

Does Mineral Resources Utilization and Governance Policy Induce Income Inequality: Contextual Findings from Historical Data of China

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Abstract

In the current literature strand, most of the literature is devoted to the role played by mineral and governance policies in environmental quality. However, their criticality in income inequality is mainly overlooked by scholarly works. This research investigated the nexus of mineral and governance policies with income inequality while exploring the importance of per capita income, health expenditure, and poverty. Covering the extended period from 1984Q1 to 2022Q4 in the case of China, this research confirms the presence of long-run equilibrium association between variables. Due to the non-normal data distribution, this research uses quantile regression and a series of robust non-parametric and parametric approaches. The research concludes that mineral resources, health expenditure, governance efficiency, regulatory quality, and poverty headcounts significantly reduce income inequality. Wealth from mineral and health expenditures substantially improves the living standards of the general public. The governance policies are also beneficial in equal wealth distribution of the country. On the contrary, per capita income and government stability are the region's leading factors of income inequality. Based on the predicted results, this research recommends improved minerals management, strengthening of governance institutions and policies, and enhancement in health expenditure to tackle the issue of income inequality.

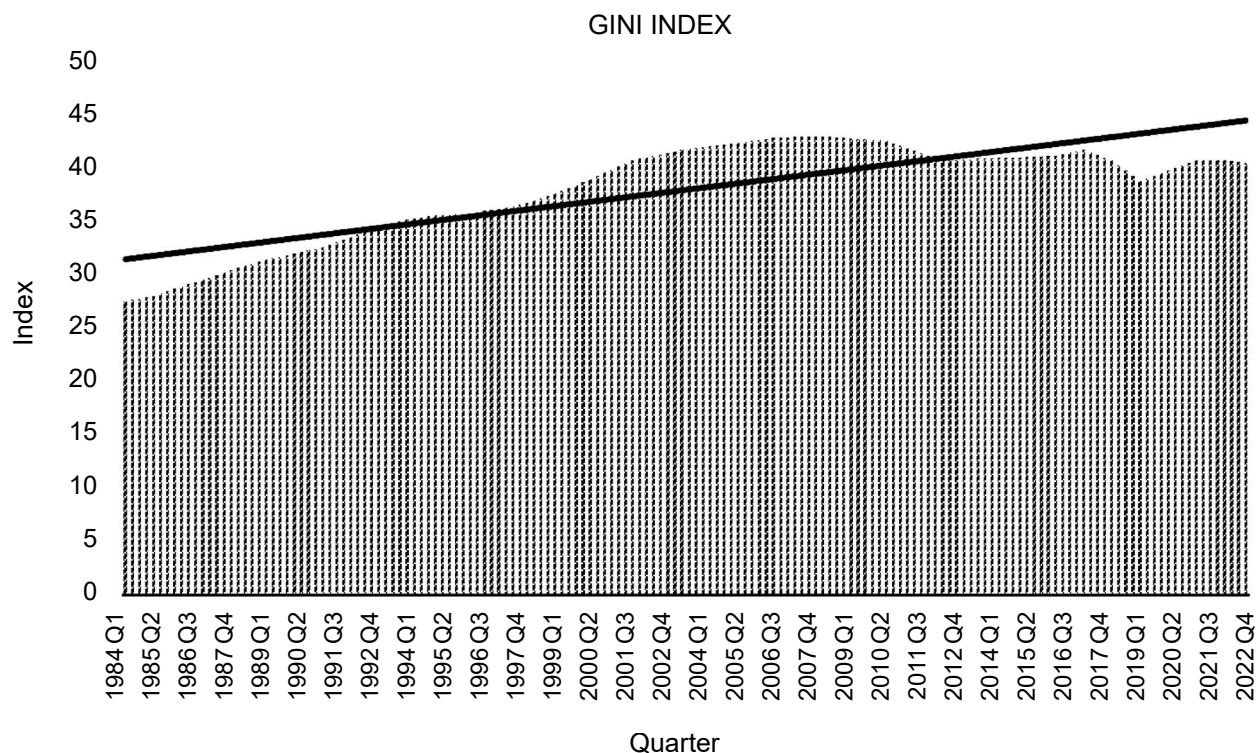
Keywords: Income inequality; mineral resources; governance policies; income; poverty; health expenditure; quantile regression.

JEL Classification: C33, O44, Q51

1. Introduction

Income inequality is a persistent issue among several nations, and China is no exception. The rise of inequality in the context of resource utilization and governance policies has drawn meaningful consideration from researchers. The United Nations has warned world economies that increasing inequality leads to social and economic instability. After 1978, inequality in China increased over three decades, but the recent stability has reduced inequality in the economy through the influence of governmental policies and decisions for income distribution (Zhang, 2021; Ponce *et al.*, 2023). The primary reason for income inequality is the high-income percentiles. In China, the measure of inequality is affected by the difference between the urban and rural incomes of the residents. For instance, from 1978 to 2007, the rising inequality was caused by the increasing share of the wealthiest residents connected with higher profits than wages. From the year 2007 to 2014, the rise of the financial crisis led to a decline in China's exports. The then Chinese government implemented fiscal stimulus along with policies for enhancing income distribution in the country. Despite these strategies and the 12th five-year plan, income inequality rose due to the increasing urban-rural gap (Molero-Simarro, 2017; Luo, Li and Sicular, 2020).

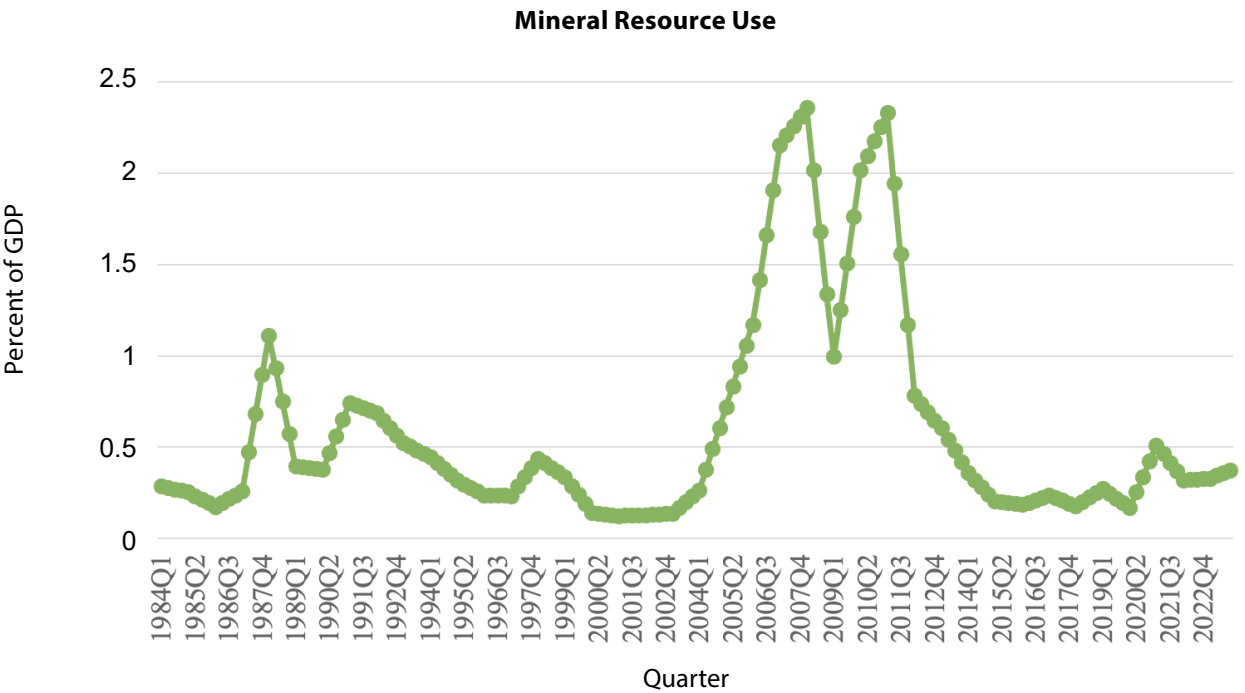
Figure 1: GINI Index for China



Source: The World Bank (<https://www.worldbank.org/en/home>)

Figure 1 presents the Gini Index trend from 1984 to 2000s. According to the World Bank, the Gini coefficient ranked at 43.7% in 2010 (Huang, Huang and Shui, 2021), which can be assessed through the figure. The trend presents the widening gap between the different income groups, which has increased over the years and is likely affected by different economic factors and policy regulations. Figure 2 and Figure 3 show the mineral rents and poverty ratio in the Chinese economy. Significant peak times can be visually observed in the figure for mineral rents. These times could be coinciding with the period of increasing economic growth. The mining business has meaningfully contributed to the economic progression of the economy (Zhou, Liu, and Niu, 2024). Besides, the volatile nature of these resources presents price fluctuations that could increase income disparity in the economy (Anyanwu, Anyanwu, and Cieřlik, 2021). Therefore, the peak times are overlapping economic growth. The dramatic reduction in poverty highlights the government’s implementation of policies that have limited the poverty gap in the economy (Sugiharti *et al.*, 2023). It can be visually analyzed that the decline from 60% of people living below the poverty line in the 1980s to 10% in recent years indicates a significant improvement in people’s living standards in China. Therefore, to ensure long-term sustainable development, providing natural resources without compromising the needs of future generations is necessary. Moreover, properly exploiting those resource revenue can be fruitful in lessening poverty gaps in the country (Fu and Liu, 2023).

