An Empirical Study of Income Inequality and Economic Growth: Evidence from the US and China

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***Abstract*—The issue of economic growth has always been an issue of concern to the world, and with economic development, income inequality has become more and more serious. Among them, the United States and China, as the two largest economies, the issue of economic growth and income inequality is critical. Therefore, this study analyses the data of GDP growth rate and Gini coefficient of China and the United States from 2008 to 2020 and conducts Ordinary Least Squares (OLS) linear regression analysis on them. Through the discussion of the empirical results, this paper concludes that China's economic growth has an inverted U-shaped relationship with income inequality, i.e., income inequality promotes economic growth to a certain extent, and when the degree of income inequality is high, it acts as a disincentive to economic growth, and, secondly, the US. economic growth has a positive relationship with income inequality. Further, this paper argues that the empirical results of the US. are consistent with the laws of economic development of developed countries, and some essential characteristics of China's economic growth are also compatible with the empirical results of this paper. Finally, this paper attributes the reasons for the difference in the relationship between China and the United States to the degree of economic development and institutional and cultural factors and gives relevant suggestions. This study has two significant contributions: firstly, this paper empirically examines the relationship between economic growth and income inequality with the latest data and makes country-by-country comparisons; secondly, this paper analyses the reasonableness of the differences in the impact of income inequality on the economy in different countries and briefly analyses the possible reasons for the differences; all in all, this paper draws valuable conclusions in both empirical and theoretical terms.**

***Keywords*—economic growth, income inequality, China and the United States**

I. Introduction

The problem of economic growth has always been an issue of concern to the world, especially to scholars of economics, and it is something they have always wanted to explore. Lucas (1998) of the University of Chicago states that "once mankind begins to think about economic growth, it is difficult to think about anything else." However, economic development is essential to every country because it symbolizes whether a country is prosperous and an important indicator of socio-economic development. It is a vital driving force for social development. Economic growth reflects not only the result of productive forces but also the improvement of social and economic standards and the living standards of urban and rural residents, reflecting the degree of national well-being. Economic growth is an essential driving force for social development and plays a vital role. And it is critical for national and regional development. Economic development can improve people's living standards and socio-economic situation and enhance the country's national strength. Every country should pay attention to economic growth and take adequate measures to promote it so that its government can prosper and prosper.

And with economic development, income inequality has become more and more serious. China's Gini coefficient has been rising since 1993, reaching a peak of 0.49 in 2001 and then declining slightly but remaining at a high level of around 0.46. This means that the degree of income inequality in our society is more extensive, and we face a more severe problem of income inequality. After China's reform and opening up, with the cost advantage brought by cheap labor to participate more actively in the international division of work, in the process of integrating into the world production system, due to the surplus of labor factors, the productivity increase brought by the new technology makes most of the income goes to the owners of the capital, which dramatically exacerbates China's income inequality until China crosses the "Lewis tipping point" and the shortage of labor supply brought about a rise in the income of the working class that the trend of widening income inequality gradually slowed down. The widening income gap will have an economic impact and pose social problems, such as social unrest and social problems caused by people experiencing poverty. This could plunge the country into chaos, which would not be conducive to social cohesion. Economically, the issue of income disparity leads to a widening of the wealth and income gap between the various strata of a country, with the rich contributing to an increase in the rate of sale of high-end goods, which is a financial burden for the poor, who have problems even feeding themselves.

Although China's current economic situation has made significant achievements, the contradiction of its long-standing irrational structure is becoming more and more prominent. This is reflected in the imbalance between domestic and external demand, investment, and consumption; weak agricultural base, large but not strong industry, and overcapacity in some sectors; lagging development of urbanization and central and western regions; and high consumption of resources and increased pressure on the environment. Under the central government's control, China's once overheated property market has begun to cool down. The effect of the property market regulation has already started to be seen in the more significant role of forcing China's economic transformation. The overheated property market has exposed a substantial problem in China's economy. Both capitalism and a mixed economy characterize the US. financial system. Within this system, businesses and private institutions make the main microeconomic decisions, and the role of the government in domestic economic life is relatively minor; however, the sum of all levels of

government accounts for 36 percent of GDP; among developed countries, the United States has a relatively small social welfare network, and government control of business is lower than in other developed countries. According to statistics, the people of the United States have achieved a very high standard of living. The American economic system has been criticized many times. Still, it does stimulate people to exploit the resources of the land and encourages them to find newer and better ways of doing things.

