

Maqsut Narikbayev University
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MASTER'S DISSERTATION

«Determinants of income inequality»

7M0124 - «Economics»

«__» _____ 20__

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Astana, 2024

Abstract of Determinants of income inequality
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May 2024

Income inequality is one of the biggest challenges for many countries as it can affect economic growth, inflation, unemployment, etc. This study focuses on the example of Kazakhstan, where President Tokayev stated that income inequality has reached unacceptable levels. The research question addressed is the impact of economic growth on income inequality in Kazakhstan.

The study used a positivist approach and quantitative methods for analyzing panel data for the period from 2000 to 2021, covering 14 regions of Kazakhstan. The analysis focuses on the relationship between GDP per capita and the Gini coefficient, a widely used measure of income inequality. However, in this case, the problem of reverse causality arises, then if not only economic growth affects income inequality, but also vice versa. To address this issue, the study is based on different methods. The study uses three methods to analyze the relationship between income inequality and economic growth: OLS method, panel data method (fixed effects model, random effects model) and instrumental variable model.

The results of the analysis indicate a negative relationship between economic growth and income inequality in Kazakhstan. In particular, as GDP per capita increases, the Gini coefficient tends to decrease, suggesting that economic growth is associated with a more equal distribution of income.

An instrumental variable (IV) model that addresses potential endogeneity issues provides the most robust estimate of this relationship. The results of the IV regression model support the hypothesis that economic development can lead to a more equitable distribution of income in Kazakhstan.

These findings have important policy implications for Kazakhstan. However, it is critical for policymakers to consider other factors that influence income distribution, such as education, social welfare programs, and institutional factors.

In conclusion, this study contributes to the existing literature by providing empirical evidence of the relationship between economic growth and income inequality in Kazakhstan. It highlights the importance of economic development in achieving more equitable income distribution and provides valuable information for socio-economic policy development.

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1. Introduction

High economic growth, low unemployment and inflation, and low inequality and poverty are the most desirable economic conditions for any state. Particular attention is paid to income inequality because its negative consequences can affect economic growth, inflation and unemployment, and there are many other negative consequences of inequality. Inequality, being one of the most serious problems for many countries, affects the economy, political stability, crime, public health, level of trust in society, etc. This problem is of particular importance for Kazakhstan because, as President Tokayev noted, inequality has reached unacceptable levels. (TengriNews, 2022)

Economic growth is the most important process for the economy of any country, since it has a positive effect on the standard of living of the population and the competitiveness of the national economy. However, it can influence inequality, which is one of the most serious problems for many countries, so it is necessary to test the existence of their relationship and determine its nature.

The literature review presented in the next section indicates a sufficient number of sources both on the topic of income inequality and on the topic of the relationship between income inequality and economic growth. However, these studies have given different results, so there is no consensus on the presence and nature of this relationship, thus there is no single formula suitable for each country. This study will fill the research gap by focusing on Kazakhstan and assessing the impact of economic growth on income differentiation.

The research question: "How does economic growth affect income inequality in Kazakhstan?" Quantitative methods are most relevant to answer this research question. After analyzing the secondary data, it is planned to estimate the linear regression model and analyze the impact of economic growth on income inequality.

2. Literature review

There is a large body of literature that describes the theoretical aspects of income inequality, its content, measurement, and ways to reduce. There are several sources whose authors are well known for their work in the field of inequality, these are Branko Milanovic and Thomas Piketty.

T.Piketty, in *The Economics of Inequality* (2015), emphasizes the importance of a detailed analysis of the socio-economic drivers of income inequality, which is an essential step towards developing effective policies to reduce inequality. Much attention is also paid to ways to reduce inequality and the conditions under which it can be implemented.

B.Milanovic and M. Ranaldi in *Capitalist systems and income inequality* (2022) discuss types of inequality, such as compositional inequality and inter-personal inequality, ways to measure income inequality (the main indicator is the Gini coefficient). In this article, much attention is paid to the ownership of factors of production (labor and capital) as the main factor of inequality.

