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Assessing Inequality of Income Distribution and Education in the Regions of Kazakhstan[1]

Abstract. In the current social conditions, the problems of inequality associated with the uneven distribution of income in society is an important research problem. Thus, it is necessary to investigate the level of regional differences in income distribution in developing countries like Kazakhstan. The study aims to assess the influence of income, social expenditures, and inequality in the distribution of education and education costs between different regions of Kazakhstan. Unlike previous scientific papers in this area, this paper uses panel data on the distribution of human capital and income in 17 regions of Kazakhstan. The methodological framework of the research is represented by methods of statistical assessment of economic inequality, such as the indicator of differentiation, reflecting the degree of social and economic inequality. Based on the proposed methodology, we analysed the disparity in the level of education and obtained data on the standard deviations of the distribution of education for the population of the regions of Kazakhstan. According to these data, inequality changes over time and affects the distribution of education and education costs between different areas. Income inequality is slightly higher in Karaganda and East-Kazakhstan regions; other areas have a more equitable income distribution by about 0.05 Gini coefficients. The regression specification shows that large megacities like Shymkent, Almaty, and Astana have a more significant influence, while Mangystau and North-Kazakhstan regions have minor power. The obtained results emphasise the importance ensuring access to education for reducing regional disparities and achieving stability in income distribution.

Keywords: regional development, regional disparities, economic growth, social inequality, social expenses, income distribution, education, Kuznets curve, Gini coefficient, Kazakhstan

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ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

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Оценка неравенства распределения доходов и образования в регионах Казахстана

Аннотация. Важной социальной проблемой является вопрос неравномерного распределения доходов. В связи с этим актуальным становится изучение региональных различий в распределении доходов в развивающихся странах, таких как Казахстан. Цель исследования — оценка влияния доходов, социальных расходов и неравенства на образование и затраты на образование в различных регионах Казахстана. В отличие от предыдущих научных работ в этой области, в данной статье анализируются панельные данные о распределении человеческого капитала и доходов в 17 регионах Казахстана. Для статистической оценки использован показатель дифференциации, отражающий степень социального и экономического неравенства. На основе предложенной методики проанализированы различия в уровне образования. Согласно полученным данным, неравенство меняется с течением времени и влияет как на образование, так и на затраты на образование в различных сферах. Неравенство доходов несколько выше в Карагандинской и Восточно-Казахстанской областях; в других регионах доходы распределены более равномерно, примерно на 0,05 коэффициента Джини. Спецификация регрессии показывает, что в крупных мегаполисах, таких как Шымкент, Алматы и Астана, исследуемые показатели оказывают большее влияние, тогда как в Мангистауской и Северо-Казахстанской областях их воздействие меньше. Полученные результаты подчеркивают важность образования для сокращения региональных различий и достижения равномерного распределения доходов.

Ключевые слова: региональное развитие, региональные различия, экономический рост, социальное неравенство, социальные расходы, распределение доходов, образование, кривая Кузнеца, коэффициент Джини, Казахстан

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1. Introduction

The problems of social inequality, which have become one of the most important in recent years, underlie the education systems in many countries. Negative trends with social, economic, and political consequences may lead to high social disproportion in terms of the income of the population, living standards, and education. In addition, backward approaches to allocating resources and material capabilities may contribute to their accumulation within limited population groups. In turn, this will contribute to the growth of property inequality between affluent and socially vulnerable people. Inequality also negatively affects the quality of human potential; income restrictions affect society's state and education level.

In the transformational economy characteristic of Kazakhstan, this problem becomes particularly relevant and vital. The tragic events and protests in Kazakhstan have shown that the population's standard of living has fallen dramatically in many regions, especially in backward areas. This is primarily due to inequality in the distribution of social benefits, such as education. Many scientific studies noted that education as a factor of differentiation of the population affects the degree of income inequality (Ram, 1984; Krugman & Venables, 1995; Benabou, 2000). In some works, human capital is considered a source of productivity increase in distribution and accumulation according to the level of education among the population (Mincer, 1974; Winegarden, 1979; Barro & Lee, 2001). Some empirical studies have shown that the expansion of education has an ambiguous effect on income distribution (Knight & Sabot, 1983; Lustig et al., 2012). Thus, inequality is a broader concept and covers all layers of society.

Institutional reforms affect social inequality differently depending on the region; for example, growth centres accumulate resources faster, and the results in the backward areas vary significantly. Therefore, the problems of inequality and accessibility of education require a compre-

hensive analysis considering the existing territorial differences. Inequality indicators describe resource distribution, particularly in certain regions, allowing for comparative analysis. In addition, inequality estimates differ depending on the chosen approaches to its measurement (Gujarati, 1995; Farris, 2010).

In Kazakhstan, differentiation conditions have changed a lot in recent years.