This paper focuses on the impact of income inequality on economic development and explores the influencing factors of income distribution that lead to income inequality. This paper contrasts the United States and China to examine the impact of income inequality on economic development. According to the regression data, China's income disparity has an inverted U-shaped and significant impact on economic growth. The regression results for the United States show a positive linear relationship between income distribution and income inequality. Thus, the results of China can confirm the theory of the inverted U-shape of Kuznets. In contrast, the results of the United States ratify the hypothesis of positive relationships in developed countries.

II. Literature Review

Human history has been recorded for millennia, and for most of that time, there has been no significant economic growth, with sustained growth beginning in the 18th century, accelerating in the mid-19th century, and reaching an unprecedented peak in the 20th century. Economic growth is closely related to income distribution, of which, according to Smith, "the distribution of income has always been one of the greatest concerns of economists. Classical economists distributed land rent, profits, and wages among the factors of production, proposing the labor theory of value, also known as the functional distribution of income". Ricardo (1928) states that "the classical theory of income distribution focuses mainly on the distribution of income in the agricultural sector, discussing the distribution of income among the three factors of production - land, labor, and capital - and arguing that the principles of marginality and surplus should govern the distribution". Marshall, on the other hand, argued that "the demand and supply of factors of production are analyzed based on the theory of equilibrium prices, where the demand for a factor of production depends on the marginal efficiency of the factor. The supply of the factor of production depends on the marginal cost of the factor. The price of the factor of production is determined when the marginal cost is equal to the marginal efficiency". Marshall's theoretical ideas and methods provided the basis for the price of products in practice. At the same time, his analysis of human capital foreshadowed many of the latest developments in the labor economy.

In 1955, Kuznets, a United States economist, put forward the "inverted U hypothesis" of income distribution differences in a lecture at the American Economic Association, which implied that income inequality would increase with economic growth until the peak of income inequality was passed when income differences would begin to decrease gradually. For a long time, until the mid-1980s, questions about economic growth and income distribution centered almost exclusively on the "inverted U hypothesis." In addition, Romer (1986) first considered technological progress as an economic variable resulting from knowledge accumulation and proposed a growth model with diminishing returns distinct from the evolution model with increasing returns, emphasizing that human capital is the main factor in economic development. Subsequently, endogenous growth can be applied in studying financial growth problems. Later, Lucas (1998) analyzed the mechanism of endogenous growth. Not only that, but Yang and Cao (2016) introduced the division of labor evolution and transaction costs to the growth model to combine this, while Grossman and Minseong (1996.) endogenized R&D activities. In short, modern economists have also made outstanding contributions to the issue of income distribution in the economy.

There are many measures of income inequality, and commonly used indicators include the Gini coefficient, the coefficient of variation, and the Atkinson index.

1) Gini index

The Gini coefficient, which is the most used inequality indicator in the country, is equal to the area between the Lorenz curve and the 45-degree line divided by the area below the 45-degree line and is calculated using the following formula:

$$\text{Gini} = A/(A+B)$$

The Gini coefficient quantifies inequality as a value between 0 and 1 by comparing the gap between the actual income distribution and a perfectly equal distribution, which is an intuitive, simple, and easy-to-understand measure. Not only that, but the Gini index can also provide a wealth of information that can help humankind gain insight into the status and trends of income inequality.

2) Coefficient of variation

The coefficient of variation is the ratio of the standard deviation to the mean and is calculated as follows:

$$CV = \sigma/\mu$$

The advantage of the coefficient of variation is that there is no need to refer to the mean of the data. The coefficient of variation is a dimensionless quantity. When the norm is close to zero, weak perturbations can have a dramatic effect on the coefficient of variation, thus causing a reduction in accuracy.