There are also articles on income inequality in Kazakhstan, which describe the specifics of the problem of inequality in our country.

M. Shahbaz, M. Bhattacharya & M. Kumar Mahalik (2017) examine the relationship of variables such as economic growth, education, financial development, democracy, FDI, and inequality using Kazakhstan data over a long period of time since 1991. As a result, the positive effect of financial development and democracy on income inequality was revealed (that is, with the growth of these indicators, inequality grows) and the negative effect of economic growth, improving the quality of education and its popularization, and the growth of FDI.

The authors identified an important problem for Kazakhstan: the underdevelopment of the financial sector. According to the results of the empirical analysis, financial development reduces inequalities only in the early stages of the transition period, then it negatively affects income equality.

Despite the high importance of the problem of inequality in Kazakhstan, there is a lack of work on this topic, especially work on the study of the relationship between inequality and economic growth. However, there is an article (B. Mukhamediyev, T. Kudasheva, A. Khitakhunov (2018)) that examines the impact of various macroeconomic indicators on income inequality in Kazakhstan. One of the main conclusions of the study is that the growth of real GDP reduces income inequality in the country.

The next large body of literature explores the relationship between inequality and economic growth. A review of the literature showed that investigators obtain varying results in their research. The reviewed articles conducted empirical studies of the relationship between income inequality and economic growth in various countries. Based on the correlation results, articles can be divided into 3 groups: those that found a positive relationship between income inequality and economic growth, those that found a negative relationship, and those that found no effect. It is important to note that most articles examine the impact of inequality on economic growth. However, this situation raises the problem of reverse causality, that is, economic growth also affects income inequality. There are studies that mention this problem (M. Brueckner and D. Lederman, 2018), but there is a dearth of studies examining how economic growth exacerbates inequality or contributes to its reduction.

Some studies have obtained different results in their papers. For example, M. Brueckner and D. Lederman studied this relationship depending on countries' initial incomes. As a result of the study, they concluded that rising inequality stimulates economic growth in low-income countries and holds back economic growth in high-income countries.

E. Cammeraat, having studied the relationship of social spending with inequality and economic growth, states that if inequality is reduced through social spending, this has no effect on economic growth. There is an article (S. Biswas, I. Chakraborty, R. Hai) which examines the reduction of inequality through taxation. This leads to a decrease in economic growth.

Y. Yang and T. Greany obtained different results depending on the period, in the short run no effect was found, but in the long run they found a positive relationship, that is, higher inequality increased economic growth in China, Japan and the United States.

Aiyar and Ebeke found out that the relationship between inequality and economic growth depends on the "nature" of inequality. If there is high inequality of opportunity, then it has a negative effect on growth; if inequality of results, then there is no effect.

Researchers studying the relationship between inequality and economic growth use a variety of methodologies in their research. The reviewed studies use panel data at the level of countries and regions.

Speaking about the methodology, it is important to mention the problem of reverse causality, that is, not only inequality affects economic growth, but vice versa. M. Brueckner and D. Lederman in *Inequality and economic growth: the role of initial income* (2018) point to the possibility of reverse causation, where higher GDP per capita may lead to less inequality.

To address this problem of mutual causation, the authors apply an instrumental variables (IV) approach. Instrumental variables are used to provide more reliable identification of causal relationships between variables.

In this case, the authors use instrumental variables to avoid bias in estimates due to reverse causation. They seek to eliminate the possibility that higher GDP per capita causes less inequality, and vice versa.

However, the authors note that the instrumental variable approach is not ideal for estimating the causal relationship between inequality and GDP per capita in a richer model where income distribution is determined by social policies, changes in tax policy, trade policy, or immigration policy. which can directly affect economic growth and are difficult to measure in the context of cross-country time series.

