

# Research on the Impact of Educational Inequality on Residents' Income Gap

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## Abstract

Education is the main means of human capital accumulation and plays an important role in income distribution. This paper first measures the educational inequality index of residents in 26 provinces in China based on the Chinese General Social Survey (CGSS) data for a non-consecutive total of eight years from 2010 to 2021. And drawing on Roemer's environment-effort dichotomy analysis framework, this paper further decomposes educational inequality into inequality of educational opportunity and inequality of educational effort, and uses the generalized method of moments estimation (GMM) to explore the impact of educational inequality on income gap, and obtain the following conclusions: First, educational inequality shows regional heterogeneity, with higher levels of educational inequality in less economically developed regions. Second, educational inequality significantly expands the income gap. Each educational inequality increases by 1%, and the income gap will expand by 0.365%. In addition, the influence of educational inequality in the eastern region has a greater impact on the income gap, and the impact of educational inequality on the income gap has gradually increased over time. Third, inequality of educational opportunity and inequality of educational effort, acting alone, both have a significant positive effect on the income gap, and the impact coefficients are 0.428% and 0.259%, respectively. Fourth, when educational opportunity inequality and educational effort work together, inequality of educational opportunity inhibits the role of an individual's own effort, resulting in inequality of educational effort no longer significantly affecting the income gap. Accordingly, this paper proposes policy recommendations to promote the balanced development of education and promote common prosperity. Accordingly, this paper proposes policy recommendations to promote the balanced development of education and common prosperity. Accordingly, this paper proposes policy recommendations to promote the balanced development of education and common prosperity.

## Keywords

Educational Inequality; Income Gap; Inequality of Opportunity; Environment; Effort.

## 1. Introduction

With the rapid development of the national economy and the steady rise in the level of residents' income, China has now fully eliminated absolute poverty, and substantial progress has been made in the policy of common prosperity, but the income gap between residents in China has continued to expand. The Gini coefficient of Chinese residents' income in 2022 has risen to 0.47, which is high above the international warning line, and the per capita income gap between urban and rural areas has expanded from 3974 yuan in 2000 to 29,150 yuan, an increase of 7.34 times. It can thus be seen that the increasingly expanding gap between the rich and the poor is the focal point of society nowadays, and it is imperative to resolve the contradiction between the people's growing needs for a better life and unbalanced and inadequate development, and to realize the common prosperity.

Educational equity and income distribution equity are two important foundations for realizing social equity, and a reasonable way of distributing educational opportunities can help realize social equity and narrow the income gap. As a result, this paper chooses to link the two to explore the impact of educational inequality on the income gap of China's residents.

The relationship between education and income has always been a research hotspot in the field of human capital. Among them, the relationship between educational inequality and the gap between income is also widely concerned. However, most of these studies measure the education distribution by indicators of inequality in educational outcomes, ignoring the structural factors in educational inequality, lacking an examination of educational opportunities, and failing to reach consistent conclusions. So this paper, based on the environment-effort binary analysis framework, decomposes educational inequality into inequality of educational opportunity and inequality of educational effort, and explores the impact of both on the residents' income gap.

## 2. Literature Review

### 2.1. Research on the Measurement of Educational Inequality

The reasonable measurement of the education inequality index can accurately reflect the education distribution of the region. Most of the existing research is based on the data of the educational years of the workers, the logarithmic variance (Winegarden, 1979[1]; Ram, 1990[2]) and standard deviations (Park, 1996[3]; Bai Xuemei, 2004[4]) of the educational period are used as indicators for measuring the inequality of education. There are also some scholars who used the absolute index of residents' education years to reflect the unequal education, such as Lu Wei (2015)[5], Zhang Chuanchuan (2022)[6]. However, subsequent researchers found that there are variations in these absolute indicators that are unrelated to the level of economic development of the region, investment in education, which do not accurately reflect the true picture of educational inequality. In view of this, some scholars began to explore new calculation methods, such as the use of more excellent and inequality indicators, which include the Gini coefficient and the generalized entropy index. Castello & Domenmch (2002)[7], Thomas et al (2003)[8], and Liu Jingming (2023)[9] all innovatively improved the method of calculating the Gini coefficient of education and calculated the Gini coefficients of education for a number of countries or regions based on the panel data of average years of schooling.