The increase in poverty has led to the expansion of social instability and tension in the regions, which requires, first, the development of a well-thought-out social policy considering sustainable development. At the same time, when developing such a policy, it is necessary to consider each region's specific features. The recommendations should improve the effectiveness of support measures and increase the targeting of regional development plans to improve the population's standard of living in each area. In addition, the transition to market relations has intensified the problems of the income distribution, the implementation of shock economic reforms has provoked large-scale and profound changes evident in the conditions of the crisis, low-income segments of the population suffer the most which increase inequality in income, social expenditures, inequality in the distribution of education, and education costs.

In the practice of Kazakh studies, there are no works assessing inequality in income distribution based on unified coefficients. There is also no generally accepted method of sequential analysis of differences in income and education distribution in the regional section in many scientific papers. The specific properties of indicators and their impact on assessing the degree of inequality are often not considered. This study examines in detail one of the main variables determining income distribution, namely education.

The scientific novelty lies in the fact that, based on the study of the available scientific literature, a methodology is proposed for a consistent analysis of the impact of income, social expenditures, and inequality in the distribution of education to reduce regional disparities and achieve sustainable economic growth.

This paper includes several sections, taking into account the introduction. The second part is devoted to the literature analysis of existing theoretical and empirical studies. The third section reveals the methodology used to analyse the relationships between differences or the influence of one variable on another. In the fourth part of the study, income inequality, education level and distribution in the regional context are examined using the proposed method. The findings are presented in the fifth section.

2. Literature Review

Inequality has increased in many countries, primarily due to the prevailing inequality of opportunities in society. In addition, unfair distribution of income may harm sustainable economic growth. The problems of inequality are related to the unequal distribution of income in society which leads to economic differentiation. In general, inequality means people have unequal access to existing resources and benefits. Differences between people lead to the stratification of society, a decrease in motivation in work activity, and a variety of social roles and positions. Higher inequality significantly affects educational opportunities, influencing social instability. Consequently, many countries seek to provide basic livelihoods for the poor and disadvantaged segments of the population through social welfare and reduce regional disparities through redistribution policies.

Thus, the level of differentiation (inequality) of the population's income is one of the most critical indicators characterising the level of economic development and the degree of uneven distribution of various resources and benefits. The process of income differentiation is influenced by many different factors: social, demographic, economic, political, etc. Some factors directly impact this process, while others have an indirect effect. Certain factors influence the formation, distribution and redistribution of income. At the same time, many factors are interrelated and interdependent as well as do not act randomly but together, thereby strengthening or weakening each other.

Many scientific studies often emphasise that human capital is one of the main factors influencing the degree of income inequality (Krugman & Venables, 1995; Benabou, 2000; Castelló & Doménech, 2002; Piketty, 2014). Thus, the influence of education on human capital is the main factor determining the lifetime earnings of an employee (Ram, 1984).

The human capital model assumes an uneven distribution by education level among the population and income level (Mincer, 1974; Winegarden, 1979). Mincer (1974) showed a positive correlation between education and income, which was considered the earliest study in this area. In addition, Winegarden (1979) used regional data from the United States and cross-sectional data from 32 countries to conclude a correlation between educational inequality and income inequality. Consequently, these early studies have confirmed that the supply of skilled workers in the la-

bour market affects inequality in terms of education and income in society.

Some empirical studies have shown that unequal distribution of education impacts economic growth. Thus, the expansion of universal education should compensate for the impact on income distribution, according to which wage inequality first increases, implying that when the supply of educated labour exceeds demand due to the expansion of educational services, wage inequality will eventually decrease (Knight & Sabot, 1983). Furthermore, education has a strong positive impact on economic growth in the long term, while income inequality is negatively associated with economic growth (Asghar et al., 2011). At the same time, inequality in education serves as a barrier between economic growth and living standards, creating income mainly for those at the top, thus making it difficult for poor people to change their standard of living (Niţă et al., 2020).

Empirical literature studying the relationship between education and income inequality based on country data analysis shows contradictory results. Barro and Lee used empirical analysis to evaluate various data. The results of their scientific research have shown that there are income gaps between countries (Barro & Lee, 2001). Later, Földvári and van Leeuwen (2011), using the most popular functional forms, found that the impact of inequality in school education on income inequality is very low, even insignificant in an economic sense.

Many studies show that the human capital model predicts a link between inequality in education and economic growth. Thus, the impact of inequality on education may affect long-term economic growth by reducing the average level of human capital (Klasen, 2002). Interestingly, school education shows the lowest return. Thus, country studies show a non-linear and negative relationship between inequality in education and schooling (de Gregorio & Lee, 2002; Thomas et al., 2003). Psacharopoulos and Patrinos (2004) found that the return on education would first decrease and then increase with higher levels of education, especially in low- and middle-income countries. Furthermore, an attempt was made to understand the continuing inequality in higher education based on logistic regression, which showed that the expansion of higher education positively impacted reducing disparities (Chesters & Watson, 2013).