Thus, the use of instrumental variables is one of the methods that econometricians can apply to address the problem of mutual causality in research on inequality and economic growth.

However, depending on the complexity of the model and the availability of relevant data, additional methods and strategies may be required to analyze this relationship more fully.

Based on a review of the literature, we can conclude that the relationship between economic growth and income inequality is determined by many factors: average income in the country, state social policy to reduce inequality, the “nature” of income inequality, etc. That is, to determine this dependence must take into account the characteristics of national economies. Because of the many factors that influence inequality, economic growth, and their interrelationships, researchers get different results for different countries and different conditions. Therein lies the complexity and importance of this research question.

3. Theoretical Framework and Methodology

Income inequality is a matter of political debate. According to the first position (the position of the right), the state should have a limited influence on the economy, relying on market forces and individual initiative of citizens, thanks to which the distribution of income will be efficient. The position of the left, on the contrary, is to increase the influence of the government and, using various tools, redistribute the incomes of the population. This conflict speaks to a different understanding of inequality: inequality of opportunity or inequality of outcomes (T. Piketty, 2015).

Inequality is divided into two categories: primary is inequality of opportunity, and residual is inequality of effort (or inequality of outcomes). Inequality of opportunity refers to personal outcomes, depending on circumstances or factors such as gender, nationality, financial status of parents, place of residence, etc. Inequality of opportunity has a negative effect on the income growth of the poor, but positively on the increase in the income of the rich. This prevents the accumulation of human capital for the poorest segments of the population, reduces investment in human capital, and therefore negatively affects economic growth (Aiyar and Ebeke, 2020). Another important aspect of this type of inequality is the perception by society. Evaluating inequality of opportunity as "unfair" causes social tension in society and can cause conflicts

between the poor and the rich. Inequality of results is considered socially acceptable, it is also called "fair", because it is obvious that those who work more - earn more, in this case, low incomes are a person's choice. Therefore, it is inequality of opportunity that is of the greatest interest for research.

Based on the literature review, we concluded that the relationship between inequality and economic growth depends on many factors. Therefore, and in order to better understand the "nature" and significance of income inequality, it is important to identify its factors.

According to Samoilov A. (2017) there are 2 types of inequality: inequality arising from the concentration of capital in the hands of certain groups, and inequality resulting from the uneven distribution of labor income. Thus, ownership of the factors of production - labor and capital - is a key factor in inequality. Capital ownership is inextricably linked to the problem of inequality of opportunity, since the capital accumulated by previous generations can be used to multiply incomes. However, the labor factor affects both inequality of opportunity and inequality of outcomes. To move up the career ladder and increase income, efforts must be made, but due to the imperfection of institutions, this can be affected not only by the personal efforts of each individual, but also by some external circumstances.

But apart from them, there are many factors that affect income inequality: macroeconomic, innovative, institutional, social.

The first group of factors is macroeconomic. Firstly, unequal exposure to macroeconomic fluctuations in various industries (for example, the crisis of 2020 suffered the greatest losses for firms operating in the service sector). Secondly, exchange rate fluctuations (which concern companies engaged in international trade). The group of macroeconomic factors also includes inflation, unemployment, average wages. (B. Nalam, M. Richiardi, L. Valenzuela, 2019)

Technological progress and the development of innovations lead to an increase in the level of education, the qualification of the workforce and to the growth of the economy (B. Nalam, M. Richiardi, L. Valenzuela, 2019). Otherwise, when quality education is available only to a limited

number of people who will thereby become highly qualified, inequality increases and most of the income is concentrated in the hands of a small part of the population. Innovations affect the technological equipment of the economy. Due to new technologies, the efficiency of the enterprise is increased, which will increase profits.

Institutional factor refers to corruption, mentality, the desire of the population to study and work.

