The test of the relationship between income inequality and economic growth—Based on the ARDL model

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Abstract: In the report of the 20th National Congress of the Communist Party of China, it was pointed out that promoting common prosperity in a solid way is the essential requirement of socialism. This paper uses the balance panel data of the post-tax Gini coefficient, per capita economic growth GDP and per capita economic growth rate of 18 countries from 1971 to 2018. By constructing the ARDL model to verify, it is concluded that the impact of income inequality on economic growth presents an "inverted U" relationship. The data set in this paper includes the sample of China, so the research conclusion of this paper is also applicable to China, and has important theoretical guidance significance for China to promote common prosperity scientifically and balance the relationship between income distribution and economic growth.

Keywords: Economic growth, ARDL model, Gini coefficient

1. Introduction

Since the reform and opening up, China's economic strength and social productivity have been greatly improved, but at the same time, the income gap between residents has also continued to increase. The Party and the government attach great importance to the distribution of residents' income. In the report of the 19th National Congress of the Communist Party of China, it is proposed to promote a more reasonable and orderly distribution of income in China, two "synchronization", namely, the growth of household income and the increase of labor remuneration should be synchronized with productivity; and points out the serious inadequate imbalance of rapid economic development, and the excessive income gap between urban and rural areas and between regions. And 2019 will be coronavirus swept the world, the crisis not only exposed the western countries market failure, government failure, regulation and other deep crisis, also exposed in the western economic and political system under the wealth pyramid and the bottom of the extreme income inequality, the inequality reveals the harmfulness of predatory behavior and the vulnerability of prosperity. This extreme inequality urgently needs our high attention and action. Therefore, we need to summarize and find the objective economic law between income inequality and economic growth, and put forward corresponding suggestions and countermeasures, so as to avoid entering the western countries astray.

This paper uses the balance panel data of after-tax Gini coefficient, GDP and per capita economic growth rate of 18 countries from 1971 to 2018. The effect of income inequality on economic growth was examined by constructing an ARDL-ECM model.

2. Literature Review

In terms of theoretical research, many scholars have discussed the influence of income inequality on economic growth from different channels. On the one hand, many studies have argued that income inequality has a negative impact on economic growth. For example, Acemoglu and Robinson (2012)[1], Krugman (2012) [2] from income inequality to greater redistribution and political rent-seeking costs, Aghion (1999) [3] from income inequality affect low income capital investment ability, Todaro (1997) [4] from income inequality, income inequality can lead to invalid loss of resources, reduce the level of social total investment and total demand, ultimately hinder economic growth. On the other hand, there are also many studies demonstrating that income inequality has a positive impact on economic growth. For example, Saint-Paul and Verdier (1993) [5] argued that societies with higher income inequality, The higher the government spending on public education will be, This will help promote human capital accumulation

and economic growth; Benabou (1996) [6] demonstrated that the higher the level of income inequality, The more complementary the human capital is, This will help boost economic growth; the Galor and Tsiddon (1997) [7] studies showed that, Income inequality strengthens labor mobility, And concentrate the highly skilled workforce in the technological progress sector, With a higher rate of technological progress, Promoted the economic growth rate.

Corresponding to the theoretical relationship of income inequality and economic growth, and also due to differences in model setting, variable selection and data sets, studies examining the relationship have not reached consistent conclusions. Many studies based on cross-sectional data have found a negative correlation between income inequality and economic growth (Alesina and Rodrik, 1994; Clarke, 1995; Castello-Climent, 2010) [8-10]; Many studies based on panel data have found a positive correlation between income inequality and economic growth (Li and Zou, 1998; Forbes, 2000) [11-12]; There are also many studies confirming that there is an "inverted U-shaped" relationship between equality and economic growth, Or the relationship depends on the level of economic development, There is even no significant relationship between the two.