Some other scholars utilized the decomposability of the generalized entropy index to decompose and measure differences in rural education levels (Dong Shuaipeng, 2022)[10] and differences in compulsory education between urban and rural areas (Lin Juan et al., 2022)[11], and comparisons revealed that educational inequality between regions are much greater than inequality within regions. Later scholars recognized that educational inequality calculated using data on education attainment is an inequality in outcomes, but social equity requires the pursuit of equity of opportunity more than anything else. Therefore, the literature in recent years began to focus on the measurement of inequality of opportunity in education. (Ferreira and Gignoux, 2011). Measures are categorized as "ex-ante method" and "ex-post method" according to whether need to identify the level of effort. Because personal efforts are difficult to measure objectively, the "ex-ante method" has been more widely used. According to whether the income determination equation is constructed, the "ex-ante method" is divided into "parametric method" and "non-parametric method" (Ferreira and Gignoux, 2011)[12]. Some scholars used the "non-parametric method" to measure inequality of opportunity. Gong Feng et al. (2017)[13] tested whether raising efforts can improve inequality of opportunity based on the propensity score matching method of the random parameter Logistic regression. Based on the decomposition method of income inequality, Shi Daqian and Zhang Zhecheng (2018)[14] used the "non-parametric method" to measure the inequality of education opportunity and

education effort. Liu Chengkui & He Yingming (2021)[15], Li Shi and Shen Yangyang (2022)[16], Zhao Xinhui (2023)[17], Sun Junhua & Wan Yang (2023)[18] used “the parametric method” to measure inequality of opportunity. Therefore, this paper will use the “ex-ante parameter method” to measure the inequality of education opportunity, and draws on the processing method of Zhang Nan et al. (2020)[19] to decompose the residual term of the model and identify the impact of the “unmeasured environment” on the education attainment.

## 2.2. Research on the Impact of Educational Inequality on the Income Gap

Regarding research on the impact of educational inequality and income gap, most scholars believe that educational inequality widens income gap. Beck & Chiswick (1966)[20], Park (1996)[21] and Wen Jiaoxiu & Wang Yanjun (2011)[22] measured educational inequality with a variety of indicators based on the data of different countries or regions, and found that the income gap of the residents increased with the widening of the educational inequality, and that the alleviation of the degree of educational inequality could significantly improve the income gap. However, some scholars put forward the opposite point of view. Psacharopoulos (1977)[23] and Ram (1984) [24] used cross-sectional data from several countries to use the coefficients of variation in the number of students at different stages of education and the variance of education periods, respectively, as measures of educational inequality. It was found that educational inequality and income gap are significantly negative, that is, improving educational inequality will not reduce the income gap, which will not reduce the income gap. Du Peng (2005)[25], Yang Jun et al. (2008)[26], and Xu Yonghong et al. (2019) [27] analyzed the data on education and income distribution in China and obtained similar conclusions. Some scholars believed that educational inequality has no significant impact on the gap between income. Foldvari & Leeuwen (2011) [28] found that the impact of educational inequality on income inequality is weak and not statistically significant. Based on the perspective of educational inequality decomposition, Shi Daqian and Zhang Zhecheng (2018)[13] examined the effects of inequality of education opportunity and inequality of effort on income gap and found that they have an inverse effect on income gap, such that the effect of overall educational inequality on income gap is no longer significant.

Although the study of the relationship between educational inequality and the income gap is getting deeper and deeper, there are still some shortcomings. First of all, most of the current studies use standard deviation or Gini coefficients to measure educational inequality, which have certain shortcomings. These indicators fluctuate greatly, and the results obtained from this analysis are poor. Indicators such as the Gini coefficient for education reflect an inequality of outcomes, but equity in education is more about ensuring equity of opportunity. Second, in terms of data selection and estimation methods, most of the data in the current study used macro data from each province, lacking a micro perspective, and the methods and variables chosen to measure inequality of opportunity were not the same. The existence of omitted variables led to low result in the measurement of inequality of opportunity. Finally, studies applying the theory and methodology of inequality of opportunity to the issue of the relationship between educational inequality and income gap are fewer in number and have not yet reached consistent conclusions.

Compared with existing research, the possible contribution of this paper lies in the following several points. The first is the calculation of educational inequality. From the perspective of inequality of opportunity, this paper adopts the “ex-ante parametric method” to decompose educational inequality. In this paper, we use multi-period “the Chinese General Social Survey” micro data, based on the environment-effort dichotomous analysis framework, to comprehensively examine the impact of multiple micro-environmental variables on individual education levels, and use “two-part clustering method” to identify the impact of “immeasurable environment” on education attainment, and decompose educational inequality into the index

of inequality of education opportunity and the index of inequality of education effort. Second, this paper divides the overall sample into subsamples from the eastern and central and western regions, and subsamples categorized by year, in order to explore the impact of educational inequality on income gap from the dimensions of region and year. Third, most of the existing studies on the impact of educational inequality on income gap have been conducted in terms of the rate of return to education, and the conclusions of the studies are still divergent. This paper empirically analyzes the relationship between education inequality and income gap after decomposition, provides new evidence for the effect between the two, and enriches the theoretical research in related fields.

