

The Effect of the Educational Inequality of Opportunity on Economic Growth

- Take Shandong Province, 2013-2021, as an Example

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Abstract: The long-term impact of educational opportunity inequality on economic growth has long been a focus. This paper investigates the correlation between educational opportunity inequality and economic growth in Shandong from 2013 to 2021. The ratio of middle schools to students is designated as the independent variable for each city, and the GDP per capita is designated as the dependent variable. Both the Gini index method and the correlation analysis are applied. The study's findings show that the trend in educational opportunity inequality has been increasing, decreasing, and then increasing overall, while the trend in the disparity between economic development has been decreasing, increasing, and then decreasing. The correlation between the two Gini indexes is negative. The educational and political factors contributing to the negative correlation are further analyzed.

Keywords: Educational Inequality, Economic Growth, Gini Index, Correlation, Education Marketization.

1. Introduction

Promoting economic growth, especially in rural and developing areas, has long been a hot topic in China. After opening up and reforming its economy in 1978, China has made great progress at a fast pace in economic development. China has become the world's second-largest economy, with an average GDP growth rate of over 9 percent yearly [1]. However, after the 2008 American loan crisis and the epidemic in 2022, respectively, the Chinese economy kept declining, although the government made every effort to save the situation.

Recently, it has been discussed that China is suffering from deflation, while there is no exact analysis or papers that point out the deflation happening in China. On the other hand, the proven fact is that Chinese economic data is flattered. Through the value-added and expenditure approaches, Lai and Zhu conclude that inflation is underestimated during downturn years. It is shown that China's growth slowdown in recent years before the COVID-19 pandemic may have been more severe than official figures suggest. Generally speaking, the true situation of the Chinese economy is probably in a worse status than it is thought.

There are several factors contributing to today's status, including educational inequality. It is universally considered that educational inequality is an obstacle to developing an economy because

cultivating a generation that will be responsible for economic development in the next one to two decades matters whether the blueprint of the nation will be better. Regarding educational inequality, the inequality of opportunities leads to the origin gap among students.

Inequality of opportunity is an important philosophical concept. Rawls [2], Dworkin [3], and many philosophers have defined and discussed the inequality of opportunity. The World Bank defines the inequality of opportunity as “*when a person’s potential to succeed in life is simply determined by the lottery of birth*”[4]. In other words, the inequality of opportunity has non-separability in one’s life and their parents’ efforts. Educational inequality of opportunity is the same – one has the best educational resources for his parents’ efforts, while the other does not.

Regarding previous theories, education opportunity is one of the most important ways to accumulate human capital. Human capital refers to the fact that human beings invest in themselves, using education, training, or other activities, which raises their future income by increasing their lifetime earnings. Fritz Machlu claimed, “*Education can, by elevating the learners' intellect, improve their quality of life... it may also improve the individuals' skills and efficiency in producing useful things* [5].” Jacob Mincer believes that human capital generates worldwide economic growth, and the growth of human capital is both a condition and a consequence of economic growth [6]. Therefore, education lays the foundation for economic growth.

Since the last century, the Chinese government has realized the importance of compulsory education and made a huge budget for education. From 1992 to 2017, according to the China National Bureau of Statistics [7], government expenditure on education and its percentage of GDP has been increasing. Although still relatively low compared to developed countries, the increasing expenditure indicates that the theme of China's education development has entered a new stage of improving quality.

However, China has encountered educational inequality with the fast-paced development. Specifically, every local government has a different amount of budget, so schools in different regions will receive different amounts of expenditure. Thus, the educational inequality exists. For example, in 2021, the government expenditure on education was 2130.200 RMB mn [8], while in Zibo, the number was 1052.600[9]. However, in terms of the number of students, there were 1.86 million students in Jinan [8], while there were roughly 1 million students in Zibo [9]. That is, every student studying in Jinan received nearly a hundred yuan more than students studying in Zibo. The lower the government expenditure is, the lower the quality of education will be. Thus, inter-city educational inequality needs to be aware of.