3. Empirical Test of The Relationship Between Income Inequality and Economic Growth

This paper selects the annual panel data of per capita growth rate, after-tax Gini coefficient and per capita economic growth of 18 countries from 1971 to 2018 as the research sample. The specific settings are as follows: (1) The per capita growth rate (growth) is the gross national income divided by the total annual population.(2) After-tax Gini coefficient (gini post) 0 means complete average, and 100 means completely unaverage.(3) Per capita economic growth (gdp) is unchanged in 2010. Gini coefficient data are from The Standardized World Income Inequality Database (SWIID) and the rest data are from the World Bank. The per capita economic growth rate growth is the explanatory variable, the post-tax Gini coefficient is the core explanatory variable, and the per capita gdp is the control variable.

ARDL models to estimate the relationship between income inequality and economic growth. The ARDL model has the following advantages: First, the ARDL model is more robust in estimparameters for small samples. Second, the ARDL model does not require the same order of the variables. No matter whether the variables are the same I (1) or I (0), the long-term relationship between the variables can be tested by the edge limit co-integration test. Third, ARDL does not need to consider the endogeneity of explanatory variables, and obtains the dynamic error correction model (ECM) through simple linear transformation to estimate the short-term effect between variables.

The first step, the stability test. The model is applicable to the following three situations: the variables are the same zero order single I (0), the same first order single I (1), or zero order single I (0) and first order single I (1) mixed.

The second step is to establish the ARDL (p, q, q, q) model. The model is as follows:

$$y_{it} = \sum \lambda_{ij} y_{i,t-j} + \sum \delta_{ij} x_{i,t-j} + \sum \rho_{ij} x^2{}_{i,t-j} + \sum \omega_{ij} z_{i,t-j} + \mu_i + \varepsilon_{it} \qquad (1)$$

i=1,2…18;t=1,2…48δωIn this model, the coefficient, ρ and respectively reflect the influence of Gini coefficient, the square of Gini coefficient and per capita economic growth rate; θ reflects the lag of economic growth rate.

The third step is to establish an ARDL-ECM model to examine the long-term and short-term effects. The expression is as follows:

$$\Delta y_{it} = \theta y_{i,t-1} + x_{it}\beta'_{1i} + x^2{}_{it}\beta'_{2i} + z_i\beta'_{3i} + \sum^{p-1} \Delta y_{i,t-j}\lambda^*_{ij} + \sum^{q-1} \Delta x_{i,t-j}\delta^*_{ij} + \sum^{q-1} x^2{}_{i,t-j}\rho^*_{ij} + \sum^{q-1} \Delta z_{i,t-j}\omega^*_{ij} + \varepsilon_{it} + \mu_i \qquad (2)$$

Where the coefficient reflects the short-term effect of explanatory variables x and z on economic growth; ecmt-1 is the lagging error correction factor, and its coefficient indicates the correction speed of long-term equilibrium relationship on short-term variables.

Through the unit root test of each variable by ADF test, the results in Table 1 show that the per capita economic growth rate (y) is the zero order single sequence I (0), and the post-tax Gini coefficient (x) is the first order single sequence I (1). The results fit the ARDL model.

Table 1 Data stationarity test results

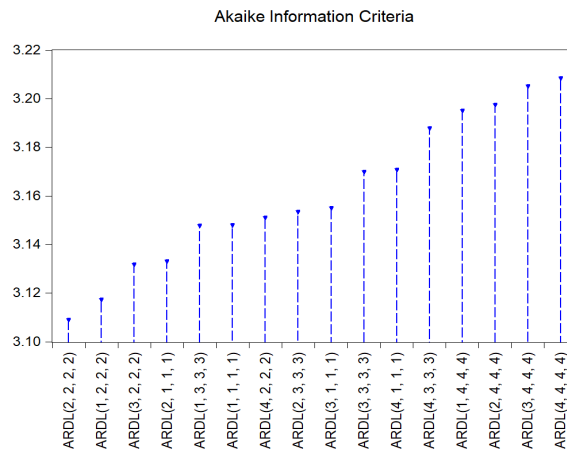| Variable name	Method of calibration	P price	Conclusion
y	IPS (level)	0.0000	steady
x	IPS (level)	0.7987	non-stationary
x2	IPS (level)	0.7658	non-stationary
z	IPS (level)	0.7975	non-stationary
x	IPS(Fist Difference)	0.0004	steady
x2	IPS(Fist Difference)	0.0002	steady
z	IPS Fist Difference)	0.0000	steady