### 3. Research Method of Disaggregating Educational Inequality

According to Roemer's (1998) [29] definition of inequality of opportunity in his theoretical framework, the level of individual education  $y_i$  is affected by environmental factors  $C_i$ , that beyond the individual's control and self-selected effort factors  $E_i$ . This article refers to the parameter method of Ferreira and Gignoux (2011) [12] to construct the following educational decisive equations:

$$y_i = \alpha + \beta C_i + \gamma E_i + e_i \quad (1)$$

In general, the degree of effort is considered to be affected by environmental factors. Effort is generally considered to be influenced by environmental factors. We assume that the effort variable can be expressed as a linear function of the environmental variable, i.e.  $E_i = \theta C_i + v_i$ . Thus equation (1) can be simplified to:

$$y_i = \alpha + \phi C_i + \varepsilon_i \quad (2)$$

Among them, coefficient  $\phi = \gamma\theta + \beta$ , contains the direct effect of the environment variable on the level of education and the indirect effect of the environment on the level of education through the effort variable. Based on the estimated results of the coefficients and the true values of the environmental variables, the smoothed distribution of education  $\{\hat{y}_i\}$  is constructed, and  $\hat{y} = \exp[\hat{\phi}C]$ . It is straightforward to calculate the absolute amount  $IOA$  and the relative amount  $IOR$  of inequality of opportunity in education.

$$IOA = I(\{\hat{y}_i\}) \quad (3)$$

$$IOR = I(\{\hat{y}_i\})/I(\{y_i\}) \quad (4)$$

Where  $I(\cdot)$  is a measure of inequality, and here in this paper we use the  $MLD$  index from the generalized entropy index. The index perfectly disaggregates educational inequality between opportunity and effort. The form of the index is as follows:

$$MLD(y) = \frac{1}{N} \sum_{i=1}^N \ln \left( \frac{\mu}{y_i} \right) \quad (5)$$

Among them,  $\mu$  indicates the period of education per capita, and  $N$  denotes the number of groups in the population according to level of education.  $y_i$  denotes the period of education for cohort  $i$ .

The residual term  $\varepsilon_i$  of model (2) includes some unmeasured environment and effort factors because the choice of environmental variables in model (2) in this paper is limited, which can result in omission of some unmeasured environmental variables. In this paper, we draw on Bjorklund et al. (2012) to decompose the residual term of model (2) to identify the effect of "unmeasured environment" on educational attainment. The steps are as follows:

For the information about the environment in which the individuals are located, a two-step clustering method is first adopted to categorize all the individuals. The optimal number of clusters obtained according to the AIC criterion is 10 groups. Defining that the sample individuals in the same group are in the same external environment, the educational decision equation in each environmental group is estimated:

$$y_i^m = \alpha + \phi C_i^m + \varepsilon_i^m (m = 1, 2, \dots, 10; i = 1, 2, \dots, N) \quad (6)$$

Where  $m$  denotes the corresponding group,  $N$  denotes the number of samples in the corresponding group  $m$ ,  $C_i^m$  denotes the corresponding vector of environmental variables in the corresponding group  $m$ , and  $\varepsilon_i^m$  denotes the residual term in the corresponding group  $m$ . At this point the residual term  $\varepsilon_i^m$  within the same group is homogeneous due to the same external environment. According to the estimation results of model (6), the variance estimates of the residual terms within each group  $\hat{\sigma}_m^2$  are calculated. Accordingly, a weighted average of the variance estimates for all groups yields the overall variance  $\sigma^2 = \sum_{m=1}^{10} f_m \hat{\sigma}_m^2$ , where  $f_m$  denotes the number of samples in each group as a proportion of the number of samples in the full sample. The overall variance  $\sigma^2$  is homoskedastic within all groups, i.e.,  $E(\sigma^2) = 0$ .