Over the past decade, China has experienced rapid economic growth which has significantly affected inequality. Xu and Zou (2000), using their own set of panel data on income inequality at the regional level, showed that the Gini coefficient increased from 0.17 in 1985 to 0.23 in 1995. Data were obtained from various provincial statistical yearbooks for 29 provinces for the years 1985–1995 (except 1987 and 1988). They found that demographics explained the difference, and growth rates varied by region. In more recent studies, Li and Wie (2017) found that rapid development in China was associated with higher wages for workers with higher education. Thus, a significant increase in the level of education affects inequality and sustainable economic growth.

Several authors note that higher economic growth is often observed in more developed regions as potential resources move to developed regions. If weak regions cannot compete, this may lead to uneven education and income distribution between regions. Berg and Ostry (2017) divided the data by regions and concluded that inequality between regions arises due to the high concentration of economic activity in certain areas. The process that causes the imbalance in these areas is very complex. This is influenced by differences in economic growth, investment distribution, access to infrastructure, and the quality of human resources in the region (Rubin & Segal, 2015; Rahmawati et al., 2020). Differences in the level of economic development, social instability, and inefficient use of resources were accompanied by an increase in interregional inequality (Marchand et al., 2020). The emergence of inequality between regions is caused by various factors that should be identified to understand their impact on economic growth.

In Kazakhstan, the selected research topic is considered from the perspective of spatial development. Thus, the critical direction of regional policy is the search and development of "growth poles" that will evenly distribute their potential among backward regions (Nurlanova et al., 2018). Kopeyeva (2020) noted that Kazakhstan lacks a specific regional policy for the development of education, the language of instruction at school, and, first of all, the region's low social and economic development. Kangalakova highlighted that for the integrated and uniform development of areas, appropriate strategic and tactical management decisions should be considered depending on each region's specifics (Kangalakova & Rakhmetova, 2021). At the same time, many Kazakh studies poorly investigate critical issues related to the evolving nature of regional inequality in the urbanising areas in Kazakhstan (Bekturganova et al., 2019; Kireyeva et al., 2021). It is also not entirely clear how to interpret regional inequality accompanied by a shift of the population from the unde-

veloped periphery (mainly rural) to the developed core (primarily urban).

Based on the literature review, it may be concluded that inequality in education has an uneven impact on income distribution. The education level of the population also depends on the region. Thus, more developed areas often become centres of attraction for highly qualified personnel. Although many scientific studies have examined the causes of income inequality, none has thoroughly analysed the exact contribution of education to income inequality.

There are exceedingly few studies that examine regional differences in income and education distribution in developing countries like Kazakhstan. A lot of regions in Kazakhstan have different starting levels of development and the economy is experiencing crisis phenomena. Previous studies have not presented similar calculations comparable to the data for the regions of Kazakhstan, considering the distribution of human capital and income. Therefore, we will try to fill this gap and develop recommendations for their solution.

This study aims to assess the impact of income, social expenditures, and imbalance in the distribution of education and education costs between different regions of Kazakhstan. This study examines in detail one of the main variables determining income distribution, namely education. Taking into account this fact, this scientific study puts the following research hypotheses:

Hypothesis 1 (H1): Regions with higher average literacy rate (EI) in Kazakhstan are more likely to have lower income inequality (Gini index).

Hypothesis 2 (H2): Regions with higher general coverage of students in higher education (EA) in Kazakhstan are more likely to have lower income inequality (Gini index).

Hypothesis 3 (H3): In Kazakhstan, regions that spend more on the social sector are more likely to have lower income inequality (Gini index).

Hypothesis 4 (H4): In Kazakhstan, regions that spend more on education are more likely to have lower income inequality (Gini index).

3. Methodology

In this paper, we tried to estimate the exact contribution of education in the distribution of income of the population in the regions of Kazakhstan based on selected variables (essential factors). Therefore, targeted efforts to reduce inequality in income distribution between areas are very relevant. This work is a quantitative study, the purpose of which is to explain the relationship between differences or the influence of one variable on another. This study used panel data representing a combination of time series over five years (from 2015 to 2019).

This section investigates the link between income disparity, educational attainment and distribution, and income levels across regions. We are studying whether the region's level of development influences the level of education and the fair distribution of income, i. e., a higher level of development in an area with high potential. In studies of inequality, as a rule, a standard set of indicators is used, for example, the Gini coefficient and the differentiation coefficient (Farris, 2020). To avoid giving more weight to the inequality by region, we followed studies of Barro and Lee (2001), Higgins and Williamson (1999), and Gujarati (1995) and ordered data by time series.

In this study, we selected the inequality data set. Variables include income, social expenditures, education sector expenditures, economic growth, and regional disparities. This research uses the 2015–2019 data of 17 areas in Kazakhstan from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan to verify the impact of the strengthening of educational attainment on the income distribution gap. The official statistics were limited and contained indicators up to 2019, and there were no data up to 2015 for regions. It further examines the heterogeneous characteristics of lowering the upper limit of educational inequality on income inequality. Whether the empirical conclusions of this paper are based on the Gini as the interpreted variable or the fixed-effects model, the regression results show sufficient robustness, and the main findings still show strong consistency under different virtual variables.