Similarly, the Chinese government realized the negative effect of educational inequality and made a corresponding policy. In December 2015, the 18th meeting of the Standing Committee of the 12th National People's Congress passed the Second Amendment to the Decision on Amending the Education Law of the People's Republic of China. Education equity was included in Chinese law for the first time. It stipulated that the state took measures to promote educational equity, promoted balanced education development, and gradually narrowed regional, urban-rural, and inter-school disparities. However, it is not very helpful since the realistic conditions gap among different regions.

The purpose of this study is to find the correlation between educational inequality of opportunity and economic growth in Shandong Province from 2013 to 2021 by comparing the regional education opportunity Gini index and the GDP Gini index. In addition, the literature makes some suggestions by analyzing the status of Shandong quantitatively.

2. Literature review

Albert Hirschman raised the unbalanced growth theory that development is a chain of disequilibria. Similarly, according to Economic growth can be measured in many aspects, including the analysis of

GDP per capita. Specifically, the difference in GDP per capita among regions can reflect the differences in economic growth.

Educational inequality can be considered from two angles, including educational inequality of opportunity and effort. The educational inequality of opportunity refers to differences in educational levels obtained by individuals due to their family background in different environments. In contrast, the educational inequality of effort refers to differences in educational levels achieved by individuals in the same environment through increased investment and effort in education.

Most published works on educational inequality do not separate the educational inequality of opportunity. That effort well, led to the debate over whether there is a correlation between educational inequality and economic development. For instance, Beck and Chiswick found a positive correlation between educational inequality and income inequality [10]; Gregorio and Lee concluded that there is a slight relation between educational inequality and the difference in average individual income [11]; Fauziana et al. claimed that primary school education has no significant effect on the Gini ratio [12]. Generally speaking, both the degree and the existence of inequality are controversial and even opposite.

Furthermore, in the Chinese administrative division system, there are two levels of cities, that is, provincial capital city and prefecture-level city. A provincial capital city, as the name implies, is beneficial because of its political status. In terms of education, there are usually numerous high-level education resources. Contrary to provincial capital cities, prefecture-level cities develop and grow independently without additional focus or concentrated resources. For example, in Jinan, the capital city of Shandong Province, there were 44 institutions of higher education [13], while in Liaocheng, a prefecture-level city of Shandong province, there were only 3 institutions of higher education [14]. A prefecture-level city is the general composition of a province.

Past studies mainly focused on urban-rural inequality in education resource distribution, while the inequality between the provincial capital city and the prefecture-level city was rarely mentioned. For instance, Henan Cheng concluded there were large gaps in educational achievements between the two areas [15]. However, the gap in education achievements between the two types of cities has not been discussed deeply by researchers.

The Gini index approach helps measure and illustrate the inequality. Currently, the Gini coefficient is mostly used to measure a country's economy. Additionally, the combination of detrending and the Gini index is rarely applied in studying the correlation.

To sum up, different researchers have different views on the effect of educational inequality of inequality on urban economic development. Second, political impact on the development of education and economic development are rarely combined and studied. Third, a new method of studying inequality must be applied to analyze the Shandong education system and economy.

3. Data and methods

3.1. Hypothesis

The positive correlation between the educational inequality of opportunity and economic growth is hypothesized in the literature. Because education helps students gain and accumulate human capital, which helps them gain higher and better economic status in society.

3.2. Data

There are two parts of the data selection, education, and GDP, separately.

As to the educational inequality of opportunities, one of the determinants is access to limited school resources. Specifically, the fewer students are in school, the more teachers' attention will be paid to each of them. In this way, students will receive attention from each teacher and a more

concentrated class atmosphere, which can be considered access to high-quality education. Thus, how many schools, that is, how many educational resources a student can receive on average, is a way to show whether the opportunity for better education is too limited.