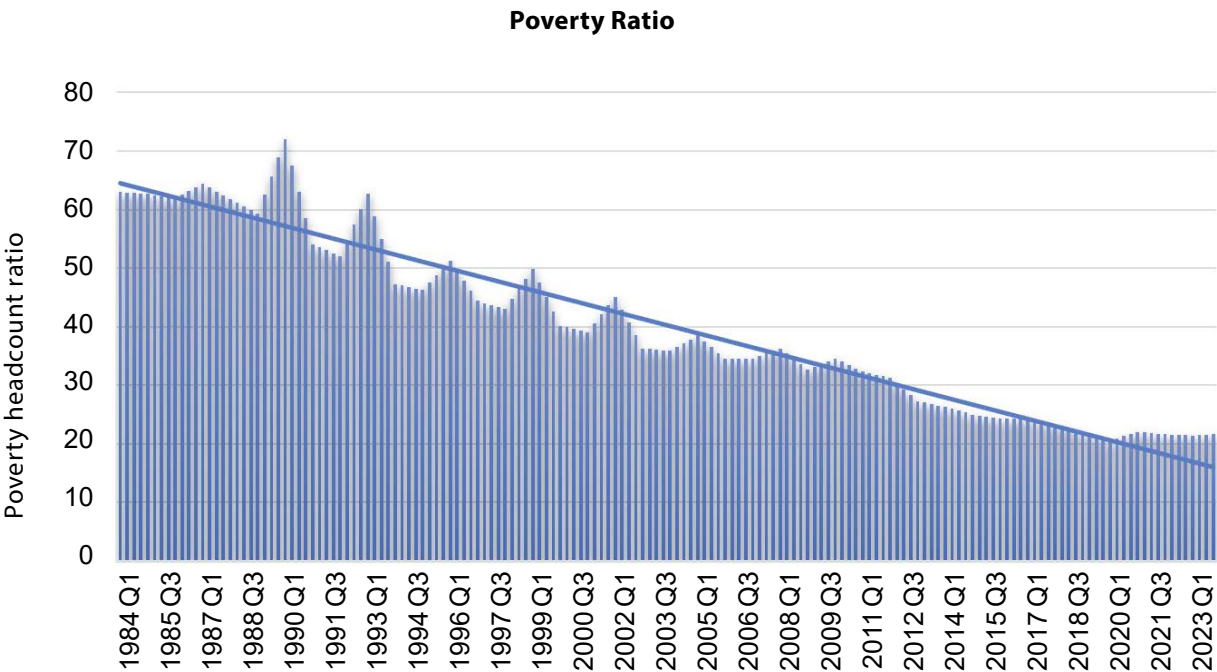
Figure 2: Mineral Rents of China



Source: The World Bank (<https://www.worldbank.org/en/home>)

Keeping the above discussion in account, the study has the following objectives. First, the study aims to inspect the role of mineral resource utilization on income inequality in the Chinese economy. Second, the influence of government indexes/indicators is assessed using the following variables: poverty, regulatory quality, and government stability in different econometric models from 1984Q1 to 2023Q4. For this purpose, the study employs parametric and non-parametric models for estimation, which help determine reliable findings. The study is significant as the income inequality trends are observed using the Gini coefficient and innovative governmental variables. This historical perspective offers a nuanced understanding of the variables and their aspects, which can be helpful for current and future policy decisions in China. Besides the research problem is to inspect the interaction between mineral resource utilization and income inequality in China by addressing how the government indicators influence this association. This will help researchers and policymakers highlight the effectiveness of different governmental policies and strategies to limit income disparity and promote economic stability.

Figure 3: Poverty Ratio of China



Source: The World Bank (<https://www.worldbank.org/en/home>)

The study contributes in the following ways. First, the study is novel in assessing the role of poverty, regulatory quality, and government stability in different econometric models, which is often ignored in contemporary studies. Besides, integrating mineral resources and governmental factors offers a unique view for analyzing the determinants of income inequality. The findings will help bridge the gap by providing valuable insights for academicians and scholars, as the present findings can be used as a template for other Global South economies suffering from similar challenges. Second, historical analysis makes a significant contribution to empirical research. The study uses an updated dataset from 1984Q1 to 2023Q4 with innovative models for assessing mineral resource utilization and governmental factors for determining the factors of income inequality.

The rest of the paper is organized as follows: Section 2 deals with the literature review. Section 3 is about data and methodology. Section 4 documents the estimated results and their brief discussion. Finally, section 5 presents the conclusion and policy implications.

2. Literature Review

This section documents the available literature on study variables to help readers understand their relationships and aspects.

2.1 Role of mineral resources and health expenses

The broad literature presents that income generated from natural resources is a blessing for some economies and a curse for others (Alvarado *et al.*, 2021). Besides, studies like Anyanwu, Anyanwu, and Cieřlik (2021) described that natural resources are volatile due to the varied income distribution of the labor force and public spending. However, the present study aims to determine the impact of mineral resources on income inequality, whose relationship and aspects are discussed in this sub-section of the study. The present literature is listed as follows. The association between mineral resources and income inequality is different across different economies depending on various circumstances such as distinct income levels, resource mismanagement, etc (Sawadogo and Ouoba, 2024). Sebri and Dachraoui (2021) reviewed the nexus between natural resources and income inequality using 40 case studies with 668 estimates. The analysis showed no consistent evidence due to the different influential effects of resources on income inequality. In another study, Davis (2020) discovered that countries with abundant natural resources tend to have other income inequalities.

Such as mining economies might have higher income inequalities, while oil-producing economies do not necessarily have high levels of inequalities. Furthermore, this rule is not

universal. In a recent study, Gokhool, Tandrayen-Ragoobur, and Kasseeah (2024) demonstrated that countries with high dependence on mineral resources are resource curse economies with high levels of income inequality. The study analyzed data from 42 countries from 2000 to 2016 using GMM analysis. On a similar nexus, Avom, Ntsame Ovono, and Ongo Nkoa (2022) empirically observed a mixed interaction of natural resources on income inequality in 42 sub-Saharan economies using panel quantile regressions. The study demonstrated that some resources increase income inequality while others reduce inequality. Another research using the Driscoll-Kraay estimator indicated the negative association between natural resources and income inequality. The results depicted natural resources reduce income inequality in the study countries.

The literature is filled with studies examining health determinants (Khezrian *et al.*, 2020; Dawes, 2020). The role of health expenses on income inequality is still in debate and is documented here for clarity. Recent research discloses that the spread of infectious diseases increases income inequality, but the provision of healthcare facilities can mitigate these. Though they do not explicitly examine the impact of health expenses, the study states investing in health reduces disparities that cause diseases (Kim, Bhattacharya and Bhattacharya, 2024). Similarly, in another research, Goenka, Liu, and Pang (2024) disclosed that pandemics tend to increase income inequality and health expenses because people invest more in health during a health crisis. In innovative research, Jianu (2020) demonstrated the role of health expenses on income inequality in European member states. The empirical analysis showed that a percentage increase in health expenses reduces 0.019 points, which denotes a negative association with each other. Likewise, in the case of India, Balani, Gaurav and Jana (2023) determined a complicated two-way association between public health expenses and income disparity across different Indian states. The results depicted a mixed interaction of health expenses and income, denoting that health expenses affect income while sometimes income tends to affect health expenditures. Gaddam and Rao (2023) empirically explored the fact that health expenses increase income inequality in India. The rising health expenses increase financial uncertainty that causes income disparities. Wang and Nguyen Thi (2022) demonstrated that continuous rises in health expenses tend to raise income disparities from the year 2004 to 2017.

2.2 Role of economic growth and government effectiveness

The influence of economic growth on income inequality is a crucial topic of discussion in the prevailing literature. It is a renowned fact that economic growth can either increase or decrease income inequality for various reasons. The dual nature makes this a challenging subject of interest in academic research (Temerbulatova *et al.*, 2024). In the case of Central and Eastern European economies, Pop (2024) observed a decreasing monotonic association of growth and inequality.

This implies that economic growth and income inequality are inversely associated without any fluctuations. Similarly, in Kazakhstan, the author discloses the mixed influence of economic growth on income inequality from 1994 to 2020. The study is not uniform due to different factors influencing the relationship: trade, labour force, investment, and government consumption (Temerbulatova *et al.*, 2024). Nonetheless, the rise in the income level significantly improves taxation. Yet, Auten and Slpinter (2024) claimed that increasing government transactions and taxations significantly leads to higher levels of real income for all income groups in the US.

More recently, Sutanto *et al.* (2024) empirically assessed the strong association between economic growth and income-related variables in another study. The study demonstrated that increasing income disparities affect the economy's growth levels. Besides, the research suggested policies for limiting income disparities and poverty issues because high growth levels lessen the country's income gaps (Ngoc and Hai, 2024). Likewise, in another study on a similar nexus, Shen and Zhao (2023), the negative relationship between income inequality and economic growth, depicting increasing income disparities hampers economic growth. The study suggested increased labour compensation and enhanced the distribution system to mitigate economic income gaps. In another research, Khan, Weili, and Khan (2023) assessed the relationship and depicted that increasing economic growth tends to decrease income inequalities in developing and BRI economies. Acheampong *et al.* (2023) empirically analyzed the complex relationship between income inequality and economic growth in different economies. In Brazil, inequality and growth are inversely related, while they are positively associated in Russia, China, and South Africa. In the case of India, the effect is negative for lower-income groups but positive for high-income groups. Since technological innovation is rapidly improving worldwide. It is the financial sectors which attracts innovations via finances, which have higher social values than that of private values (Lerner *et al.*, 2024).