Socio-demographic factor. Firstly, over the years, population growth is slower, secondly, a large uneven distribution of capital, in contrast to labor income, increases inequalities, thirdly, there is inequality between age groups, which is also associated with the distribution of capital, as well as with the volume of consumption. (B. Nalam, M. Richiardi, L. Valenzuela, 2019) In addition, the predominance of the number of women causes an increase in inequality, this is due to the low social security of women: going on maternity leave, early retirement.

For this study, it is planned to use a positivist approach, because we are interested in HOW economic growth affects inequality . Therefore, quantitative methods are the most relevant for this approach.

In order to determine the relationship between inequality and economic growth, I will use a regression model, where the dependent variable is the Gini coefficient (which measures income inequality), and the independent variable is GRP per capita (which represents economic growth). Since there is a problem of reverse causality in this case, in addition to the OLS model, I will also use the panel data method and the IV model to solve this problem.

4. Data analysis

There are many indicators that measure income inequality, but one of the most popular is the Gini coefficient, which will be used in this work. It demonstrates how much the actual distribution of measured values deviates from their completely uniform distribution between individuals. The dataset used in this analysis consists of panel data spanning the period from

2000 to 2021, covering 14 regions of Kazakhstan. The Gini coefficient is calculated for each region and year, providing a comprehensive view of income inequality dynamics over time and across regions.

Below is a graph of data on the Gini coefficient by region of Kazakhstan. The graph shows that the value of the inequality coefficient fluctuates greatly, and it is difficult to trace any dynamics. However, it is important to note the high points and low points on the graphs. The two highest values of the Gini coefficient correspond to the level of inequality in Astana in 2006 and 2008. This may be due to the financial crisis of 2007-2008 and its negative consequences. As can be seen from the graph, it had the strongest impact on inequality in the capital.

Also, on the graph we can see the lowest points; they correspond to the level of inequality in the Mangistau region in 2009 and 2017. Mangistau region is an industrial region of Kazakhstan, which accounts for about 25% of the republic's oil and gas production. (Qazaq Culture, n.d.) The lowest level of inequality in Kazakhstan was recorded here for the period from 2000 to 2021; it occurred in 2009; as can be seen from the graph, during this period there was a strong decline in inequality after the economic crisis.