As for the construction of dynamic panel models, relying on static panels may lead to poor estimates due to the persistence of income inequality among residents. This problem may be overcome by using dynamic panels. In addition, since macro-prudential policy variables and control variables may have a specific endogenous nature, the use of active panels may also help avoid endogenous problems to a certain extent. The built dynamic panel model is as follows:

$$Gini_{r,t} = \beta_{0,t} + \beta_1 EI_{r,t} + \beta_2 EA_{r,t} + \beta_3 \log GRP_{r,t} + \\ + \beta_4 R_{r,t} + \beta_5 \text{controls}_{r,t} + \varepsilon_{r,t}, \quad (1)$$

where G — the Gini coefficient; EI — the educational inequality; EA — the educational attainment; logGRP — gross regional product (GRP) per capita, R — regional models, r — region, t — time periods.

Table 1

Dataset description

	Education attainment		Gini Coefficient	
All regions	2015	2019	2015	2019
Mean	0.498	0.654	0.241	0.251
Standard deviation	0.329	0.489	0.034	0.040
Maximum	1.233	0.133	0.292	0.316
Minimum	0.125	1.942	0.180	0.184

Note: compiled based on data from the Bureau of National Statistics.

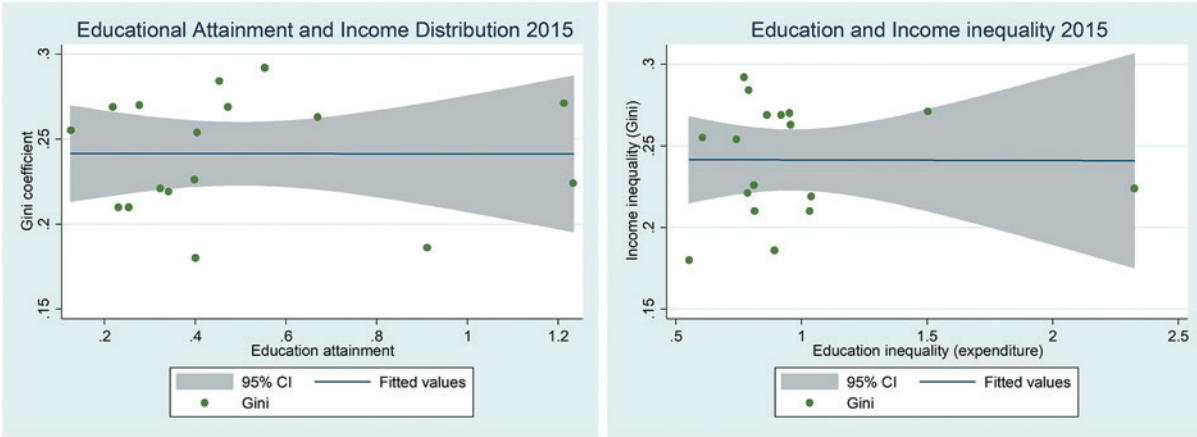

Fig. 1. *The relationship between differentiation in income distribution and education in the regions of Kazakhstan, 2015 (source: compiled by the authors based on the results of their own calculations)*

To investigate the development of educational attainment, we first construct the following regression (2):

$$E_{r,t} = \beta_{0,t} + \beta_1 EI_{r,t-1} + \beta_2 EA_{r,t-1} + \beta_3 \log GRP_{r,t-1} + \\ + \beta_4 R_{r,t-1} + \beta_5 \text{controls}_{r,t-1} + \varepsilon_{r,t-1}. \quad (2)$$

Since 2015, educational attainment has increased on average across all locations. As a result, new data is expected to emerge from places where inequality is higher than the national average. The regressions include the geographical models to account for income distribution disparities not explained by education or income. As our data show that there are no other critical regional models in the equation, we include models for all regions of Kazakhstan. Table 1 describes the dataset used in this study.

We consider a simple cross-correlation between income inequality and educational indicators before delving into the specifics of the findings. In 2015, the Gini coefficient was displayed against the region's average literacy rate. According to the negative connection, higher education lowers disparities. Figure 1, on the other hand, demonstrates a positive link between income and educational inequality.

4. Results and Analysis

There is often a positive correlation between the scale of government expenditures and the investment rate. Introducing these variables simultaneously will cause certain multiple linearities resulting in some variable coefficients being estimated to be insignificant. To exclude the impact of various collinearities on the estimation results, according to the correlation between the control variables and the significance of the effects on regional economic growth, the control variables were removed step by step, and the final estimation results after excluding the appropriate variables were reported in Table 2.