Based on the overall variance, the weights of the variance of each group are calculated to obtain  $k = (1/\sum_{m=1}^{10} f_m \hat{\sigma}_m^2)^{1/2}$ . The residual terms of the full sample  $\varepsilon_i$  are decomposed accordingly.

$$y_i = \alpha + \phi C_i + (\varepsilon_i - \varepsilon_i/k\hat{\sigma}_m) + \varepsilon_i/k\hat{\sigma}_m \quad (7)$$

In this case,  $(\varepsilon_i - \varepsilon_i/k\hat{\sigma}_m)$  is the portion of heteroskedasticity after removing within-group homoskedasticity, i.e., the effect of the "unmeasured environment" on education.  $\varepsilon_i/k\hat{\sigma}_m$  is the homoskedasticity component, which has the same distribution within all environmental groups. The inequality of opportunity index  $IOA$ , recalculated according to equation (7), incorporates the effects of the "unmeasured environment".

## 4. Data, Models and Variable Selection

### 4.1. Data on the Disaggregation of Educational Inequalities

This paper selects the panel data (2010-2013, 2015, 2017, 2018, 2021) for a total of 8 years for 26 provinces (including municipalities or autonomous regions) in China that are currently released to the public by the China General Social Survey (CGSS). Because some variable data is seriously missing or unsuitable, the data of Hainan, Qinghai, Ningxia, Xinjiang and Tibet have been deleted. After deleting the missing observations of education and environment variables, the sample sizes of 10263, 5087, 8123, 9462, 8345, 9167, 8754, and 9738 were obtained for the eight years, respectively. On this basis, the inequality of educational opportunities and the inequality of educational efforts indices for each province during the sample period are obtained according to the decomposition method of educational inequality in the previous section.

### 4.2. Empirical Models and Variable Selection

In order to test the effect of educational inequality on income gap, this paper is based on the equations of Mingse, refer to the empirical model of Foldvari & Leeuwen (2011)[12]the empirical model, and the setting model is as follows:

$$Ineq_{i,t} = \alpha_0 + \alpha_1 lnMLD_{i,t} + \alpha_2 exp + \alpha_3 lnaver_{it} + \sum_{i=1}^{27} \gamma_p X_{i,t} + \eta_i + \mu_t + u_{i,t}$$

Decomposing educational inequality  $MLD_{i,t}$  into inequality of educational opportunity  $EIO_{it}$  and inequality of educational effort  $EIE_{it}$  yields the following model:

$$Ineq_{i,t} = \alpha_0 + \alpha_1 lnEIO_{it} + \alpha_2 lnEIE_{it} + \alpha_3 exp + \alpha_4 lnaver_{it} + \sum_{i=1}^{27} \gamma_p X_{i,t} + \eta_i + \mu_t + u_{i,t}$$

Among them, the explanatory variable is the income gap variable .exp is a working experience variable,  $EIO$  is the variable of inequality of educational opportunity,  $EIE$  is the variable of inequality of educational effort.  $aver$  is the variable of aver education attainment .  $X$  are the other macro-control variables selected in this paper to influence income gap, including the level of economic development, government investment in education, openness to the outside world, and industrial structure variables.  $\eta_i$  is the provincial cross-section effect,  $\mu_t$  is the time effect, and  $u_{i,t}$  is the random error term.

The variables in the empirical model of this paper are characterized as follows: ①The income gap variable ( $Ineq$ ), measured in the baseline regression by the Gini coefficient of income across provinces and municipalities. ②The work experience variable ( $exp$ ), characterized by the Gini coefficient of the number of years worked by residents in each province. ③The variable of aver education attainment ( $aver$ ) is expressed in the average education years of residents of various provinces. It was calculated by referring to relevant literature and using population data by education level for ages 6 and older in each region from the “China Statistical Yearbook”. ④Economic development ( $lnGDP$ ), expressed as the natural logarithm of per capita in each province. ⑤Government expenditure on education ( $gov$ ), which is expressed in this paper using the ratio of government's share of public education expenditure. ⑥Openness to the outside world ( $open$ ), measured as the share of total exports and imports of goods. ⑦Industrial structure ( $str$ ), measured by the share of value added of the secondary sector.

**Table 1.** The descriptive statistics of the main variables

Variable Name	Mean	Min	Max	SD	Obs
<i>Ineq</i>	0.394	0.274	0.491	0.051	208
<i>MLD</i>	0.159	0.089	0.233	0.021	208
<i>EIO</i>	0.071	0.028	0.142	0.022	208
<i>EIE</i>	0.088	0.051	0.131	0.015	208
<i>aver</i>	8.586	6.764	12.665	0.990	208
<i>exp</i>	0.41	0.25	0.72	0.091	208
<i>lnGDP</i>	10.539	8.972	11.767	0.570	208
<i>str</i>	0.469	0.190	0.600	0.077	208
<i>gov</i>	0.046	0.025	0.095	0.014	208
<i>open</i>	0.303	0.029	1.668	0.339	208

As the income gap variables and the indices of educational inequality in this paper are calculated based on the CGSS micro database. In order to match these data, all other variables in the empirical model are taken from the “China Statistical Yearbook” of the corresponding year or calculated by relevant variables. The descriptive statistics of the main variables are shown in Table 1.