The association between government effectiveness and income inequality has yet to be discussed in research. The following few studies elaborate on this nexus. Along the same line, Sidek (2021) empirically explored the relationship between government effectiveness and income inequality using government expenditures for 122 sample economies. The empirical estimates demonstrated that income inequality inversely affects economic growth, while Russia, China, and South Africa positively influence the development of the economy. In innovative research, Dhital, Jiang, and Reese (2023) discovered that government effectiveness through the effective use of policies tends to limit income disparities. The study was conducted using U.S. data from 1990 to 2018. In another panel data analysis in 21 OCED nations, Ulu (2018) emphasized that increased government spending increases government effectiveness and helps lower income inequality in the study economies because income inequality is greatly influenced by government activities such as taxes, expenditures, and regulations (Vito, 1998).

Similarly, Dean *et al.* (2020) stressed that government effectiveness by taxing the rich and supporting the poor is a necessary step. Besides, better education can pave the way for a better society and income equality. These activities help reduce income disparities and increase the economy's growth (Hung *et al.*, 2020).

2.3 Impact of poverty, regulatory quality, and government stability

Cuesta, Madrigal, and Pecorari (2024) observed that poverty is strongly connected with income inequality. The study demonstrated that poverty plays an imperative role in increasing income inequality. Therefore, the study suggested limiting poverty to improve social sustainability, which will help restrict income inequality since more poverty will lead to crime and induce income disparity. Hence, the government needs to strengthen policies and limit the poverty gap to foster economic growth and reduce income disparity in the economy (Sugiharti *et al.*, 2023). On the opposite side, income inequality significantly affects the poverty levels in the country. A renowned study depicted the impact of income inequality on poverty. Though the effect was minimal, it still impacted the poverty levels in the case of Central Sulawesi Province (Darise 2023).

Similarly, Akram *et al.* (2011) observed the positive interaction of poverty with income inequality, depicting that poor governance has increased the poverty levels in the study economy. Good governance is imperative in reducing income inequality because promoting good governance is crucial for government stability, which helps minimize income disparities in the economy (Huang and Ho, 2018). Likewise, Ofori, Dossou and Akadiri (2023) described that good governance helps in economic and political stability that overall reduces income inequality in the economy.

Besides, good governance enhances the business environment and improves income distribution. Political stability, a broader term for government stability, is necessary to decrease income disparities. Political stability helps ensure governmental institutions' smooth functioning and policy implementation (Zhuang, de Dios and Martin, 2010). Dossou *et al.* (2023) empirically assessed the impact of governance quality on income inequality in 42 sub-Saharan economies. The study demonstrated that achieving fair income distribution requires enhanced governance quality. The prevention of corruption and promotion of good governance increase income equality. In contrast, Chambers and O'Reilly (2022) and McLaughlin and Stanley (2016) examined the positive nexus between regulatory quality and income inequality in different economies.

2.4 Comparative Analysis of Variables

Variable Pair	Similarities	Contrasts
Mineral resources and income inequality	Present studies suggest a heterogeneous relationship between natural resources and income inequality, depending on the resource type and country-specific factors (Sebri and Dachraoui, 2021; Davis, 2020).	Some economies experience higher inequality from mining resources, while others, especially oil-dependent ones, do not necessarily have high-income disparities (Davis, 2020).
Health expenses and income inequality	Several studies (Jianu, 2020; Goenka, Liu and Pang, 2024) show a negative association, where health expenses reduce income inequality by improving access to healthcare.	In some cases (Wang and Nguyen Thi, 2022; Gaddam and Rao, 2023), rising health expenses increase income inequality, especially in low-income populations due to financial uncertainty.
Economic growth and income inequality	Economic growth is generally found to either increase or reduce income inequality depending on the country's context (Pop, 2024; Sutanto <i>et al.</i> , 2024).	The nature of this relationship varies by region: inversely related in some economies (Brazil), while in others (China, Russia), economic growth increases inequality (Acheampong <i>et al.</i> , 2023).
Government effectiveness and income inequality	Studies (Dhital, Jiang, and Reese, 2023; Dean <i>et al.</i> , 2020) emphasize that effective government policies, such as taxation and spending, reduce income inequality.	Government effectiveness has a variable impact, where some studies (Sidek, 2021) demonstrate that poor governance and political instability can hinder equitable income distribution and even exacerbate inequality.
Poverty, regulatory quality and government stability	Most studies agree that poverty exacerbates income inequality, and good governance is essential for reducing income disparities (Cuesta <i>et al.</i> , 2024; Ofori <i>et al.</i> , 2023).	While poverty is a key driver of inequality (Akram <i>et al.</i> , 2011) In others interaction is minimal (Darise, 2023). Regulatory quality has been shown to either worsen or improve inequality, depending on context.

Source: Authors’ own elaboration

2.5 Theoretical literature

The study is grounded on resource curse theory. The primary focus of the study is on mineral resources and income inequality in China which significantly aligns with the basics of the resource curse hypothesis. The theory suggests that rich and advanced economies suffer from inequality, poor governance and resource mismanagement which is in line with the study objectives. The present study aims to inspect the interaction between mineral resource utilization and income inequality in China by addressing how government indicators influence this association by providing insights to researchers and policymakers and highlighting the effectiveness of different governmental policies and strategies to limit income disparity and promote economic stability.

Besides, the historical views and prevalent studies often supported the existence of the resource curse hypothesis but some seem to give opposing views in the case of China (Zhang and Brouwer, 2020) Badeeb, Lean and Clark, 2017).

3. Data and Methods

3.1 Data and models

Following the research objectives and previous literature, this research addresses the issue of income inequality while emphasizing the crucial role of minerals and governance policy. In this regard, the present research constructed the following research models:

Model 1

$$GI_t = \alpha_1 + \beta_1 MNR_t + \beta_2 GDPPC_t + \beta_3 CHE_t + \beta_4 GEF_t + \beta_5 POV_t + \varepsilon_t \quad (1)$$

Model 2

$$GI_t = \alpha_1 + \beta_1 MNR_t + \beta_2 GDPPC_t + \beta_3 CHE_t + \beta_4 GEF_t + \beta_5 RQ_t + \varepsilon_t \quad (2)$$

Model 3

$$GI_t = \alpha_1 + \beta_1 MNR_t + \beta_2 GDPPC_t + \beta_3 CHE_t + \beta_4 GEF_t + \beta_5 GS_t + \varepsilon_t \quad (3)$$

In the above models, the key dependent variable, *i.e.*, income inequality, is proxied via the Gini Index (G.I.). However, the regressors include the mineral rents (MNR, measured as a percent of GDP), income – is proxied via per capita gross domestic product (GDPPC, measured as constant US\$ 2015), current health expenditure (CHE, measured as a percentage of GDP), poverty headcount ratio at the societal poverty line (POV, measured as the percentage of population), and governance indicators [including Government Effectiveness (GEF), Regulatory Quality (*RQ*), and Government Stability (G.S.)]. The primary reason for considering *RQ* and G.S. in separate models is to avoid the issue of serial correlation biases. Besides, the models' intercepts are presented via α , and the variables' slopes are depicted by β . At the same time, the random error term is indicated by ε for the quarterly data from 1984Q1 to 2022Q4 in the case of China.

3.2 Estimation strategy

Quantitative techniques are utilized in this research to determine variables' descriptive statistics and normality. The present study, therefore, uses descriptive analysis to establish the median, mean, range, and standard deviation of all the factors. The minimum and the maximum are the ranges that are frequently used in empirical research. Here, the measures of Skewness and Kurtosis of the distribution of the concerned variable have been calculated in the present study. Apart from these assessments, the current study uses the test of Jarque and Bera (1987) that enables the checking for both excess Kurtosis and Skewness, which should have zero expected values. This test is frequently depicted in its conventional format as follows:

$$JB = \frac{N}{6} \left(S^2 + \frac{(K-3)^2}{4} \right) \quad (4)$$

The second step of this study's procedure is determining each variable's unit root. Engle-Granger single equation cointegration evaluation technique uses the augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979). This research used the ADF approach to analyze the stationarity properties of time series data for given stationarity tests.

Accordingly:

$$\Delta y_t = \beta_0 + \beta_{1t} + \sum u \Delta \alpha y_{t-1} + e_t \quad (5)$$

In this regard, β_{it} is a random shock variable, with Δy_{it} being the first difference of the series under consideration. In Equation 5, α is connected with y_{it-1} for the specification of a lag length that makes the error term independent. In previous literature, the Phillip-Perron and the Dickey-Fuller tests were used as econometric techniques to confirm the existence of a unit root in a series. Dickey and Fuller (1979) introduced a unit root test, which Elliott, Rothenberg and Stock (1992) modified with the GLS technique. For their argument that the modified test presents more samples and improved practical accuracy compared to traditional approaches, the researchers have presented proof. In line with the Elliott, Rothenberg and Stock (1992) study, the "DF-GLS" enabled the identification to be beneficial, mainly in situations where the mean or trend could not be identified. Against the functional form, hypothesizing the presence of a unit root.