The sample calculated data is shown as follows:

Table 1: Average Students Per School Calculated 2013.

City	Number of Middle Schools	Number of Students at School	NMS/NSS
Tai'an	138	189183	0.00073
Zaozhuang	98	125073	0.00078
Dongying	72	90701	0.00079
Jinan	213	253681	0.00084
Zibo	158	181451	0.00087
Linyi	293	326701	0.00090
Liaocheng	167	183436	0.00091
Jining	250	272858	0.00092
Heze	313	341427	0.00092
Dezhou	177	188498	0.00094
Rizhao	90	94232	0.00096
Qingdao	234	239594	0.00098
Yantai	212	215101	0.00099
Weifang	274	268126	0.00102
Weihai	86	82609	0.00104
Binzhou	142	127129	0.00112

In Table 1, it can be easily observed that as to the gap in economic growth, that is, economic inequality, values of GDP per capita of each city from 2013 to 2021 are collected and used in this paper. Although the Gini index of GDP itself is easier to manipulate, GDP per capita better explains the economic status of each citizen in each city instead of the whole picture regardless of the economic amount of the city, the size of the population, etc.

3.3. Methodology

Two approaches are used in the paper. One is the Gini index approach, and the other is the correlation approach. For one thing, the Gini index approach is the most well-known way to measure inequality. For another, the correlation approach checks the correlation and whether it is positive or negative.

3.3.1. Gini Index Approach

To measure the educational inequality of opportunities, the Gini index approach is used in this paper. An approach to calculating the index is to define the Gini coefficient as half of the relative mean absolute difference, the same as the coefficient shown in the Lorenz curve. If x_i is the wealth or income of individual i , and there are n individuals, then the Gini coefficient G is given by whose formula can be expressed generally as follows:

$$G = \frac{\sum_{i=1}^n \sum_{j=1}^n |x_i - x_j|}{2 \sum_{i=1}^n \sum_{j=1}^n x_j} \quad (1)$$

However, only when the value of the Gini coefficient is required does the formula work. Thus, the geometric way is needed. Specifically, the data is calculated based on the corresponding Lorenz curve

and its properties. In other words, the geometric definition of the Gini index, the area between the Lorenz curve and the diagonal line of complete equality, is needed. The process is generally shown as follows:

First, sort the raw data from smallest to largest. Second, label each piece of data from 0 to the last number. The point is the first piece of data is labelled as 1, and the 0 does not mean anything related to the city. Third, calculate the sum of the data by parts, respectively. Fourth, divide the last value in step 3 by the largest value of the label in step 2, whose value represents the coefficient of the Laurens Curve. Fifth, manipulate the divided value with each label made in step 2, respectively. In those three former steps, remember to put the sum column after the share column to make graphing easier. Sixth, to get the area under the Lorenz curve, each area between the two labels is segmented and considered a trapezoid. Then, calculate the area of each trapezoid. Seventh, the Gini index can be calculated by inserting an Excel function based on (1).

Both the Gini index of educational inequality of opportunity and the Gini index of economic development need measuring, and there are two slightly different methods to measure them. Thus, there are two examples of respectively two aspects shown here. One example is the calculation of the data for 2018, as shown in Table 2.

First, based on the derived data before, the average ratio between students at school and the number of middle schools is sorted from smallest to largest. Second, each city is labeled from 1 to 16, and an additional 0 is added at the top of the column to draw the Lorenz curve. Third, raw data is added respectively. For instance, the first term is assigned a value of 0 itself, the second term equals 0 and 0.00071165, corresponding to the data of Linyi, and the third term is the sum of the data of Lin and the data of Tai'an. Fourth, the largest term, the sum of all terms, 0.00916170, is divided by the largest label, 16. This value, 0.000893160 will be the basic unit of the share on the Lorenz curve of each city. Fifth, the basic unit is manipulated with each label. Sixth, the difference between each of the two labels, that is, 1, is considered the height of each trapezoid. the larger value of the raw data is considered base 2, and the other one is base 1. Using the formula of the area of the trapezoid, calculate each area. Finally, based on (1), the value of the Gini index comes out.