3) Atkinson's index

Atkinson's coefficient is based on the theory of welfare economics and begins with the calculation of the equivalent income y, at which social welfare is consistent with actual interest. Define $IA = 1-y/u$ as the Atkinson coefficient, with larger values indicating greater inequality.

Various factors affect income distribution, among which geography, institutions, and education are the ones that have a more significant impact on income distribution.

Regarding geographic factors, it is divided into urban and rural areas. Using data from the Agricultural Research Centre for the period 1995–2002, Wang *et al*., (2005) used a combination of shapely values and regression analysis to analyze the inequality of total household income in rural China and found that geographic factors contribute significantly to income inequality. According to the data on the urbanization rate and urban-rural per capita income gap of 30 provinces and municipalities in China in 2002, there is a

clear negative relationship between urbanization and the urban-rural income gap. It means the higher the urbanization rate, the lower the urban-rural per capita income gap. At the same time, urbanization can be an essential factor in reducing the income gap between urban and rural areas. The short-term effect of urbanization can lead to an increase in the income gap, but the medium- and long-term effect is to reduce it.

In terms of the system, it is mainly reflected in the system's irregularities, such as inadequate systems, irregular procedures, and lack of public supervision, which exacerbate the inequality of distribution. Nie (2016) with survey data from the China Income Distribution Research Institute (CIDRI) in 2010, found that industry monopoly is second only to education level as a determinant of the employee wage gap. Not only that, but Liu *et al*., (2019) found that leverage exacerbates income inequality. Rational marketization allocates resources through fair competition and the survival of the fittest. The reform of property rights will be put on a standardized and transparent track, and the institutionalized management will be as fair and just as possible under the supervision of the public.

In terms of education, the level of education has a significant impact on per capita income. According to a 2004 survey by the National Economic Research Institute on a national sample of 3,200 urban migrant workers (including a few self-employed), the average monthly incomes categorized by level of education were as follows: 769 yuan for those who had not graduated from primary school, 815 yuan for those who had graduated from primary school, 960 yuan for those who had graduated from junior middle school, 1,268 yuan for those who had graduated from senior middle school, and 1,554 yuan for those who had graduated from a tertiary institution. This illustrates the importance of education to income distribution. Before 1978, the distribution of educational opportunities evolved from a state of extreme inequality towards equalization. After 1978, on the other hand, the disparity in the distribution of educational opportunities gradually increased.

Income inequality and economic growth have been popular areas of research. So far, studies on the interrelationship between inequality and growth have not reached a consistent conclusion. This triggered many scholars to empirically study the relationship between income inequality and economic growth in economies. Empirical studies on different countries often yielded different results.

Perotti (1993) also examines the relationship between income inequality and economic development from a human capital perspective. The difference is that Perotti considers the externality of human capital investment, where an increase in the level of human capital input of some workers raises the output level of other workers.

Perotti's analysis shows that the model's predictions of the relationship between inequality and economic growth are consistent with Kuznets' inverted U-shaped hypothesis in the cross-section but not necessarily in the time-series dimension. Not only that, Perotti (1993), using a sample of 67 countries and territories with middle-class income shares reflecting the degree of income equality, found that moderate-class income shares are positively associated with economic growth, especially in developed countries, with a greater degree of positive effect and significance. Clarke (1992) used cross-sectional data for 81 countries and territories, and Li and Zou (1998) used panel data for 46 countries and regions from 1960–1990 to reach the same conclusion.

Chen *et al*., (2010) and Wan found the interaction of income gap, investment, education and economic growth. It is found that the income gap always shows a negative impact on economic growth in terms of the cumulative effect. In contrast, economic growth is conducive to reducing the income gap, and this finding supports the Kuznets inverted U-shaped relationship. Wan *et al*., (2018) used several different databases to calculate various inequality measures, decomposed by population area and sub income and found that mainly by the rise in the proportion of middle-income groups and the decline in occupational income inequality, China's wealth gap has experienced an inverted U-shape turn in recent years, which is also precisely supportive of the Kuznets inverted U-shape relationship.