Following the consideration of stationary behaviour, it is essential to check for a persistent relationship between the components of this study. On this basis, there are many methodologies for the analysis of time series. To analyze the cointegration phenomenon, the present study employed the evaluation technique offered by Maddala and Wu (1999) with the Johansen-Fisher cointegration assessment. The only advantage of the Johansen-Fisher cointegration approach worth mentioning is that the method is relatively more flexible than some of the other methods.

Furthermore, the Johansen–Fisher cointegration test procedure provides a convenient graphical user interface, and its theoretical background is relatively sound. Furthermore, the investigation established by Hanck (2009) argued that it is more effective than conventional assessments.

This work employs the methodology of the quantile regression, which was pioneered by Koenker and Basset Jr. (1978) of the long-run effects of the regressors after going through the time series analysis to test for normality, unit root, and cointegration. The Jarque and Bera (1987) test estimations depict a skewness distribution, making applying conventional methods to estimations impossible. Hence, this study used the quantile regression method to tackle the problem of non-normality. Further, the estimated coefficients in this study are obtained using the quantile regression approach, which provides the predicted coefficients at the given cut-off quantile to eliminate the tendency of overestimating/underestimating the calculated coefficients by the traditional methods. Due to the model's results in both the redistributive sense and mere individual variability, the quantile regression methodology is more effective than the least squares methodology in providing broader information concerning the relation between the analyzed variables (Cheng *et al.*, 2019). Also, in comparison with the conventional regression analysis, it is more potent since it offers more detail regarding the role of the regressors than the average one (Qin *et al.*, 2021). The previously mentioned regression expressions are given by the following equations, which are represented by Eq. (1), (2), and (3). It is possible to apply the suggested methodology by converting these models into quantile regression [Eq. (6), (7), and (8)], as shown below:

$$Q_{GI_t}(\theta | \beta_t) = \alpha_t + \beta_{1,\theta} MNR_t + \beta_{2,\theta} GDPPC_t + \beta_{3,\theta} CHE_t + \beta_{4,\theta} GEF_t + \beta_{5,\theta} POV_t + \varepsilon_{it} \quad (6)$$

$$Q_{GI_t}(\theta | \beta_t) = \alpha_t + \beta_{1,\theta} MNR_t + \beta_{2,\theta} GDPPC_t + \beta_{3,\theta} CHE_t + \beta_{4,\theta} GEF_t + \beta_{5,\theta} RQ_t + \varepsilon_{it} \quad (7)$$

$$Q_{GI_t}(\theta | \beta_t) = \alpha_t + \beta_{1,\theta} MNR_t + \beta_{2,\theta} GDPPC_t + \beta_{3,\theta} CHE_t + \beta_{4,\theta} GEF_t + \beta_{5,\theta} GS_t + \varepsilon_{it} \quad (8)$$

In the equations above, θ in the subscript meant quantiles of each parameter. This present study used four quantiles, which include Q25th, Q50th, Q75th, and Q90th, to scientifically examine the role played by *MNR*, *GDPPC*, *CHE*, *GEF*, *POV*, *RQ* and *GS* on G.I. in the context of China.

Once the empirical results are achieved via quantile regression, this study investigates the models' robustness via robust time series estimators. In this regard, the present study uses a non-parametric "Bootstrap quantile regression (BSQR)" approach along with the cointegration regressions, including the Fully Modified Ordinary Least Square (FMOLS), Dynamic Ordinary Least Square (DOLS), and Canonical Cointegration Regression (CCR) approaches. All these estimators offer robust empirical evidence to confirm the outputs of the quantile regression. Moreover, this study also uses the Granger causality test of Granger (1969), which evaluates the causality between the research variables.

4. Results and Discussions

4.1 Empirical results

Table 1 describes the results from the descriptive and normality test. The average values, denoted by the mean coefficient, slightly match the median coefficients. The median values below show the tendency of variables affected by outliers but less than the mean value. The variables with equality of mean and median variables depict data as balanced, such as *GDPPC*, *CHE*, and *G.S.*, which have almost similar values. The rest show an unbalanced set of data variables. Maximum and Minimum values present the highest and lowest values. The variability of the variable is denoted by standard deviation, which indicates that the data is spread around the mean values. The poverty variable has shown the highest variability, with a value of 14.46.

The normality tests measure the symmetry of the data distribution. Skewness, Kurtosis and Jarque–Bera analysis present these characteristics of data. In Table 1, Mineral rents have shown the highest value of Kurtosis, denoting higher peak and heavy-tailed distribution with a 5.28 statistical value. Besides, the value of Skewness is also higher for Mineral rents, with a 1.82 statistical value indicating right-tailed or fatter-tailed distribution. The same goes for Jarque–Bera’s statistics. The economic growth variable has the lowest statistics for Kurtosis, Skewness and Jarque–Bera analysis, with 1.66 Kurtosis and -0.11 Skewness values, respectively. The probability values further confirm the deviation from a normal distribution of the study variables.

Table 1: Descriptive statistic and normality test

	<i>GI</i>	<i>MNR</i>	<i>GDPPC</i>	<i>CHE</i>	<i>POV</i>	<i>GEF</i>	<i>RQ</i>	<i>GS</i>
Mean	38.21909	0.589252	3.486331	4.568003	40.25744	0.030636	−0.311355	0.930067
Median	40.50000	0.361148	3.481238	4.402405	36.84799	−0.124513	−0.294017	0.937580
Maximum	43.20000	2.362211	4.085433	5.593597	72.00000	0.809332	−0.179301	1.079181
Minimum	27.70000	0.124862	2.775393	3.674914	20.60000	−0.348654	−0.582766	0.602060
Standard deviation	4.571635	0.576260	0.408134	0.440282	14.46218	0.314149	0.069103	0.116342
Skewness	−0.831332	1.822814	−0.105670	0.814718	0.357368	0.780885	−1.193307	−1.361450
Kurtosis	2.409388	5.275542	1.663315	2.984628	1.919583	2.275088	5.211462	4.542495
Jarque–Bera	20.75518	123.1246	12.20928	17.70197	11.18767	19.76415	70.57657	65.28981
Probability	0.000031	0.000000	0.002232	0.000143	0.003721	0.000051	0.000000	0.000000
Observations	160	160	160	160	160	160	160	160

Source: Calculated and organized by the authors to get

Table 2 shows the outcomes from the Unit root analysis. Data stationarity depicts that mean, variance, and autocorrelation are constant with time. The study used the Augmented Dickey–Fuller test and the Dickey–Fuller Generalized Least Square test for this purpose. In both tests, at level $I(0)$, few variables have shown stationarity, while after required differencing at the first difference $I(1)$, most variables become stationary. In *ADF*, *GDPPC* is stationary, while the rest becomes stationary after the first difference. In the DF-GLS test, *MNR*, *POV*, and *RQ* are stationary at level, and the rest become stationary after the first difference, as presented below. The Asterisks show the significant statistics with respective coefficient values in the table.

Table 2: Unit Root Estimates

Variable	ADF		DF-GLS	
<i>GI</i>	−6.401***	—	−0.668	−3.762***
<i>MNR</i>	−1.305	−5.086***	−3.092**	—
<i>GDPPC</i>	−5.281***	—	−0.248	−2.726**
<i>CHE</i>	1.424	−4.424***	−1.533	−4.630***
<i>POV</i>	−0.942	−5.986***	−5.896***	—
<i>GEF</i>	0.574	−4.991***	−2.543	−5.269***
<i>RQ</i>	−1.591	−5.539***	−4.036***	—
<i>GS</i>	−0.780	−4.280***	−2.380	−3.862***

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

Table 3 shows the results from cointegration for three Models (1, 2 and 3). In Model 1, the null hypothesis is rejected for none and At most, 1, 2, and 3 cointegrating equations suggest the variables have significant long-term relationships in the data. The overall results depict that there are likely 3 or 4 correlations among the study variables. In Model 2, the null hypothesis of no cointegration is rejected at none with a p -value of 0.01. The overall results show up to 2 to 3 prominent cointegrating associations.

Similarly, for Model 3, 3 to 4 cointegrating associations depict a strong cointegration or long-term equilibrium among the study variables. The complete cointegration estimates show an indication of long-term correlation among the study variables. However, Models 1 and 3 show strong cointegration, while Model 2 shows a comparatively weaker presence of cointegrating vectors.