## 5. Empirical Results and Analysis

### 5.1. Results of the Measurement of Educational Inequality

**Table 2.** Results of the educational inequality measure

Provinces	Year of 2010		Year of 2015		Year of 2021	
	Education inequality index	Ranking	Education inequality index	Ranking	education inequality index	Ranking
Beijing	0.1232	18	0.1239	24	0.1025	25
Tianjin	0.1115	23	0.1099	26	0.1168	24
Hebei	0.1354	13	0.1419	22	0.1291	23
Liaoning	0.1289	16	0.1519	17	0.1312	19
Shanghai	0.1226	19	0.1187	25	0.0889	26
Jiangsu	0.1626	3	0.2038	2	0.1831	7
Zhejiang	0.1338	15	0.1708	8	0.2006	2
Shandong	0.1552	7	0.1799	6	0.1637	12
Fujian	0.1748	2	0.1844	5	0.1971	3
Guangdong	0.1343	14	0.1622	11	0.1807	8
Shanxi	0.0992	25	0.1432	20	0.1605	15
Heilongjiang	0.1133	22	0.1330	23	0.1380	20
Jilin	0.1070	24	0.1431	21	0.1618	13
Jiangxi	0.1510	9	0.1970	3	0.1863	6
Anhui	0.1578	5	0.1676	10	0.1612	14
Henan	0.1238	17	0.1537	15	0.1645	9
Hubei	0.1396	12	0.1515	18	0.1375	21
Hunan	0.0975	26	0.1519	16	0.1518	17
Inner Mongolia	0.1179	21	0.1570	12	0.1645	11
Guangxi	0.1212	20	0.1458	19	0.1361	22
Chongqing	0.1564	6	0.1563	14	0.1603	16
Sichuan	0.1445	11	0.1702	9	0.1659	10
Guizhou	0.1593	4	0.1853	4	0.1953	4
Yunnan	0.1502	10	0.1565	13	0.1511	18
Shaanxi	0.1538	8	0.1772	7	0.1892	5
Gansu	0.1820	1	0.2230	1	0.2334	1

As can be seen from Table 2, during the sample period, Gansu, Guizhou and Fujian have higher educational inequality indices, indicating that compared to other provinces, the differences in the educational attainment of residents in these four provinces are greater. And it is not difficult to see that the level of educational inequality in Guizhou and Gansu provinces is still increasing from 2010 to 2010. In contrast, Beijing and Shanghai have lower levels of educational inequality and show a slowly declining trend of change over time. In addition, the level of educational inequality is relatively low in the eastern region and relatively high in the western region, which

shows that the level of educational inequality is closely related to the level of regional economic development.

## 5.2. Analysis of the Impact of Educational Inequality on Income Gap

The endogenous problem is caused by the possibility of bidirectional causality between both income gap and educational inequality. For this reason, this paper refers to Galora's study and uses the GMM system approach to introduce the lagged variable of the difference variable as an instrumental variable, thus solving the endogenous problem of the model to a certain extent. The results of *Sargan* test showed that the instrumental variables were valid.

The data used in the model is the panel data of 26 provinces in 8 years, in order to avoid the appearance of pseudo-regression, this paper also conducts the smoothness test for each variable. Table 3 demonstrates the results of the two unit root tests. The results show that the unit root test for all variables passes and the data can be considered smooth.

**Table 3.** Results of the smoothness test for variables.

Variables	IPS test	LLC test
<i>Ineq</i>	-5.7639***	-11.4935***
<i>MLD</i>	-5.6701***	-18.3827***
<i>EIO</i>	-6.4365***	-12.6630***
<i>EIE</i>	-5.7458***	-13.8766**
<i>aver</i>	-4.5074***	-15.6457***
<i>exp</i>	-1.3768**	-2.3847**
<i>lnGDP</i>	-1.4614*	-1.8685**
<i>str</i>	-1.3365*	-4.2847***
<i>gov</i>	-5.7342**	-14.9465***
<i>open</i>	-1.4655**	-1.6721*

(1) Benchmark regressions based on different years and regions.

Table 4 reports the results of the regression of overall educational inequality on income gap. The estimation results of model 1 show that in general, educational inequality significantly increases the income gap, and the test is passed at a significant level of 1%. The regression coefficient is 0.365, which means that educational inequality will increase by 1%, and the income gap will increase by 0.365%.