Meanwhile, Xu and Zhang (2012) explored the possible existence of multiple inflection points of the Kuznets inverted U-shaped curve in China during the economic transition period. Using the non-parametric local polynomial estimation method, they measured the existence of three inflection points in the inequality curve of economic growth and income distribution, showing a "roller coaster" pattern from a concave rapid rise to a convex decelerating rise, then to a hollow rapid rise and finally to a convex decelerating rise. On the other hand, Li and Zhu (2018) believe that 2008 was the inflection point of income inequality, but the Gini coefficient has risen again in recent years. It is thought that further deepening of economic and political system reform is needed to reduce income disparity. According to Yang and Cao (2016), using the Gini coefficient decomposition and difference decomposition method, they found that the decline in total income inequality in China from 2002 to 2011 was due to the reduction in wage income inequality, and the contrary, transfer income would increase absolute income inequality.

III. Model Setting

A. Modelling

Based on the author's compilation of the literature, this paper argues that there is a theoretical relationship between the economic growth rate, the labor income gap, and the capital income gap. To test the relationship between the economic growth rate and the labor income gap, the model in this paper is set as an Ordinary Least Squares (OLS) linear regression. Its main idea is to minimize the sum of squares of the residuals of the faithful and predicted values by determining the unknown parameter (usually a parameter matrix). The model setting of this paper is a deformation of Ordinary Least Squares (OLS) linear regression as follows:

$$Growtht = \alpha 1 Gini\_waget + \alpha 2\ Gini\_waget2 + \varepsilon t$$

The explanatory variable is Growtht: Growtht represents the economic growth rate in period t. The primary explanatory variable is the Gini coefficient: Gini_waget represents the labor income gap index of region I in period t; Gini_waget2 represents the squared term of the labor income

gap index. In this paper, the relationship between the labor income gap and economic growth is initially set as an inverted U-shape relationship, so the squared term is introduced to verify it. α1 and α2 represent the regression coefficients, and εt defines the random disturbance term.

B. Variables

Explained variable: the explained variable in this paper is GDP growth rate (Growth). The GDP growth rate is a dynamic indicator reflecting the degree of change in the level of economic development in a certain period, and it is an essential indicator reflecting whether the economy of a country or region is dynamic. Its level means the speed of economic growth and the time it takes for people's living standards to improve. The GDP growth rate is calculated by dividing the constant price GDP of the current period by the continual price GDP of the same base period of the previous year and then by 100 percent. Explanatory variables: In this paper, the Gini coefficient represents the degree of income inequality. The Gini coefficient is the most used inequality indicator in the country, and it is equal to the area between the Lorenz curve and the 45-degree line divided by the area below the 45-degree line, calculated by the formula: Gini = A/(A+B). The Gini coefficient quantifies inequality as a value between 0 and 1 by comparing the gap between the actual income distribution and a perfectly equal distribution, making it an intuitive, easy-to-understand measure. Also, the Gini index can provide a wealth of information to help humankind gain insight into the current status and income inequality trends. The Gini Coefficient is an internationally recognized indicator for measuring the income disparity of residents in a country or region. The maximum Gini coefficient is "1" and the minimum equals "0". The closer the Gini coefficient is to zero, the more equal the income distribution tends to be.

C. Data Sources

In this paper, we select data from the World Bank about the United States and China. It contains the annual GDP and Gini coefficient data of the United States and China from 2008 to 2020. World Bank is an international database that covers social, economic, and environmental-specific data of many countries worldwide. The data used for the empirical evidence in this paper are all from the latest World Bank database.

IV. Empirical Findings

A. Descriptive Statistics of the Data

In this paper, using World Bank data for the period 2008–2020, we obtained the GDP growth rate and the Gini coefficient of the United States and China for each year, with descriptive statistics by year (see Table 1).

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$Growth_{US}$	13	0.075	0.021	0.022	0.106
$Growth_{CHN}$	13	0.013	0.019	−0.028	0.029
$GINI_{US}$	13	0.403	0.023	0.371	0.437
$GINI_{CHN}$	13	0.409	0.005	0.397	0.415

And from Fig. 1, China's Gini coefficient shows a downward trend. From 2007, China's Gini coefficient rose, with the highest value in 2010 of 0.424. China's income inequality gap is more significant. From 2010, the Gini coefficient continued to decline until 2020 to 0.371, indicating that China's income gap is gradually reduced, and the distribution of wealth is relatively reasonable.