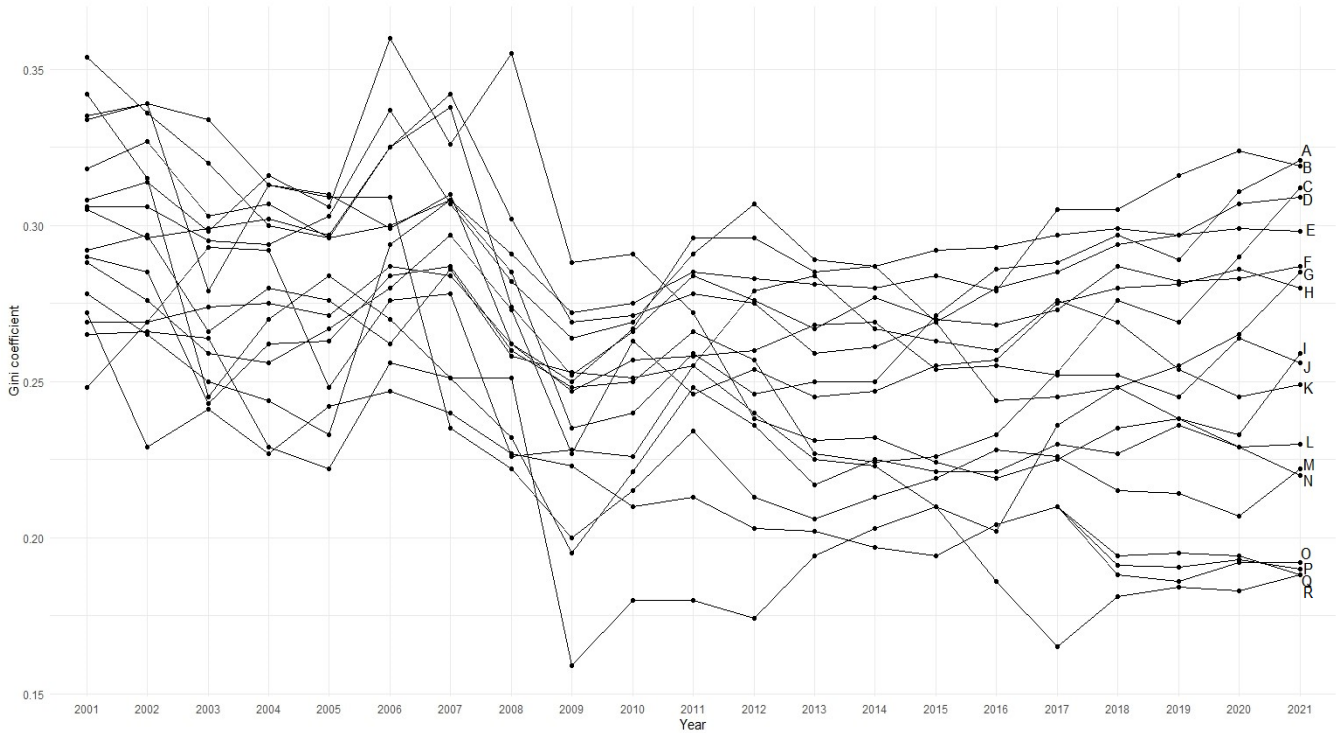


Figure 1 - Dynamics of the Gini coefficient by region of Kazakhstan (2001-2021)

(Note: A - Almaty (city) ; B - East Kazakhstan Region; C - Pavlodar Region; D - Karaganda Region; E - North Kazakhstan Region; F - Akmola Region; G - Aktobe Region; H - Almaty Region; I - Astana (city); J - Kostanay Region; K - West Kazakhstan Region; L - Kyzylorda Region; M - Atyrau Region; N - Zhambyl Region; O - Turkistan Region; P - South Kazakhstan Region; Q - Mangystau Region; R - Shymkent (city))

Data source: 3. BUREAU OF NATIONAL STATISTICS (2023). Основные показатели дифференциации доходов населения РК. <https://stat.gov.kz/ru/industries/labor-and-income/stat-life/publications/117707/>

Other Data. Panel data on gross regional product (GRP) per capita spanning the period from 2000 to 2021, covering 14 regions of Kazakhstan. The graph shows positive dynamics of GRP with a minimum number of fluctuations. The highest level of GRP per capita over the entire time period corresponds to the Atyrau region. This is one of the richest regions of Kazakhstan, which is rich in various natural resources, especially oil and gas. (<https://qazaqculture.com/ru/regions/atyrauskaya-oblast>) Also, two cities of republican status - Astana and Almaty - are characterized by high GRP; in 2021, GRP per capita in these regions was 7.4 and 7.5 thousand tenge, respectively.