Table 3: Cointegration estimates

Model 1			
Hypothesis no. of CE(s)	Eigenvalue	Trace Stats	Max-Eigen Stats
None *	0.408	191.057***	80.618***
At most 1 *	0.260	110.440***	46.448***
At most 2 *	0.190	63.992***	32.533**
At most 3*	0.104	31.459**	16.844
At most 4	0.069	14.615*	10.931
At most 5	0.024	3.684*	3.684*
Model 2			
Hypothesis no. of CE(s)	Eigenvalue	Trace Stats	Max-Eigen Stats
None *	0.249	129.391***	45.017***
At most 1 *	0.205	84.374***	36.037***
At most 2	0.143	48.336***	24.283**
At most 3	0.091	24.054*	14.943
At most 4	0.052	9.110	8.445
At most 5	0.004	0.665	0.665
Model 3			
Hypothesis no. of CE(s)	Eigenvalue	Trace Stats	Max-Eigen Stats
None *	0.424	216.021***	0.424***
At most 1 *	0.312	131.189***	0.312***
At most 2 *	0.215	73.585***	0.215**
At most 3	0.131	36.299***	0.131
At most 4	0.075	14.619*	0.075
At most 5	0.017	2.665	0.017

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

The study moves towards the regression analysis, the outcomes of which are presented in Table 4. In Model 1, the influence of mineral resources on income inequality is given first, indicating a negative association with the dependent variable in all quantiles. This shows that increasing mineral rents decreases income inequality in the country. The higher the quantile, the higher the effect. Second, the impact of GDPPC is strongly positive on income inequality in China. This shows that increasing economic growth per capita will increase income inequality in the country, suggesting that when per capita rises, inequalities also rise in all quantiles. Third, the role of health expenses is negative in all quantiles, which depicts an inverse association. With increasing quantile, the impact becomes more negative and significant. Fourth, the poverty effect on income inequality is small, but it is primarily negative. However, the effect loses its significance in the higher quantiles. Fifth, the role of government effectiveness is also negative across all quantiles, showing that increasing government effectiveness helps decrease income inequality in the country. The graphical explanation of Model 1 variables for each quantile is presented in Figure 4 below. Each variable's quantile movement shows how dependent and independent variables interacted.

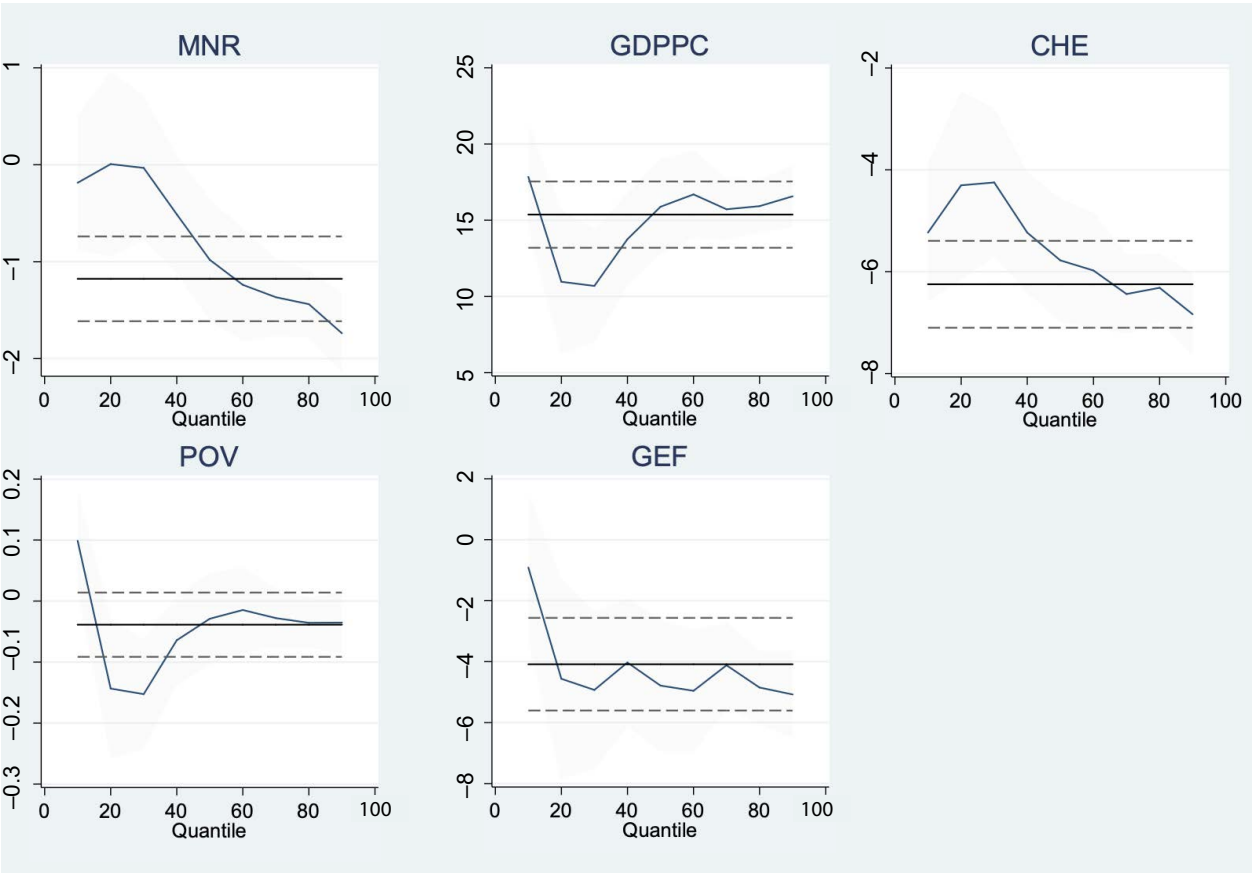
Table 4: Quantile estimates for Model 1

Variable	Coefficient at Q0.25 [Std. Er.]	Coefficient at Q0.50 [Std. Er.]	Coefficient at Q0.75 [Std. Er.]	Coefficient at Q0.90 [Std. Er.]
<i>MNR</i>	−0.063 [0.381]	−0.981*** [0.315]	−1.382*** [0.164]	−1.738*** [0.207]
<i>GDPPC</i>	11.669*** [1.895]	15.881*** [1.566]	15.429*** [0.816]	16.566*** [1.031]
<i>CHE</i>	−4.277*** [0.742]	−5.778*** [0.613]	−6.417*** [0.320]	−6.836*** [0.404]
<i>POV</i>	−0.133*** [0.046]	−0.029 [0.038]	−0.035* [0.020]	−0.035 [0.025]
<i>GEF</i>	−5.164*** [1.322]	−4.785*** [1.093]	−4.121*** [0.570]	−5.076*** [0.720]
Constants	22.142*** [7.994]	11.291* [6.606]	16.761*** [3.444]	15.238*** [4.350]

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

Figure 4: Quantile coefficients (QR) for Model 1



Source: Calculated and organized by the authors to get

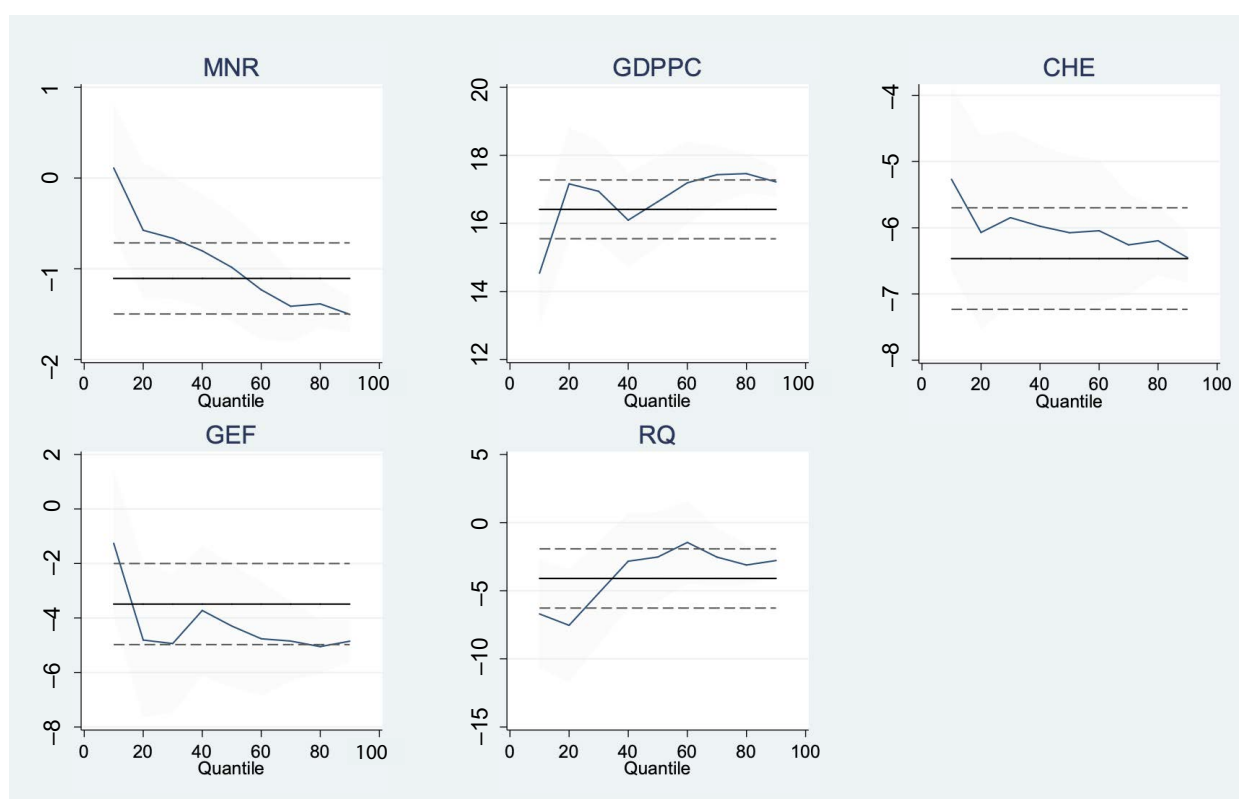
Table 5 shows the results from quantile regression estimates for Model 2. First, the role of mineral resources is negative across all quantiles, as shown in model 1 above. However, the magnitude is lower than the first model. Second, the role of GDP per capita is positive across all quantiles, which is quite similar to model 1 above. Third, the influence of CHE and GEF is similar to the outcomes presented in model 1, which depicts a robust negative impact at higher quantiles. Instead of poverty, the role of regulatory quality is assessed on income inequality in this model, which depicts a negative association with income inequality. It shows that increasing the country's regulatory quality helps lessen income inequality. The graphical presentation is presented in Figure 5 below. The graph below visually presents the estimated coefficients of all variable's quantiles.