Within the scope of static panel data methodologies, three predominant models are conventionally recognised: the pooled ordinary least squares model (Pooled OLS), the fixed-effects model (FE), and the random-effects model (RE). Given the intricacies inherent in each dataset, it becomes essential to judiciously select the most pertinent model for rigorous analysis. As an initial step, a methodological juxtaposition between the Pooled OLS model and the fixed-effects model was undertaken. The derived *F*-statistics conclusively signalled the unsuitability of the Pooled OLS model, thereby necessitating its rejection. Following this, the Hausman test was invoked to ascertain the relative merit of the fixed-effects and the random-effects models. The empirical findings from this evaluative procedure underscored the superiority of the fixed-effects model, notably surpassing the random-effects model at a 5 % significance level.

Table 2

Regression results in income inequality in the regions of Kazakhstan

Variables	Gini index		
	2.1	2.2	2.3
EI	0.0247 (0.008)	0.0284 (0.014)	0.0328 (0.013)
EA	0.0139 (.011)	0.0200 (.013)	0.0171 (0.014)
LogGRP		0.0359 (0.043)	0.0272 (0.042)
LogGRP2		–0.0026 (0.003)	–0.0024 (0.003)
Socexp/GRP			1961.494 (1297.37)
Eduexp/GRP			–0.2934 (0.410)
Regional models			
Akmola region	–0.004 (.007)	0.045 (.019)	0.019 (.031)
Aktobe region	–0.031 (0.008)	0.019 (0.018)	0.004 (0.021)
Almaty region	(omitted)	0.051 (0.019)	0.038 (0.024)
Atyrau region	–0.064 (0.007)	(omitted)	(omitted)
West-Kazakhstan region	–0.024 (0.010)	0.026 (0.019)	0.011 (0.021)
Zhambyl region	–0.051 (0.007)	–0.002 (0.022)	–0.031 (0.040)
Karaganda region	0.014 (0.008)	0.066 (0.017)	0.062 (0.017)
Kostanay region	–0.025 (0.007)	0.024 (0.019)	0.002 (0.024)
Kyzylorda region	–0.056 (.007)	–0.006 (.021)	–0.033 (.035)
Mangystau region	–0.090 (0.006)	–0.033 (0.011)	–0.046 (0.013)
Pavlodar region	–0.028 (0.007)	0.023 (0.016)	0.007 (0.019)
North-Kazakhstan region	0.006 (0.007)	0.056 (0.019)	0.014 (0.039)
Turkistan region	–0.087 (0.006)	–0.036 (0.024)	–0.053 (0.051)
East-Kazakhstan region	0.017 (0.007)	0.067 (0.019)	0.059 (0.020)
Astana city	–0.097 (0.016)	–0.049 (0.028)	–0.047 (0.027)
Almaty city	–0.022 (0.016)	0.026 (0.023)	0.033 (0.024)
Shymkent city	–0.102 (0.012)	–0.057 (0.029)	–0.080 (0.032)
_cons	0.250 (0.007)	0.075 (0.143)	0.128 (0.147)
R squared	0.938	0.939	0.943
Adjusted *R* squared	0.922	0.920	0.923
Root MSE	0.010	0.010	0.010
Observations	85	85	85

Source: compiled by the authors based on the results of their own calculations.

In light of these analytical outcomes, this research unreservedly endorses the fixed-effects model (FE) as the optimal estimation paradigm for the dataset in question. Comprehensive regression results, spanning all the sampled data, are systematically delineated in columns (2.1), (2.2), and (2.3) of Table 2.

Further, it is necessary to investigate whether there are differences in the impact of educational attainment on income inequality among different types of regions. For equation 1, the educational inequality coefficient of column 2.1 in Table 2 is positive, indicating that the policy of lowering the upper limit of educational inequality has expanded the Gini coefficient. This result validates the inference of the theoretical model. The educational inequality represented by the national statistics has affected the income distribution gap, which involves income redistribution. The result is negative; it shows that educational inequality in some less developed regions did not have an expansion effect on the degree of income inequality. On the contrary, they helped narrow the gap between rich and poor citizens. The symbols and significance of the educational attainment coefficients in Column 2.1 of Table 2 are the same as those in Columns 2.2 and 2.3, where the coefficients of the square of log of GRP per capita are both negative. The view that educational attainment has a heterogeneous impact on residents' income gap in different regions is inconsistent. However, due to the weak significance of the coefficients in Column 2.3, this paper needs to confirm the robustness of this result further. Judging from the regression results of the subsamples, the coefficients of educational expenditures/GRP and Social expenditure/GRP in Column 2.3 regions are -0.2934 and 1961.494, and the significance of the former coefficient is higher. Judging from the importance of the coefficient, this heterogeneous characteristic is more evident in emerging regions.

