6.

Table 6 Model results of the impact of income gap on economic growth

	C.J.	c
Anhui Province	2.7880	-9672.109
Beijing City	2.7880	21578.84
Chongqing City	2.7880	4625.421
Fujian Province	2.7880	16937.02
Guangdong Province	2.7880	6901.345
Gansu Province	2.7880	-25916.67
Guangxi Zhuang Autonomous Region	2.7880	-16250
Guizhou Province	2.7880	-21284.42
Hainan Province	2.7880	-4753.851
Hebei Province	2.7880	-6451.302
Heilongjiang Province	2.7880	-3055.993
Henan Province	2.7880	-2974.019
Hubei province	2.7880	8087.827
Hunan Province	2.7880	-10919.7
Jilin Province	2.7880	5709.524
Jiangsu Province	2.7880	-8264.405
Jiangxi Province	2.7880	-842.5642
Liaoning Province	2.7880	31704.48
Inner Mongolia Autonomous Region	2.7880	5672.171
Ningxia Hui Autonomous Region	2.7880	-4765.04
Qinghai Province	2.7880	-10545.81
Shaanxi Province	2.7880	-3104.987
Sichuan Province	2.7880	-9034.185
Shandong Province	2.7880	6444.109
Shanghai City	2.7880	26424.78

Shanxi Province	2.7880	-12439.67
Tianjin City	2.7880	52419.68
Xinjiang Uygur Autonomous Region	2.7880	-8398.194
Tibet Autonomous Region	2.7880	-18695.55
Yunnan Province	2.7880	-24080.28
Zhejiang Province	2.7880	14943.55

The urban-rural disposable income gap is also positively correlated with per capita GDP, and the regression coefficient of CJ is 2.7880. From the analysis of intercept term, the value of reflection impact intercept term is more significant than that of positive impact intercept term, and the variation range is more prominent, among which Tianjin City has the most considerable value, reaching 52419.68; The smallest value is -25916.67 in Gansu Province, which is opposite to the positive change. It shows that with the increasing income gap, economic growth also increases. That is, the expansion of the income gap can promote economic growth.

4 CONCLUSION

From the results of the above two models, we can see that the interaction between China's economic growth and income gap shows a positive relationship from 2013 to 2019. It shows that the intensification of income gap will also promote economic growth. In turn, economic growth will also lead to the intensification of the income gap However, the impact of different regions on variables is also different. For example, in Yunnan, Gansu and other places, the impact of economic growth on income gap is not as good as that in other regions, and the impact of income gap on economic growth is also weaker than that in other regions. However, Shanghai and Tianjin have the opposite impact. It shows that the influence between regions should be considered when considering the relationship between the two. In conclusion, when considering the relationship between economic growth and the income gap, we should pay attention to their interaction and the different effects between different regions.

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