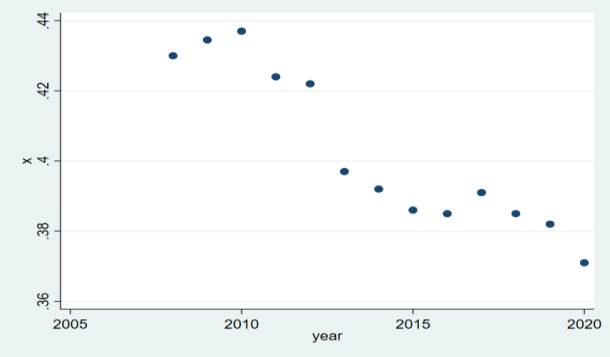

Fig. 1. Scatterplot of changes in China's Gini coefficient.

In contrast, we can see from Fig. 2 that the income gap in the United States is unstable, with a minimum of 0.371 in 2010, a significant difference from 2019. The maximum is in 2019 and 2014, both at 0.415. It indicates a large income gap and uneven distribution of wealth in that period. However, the overall trend is upward.

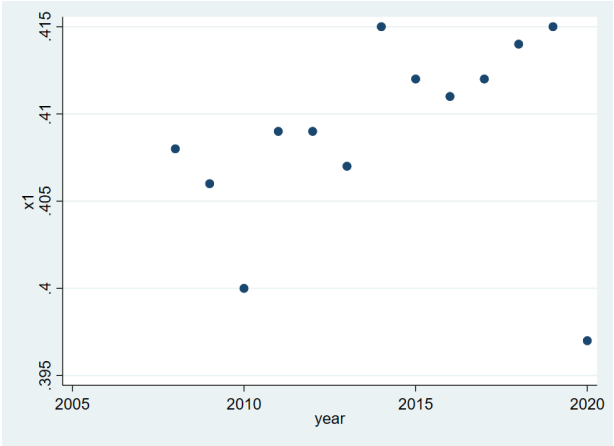

Fig. 2. Scatterplot of changes in Gini coefficients for the US.

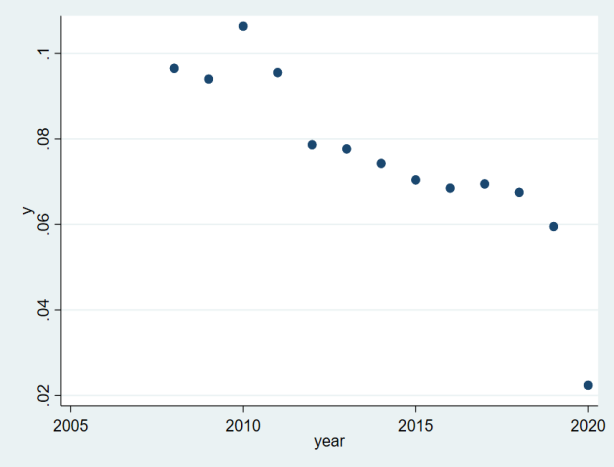

Fig. 3. Scatterplot of changes in China's economic growth rate.

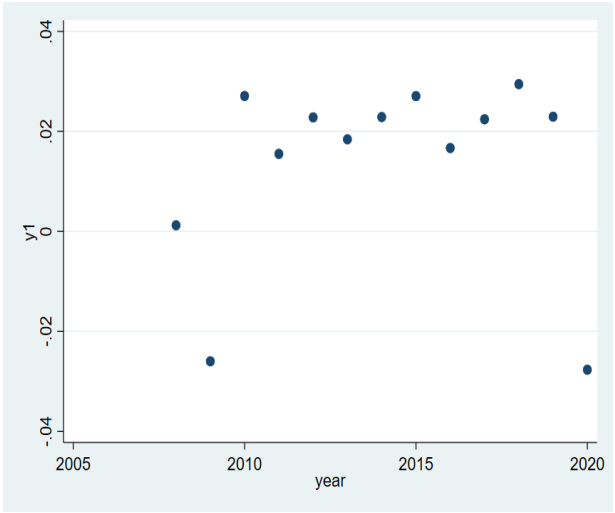

Fig. 4. Scatterplot of changes in the growth rate of the US economy.