In terms of control variables, the square of log of GRP per capita coefficients of each column in Table 2 is insignificant. The positives and negatives are not uniform, indicating that a regions' GRP has little impact on the income distribution gap. The coefficient of educational expenditures/GRP in emerging areas is negative, which shows that the ratio of educational expenditures to GRP in regions is positively correlated with the degree of income inequality. Regarding educational expenditures/GRP, the coefficient symbols have opposing signs, indicating that the higher the proportion of government expenditures on education, the smaller the income distribution gap between residents. The possible reason behind

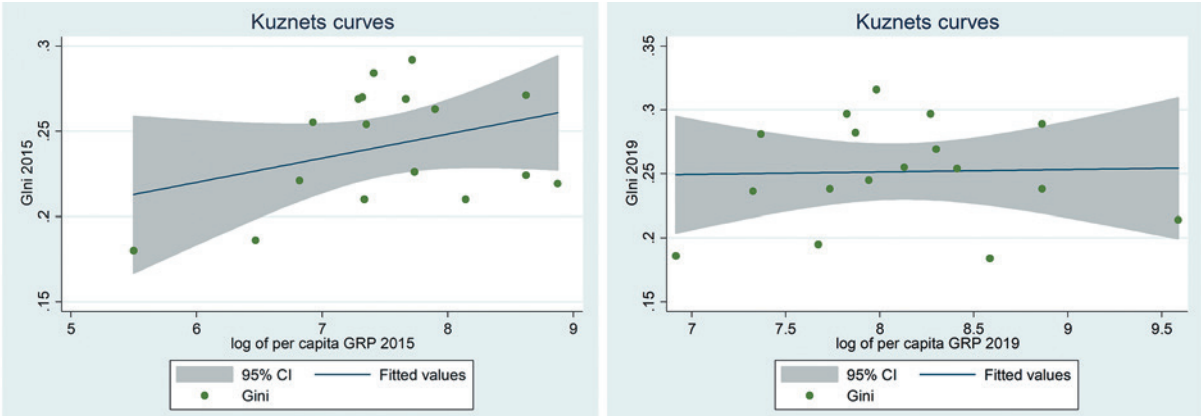

Fig. 2. *Kuznets curves (source: compiled by the authors based on the results of their own calculations)*

this phenomenon is that the higher the GRP, the greater the government's expenditures on income redistribution. The government subsidises the poor through economic policies such as subsidies, transfer payments, or job creation, thereby helping to eliminate the excessively high-income gap. The social expenditures/GRP coefficients in Table 2 are significantly positive, indicating that the intensification of systemic social expenditures may increase the income distribution gap.

Our findings are based on a limited geographic region. Income inequality appears to be slightly higher in Karaganda and East-Kazakhstan regions than in the rest of the area, by around 0.15 of the Gini coefficient. Other regions have a more equitable income distribution by about 0.05 of the Gini coefficients. As a result, there is a significant income difference between Karaganda and East-Kazakhstan and other regions of Kazakhstan.

Our findings in Figure 2 show that nonlinearity in the link between income and its distribution is considerable for many specifications. This holds even when the relationship is approximated for each period.

It can be seen from Table 2 that, consistent with the inference of the theoretical model, the coefficient of income inequality is significantly positive, and the coefficient of the second term of income inequality is highly negative, that is, there is an inverted Kuznets curve relationship between income inequality and regional economic growth. At the same time, the coefficient of the interaction term between income inequality and GRP per capita is significantly positive for 2015, indicating that with the increase in regional economic development, the Kuznets curves gradually move to the right. In other words, the level of income inequality that is most beneficial to regional economic growth gradually increases as the level of economic development increases. It needs to be further explained that there are two problems with the estimation results. First, because the level of regional economic development will affect the position of the Kuznets curves, it is impossible to judge the inflection point of the Kuznets curves through the estimation coefficients. Second, the level of economic development (GRP per capita) and the interaction between the level of regional economic development and income inequality inevitably, there is a certain degree of multicollinearity.

After centralised processing of income inequality and GRP per capita, the interaction items are constructed, and the coefficients of the corresponding models are estimated. From the information provided in Table 2, it can be found that when the influence of the horizontal axis on the position of the Kuznets curves is not considered, the inflection point of the Kuznets curves is approximately 0.549. Table 2 shows that the estimated coefficient of the one-time item of income inequality is no longer significant after centralised processing. However, the estimated coefficient of the two-time item and the interaction item is still negative, which will not affect the basic conclusions of this paper. The coefficients regression can pass the test of the Kuznets curve.

Although a large literature has studied the impact of income inequality on regional economic growth and discovered Kuznets curves relationship between the two, relatively little research has been done on how the relationship between the two will change as the level of regional economic development increases. The findings of this article have profound policy implications. With the improvement of regional economic development, the level of income inequality that was initially conducive to economic growth may turn to hinder economic growth. Therefore, regional economic development should pay more attention to adjusting income inequality promptly to keep it within a reasonable range. The valid range of income inequality varies depending on economic growth, and no uniform standard is suitable for any period and region.

