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Two-Factor Model of Stratification of the Population of the Republic of Kazakhstan "Income"—"Quality of Life Index"

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Abstract There are acute problems of income inequality and poverty around the world. In each particular case, it is important to study the causes and to develop mechanisms for their elimination. In Kazakhstan there have been many attempts to study poverty, but there have not been studies of groups near poverty or at risk of becoming impoverished. This paper presents a model of classifying the population into four groups according to two factors: income and quality of life. The study of each group's profile can assist in the development of an effective social policy strategy on the basis of targeted support for each group through the consideration of their needs. It could help Kazakhstan to resolve issues of poverty and income inequality and increase the level and quality of life of the population.

Keywords Quality of life index • Income • Deprivation • Standards level • Income inequality

1 Introduction

In modern society, every country has a number of objectives: (1) to assure the social equity and protection of its population, (2) to create decent living standards for every citizen, (3) to establish equal starting opportunities, (4) to support socially unprotected groups of the population, and (5) to remove social inequality through a variety of mechanisms of redistribution of income between social strata. Over the past decade, Kazakhstan has had rapid economic growth. According to the World Bank (WB 2015), GDP per capita at PPP in US dollars grew 8.46-fold from 2001 to

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2014; however, it is mainly due to the extractive industries, namely gas, metals, and oil. At the same time, a high degree of social stratification into rich and poor has been observed in the country.

This constitutes a relevant social problem. Current research has proven that excessive inequality in a population is not only a destabilizing factor creating the threat of potential conflicts, but it also adversely affects economic and demographic indicators of the country (Bobkov 2009; Gornig et al. 2010). In the context of unequal distribution of economic, intellectual and other resources, the separation of certain groups in society enables the formation of a social identity and sets interaction boundaries between individuals and groups with different social status.

Issues of allocation of certain social groups in society were laid down in the 1920s by Max Weber (1978), who identified the main elements of inequality of wealth, prestige, and power. Then, these studies were continued by Sorokin (1957), Parsons (1940), Lloyd et al. (1949), and Edwards (1938). After the collapse of the Soviet Union, the processes of social stratification and polarization of incomes have increased dramatically. To the study of this question there were articles of Flakierski (1992), Stark and Bruszt (1998), Hanley (2000), Aliev (2013), and Guriev and Rachinsky (2006).In Kazakhstan, income inequality and polarization of society have been observed against the background of strong growth of oil and mining industries, which imposes a special shade. At the same time, Hare and Naumov (2008) in their work found that "oil shock" had no impact on inequality and poverty in the country. Pomfret (2006) analyzed the distribution of consumption in Kazakhstan in the 1990s and noted the constancy of the Gini coefficient. Howie and Atakhanova (2014) using data at the household level showed that Kazakhstan has reduced income inequality. Satti et al. (2015) revealed the presence of a U-shaped relationship between financial development and income inequality.

The aim of the present work is to construct a model in order to distinguish four groups: the poor, those leaving poverty, the vulnerable, and the wealthy. This approach combines objective (income) and subjective (deprivation) factors. In the future, this model may be refined, as adjustments may be required for both factors.

By separating society into strata and studying each of the four groups' demographic, economic, and psychological features, we have obtained information which enables us to develop a competent policy for redistribution of income in society.

2 Methodology

In 1995, Gordon (1995) conducted research in Great Britain, where he offered a new approach to identifying lines for division of the population into groups. In this approach, deprivation and income poverty lines were used to define four groups. On one side, the number of necessary goods a household was deprived of was considered and on the other side, the household income level.

Gordon's method was the basis for this paper's "income—quality of life index" model. The population was divided into groups by these two factors: income (above

median and below median) and quality of life index (by the number of deprived items, or "deprivations"). The formation of this stratification was conducted in several stages:

1. Formation of a list of basic needs.
2. Formation of a list of deprivations.
3. Calculation of the quality of life coefficient.
4. Identification of lines for dividing the population into two groups by deprivation level.
5. Verification of the lines for grouping by deprivation level.
6. Division into groups by level of income (above or below the median)

Calculations were carried out using the Household Survey database compiled by the Statistics Agency of Kazakhstan in 2009. The Household Budget Survey (12,000 households) includes indicators for income, expenditure and consumption, socio-demographic characteristics, labor market and living conditions on the basis of annual, quarterly and daily surveys.