The sub-regional regression results of Models 2 and 3 show that educational inequality in the eastern region and the central and western regions still significantly increases the income gap. The regression coefficient of educational inequality is 0.280 in the eastern region and 0.213 in the western region, indicating that educational inequality in the eastern region has a greater impact on the income gap than in the central and western regions. This result is in line with the expectation. Due to the imbalance between the development of the eastern and central-western regions of China, the eastern region is far ahead in terms of economic development, with advanced urbanization and industrialization, booming high technology, and many middle- and high-end employment opportunities, which leads to the fact that it is easier for individuals with a higher level of education to obtain higher-paying jobs, and which is the driving force for the mobility of the labor force with high education level to the eastern coastal region.

In order to further enrich the conclusions of this paper, different sub-samples of years were selected for measurement. As can be seen from the table below, the effects of educational inequality on income gap are all significant at the 5% significance level. In terms of the coefficient of the impact of educational inequality on the income gap, the regression coefficient



was 0.257 in 2010, 0.341 in 2015, and 0.469 in 2021. Overall, it appears that the role of educational inequality in widening the income gap has increased over time. One explanation is that the chronic problem of "diploma-centric" has intensified to the extent that education has become the most important factor affecting income. In addition, according to the theory of human capital, individuals with a prior advantage in education will maintain this advantage for a long time. Therefore the gap in the stock of human capital grows wider over time, and the role of educational inequality in enhancing the income gap is increasing.

In terms of control variables, the work experience variable has a significant positive effect on the income gap according to the estimation results for all samples. This result is in line with daily experience. With the increase of work experience, individuals' professional skills and labor productivity will increase, thereby increasing the salary, the wider the gap between the work experience and the wider the gap between individual income. For macro variables, variable of average education attainment and government expenditure on education are basically significantly negatively correlated with income disparity in all models, indicating that China is still at a stage where education expansion can promote fairness in income distribution, and that education expansion is indeed conducive to the improvement of income inequality.

**Table 4.** Estimation results based on different regions and years

	M1:GMM	M2:East	M3:Midwest	M4:2010	M5:2015	M6:2021
<i>MLD</i>	0.365*** (3.49)	0.280** (2.43)	0.213*** (3.84)	0.257* (1.83)	0.341** (2.28)	0.469*** (4.86)
<i>aver</i>	-0.032** (-2.18)	-0.046*** (-4.63)	-0.028* (-1.73)	-0.021* (-1.79)	-0.025** (-2.32)	-0.048** (-2.18)
<i>exp</i>	0.102* (1.74)	0.0241*** (3.94)	0.088 (0.78)	0.139** (2.13)	0.121** (2.30)	0.093* (1.74)
<i>lnGDP</i>	-0.053* (-1.79)	-0.127* (-1.85)	-0.036 (-0.62)	-0.045 (-0.89)	-0.052 (-1.22)	-0.056 (-1.19)
<i>str</i>	0.019* (1.75)	0.024 (1.29)	0.033 (1.28)	0.029 (0.97)	0.026 (0.88)	0.021* (1.81)
<i>gov</i>	0.037** (2.18)	0.028 (1.32)	0.040** (2.43)	0.019 (1.42)	0.023* (1.73)	0.039* (1.84)
<i>open</i>	-0.026* (-1.68)	-0.032 (-0.37)	-0.019 (-0.51)	-0.010 (-0.39)	-0.017 (-0.24)	-0.031** (-2.15)
constant	0.686* (1.71)	0.963* (1.89)	0.824 (1.78)	0.872 (1.38)	0.926* (1.81)	0.938* (1.72)
p-value for the <i>Sargan</i> test	0.998	0.997	0.997			
AR(2)	0.641	0.447	0.385	0.191	0.248	0.264
N	208	80	128	26	26	26

t statistics in parentheses.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01.

(2) Measurement results from the decomposition of educational inequality

This paper further decomposes the educational inequality index of each province into inequality of education opportunity and inequality of education effort. The inequality of education opportunity and inequality of education effort indices are measured according to the theoretical decomposition model in the previous section. Table 5 shows the estimation results of the model of the impact of inequality of education opportunity and inequality of education effort on income gap.