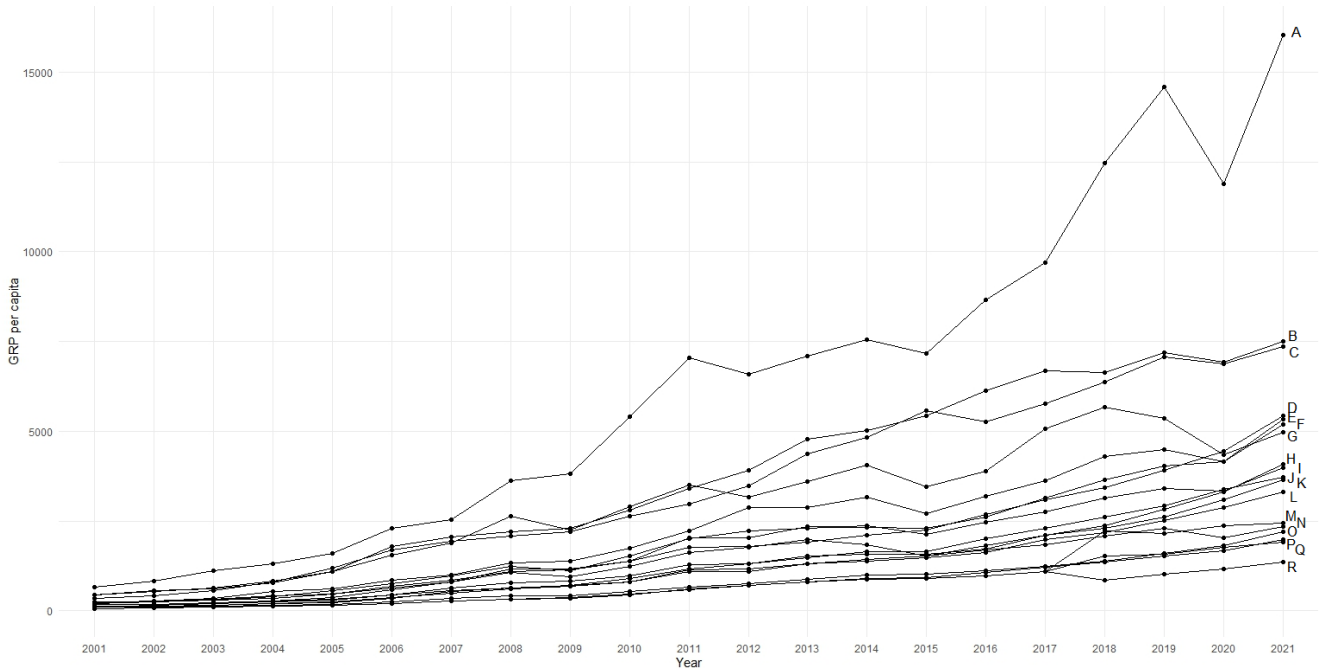


Figure 2 - Dynamics of the GRP per capita by region of Kazakhstan (2001-2021)

(Note: A - Atyrau Region; B - Almaty (city); C - Nur-Sultan (city); D - Karaganda Region; E - West Kazakhstan Region; F - Pavlodar Region; G - Mangystau Region; H - Kostanay Region; I - Aktoobe Region; J - East Kazakhstan Region; K - Akmola Region; L - North Kazakhstan Region; M - Shymkent (city); N - Kyzylorda Region; O - Almaty Region; P - Jambyl Region; Q - South Kazakhstan Region; R - Turkestan Region)

Data source: BUREAU OF NATIONAL STATISTICS (2023). ВРП на душу населения. https://stat.gov.kz/upload/iblock/46b/36cg73147bkquenv4gmn2tc5wgjgdx7l/5.%20%D0%92%D0%A0%D0%9F%20%D0%BD%D0%B0%20%D0%B4%D1%83%D1%88%D1%83%20%D0%BD%D0%B0%D1%81%D0%B5%D0%BB%D0%B5%D0%BD%D0%B8%D1%8F.xlsx?sphra se_id=394866

This study also uses panel data on industrial turnover index and foreign trade turnover by regions of Kazakhstan. All data is taken from the official website of the Bureau of the National Statistical Agency for Strategic Planning and Reform of the Republic of Kazakhstan.

5. Model description

To study the dependence of income inequality on economic growth, I use panel data of the Gini index and gross regional product (GRP) per capita for the regions of Kazakhstan for 2000-2021. I want to conduct research using three methods: OLS method, panel data method (fixed effects model, random effects model) and instrumental variable model.

5.1 OLS method

The relationship between the Gini index (y_i) and gross regional product (GRP) per capita (x_i) is modeled as:

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

Where:

y_i – Gini index

x_i – GRP per capita

When analyzing this model, the problem of non-normal distribution of residuals (using the Shapiro test) was identified, which means that estimates of the model coefficients may be biased or ineffective, this may affect the results of studies based on this model.