Table 3

Panel regression for educational attainment in the regions of Kazakhstan

Variables	General coverage of students in higher education		
	3.1	3.2	3.3
EI lagged ($t-1$)		1.0264 (0.139)	0.9987 (0.141)
EA lagged ($t-1$)	–0.3739 (0.245)	–0.5437 (0.170)	–0.4386 (0.182)
LogGRP ($t-1$)	–10.2733 (0.440)	0.2853 (0.369)	0.3083 (0.370)
LogGRP2 ($t-1$)	0.1078 (0.029)	–0.0044 (0.025)	–0.0021 (0.025)
Socexp/GRP lagged ($t-1$)			6059.67 (8572.28)
Eduexp/GRP lagged ($t-1$)			5.451 (3.366)
Regional models			
Akmola region	0.74 (0.17)	0.31 (0.13)	0.09 (0.22)
Aktobe region	0.88 (0.14)	0.24 (0.13)	0.15 (0.15)
Almaty region	0.55 (0.17)	0.20 (0.12)	0.08 (0.16)
Almaty city	0.11 (0.15)	0.46 (0.19)	0.43 (0.20)
Atyrau region	(omitted)	(omitted)	(omitted)
East-Kazakhstan region	0.85 (0.15)	0.19 (0.13)	0.12 (0.14)
Karaganda region	0.82 (0.13)	0.12 (0.13)	0.12 (0.13)
Kostanay region	0.82 (0.15)	0.18 (0.13)	0.08 (0.17)
Kyzylorda region	0.74 (0.18)	0.35 (0.13)	0.08 (0.24)
Mangystau region	0.24 (0.10)	0.03 (0.07)	0.03 (0.08)
North-Kazakhstan region	0.68 (0.16)	0.28 (0.12)	0.02 (0.26)
Astana city	10.45 (0.35)	0.73 (0.26)	0.49 (0.30)
Pavlodar region	0.70 (0.13)	0.15 (0.11)	0.09 (0.13)
Shymkent city	10.73 (0.19)	0.53 (0.21)	0.42 (0.23)
Turkistan region	0.85 (0.21)	0.43 (0.15)	–0.07 (0.38)
West-Kazakhstan region	1.05 (0.12)	0.22 (0.14)	0.15 (.15)
Zhambyl region	0.91 (0.01)	0.33 (0.14)	0.02 (0.28)
_cons	3.42 (1.540)	–1.63 (1.262)	–2.23 (1.323)
R squared	0.959	0.981	0.982
Adjusted R squared	0.943	0.973	0.973
Root MSE	0.091	0.063	0.062
Observations	68	68	68

Source: compiled by the authors based on the results of their own calculations.

The estimation results of the coefficients of the control in Table 2, consistent with the findings of the existing literature, show that an increase in the dependency ratio of the population will reduce the regional economic growth rate, government expenditures have significantly promoted economic growth, and the degree of regional economic openness and marketization have a positive impact on regional economic development.

Table 3 shows the regressions for educational attainment.

Results in regression 3.1 showed estimating equation (2) with the lagged dependent variable. Even after controlling for specific areas' low GRP per capita, we find that a geographical model for the least developed regions has significant negative intercepts, suggesting that the least developed regions have the minor education. On the other hand, none of the other geographic models are statistically significant. Inequity in education in the past does not help to explain current educational levels.

As shown in Table 3, whether the general coverage of students in higher education can be increased is limited by the level of education. The higher the education level, the higher the income. The education inequality has a more significant effect on the gross enrolment in higher education, indicating that the degree of education substantially impacts the promotion of general coverage of students in higher education. The relationship between the level of education and GRP per capita in regions is more transparent, and it has a more significant effect on promoting gross enrolment in higher education. In contrast, the relationship with educational attainment is relatively weak. The results of the regression are consistent with this result. The sensitivity of the population's income level in Kazakhstan regions to the level of education is almost the same.

The effects of Log$GRP_{2\,(t-1)}$, Socexp/GRP lagged ($t-1$), and Eduexp/GRP lagged $_{(t-1)}$ on the gross enrolment in higher education are consistent with the results of the regression. However, with the increase of the coefficient points, the regression coefficient of Eduexp/GRP on the gross enrolment in higher education gradually shows a downward trend; with the increase of Log$GRP_{2\,(t-1)}$, Socexp/GRP lagged $_{(t-1)}$, the lower the general coverage of students in higher education, on the contrary, the higher the gross enrolment in higher education. The higher the coefficient point, the more significant the inhibitory effect of the contract signing rate on the growth of the gross enrolment in higher education of the region's population.