Table 2: Education in Each City in Shandong Province 2018.

City	NMS/NSS	Label	Share	Sum of NMS/NSS	Area	Gini Coefficient
		0	0	0	0	0.122907475
Linyi	0.00071165	1	0.000893160	0.00071165	0.000355825	
Tai'an	0.00075471	2	0.001786321	0.00146636	0.001089005	
Zaozhuang	0.00075494	3	0.002679481	0.00222130	0.001843829	
Rizhao	0.00079652	4	0.003572641	0.00301781	0.002619557	
Dezhou	0.00083415	5	0.004465801	0.00385197	0.003434892	
Dongying	0.00086267	6	0.005358962	0.00471464	0.004283304	
Jining	0.00086481	7	0.006252122	0.00557945	0.005147042	
Heze	0.00087471	8	0.007145282	0.00645415	0.0060168	
Zibo	0.00088759	9	0.008038442	0.00734174	0.006897949	
Liaocheng	0.00089946	10	0.008931603	0.00824121	0.007791476	
Qingdao	0.00092049	11	0.009824763	0.00916170	0.008701452	
Weifang	0.00096127	12	0.010717923	0.01012297	0.009642333	

Table 2: (continued).

Jinan	0.00101081	13	0.011611083	0.01113378	0.010628374	
Weihai	0.00102769	14	0.012504244	0.01216147	0.011647622	
Yantai	0.00105331	15	0.013397404	0.01321478	0.012688121	
Binzhou	0.00107579	16	0.014290564	0.01429056	0.01375267	

The corresponding Lorenz Curve is shown as follows:

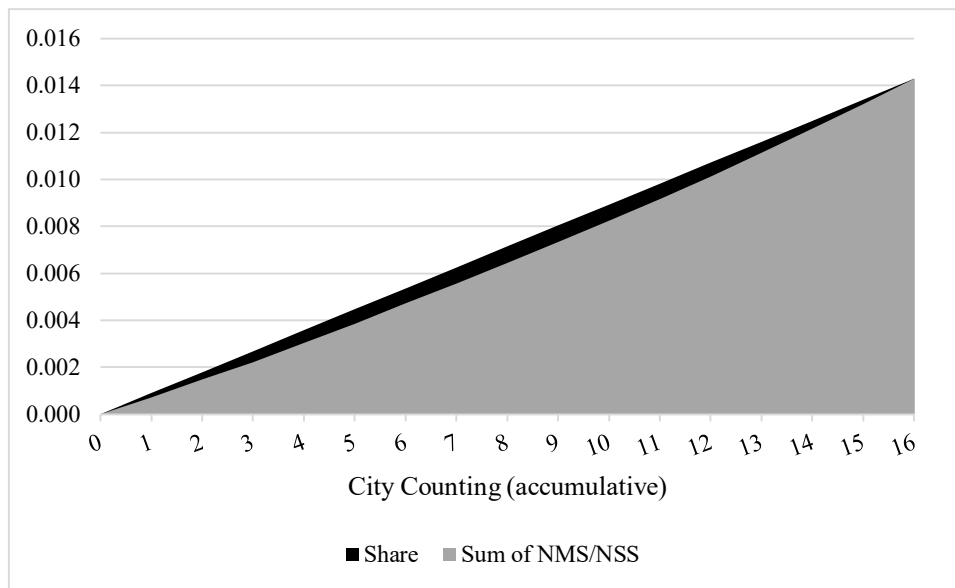


Figure 1: The Lorenz Curve of Educational Inequality of Opportunity in Shandong, 2018.

In Figure 1, the dark part above the large grey section represents the inequality geometrically.