First, without adding macro control variables, the income gap is regressed separately with inequality of education opportunity and inequality of education effort, so as to identify the effect of each on the income gap, and the model results are model 1 and model 2, respectively. The estimation results show that inequality of education opportunity significantly widens the income gap, i.e., all other things being equal, for every 1% increase in inequality of education opportunity, the income gap will widen by 0.428% on average. At the same time, inequality of education effort also has a significant positive effect on the income gap, with a regression coefficient of 0.359, which means that the greater the difference in the level of effort of an individual's acquired efforts, the greater the income gap, i.e., without taking into account the influence of the innate environment, the individual can raise the level of income and reduce the income gap by narrowing the level of effort compared with that of others.

Besides, the regression coefficient of inequality of education opportunity is larger than the coefficient of inequality of education effort, which indicates that the impact of inequality of educational opportunities on income gap is larger than inequality of efforts, implying that the impact of differences in family environment background on income gap is larger than the impact of differences in individual's own efforts on income gap. After adding macro control variables (model 3 and model 4), inequality of education opportunity and inequality of education effort still significantly widen the income gap.

**Table 5.** Measurement results from the decomposition of educational inequality

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>EIO</i>	0.428*** (3.85)		0.362*** (4.92)		0.396*** (3.79)	0.341** (3.43)
<i>EIE</i>		0.259*** (3.41)		0.227*** (5.37)	-0.104 (-0.48)	-0.153 (-0.43)
<i>aver</i>	-0.024** (-2.14)	-0.015** (-2.36)	-0.019* (-1.81)	-0.032* (-1.90)	-0.031* (-1.83)	-0.065* (-1.72)
<i>exp</i>	0.029* (1.78)	0.046* (1.81)	0.013 (0.43)	0.024* (1.82)	0.038* (1.79)	0.078 (1.43)
<i>lnGDP</i>			-0.062 (0.83)	-0.083 (0.58)		-0.077 (0.63)
<i>str</i>			-0.014* (-1.68)	-0.021* (1.72)		-0.013* (1.84)
<i>gov</i>			0.038* (1.73)	0.031** (2.77)		0.022* (1.95)
<i>open</i>			0.025 (0.61)	0.028 (0.79)		0.021 (0.42)
constant	0.536** (2.19)	0.748*** (4.69)	0.694** (2.15)	0.876* (1.96)	0.637* (1.95)	0.825* (1.72)
p-value for the <i>Sargan</i> test	0.997	0.997	0.998	0.996	0.999	0.998
AR(2)	0.476	0.364	0.419	0.435	0.384	0.539
N	208	208	208	208	208	208

t statistics in parentheses.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01.

Model 5 is the regression result of adding both inequality of education opportunity and inequality of education effort, the effect of inequality of education opportunity on income gap is still positive and significant, with a regression coefficient of 0.396, while inequality of

education effort becomes negative and insignificant. After adding macro control variables (model 6), the effect of inequality of education opportunity on the widening of the income gap remains significant, while inequality of educational effort remains negative and insignificant. This suggests that inequality of education opportunity has a greater impact on the income gap than inequality of education effort, and the family environment gap is too large to inhibit the role of the individual's own efforts, resulting in the individual's own efforts and the individual income gap no longer correlate. The family environment gap is too large to inhibit the role of the individual's own efforts, resulting in the individual's own efforts and the individual income gap no longer correlate. At this point, it may be difficult for an individual's hard work to make up for the disadvantage of innate family conditions, and improving one's own efforts may no longer reduce the income gap.

### 5.3. Robustness Tests

In order to test the robustness of the estimation results in this paper, the following robustness tests are performed on the model. ① Replacement the variable of income gap. This paper draws on the research method of Shi Daqian (2018) to make individual income dates in the CGSS database were quintupled, and income gap indicators were measured by calculating income gaps for different groups using mean logarithmic deviation. ② Replace the variable of educational inequality. The number of clusters chosen for the benchmark regression to categorize individuals using the two-step clustering method is 10, i.e., the number of environmental groups defined is 10. Models 4-6 are clustered with 12 groups, and the model is tested using the inequality of education opportunity and inequality of education effort obtained by decomposing on this basis.