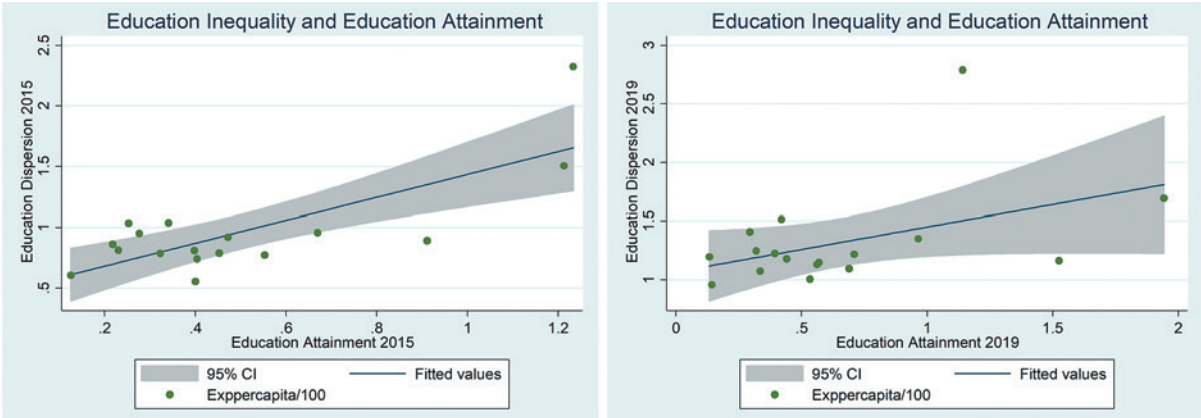

Fig. 3. *Education Attainment and Education Dispersion relationship in 2015 and 2019 in the regions of Kazakhstan (source: compiled by the authors based on the results of their own calculations)*

In the regression specification with a non-lagging variable of higher education coverage, it may be observed that large megacities with a population of more than a million people, Shymkent, Almaty, and Astana, have a more significant impact. At that time, regions with lower GRP per capita show a slight relationship, and the Turkestan region has an entirely negative one.

Figure 3 is supported by the computed coefficients on educational attainment and its square.

Considering the lagging impact of regional education and income disparities, this paper incorporates regional education inequality and regional income disparities and their lagging items as endogenous variables that affect each other into the linkage engineering group model and takes the per capita education funding ratio of regional areas as an essential research variable to study its impact on regional education inequality and urban-rural income disparities. This paper finds that the interaction between the regional income gap and regional education inequality has obvious time-lag characteristics. In the long term, regional education inequality will exacerbate the regional income gap, and the regional income gap will further increase the degree of regional education inequality. There are significant differences in the impact of regional capital investment at different stages of education (primary school, junior high school, and high school) on the inequality of regional education. Narrowing the gap in funding for junior high school education in regional areas may effectively reduce the inequality in regional education and may further narrow the income gap between urban and rural areas. However, narrowing the gap in the region's primary or high school education funding has no significant effect on reducing regional education inequality and narrowing the regional income gap.

State social expenditures are the explanatory factors in regression 3.3 and regression 3.4. Since the coefficient of these expenditures is negative, an increase in state social expenditures may reduce the level of inequality in education. Finally, we have found that public social expenditures cause educational disparities and regional differences in income inequality.

Based on the study results, only research hypothesis H4 may be accepted, which shows that regions with higher government expenditures on education are more likely to have lower income inequality (Gini index) in Kazakhstan. Hypotheses H1, H2, and H3 do not have an evidence base according to the results of the study; therefore, they were rejected.

5. Conclusions

In contrast to research papers that consider the impact of educational attainment on income inequality at the country level (Park, 1996), this paper conducted an empirical study of regional-level panel data. Four research hypotheses were put forward, which were tested based on the obtained regression results. They showed a positive relationship between educational variables and income inequality, therefore, it may be concluded that in the case of the regions of Kazakhstan, these factors are not significant for the income equation of the population. The Kuznets curve also shows that an increase in GRP per capita does not contribute to income equality (especially in 2015), as it has a positive relationship. So educational attainment's role in reducing the income gap may not be considered significant.

In general, over the past 30 years, there has always been a significant gap in the well-being of people in the regions of Kazakhstan, where the country's leadership has begun to implement reforms to create a middle class. Thus, the influencing factors on the Gini index in the regions are not limited to educational variables only, and it is obvious that such fundamental things as the qual-

ity of institutions, the level of corruption, etc. are still the main determinants. The average literacy rate in Kazakhstan was always high, and its effect on population's income level cannot be a crucial factor, at least according to the results. The problem of coverage in the country's universities is also not in the first place, as thousands of grants are allocated annually both for local universities and for foreign ones, thanks to such programmes as "Bolashak".

Based on an accepted hypothesis, the following policy implications can be drawn. According to the results obtained, government expenditures on education directly have a positive impact on income equality and, accordingly, on the population's quality of life. Creating a variety of opportunities for obtaining high-quality higher education should become a priority when determining the strategy for economic development of the regions. Unfortunately, today all the leading universities are located in big cities like Astana, Almaty, and Shymkent, which shows their underdevelopment in the rest of the regions, especially in the regions of western Kazakhstan. Consequently, the results of this study may be used by local executive bodies (Department of Education Management of Municipalities) for further decisions on the development of regions. They may also serve as a foundation for further research with new data and variables.

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