Second, Gini indexes of GDP per capita need calculating as well. Similar to the former calculation of the education Gini index, the Gini index of GDP per capita describes the differences in the economic growth and development among cities in Shandong.

In addition, since Jinan and Laiwu merged in 2019 and were collectively referred to as Jinan, the GDP data of Laiwu and Jinan cities are weighted based on their population ratios, where Jinan accounts for 0.8401 and Laiwu accounts for 0.1599.

The entire process is similar. First, rank the GDP per capita data from smallest to largest. Second, label each city with 1 to the last one, and add 0 to the first cell in the column. Third, calculate the sum of the data by parts, respectively. Fourth, divide the last value in step 3 by the largest value of the label in step 2, whose value represents the coefficient of the Laurens Curve. Fifth, manipulate the divided value with each label made in step 2, respectively. In those three former steps, remember to put the sum column after the share column to make graphing easier. Sixth, to get the area under the Lorenz curve, each area between the two labels is segmented and considered a trapezoid. Then, calculate the area of each trapezoid. Seventh, the Gini index can be calculated by inserting an Excel function based on (2). As in Table 3, each step and corresponding data is presented.

Table 3: GDP per capita in Each City in Shandong Province 2021.

City	GDP Per Capita	Label	Share on the L Curve	Sum of Raw Data	Area of Each Trapezoid	Gini Index
		0	0	0	0	0.324143
Liaocheng	44485	1	83737	44485	22242.5	
Heze	45366	2	167474	89851	56046.75	
Linyi	49585	3	251211	139436	97741.375	
Zaozhuang	50613	4	334948	190049	143895.1875	
Tai'an	54917	5	418685	244966	194430.5938	
Jining	60728	6	502422	305694	250062.2969	
Dezhou	62223	7	586159	367917	308989.6484	
Binzhou	73078	8	669896	440995	374992.3242	
Rizhao	74434	9	753633	515429	445210.6621	
Weifang	74606	10	837370	590035	517622.8311	
Zibo	89238	11	921107	679273	598447.9155	
Weihai	118925	12	1004844	798198	698322.9578	
Yantai	122818	13	1088581	921016	809669.4789	
Jinan	123075	14	1172318	1044091	926880.2394	
Qingdao	138849	15	1256055	1182940	1054910.12	
Dongying	156852	16	1339792	1339792	1197351.06	

3.3.2. Correlation Analysis

The next step is to analyze the correlation between the educational inequality of opportunity and economic development. The general formula to derive the correlation between two targets is as follows:

$$r = \frac{n \times (\sum(X,Y) - (\sum(X) \times \sum(Y)))}{\sqrt{(n \times \sum(X^2) - \sum(X)^2) \times (n \times \sum(Y^2) - \sum(Y)^2)}} \quad (2)$$

where r refers to the correlation coefficient, X refers to a variable, Y refers to the other variable, and n refers to the number of observations. The correlation coefficient r is measured on a scale varying from + 1 to - 1. The complete correlation between two variables is expressed by either + 1, which suggests two variables are totally related, or -1, which indicates there are no factors that link them together and they vary independently. When one variable increases as the other increases, the correlation coefficient r is positive; when one decreases as the other increases, the r is negative.

In the work, the function inserted in Excel is used instead of using formula (2) to calculate the coefficient of the correlation. The CORREL function inserted initially in Excel is used in the literature. Specifically, after typing the “CORREL” into the cell, the correlation formula (2) is automatically inserted in the form. Then select the two rows of the data of the two variables. Finally, there will be a coefficient, which is the final result.

Table 4: Correlation Analysis Between Educational Inequality of Opportunity and Economic Growth.

Year	Education Inequality of Opportunity	Economic Growth
2013	0.11527737	0.33849994
2014	0.12100286	0.33787313

Table 4: (continued).