**Table 6.** Results of robustness tests.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>EIO</i>	0.375*** (4.83)		0.352** (3.76)	0.328*** (4.23)		0.324** (2.24)
<i>EIE</i>		0.204*** (4.73)	-0.109 (-0.75)		0.286*** (5.46)	-0.185 (-0.62)
<i>aver</i>	-0.008** (-2.36)	-0.027* (-1.71)	-0.092** (-2.15)	-0.021* (-1.83)	-0.029* (-1.87)	-0.043* (-1.69)
<i>exp</i>	0.017 (0.94)	0.042* (1.87)	0.067 (0.38)	0.010 (0.53)	0.040* (1.98)	0.052 (0.34)
<i>lnGDP</i>	-0.089 (-0.38)	-0.095 (0.27)	-0.082 (0.47)	-0.076 (0.31)	-0.092 (0.45)	-0.032 (0.54)
<i>str</i>	-0.023* (-1.74)	-0.035* (1.72)	-0.008 (1.35)	-0.008 (-1.43)	-0.012* (1.97)	-0.004 (0.44)
<i>gov</i>	0.032** (2.48)	0.042* (1.91)	0.028* (1.83)	0.046* (2.03)	0.038* (1.78)	0.049* (1.82)
<i>open</i>	0.029 (0.70)	0.035 (0.85)	0.013 (0.74)	0.032 (0.21)	0.021 (0.83)	0.012 (0.29)
constant	0.632** (2.01)	0.769* (1.77)	1.254* (1.78)	0.486** (2.43)	0.912* (1.87)	1.137* (1.84)
p-value for the <i>Sargan</i> test	0.998	0.997	0.996	0.998	0.997	0.996
AR(2)	0.476	0.464	0.387	0.447	0.498	0.409
N	208	208	208	208	208	208

t statistics in parentheses.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01.

The results of all the robustness tests show that both inequality of education opportunity and inequality of education effort remain significant in widening the income gap when acting alone. Under the combination of inequality of education opportunity and inequality of education effort, the former still significantly widens the income gap, but the effect of the latter is no longer significant. This proves that the findings of this paper are more reliable.

## 6. Research Conclusion and Policy Suggestions

The report of the 19th National Congress of the Communist Party of China is solemnly promised that my country must basically achieve the common prosperity of all people in the middle of this century, and the core of common prosperity is education fairness. Most of the current research focuses on the impact of overall educational inequality on the income gap, ignoring the fact that educational inequality is composed of inequality in education opportunity and inequality in education effort, and thus ignoring the role of these two types of inequality on the income gap, so the conclusions about the impact of educational inequality on the income gap are not consistent. To this end, this paper measured the educational inequality index in each region based on the micro database of the China General Social Survey (CGSS), and relies on Roemer's environment-effort binary analysis framework to decompose educational inequality, and to explore the impact of educational inequality on China's residents' income gap. Through the empirical analysis of the previous article, the results of the following research are obtained in this article:

(1) Educational inequality is characterized by regional heterogeneity. Generally speaking, from 2010 to 2021, the ranking of educational inequality of provinces in different years has not changed much, but the degree of educational inequality in economically developed regions is significantly lower than that in economically less developed regions. And the degree of educational inequality in provinces with higher levels of economic development shows a downward trend, while the degree of educational inequality in provinces with backward economic development, such as Guizhou and Yunnan, is still increasing. The impact of educational inequality on income disparity is stronger in the eastern region than in the central and western regions, and the impact of educational inequality on income disparity increases over time. By analyzing of control variable results, this article also found that the work experience variables have a significant positive impact on the income gap. The average education period variables and government education expenditure variables are basically significantly negatively related to the income gap in all models.

(2) Both inequality of educational opportunity and inequality of educational effort are significantly and positively associated with income disparity when acting alone. When inequality of educational opportunity and inequality of educational effort are combined, inequality of educational effort no longer significantly affects income disparity, due to the positive and negative effects of innate family circumstances and an individual's own efforts.

Based on the conclusions of the study, this paper puts forward the following recommendations:

① Balance the distribution of educational resources. While promoting investment in education and increasing the rate of return on education, efforts should be made to improve the allocation of educational resources to disadvantaged groups, and to strengthen policy favoritism and economic support for compulsory education in rural and impoverished areas. For example, a multilevel, high-quality school education system should be established in poor areas, and educational support for children from poor families should be made a long-term and important part of poverty alleviation, so as to increase the quantity and quality of education for children from low-income groups, and to gradually realize educational equity, thereby narrowing the gap between the rich and the poor in society. ② Not only is it necessary to pay attention to the differences in the ability of different groups to obtain educational opportunities, but it is also

necessary to take measures to compensate for and safeguard educational resources. The government should further promote the spirit of self-reliance and hard work, and to strengthen the concept of fair competition, so that individuals can narrow the income gap through positive efforts.③Improving the income distribution and social security systems to reduce the income gap.By improving the income distribution system, rationalizing workers' salaries, establishing a sound social security system,and formulating a complete employment subsidy and social relief measures to ensure the rights and interests of low -income people,so as to gradually narrow the income gap between different groups, expand the size of the middle class of society, and reduce the social income gap.

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