To address this issue, we applied a logarithmic transformation to the model, resulting in:

$$y_i = \beta_0 + \beta_1 \cdot \log x_i + \varepsilon_i$$

The transformed model indicates that with a 1% increase in GDP per capita, the Gini coefficient decreases by 0.006237.

After the transformation, we found that the residuals exhibit a symmetrical distribution, with the median close to 0, and a narrow spread, with a standard error of the residuals of 0.0386. However, a new problem arises with this model, as it explains only 4% of the variation in the dependent variable, as indicated by the Multiple R-squared value.

Therefore, the model built on the basis of the OLS method explains the decrease in the level of income inequality by economic growth. However, it is important to note that the model's low R-squared value indicates that there are likely other factors influencing income inequality that are not captured by this model.

5.2 Panel data method

The following method is expected to be more suitable for this study as it can take into account both time series and cross-sectional variations in data, providing a powerful tool for analyzing the relationship between economic variables. To obtain the most accurate results, we conducted studies for two models: a fixed-effects model and a random-effects model.

To determine which model was more suitable for our analysis, we performed a Hausman test. The p value for the Hausman test is 0.0375, which is less than the standard significance level of 0.05. This indicates that we reject the null hypothesis that random effects models and fixed effects models are equally effective. Therefore, in this case, preference is given to the fixed effects model.

Fixed effects model for this research that GDP has a statistically significant effect on the Gini coefficient. This model demonstrates a negative relationship, that is, the higher the GRP, the lower the income differentiation coefficient.

However, it is important to note that the fixed effects model faces a challenge in terms of its explanatory power. The model exhibits a low R-squared value, which indicates that only a small proportion of the variation in the Gini coefficient can be explained by GDP per capita alone. This limitation suggests that there may be other factors not accounted for in our model that influence income inequality in Kazakhstan.

5.3 IV model

The last method that will be used in this paper to analyze the impact of economic growth on income inequality is the instrumental variables method.

In the IV model, gross regional product (GRP) per capita is treated as an endogenous variable, meaning it may be correlated with the error term in the regression equation. To address this endogeneity, we use instrumental variables, such as the Industrial Production Index and Foreign Trade Turnover, which are assumed to be uncorrelated with the error term and are used as proxies for GRP per capita.

It is necessary to check whether the selected instruments are suitable as IV for our model; for this we will conduct the Hansen test. The Hansen test results suggest that the instruments are valid for the IV model. The null hypothesis of correct instrument specification is not rejected,

indicating that the instruments are exogenous and meet the conditions for IV regression. This provides confidence in the validity of the instrumental variables used in our analysis.

The IV model estimates that with a one-unit increase in GRP per capita, the Gini coefficient decreases by 0.00003. This coefficient is found to be statistically significant at a significance level of 0.05, indicating the presence of an inverse relationship between GDP and the Gini coefficient when using instrumental variables. This result suggests that higher economic growth is associated with lower income inequality, supporting the hypothesis that economic development can lead to more equitable distribution of income.

Overall, the IV method provides a robust approach to estimating the relationship between economic growth and income inequality, accounting for potential endogeneity issues and providing reliable estimates of the impact of economic growth on income distribution.

6. Results

The results of the analysis of three models answer the research question about the relationship between economic growth and income inequality in Kazakhstan.

The regression output by the OLS method is presented in Table 1. A negative relationship was revealed between GDP per capita and the Gini coefficient. However, this model shows limited explanatory power, explaining only 4% of the variation in income inequality. This suggests that factors beyond economic growth play an important role in income distribution.

Table 1

The effect of economic growth on income inequality: OLS model.

Gini			
<i>Predictors</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	0.30	0.28 – 0.33	<0.001
GDP log	-0.01	-0.01 – -0.00	<0.001
Observations	378		
R ² / R ² adjusted	0.035 / 0.032		

The panel data method, namely the fixed effects model, also revealed a negative relationship between GDP per capita and the Gini coefficient. However, similar to the OLS method, it shows a low R-squared value, indicating that a significant portion of income inequality remains unexplained.