2015	0.12526311	0.33474905
2016	0.13122863	0.33109177
2017	0.13026696	0.33447251
2018	0.12290747	0.33539715
2019	0.12010884	0.32912937
2020	0.13712357	0.32460439
2021	0.15307601	0.32414303
Correlation	-0.8030312	

In Table 4, there is a negative correlation, approximately -0.803, between education inequality of opportunity and local economic development.

3.4. Discussion

In conclusion, the data shows relative stability, where the range of changes in the overall data is less than 0.1, which suggests that the status of the development in education and the economy in Shandong is relatively stable.

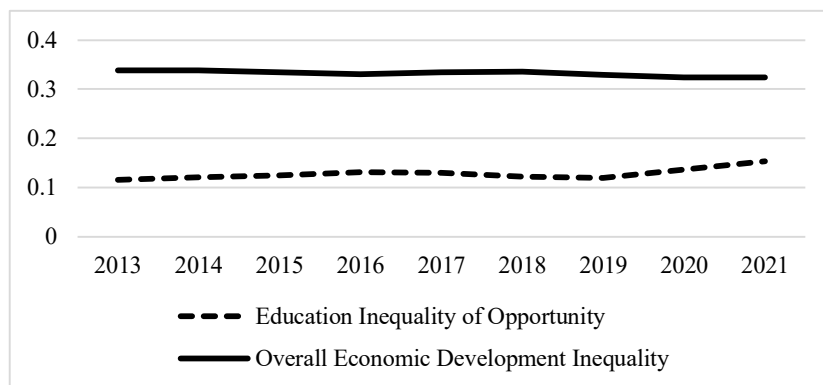


Figure 2: The Correlation Between the Gini Index of Educational Inequality of Opportunity and the GDP Gini Index in Shandong, 2013-2021.

A negative correlation exists between the educational inequality of opportunity and economic growth, according to Figure 2. Additionally, three distinct periods of growth and decline can be observed: 2013-2016, 2017-2019, and 2020-2021. In particular, the educational Gini index showed a general trend of rising, while the overall economic inequality Gini index exhibited a downward trend. The educational inequality of opportunity value rose from 2013 to 2016, fell from 2017 to 2019, and rose again from 2020 to 2021; the overall economic development value declined with a temporary increase from 2017 to 2019.

In a market, to explain the increase in educational inequality of opportunity, the more inequality there is, the total wealth there will be in the whole market, while education should not be a market filled with competition, especially in China. Therefore, the conclusion will be that Chinese education has been marketized. The marketization of education has long been a contradictory topic in Chinese academia. 20 years ago, Pan claimed the marketization of education should be promoted across the country because the Chinese economy was resilient enough to make it come true[16]; 30 years ago, Liu suggested China combine planning and marketing on the compulsory education level to benefit

the public[17]; in 2020, Hou found it unequal and unfair for rural families both to receive the result of the marketization of compulsory education in China and to accept the assigned compulsory education resources[18]. There have been fierce debates and arguments on this topic, while in different regions, there are different situations and seemingly reasonable resolutions. In this way, the more intense the competition is, the fewer educational opportunities in relatively underdeveloped regions because the balance will tilt towards the fiercely competitive side. Thus, the Gini coefficient kept increasing from 2020 to 2021.

Besides the debate on whether Chinese education should be marketized, the marketization of education does negatively impact the overall society, and one of them is the exacerbating inequality. In 2020 and 2021, the Double-reduction Policy in China mandated the closure of all profit-oriented K-12 education programs and companies. However, this led to a surge in demand for private classes and individual tutors, which were procured by worried Chinese parents. These transactions were not captured or reflected in the GDP, even though they involved consumption. Consequently, the market competition intensified, while the GDP remained stagnant according to the annual data. This phenomenon can be reasonably interpreted as a market failure.