According to Figs. 3 and 4, China's economic growth rate is gradually decreasing, which may be attributed to the narrowing of the income gap. In 2010, China's economic growth rate of 9.5 percent was the highest in 2007–2020. As it happens, China's income gap was at its highest in 2010. One might speculate that the wider the income gap, the more it drives economic growth. In contrast, the US economic growth rate was relatively stable after 2009. It fluctuated more before that. According to Table 1, the economic growth rate of the United States was −2.5% in 2009, reaching a negative growth rate, but the overall income growth rate of the United States was stable. Based on the statistical charts, the relationship between the two in the United States cannot be seen, pending further regression analysis.

B. Regression Results

To verify the relationship between income disparity and economic growth rate, this paper uses the Ordinary Least Squares (OLS) linear regression model to empirically regress the economic growth rate and Gini coefficient data of the United States and China from 2008 to 2020. The empirical results are shown in Tables 2 to 4. This paper uses the regression coefficients of x and y, R-squared, F-test, p-value, and t-value to verify the significance of the independent variables on the dependent variables and, thus, the relationship between the explained variables and the explanatory variables. Among the three models, the effect of income disparity on the economic growth rate of the Chinese model is entirely consistent with the theory of inverted U. The other two models are not significant enough. Still, one of the linear regressions is more effective.

Table 2. Regression results: China's GDP growth rate and Gini coefficient (inverted U-shaped setting)

y	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
x	17.118	6.158	2.78	0.019	3.397	30.838	**
x2	−20.059	7.571	−2.65	0.024	−36.93	−3.189	**
Constant	−3.555	1.249	−2.85	0.017	−6.337	−0.773	**

*** p < 0.01, ** p < 0.05, * p < 0.1

In the Chinese inverted U-shaped model (see Table 2), the coefficients of the independent variables are positive, the squared coefficients are harmful, and the parabola is facing downwards, precisely in line with the inverted U-shaped structure. The p-value is much less than 0.5, and the t-value is large, which indicates vital significance. Also, the R-squared is 0.863, close to 1, and the fitting effect is excellent, and the more realistic the fitted function is, the more natural it is. According to the table, the F-test is relatively large, reflecting a good fit and the stronger the significance. Overall, the impact of income disparity on economic growth in China is inverted U-shaped, rising first and then falling, and it is significant.

Table 3. Regression results: US GDP growth rate and Gini coefficients (inverted U-shaped setting)

y1	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
x1	−1.16	125.873	−0.01	0.993	−281.623	279.303	
x12	4.036	154.838	0.03	0.98	−340.964	349.037	
Constant	−0.187	25.578	−0.01	0.994	−57.178	56.804	

*** p < 0.01, ** p < 0.05, * p < 0.1

According to Table 3, the coefficient of the square of the independent variable is positive for the United States, indicating that the model is not related to the inverted U-shape. The p-value of the US is 0.98, which is very close to 1, and the t-value is close to 0, indicating that the inverted U-shaped model is not significant in the US. The R-squared and F-tests are 0.365 and 2.875, respectively, reflecting a poor fit and weak significance.

Table 4. Regression results: US GDP growth rate and Gini coefficient (linear regression)

y1	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
x1	2.122	0.844	2.51	0.029	0.265	3.979	**
Constant	−0.854	0.345	−2.48	0.031	−1.613	−0.095	**

*** p < 0.01, ** p < 0.05, * p < 0.1

According to Table 4, in US linear regression, the coefficient of the independent variable is positive, and the dependent variable increases with the increase of the

independent variable. The p-value is small, and the t-value is significant, indicating that the United States's linear regression is significant and homoscedastic. R-squared is 0.365, which is a fair fit. Overall, the relationship between economic growth rate and income disparity in the United States is a positive linear relationship with a significant regression result.