Table 2

The effect of economic growth on income inequality: the fixed effects model.

Gini			
<i>Predictors</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
GDP	-0.00	-0.00 – -0.00	<0.001
Observations	378		
R ² / R ² adjusted	0.185 / 0.144		

The panel data random effects model, although more efficient than the fixed effects model in terms of estimation, may be less suitable if there are unobserved time-invariant factors that systematically affect both GDP per capita and the Gini coefficient.

Table 3

The effect of economic growth on income inequality: the random effects model.

		Gini	
<i>Predictors</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	0.27	0.26 – 0.29	<0.001
GDP	-0.00	-0.00 – -0.00	<0.001
Observations	378		
R ² / R ² adjusted	0.172 / 0.169		

The instrumental variable (IV) model provides a more robust approach, addressing endogeneity concerns. The IV model estimates a statistically significant negative relationship between GDP per capita and the Gini coefficient, suggesting that higher economic growth is associated with lower income inequality. This finding supports the hypothesis that economic development can lead to a more equitable distribution of income.

Table 4

The effect of economic growth on income inequality: IV model.

Results of IV Regression Model with Two-Stage Least Squares (2SLS)		
	<i>Dependent variable:</i>	
	<i>Gini instrumental variable</i>	<i>GDP OLS</i>
	IV Regression (1)	First Stage (2)
GDP	-0.00003** (0.00001)	
IPI		-35.003** (12.539)
FTT		
Constant	0.316*** (0.022)	5,612.765*** (1,332.511)
Instrumental Variables:		
	IPI: Industrial Production Index	
	FTT: Foreign Trade Turnover	
Observations	378	378
R ²	-2.146	0.020
Adjusted R ²	-2.154	0.018
<i>Note:</i>	* p<0.05; ** p<0.01; *** p<0.001	

The instrumental variable (IV) regression model shows a statistically significant effect of GDP on income inequality (Gini coefficient). The coefficient estimate for GDP is -3.022e-05 (p = 0.00978), indicating that a one-unit increase in GDP leads to a decrease in the Gini coefficient by -3.022e-05 units. The model's R-squared value is -2.146, which may suggest issues with the model or data. Overall, the results support the hypothesis that GDP has a significant impact on income inequality when accounting for potential endogeneity issues.

Based on the results provided, the instrumental variable (IV) regression model appears to be the most appropriate and reliable method for estimating the relationship between economic growth and income inequality in Kazakhstan. Unlike the OLS and panel data models, the IV model addresses endogeneity concerns, providing more robust estimates. The statistically significant effect of GDP on the Gini coefficient in the IV model supports the hypothesis that economic growth is associated with lower income inequality. However, the negative R-squared value in the IV model suggests that the model may have limitations or issues with the data that need further investigation.

7. Conclusion

This study aimed to analyze the impact of economic growth on income inequality in Kazakhstan. Analyses conducted using various econometric models, including OLS, panel fixed effects, and instrumental variable (IV) models, consistently indicate a negative relationship between GDP per capita and the Gini coefficient. That is, as economic growth increases, income inequality tends to decrease in Kazakhstan.

An instrumental variable (IV) model that addresses potential endogeneity issues provides the most robust estimate of this relationship. This confirms that higher economic growth is associated with lower income inequality, supporting the hypothesis that economic development can lead to a more equitable distribution of income in Kazakhstan.

These findings are of great importance for socio-economic policy in Kazakhstan. They suggest that policies aimed at promoting economic growth can also help reduce income inequality. However, it is critical for policy development to consider the many other factors that influence income distribution in order to develop effective strategies to address inequality.

Overall, this study provides valuable insight into the relationship between economic growth and income inequality in Kazakhstan, highlighting the importance of economic development in achieving a more equitable income distribution in the country.

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