On the level of the household registration system, the hukou system, the twist that all benefits brought by urban registration were decreased compared to the growing benefits brought from rural registration (although the suggestion was to help rural residents become urban residents with urban registrations) happened[19], plenty of families with school-aged kids moved from cities to the countryside to share free households, which made consumptions, investments, government expenditures, and exports existed more from rural or underdeveloped areas. On the other hand, before the huge twist, rural residents with kids tended to move from the countryside to cities to accept better education with the help of the household registration system and school choice policy. In summary, the inequality was greater before 2016 and less after 2016.

At the government budget level, there are two aspects to explain. For one thing, COVID-19 led to less government expenditure and expenses after 2020. Specifically, because of the epidemic, the revenue local governments received became less, so the expenditure on education and its improvement became less. However, although the overall standard became lower together, urban governments could spend a higher proportion of GDP since urban enterprises were supported by the central government [20], which suggests local governments only needed to spend a proportion of their expenditure. At the same time, rural individual stores were not included in the policy. In this way, the inequality of education increased from 2020 to 2021.

For another, the poverty reduction policy in China encouraged, or even forced, local governments to improve the quality of compulsory education in rural areas [21]. Plus, the deadline for poverty reduction would be met right after 2019, which burdened each regional government. Thus, the inequality level declined from 2017 to 2019.

Further to the downtrend of GDP per capita in Shandong, in terms of education, there are several reasons to explain this phenomenon. First, as one of the largest provinces famous for its stressed education system, the Shandong government has been criticized and urged to switch its education system. Since 2000, the number of newborn populations has been fluctuating between 15 and 18 million [8], which indicates all compulsory education schools in Shandong have to be responsible for about 9 times 16.5 million students. Thus, with highly concentrated attention, the Shandong government needs to spend more and more on education, which is usually much higher than in other provinces [22], finally becoming a heavy burden. Second, based on the relatively low level of compulsory education in Shandong from 2000 to 2010 and rat races recur, the newest generation aged 18-30 in Shandong have fewer motivations than those aged 30 and older, who did not receive high-quality education as well but have more motivations to compete with one another. Thus, the economic development, or the shown data instead of the development, looks worse.

Also, with the higher pressure from the central government and the overall trend of economic development, not only Shandong but also many other provinces suffer from them, leading to worse economic status. Specifically, because of the intensified centralized distribution of all kinds of resources, education and production resources abundant in the east part of China are likely to be distributed on average in China, which harms the motivation of the production in the east part of China. However, it decreases the economic gap between the east and the West, referring to the downturn in the difference in economic growth in Shandong from 2020 to 2021.

4. Conclusion

The focus of the paper is the effect of educational inequality on opportunity and economic growth. According to the results of the analysis of the Gini indexes of both the students/the number of middle schools and the GDP per capita in Shandong from 2013 to 2021, the overall trend of educational inequality of opportunity is from increasing, decreasing, and again increasing, the trend of the difference in economic development is from decreasing, increasing, and then decreasing. the correlation between the two Gini indexes is negative. The result indicates the marketization of the Shandong education system, the negative impact of COVID-19, and both positive and negative impacts exerted by the household registration system. The research will be an overall holistic analysis and review of the recent 10-year status of the education inequality of opportunity and economic development in Shandong, China. The government should improve the economy by enhancing the educational conditions for the next generation to positively affect economic growth instead of allowing education to be market-oriented.

The paper mainly examines how educational inequality affects opportunity and economic growth. The Gini indexes of both the students/the number of middle schools and the GDP per capita in Shandong Province from 2013 to 2021 reveal an overall pattern of educational inequality of opportunity that fluctuates from rising, falling, and rising again, while the disparity in economic development shifts from shrinking, expanding, and shrinking again. The two Gini indexes show a negative correlation. This outcome reflects the marketization of the Shandong education system, the adverse impact of COVID-19, and the mixed effects of the household registration system. The research provides a comprehensive and holistic assessment and evaluation of the recent 10-year situation of the education inequality of opportunity and economic development in Shandong, China. The government should promote the economy by improving the educational opportunities for the next generation to positively influence economic growth rather than allowing education to be market-driven.

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