Figure 1. The AIC guidelines

As shown in Figure 1, the AIC criterion is used to determine the optimal lag order of the model, and the optimal lag order is estimated to be order 2, where the maximum lag order is limited to 4, so the long-term dynamic relationship between variables ARDL (2,2,2,2) is obtained. Table 2 shows the specific estimation results. In the long term, the post-tax Gini coefficient is positively correlated with economic growth, and the square of the post-tax Gini coefficient is negatively correlated with economic growth, indicating that income inequality and economic growth are a non-linear relationship, which is an inverted U-shaped relationship.

Table 2 Long-term equilibrium coefficient estimates for ARDL (2,2,2,2)

Explanatory variable	Coefficient	Standard error	T statistics	P price
x	0.3331	0.1059	3.1447	0.0017
x^2	-0.0036	0.0014	-2.4841	0.0132
z	-0.0583	0.0074	-7.8239	0.0000

Construct the ARDL-ECM model to estimate the short-term dynamic relationship of income inequality and economic growth. As shown in Table 3, the corrected effect value of the model error was-0.9274, indicating that the model was set correctly.

Table 3 ARDL-ECM parameter estimation results

explanatory variable	Coefficient	Standard error	T statistics	P price
Ecm(-1)	-0.9274	0.0676	-13.7100	0.0000
dy	0.0524	0.0163	3.2008	0.0014
dx	38.1743	26.7735	1.4258	0.1544
Dx(-1)	11.0800	12.7012	0.8723	0.3833
Dx2	0.4478	0.3088	-1.4500	0.1475
Dx2(-1)	-0.1314	0.1536	-0.8554	0.3926
dz	11.5680	2.9360	3.9399	0.0001
Dz(-1)	-1.3831	1.3252	-1.0436	0.2970

4. Conclusion and Policy Recommendations

4.1. Conclusion

According to the above empirical analysis, it can be seen that the relationship between income inequality and economic growth is inverted U-shaped, that is, a low Gini coefficient will hinder economic growth, and a Gini coefficient above a certain threshold will hinder economic growth. But the above argument cannot analyze how income inequality affects economic growth. We can make the following conjectures. For example, Lei Xin believes that income inequality is an inverted U-shaped relationship on economic growth, which may be caused by the contrast between unequal opportunity and effort inequality. Inquality of opportunity has a negative impact on economic growth, and effort inequality has a positive impact on the economy. When opportunity inequality is weaker than effort inequality, it will stimulate economic development; otherwise, it hinders economic development.

4.2. Policy Recommendations

First, the problem of income distribution must be solved in economic development. Only when the economy develops and the social material level is enriched, can there be a basis for improving income distribution. At present, the redistribution of existing wealth is obviously not conducive to social stability, so must be on the distribution of new social wealth (income), for new social wealth (income) must through fiscal, tax means appropriately to the low-income class, such as increase investment in rural agricultural facilities, increase investment in medical facilities, etc.

Secondly, we must establish and perfect a reasonable social distribution system. The current social distribution system is still difficult to give full play to the incentive role of income distribution on individual enthusiasm in many aspects. To some extent, the accumulation of wealth of the rich is based on the basis of gray or even illegal, and the mentality of "hatred for the rich" is largely caused by this. Therefore, the social distribution system must ensure that individual efforts are rewarded accordingly, while eliminating unreasonable gray or even illegal ways of wealth accumulation.

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