Table 5: Quantile estimates for Model 2

Variable	Coefficient at Q0.25 [Std. Er.]	Coefficient at Q0.50 [Std. Er.]	Coefficient at Q0.75 [Std. Er.]	Coefficient at Q0.90 [Std. Er.]
MNR	-0.634 [0.403]	-0.984*** [0.301]	-1.356*** [0.170]	-1.502*** [0.099]
GDPPC	17.240*** [0.889]	16.638*** [0.664]	17.473*** [0.376]	17.219*** [0.219]
CHE	-5.892*** [0.789]	-6.075*** [0.589]	-6.173*** [0.334]	-6.452*** [0.195]
GEF	-5.202*** [1.531]	-4.294*** [1.143]	-5.001*** [0.647]	-4.851*** [0.378]
RQ	-6.087*** [2.237]	-2.520 [1.670]	-2.875*** [0.945]	-2.778*** [0.552]
Constants	3.134 [5.169]	7.991** [3.859]	6.239*** [2.184]	8.766*** [1.275]

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

Figure 5: Quantile coefficients (QR) for Model 2

Source: Calculated and organized by the authors to get

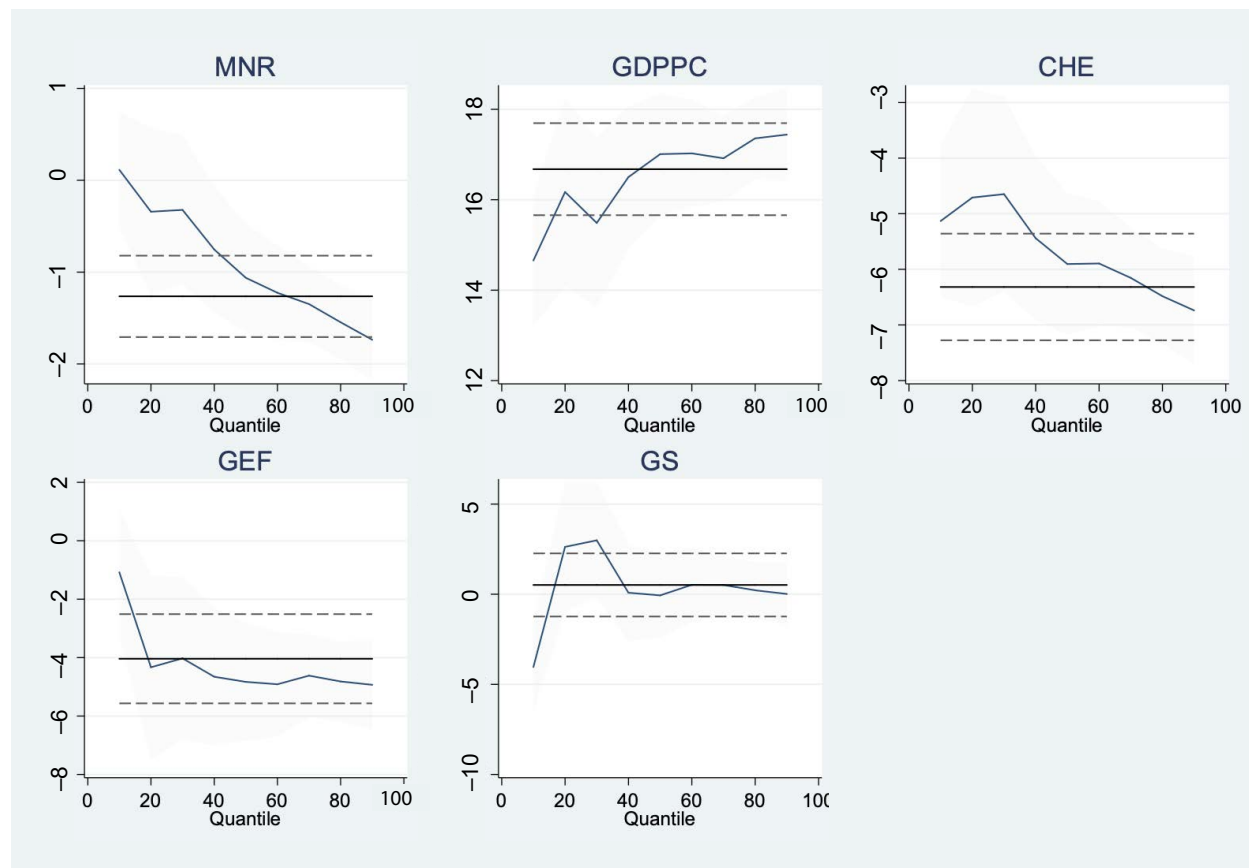
Table 6 presents the outcomes from model 3 using quantile regression. The findings of Model 3 are consistent with Model 1 and Model 2's direction, particularly for the variables *MNR*, *GDPPC*, *CHE* and *GEF*. However, the magnitude of the effect might be higher or lower. Moreover, the additional variable in Model 3, Governmental Stability, has not shown any significant influence on income inequality, depicting that government stability has little to do with income disparity in the economy. The graphical analysis of these variables and their estimated coefficient movements across all quantiles is presented in Figure 6 below.

Table 6: Quantile estimates for Model 3

Variable	Coefficient at Q0.25 [Std. Er.]	Coefficient at Q0.50 [Std. Er.]	Coefficient at Q0.75 [Std. Er.]	Coefficient at Q0.90 [Std. Er.]
<i>MNR</i>	−0.341 [0.482]	−1.062*** [0.296]	−1.495*** [0.202]	−1.737*** [0.225]
<i>GDPPC</i>	16.062*** [1.108]	17.010*** [0.680]	16.962*** [0.463]	17.441*** [0.517]
<i>CHE</i>	−4.674*** [1.043]	−5.905*** [0.641]	−6.442*** [0.436]	−6.738*** [0.487]
<i>GEF</i>	−4.611*** [1.661]	−4.828*** [1.020]	−4.395*** [0.695]	−4.932*** [0.775]
<i>GS</i>	2.713 [1.903]	−0.065 [1.169]	0.647 [0.796]	0.018 [0.888]
Constants	0.880 [6.231]	6.870* [3.828]	9.565*** [2.607]	10.316*** [2.907]

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

Figure 6: Quantile coefficients (QR) for Model 3

Source: Calculated and organized by the authors to get

The study now employs Bootstrap Quantile Regression for robustness analysis to provide an alternate estimation process that helps check the reliability and consistency of the above models' results. After careful assessment of the estimated results, it is confirmed that the findings are consistent in terms of the direction and significance of the results. The magnitude is slightly different, but the overall method provided consistent signs that validated the original outcomes for Models (1, 2, and 3) disclosed above. *GDPPD*, *CHE*, *GEF*, *MNR*, *POV*, *RQ*, and *GS* have presented reliable outcomes depicting the empirically assessed relationship robust to income inequality in the Chinese economy. In other words, the role of *GDPPD*, *CHE*, *GEF*, *MNR*, *POV* and *RQ* is crucial in determining income inequality. The visual presentation of the estimated robust models is shown in Figures 7, 8, and 9 below. Each model coefficient across all quantiles can be visually seen in the figures.