C. Further Analyses

Based on the analysis and implications of the regression results above, this paper concludes that the trend in economic growth rates in the US is consistent with a positive relationship. Castello (2010), using panel data for 56 countries and territories for the period 1960–2000, finds that, for the entire sample, the impact of income disparity on economic growth is negative, with a positive impact in high-income countries and, conversely, a low-income country's influence is negative. This finding is confirmed by the fact that the effects of income disparity on economic growth are positive in the United States, as shown by the regressions in this paper. According to Deininger and Squire, using a panel of 66 countries and regions, income disparity hinders economic growth in poor countries and promotes economic development in rich countries.

For China this paper concludes that China's income gap has an inverted U-shape to its economic growth rate, which has some theoretical basis. Studies by Chinese scholars have shown that widening the income gap in the early stage of reform and opening up will promote economic growth. In contrast, with economic development, widening the income gap will hinder economic growth when the income level reaches a certain level. In-depth analysis reveals that the above results are not contradictory. In the early stage of China's reform and opening up, the widening of income disparity stimulated the low-income class to increase their labor supply, start their businesses, or go into business to raise their income, and the widening of income disparity promoted economic growth in the early stage of the reform and opening up. As China's economy develops further and enters the middle-income stage, the relationship between income disparity and economic growth converges with other countries, which manifests itself in the fact that the widening of income disparity will hamper the economy. The inverted U-shaped conclusion of this paper also confirms this conclusion.

However, after a particular stage of development, the hindering effect of income disparity on economic growth began to receive attention from foreign scholars in the early 1990s. The background is that after entering the middle-income stage after the 1980s, certain Southeast Asian countries and South American countries experienced stagnation in economic growth due to the diminishing marginal output of factors of production and were unable to become high-income countries, so when the income gap grows, economic growth will be hindered. The comprehensive income gap will also lead to macroeconomic adverse cycles between industries, urban and rural areas, and regions.

V. Conclusion

In the empirical analysis in the previous chapter, this paper uses data on GDP growth rates and Gini coefficients of China and the United States from 2008 to 2020. It conducts Ordinary Least Squares (OLS) linear regression analyses on them. Through the discussion of the empirical results, this paper concludes that China's economic growth and income inequality have an inverted U-shaped relationship, i.e., income inequality promotes economic growth to a certain extent, and when the degree of income inequality is high, it acts as a disincentive to economic growth, and, secondly, the United States has a positive relationship between economic growth and income inequality. The results show that the effect of income disparity on economic growth in the United States is in line with the economic theory that hinders economic development in poor countries and promotes economic growth in rich countries. So, from the difference between the results of China and the United States, China shows an inverted U-shape. In contrast, the United States offers a linear and positive image. It can be concluded that the complexity of income inequality and economic growth has different relationships and results according to different situations.

This paper argues that this difference between China and the United States may be due to the following factors: firstly, the degree of economic development. The United States is a developed country, while China is a developing country. The relationship between economic growth and income inequality differs depending on the degree of economic development. Secondly, it is the factor of the system. As a socialist country, the role of market and government in China is different from that of the United States, which naturally affects economic growth and income inequality, so the relationship between economic growth and income inequality in China is different from that in the United States as a capitalist country. Lastly, there is the factor of culture. In ancient and contemporary times, Chinese culture prefers fairness more. In contrast, the United States has a developed capitalist economic system and culture and can practice a promotional relationship.

Based on the results of China and the United States derived from this paper, it can be concluded that the relationship between economic growth and income inequality is different in different countries. In the case of China, when the economy develops to a particular stage, the elevation of the income gap will affect the economy's further growth, so the government and society have to pay attention to the problem of income inequality. Based on the issues faced, practical strategies should be formulated to achieve stable economic development.

Future research could further explore mechanism of how the relationship between economic growth and income inequality varies among countries, focusing on how government policies and market mechanisms influence this relationship at different stages of economic development and cultural context, and more different factors on the impact of income inequality on economic growth.

Conflict of Interest

The author declares no conflict of interest.

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