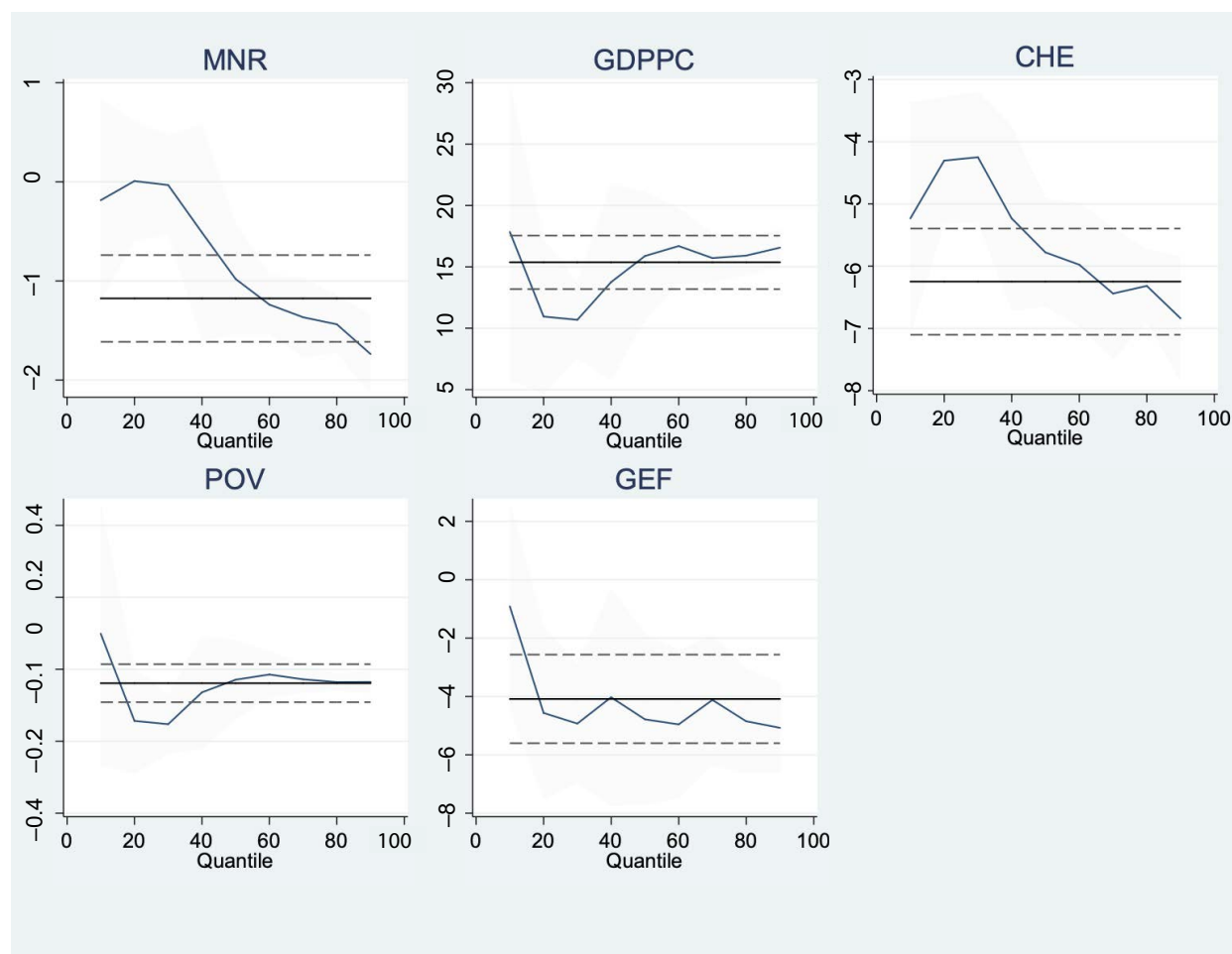
Table 7: Robustness via non-parametric (Bootstrap quantile regression) approach

Model 1				
Variable	Coefficient at Q0.25	Coefficient at Q0.50	Coefficient at Q0.75	Coefficient at Q0.90
<i>MNR</i>	−0.063	−0.981***	−1.382***	−1.738***
<i>GDPPC</i>	11.669***	15.881***	15.429***	16.566***
<i>CHE</i>	−4.277***	−5.778***	−6.417***	−6.836***
<i>POV</i>	−0.133	−0.029	−0.035	−0.035***
<i>GEF</i>	−5.164***	−4.785***	−4.121***	−5.076***
Constants	22.142	11.291	16.761***	15.238***
Model 2				
<i>MNR</i>	−0.634**	−0.984***	−1.356***	−1.502***
<i>GDPPC</i>	17.240***	16.638***	17.473***	17.219***
<i>CHE</i>	−5.892***	−6.075***	−6.173***	−6.452***
<i>GEF</i>	−5.202***	−4.294**	−5.001***	−4.851***
<i>RQ</i>	−6.087**	−2.520*	−2.875***	−2.778**
Constants	3.134	7.991	6.239**	8.766
Model 3				
<i>MNR</i>	−0.341	−1.062***	−1.495***	−1.737***
<i>GDPPC</i>	16.062***	17.010***	16.962***	17.441***
<i>CHE</i>	−4.674***	−5.905***	−6.442***	−6.738***
<i>GEF</i>	−4.611**	−4.828***	−4.395***	−4.932***
<i>RQ</i>	2.713	−0.065	0.647	0.018
Constants	0.880	6.870	9.565***	10.316**

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

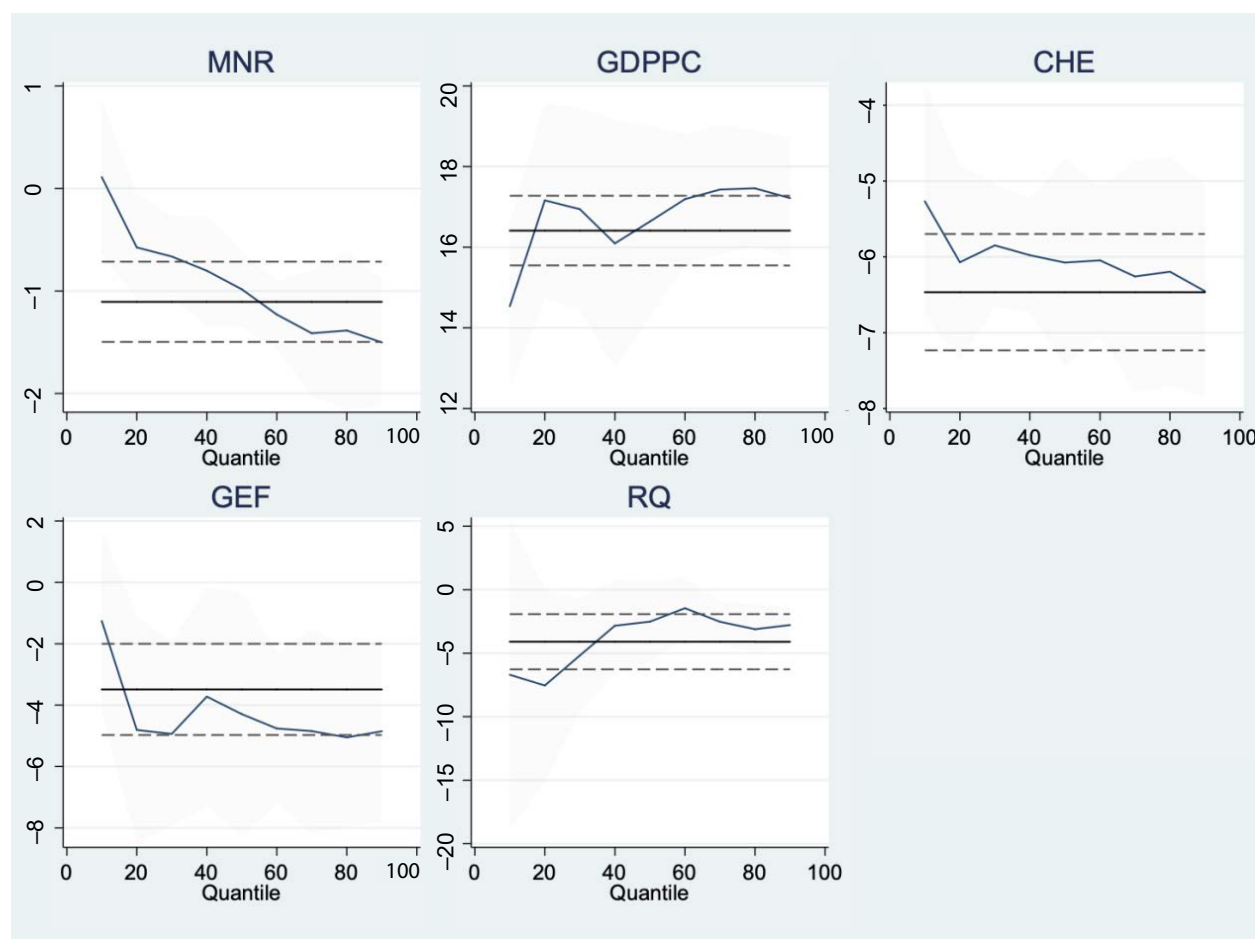
Source: Calculated and organized by the authors to get

Figure 7: Quantile coefficients (BSQR) for Model 1



Source: Calculated and organized by the authors to get

Figure 8: Quantile coefficients (BSQR) for Model 2



Source: Calculated and organized by the authors to get

Figure 9: Quantile coefficients (BSQR) for Model 3

Source: Calculated and organized by the authors to get

Now, the study utilizes the three different cointegration methods to check the robustness of the estimated results and models. these verify the long-term stability and consistency of the variables in different models. Again, every variable showed consistent results and validated the robustness of the models and estimated results. The relationship indicated through the quantile regressions is robust and reliable across all models, confirming the findings are reliable.

Table 8: Robustness via cointegration regressions

Model 1						
FMOLS			DOLS		CCR	
Variable	Coefficient	Std. Er.	Coefficient	Std. Er.	Coefficient	Std. Er.
<i>MNR</i>	−1.384***	0.438	−1.379**	0.582	−1.359***	0.408
<i>GDPPC</i>	15.694***	2.199	15.501***	3.551	15.592***	1.986
<i>CHE</i>	−6.452***	0.853	−6.494***	1.102	−6.425***	0.822
<i>POV</i>	−0.040	0.053	−0.043	0.089	−0.042	0.049
<i>GEF</i>	−4.141***	1.526	−4.095**	1.865	−4.116***	1.453
Constants	15.550*	9.261	16.634	14.879	15.830*	8.569
Model 2						
<i>MNR</i>	−1.237***	0.396	−1.201**	0.480	−1.221***	0.383
<i>GDPPC</i>	16.604***	0.886	16.459***	1.063	16.573***	0.835
<i>CHE</i>	−6.594***	0.777	−6.435***	0.968	−6.574***	0.758
<i>GEF</i>	−3.381**	1.513	−3.285*	1.869	−3.364**	1.436
<i>RQ</i>	−4.285*	2.200	−4.607*	2.765	−4.296**	2.121
Constants	9.941*	5.114	9.383	6.443	9.949**	4.883
Model 3						
<i>MNR</i>	−1.532***	0.441	−1.509***	0.527	−1.492***	0.416
<i>GDPPC</i>	17.137***	1.037	16.935***	1.209	17.046***	0.944
<i>CHE</i>	−6.752***	0.954	−6.808***	1.169	−6.676***	0.911
<i>GEF</i>	−3.887**	1.520	−3.758**	1.876	−3.881***	1.439
<i>GS</i>	−0.160	1.761	0.196	1.969	−0.001	1.636
Constants	10.505*	5.684	11.317	7.234	10.307*	5.446

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

Following the regression outcomes, this research tested the multicollinearity for each of the research model and the estimations are described in Table 9. The results asserted that the individual (variable) variance inflating factor (VIF), and the mean VIF are lower than ten. This indicates that there is no evidence of severe multicollinearity in the research models.

Table 9: Testing multicollinearity (VIF)

Variable	Model 1	Model 2	Model 3
<i>GDPPC</i>	4.63	6.88	7.79
<i>MNR</i>	3.27	2.81	3.32
<i>GEF</i>	1.72	2.09	1.71
<i>CHE</i>	7.26	6.31	7.07
<i>POV</i>	2.95	—	—
<i>RQ</i>	—	1.25	—
<i>GS</i>	—	—	2.11
Mean VIF	3.97	3.87	4.40

Source: Calculated and organized by the authors to get

In order to estimate whether one series forecasts the other, we apply causality analysis. The study employs the Granger causality analysis, the estimated outcomes of which are displayed in Table 10. Few variable pairs have shown a bidirectional association, while the rest have unidirectional relationships. For instance, *GDPPC* and *GI*, as well as *CHE* and *GI*, have bidirectional granger associations that denote complex relationships with each other. While *MNR*, *POV*, *GEF*, *RQ*, and *GS* are unidirectionally associated with the Gini coefficient (*GI*), indicating these variables affect income inequality and are not affected by income inequality.

Table 10: Granger causality estimates

Pairwise Granger Causality Tests		
<i>H₀:</i>	<i>F-Statistic</i>	<i>Prob.</i>
<i>MNR → GI</i>	2.146	0.145
<i>GI → MNR</i>	0.162	0.688
<i>GDPPC → GI</i>	21.295***	0.000
<i>GI → GDPPC</i>	55.580***	0.000
<i>CHE → GI</i>	10.005***	0.002
<i>GI → CHE</i>	3.543*	0.062
<i>POV → GI</i>	10.979***	0.001
<i>GI → POV</i>	2.684	0.103
<i>GEF → GI</i>	8.310***	0.005
<i>GI → GEF</i>	1.543	0.216
<i>RQ → GI</i>	14.575***	0.000
<i>GI → RQ</i>	0.131	0.718
<i>GS → GI</i>	9.107***	0.003
<i>GI → GS</i>	2.479	0.117

Note: $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.10$ (*).

Source: Calculated and organized by the authors to get

4.2. Discussion of findings

The estimated results are, in one way or another, consistent with the prevailing studies, reflecting nuanced outcomes. First, the nexus between negative mineral resource utilization and income inequality is in line with the study of (Avom, Ntsame Ovono and Ongo Nkoa, 2022). The results claim that some natural resources tend to reduce income inequalities, and mineral resources in China help in limiting income inequality. This implies that natural resources help reduce income disparities by providing resource revenues to the people, properly allocating resources, and providing direct benefits to lower-income groups. Besides, studies suggest that countries experience both negative and positive effects of natural resources on the economy depending

on how the resources are managed (Acheampong *et al.*, 2023). Second, the role of economic growth is positive in the study economy, indicating that increasing economic growth raises income inequality. This result is comparable to the study of (Acheampong *et al.*, 2023) which empirically analyzed the complex relationship in different economies. Among the study nations, China and South Africa showed a positive interaction between economic growth and income inequality. Third, improved health expenses tend to limit income disparities in the country. The nexus result is comparable to the study (Jianu, 2020), implying that the role of health expenses on citizens tends to lower the income inequality ratio significantly. Fourth, the role of government effectiveness on income inequality is also significantly negative, depicting that the effective use of policies tends to limit income disparities. Governmental activities help reduce income disparities and increase economic growth. Economies with strong institutions and regulatory frameworks tend to meaningfully manage their resources by avoiding the resource curse (Hung *et al.*, 2020). This nexus result is comparable to the findings of (Dhital, Jiang, and Reese, 2023). Fifth, the interaction between poverty and income inequality is also negative but insignificant. The relationship is weak, but it shows limiting the poverty index is necessary to remove income disparities in the country. more poverty always attracts crime and induces income disparity. Henceforward, the government must strengthen policies and limit the poverty gap to foster economic growth and reduce income disparity (Sugiharti *et al.*, 2023). Lastly, the role of regulatory quality is significant in the study, which depicts the presence of good governance that helps control regulatory quality. The literature suggests that good governance enhances the business environment and improves income distribution. It ensures the smooth functioning of governmental institutions and stresses effective policy implementation. Also, regulatory quality as well as government effectiveness tend to stabilise economies and limit income disparities making resources a blessing in the country (Zhuang, de Dios and Martin, 2010; Dossou *et al.*, 2023).

The above comparison of the results with the prevalent literature shows how governmental-related factors are important in influencing income distribution. The discussion implies that to address income disparities and remove the rich-poor gap, economic as well as governmental factors are necessary for formulating policies that contribute to better income distribution.

5. Conclusion and Policy Implications

The present research provides interesting insights into the factors affecting income inequality, reflecting the multifaceted nature of the variable. The present paper investigates the role of mineral resources combined with a few governmental policies in influencing income inequality in China using a historical dataset from 1984 to 2023. The estimated outcomes highlight the significance of comprehensive policy implementation that helps promote sustainable development and limits

the poverty gaps by emphasizing fair income distribution and equitable regulations crucial for a sustainable society and economic progression. Hence, based on the study findings, the following are some policy recommendations.

First, the negative association of mineral resources suggests effective management. The revenues collected from mineral rents must be appropriately allocated or funded for services like education and healthcare. This helps the lower-income groups by bridging the rich-poor gap because the underprivileged are often deprived of necessities like health and education. In addition, China can adopt a customized resource management revenue system in resource-abundant regions. This system will help local communities in which local governments directly invest by addressing regional inequality effectively. Moreover, the wealth generated from these resources can be utilized by sustainable industries to promote sustainable growth.

Second, economic growth is the backbone of economic development. Therefore, the study suggests implementing tax reforms targeting the rich for even distribution of income and resources. Growth boosts the economy, but effective strategies such as welfare and tax systems help the country's vulnerable and poor income groups. Similarly, implementing government policies that address income disparities is necessary. Transparency and accountability of governance help in this regard because ensuring that public funds are utilized for intended programs will help limit income inequality. Likewise, poverty cannot be condensed alone. It will be reduced when the system is efficient and focuses on cultivating low-income people. Improving the living conditions of lower and middle-income groups helps reduce poverty and income inequality. Poverty induces crime in the country because when people have nothing to eat. They will turn to illegal and criminal activities to fulfil their needs. Hence, it is necessary to address poverty by providing educational and employment opportunities to the people, especially those experiencing poverty, to build a stable foundation for society.

Third, investing in healthcare facilities for lower-income groups will help alleviate the financial pressure on poor people. Hence, subsidizing health facilities will not only improve the citizens' health but also decrease the income inequality in the country because healthy people give healthy societies and increase the overall productive capacity of the economy. The resource-abundant regions likely face environmental difficulties due to mining activities. Therefore, certain policies focused on improving health infrastructure in these areas are required to limit health crises among citizens.

The study has the following limitations and future recommendations. The study uses limited variables to investigate income inequality in China. Hence the study suggests incorporating variables like technological advancement, international trade, and foreign investment to fully understand the concept more deeply for future purposes. Second, the study can be resourceful

if it is simulated for other countries or regions within China, especially resource-abundant economies/regions by using comparative analysis between different types of resources. Therefore, future research focuses on specific regions or provinces within China or other resource-abundant economies for a nuanced understanding of income inequality and overall economic progress.

Abbreviations

GMM	Generalized Methods of Moments
FMOLS	Fully Modified Ordinary Least Squares
DOLS	Dynamic Ordinary Least Squares
CCR	Canonical Cointegrating Regression
MNR	Mineral Rents
GDPPC	Per Capita Gross Domestic Product
CHE	Current Health Expenditure
GEF	Government Effectiveness
<i>RQ</i>	Regulatory Quality
POV	Poverty
G.S.	Government Stability
G.I.	Gini Index

Acknowledgement

This work was supported by the Social Sciences Planning Youth Project of Anhui Province (Grant No. AHSKQ2022D046).

Conflicts of interest

The authors hereby declare that this article was not submitted or published elsewhere. The authors have no conflicts of interest to disclose.

AI usage statement: The author confirms that no artificial intelligence (AI) or AI-assisted tools were used in the creation of this manuscript.

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