In the first stage, basic necessities were identified and deprivations were selected to create a quality of life index. The list of basic necessities was formed through several sub-stages: First, using the database of household surveys of the Statistics Agency of the Republic of Kazakhstan, we identified a list of durable goods owned by the household. Through frequency and correlation analysis, the degree of their sensitivity to income distribution was established. To obtain more accurate estimates of the income which is used for consumption, we corrected through the subsistence minimum value. We did this to remove the impact of regional disparities. Then through correlation analysis, the interconnection of particular durable goods was identified. As a result, 4 out of 27 indicators were selected: presence in the home of (1) a refrigerator, (2) a washing machine, (3) a vacuum cleaner, and (4) a personal computer.

The next step was to define a list of home amenities (the presence of a water supply, electricity, gas, central heating, etc.). Then, through frequency and correlation analysis, the types of amenities which are sensitive to income distribution (quintile groups) were selected. As a result, 4 of the 10 criteria were selected: the presence of (1) central heating in the household, (2) a telephone, (3) hot water, and (4) plumbing.

Next step was to create a list of deprivations. The questionnaire from the Statistics Agency of Kazakhstan contains 11 deprivations. On the basis of frequency and correlation analysis, 11 of the deprivations were selected: (1) households are not able to have enough food, (2) are not able to by fruit for their children regularly, (3) do not have necessary clothing and footwear for all family members for the winter months, (4) are not able to provide money for their children for meals at school, (5) pay utility bills in full and on time, (5) do not have money for vital medicines, (7) cannot buy even cheap furniture, (8) cannot buy fruit for children, (9) cannot buy sweets and toys for children, (10) cannot pay for children to go to kindergarten, (11) cannot give money to children for school meals, (12) cannot buy the necessary sizes of clothing for children as they grow.

Table 1 Verification of the reliability coefficients using Cronbach's test

Method 1 (space saver) will be used for this analysis					
RELIABILITY ANALYSIS—SCALE (ALPHA)					
Source of variation	Sum of Sq.	DF mean	Square	F	Prob
Between people	4711.5886	11,836	0.3981		
Within people	38433.7895	213,066	0.1804		
Between measures	14343.3739	18	796.8541	7047.1251	0.0000
Residual	24090.4156	213,048	0.1131		
Total	43145.3781	224,902	0.1918		
Grand mean	0.2588				
Item-total statistics					
	Scale mean if item deleted	Scale variance if item deleted	Corrected item—total correlation	Alpha if item deleted	
Q1	4.1853	6.3422	0.4599	0.6853	
Q2	4.5648	6.4244	0.3758	0.6954	
Q3	4.1249	6.6980	0.3344	0.7001	
Q4	4.3546	5.9426	0.5685	0.6691	
Q5	4.6892	6.5993	0.3650	0.6967	
Q6	4.2902	6.0544	0.5360	0.6741	
Q7	4.4822	5.9853	0.5491	0.6718	
Q8	4.8619	7.2069	0.2459	0.7091	
Q9	4.8544	7.2910	0.1618	0.7141	
Q10	4.7843	7.0294	0.2318	0.7097	
Q11	4.8521	7.4174	0.0626	0.7202	
Q12	4.6561	7.0227	0.1491	0.7211	
Q13	4.5637	7.1284	0.0808	0.7313	
Q14	4.8054	7.0079	0.2723	0.7062	
Q15	4.8970	7.3886	0.1986	0.7130	
Q16	4.8743	7.2434	0.2532	0.7092	
Q17	4.8694	7.2236	0.2543	0.7089	
Q18	4.9050	7.4800	0.1148	0.7162	
Q19	4.9072	7.5254	0.0488	0.7179	

Reliability coefficients
N of Cases = 11837.0 N of Items = 19
Alpha = 0.7159

Thus, the list of deprivations, consisting of 19 different characteristics (11 deprivations and eight household property characteristics) was obtained. In the second stage, the reliability of coefficient markers was verified using Cronbach's alpha test (Cronbach 1951). The test results obtained using SPSS 11.0 software for statistical analysis is presented in Table 1.

The reliability coefficients, equal to 0.7159, are sufficiently high. On the basis of coefficient Corrected Item—Total Correlation, items 11, 12, 13, 18, and 19 are considered insufficient for further use.

Therefore, 14 features were selected for use in developing the life quality coefficient and later stratification: (1) presence of a washing machine, (2) of a vacuum cleaner, (3) of a personal computer, (4) of central heating, (5) availability of a telephone, (6) presence of a hot water supply, (7) presence of plumbing, (8) availability of a refrigerator at home, (9) lack of enough food at times or food was not always of a desired variety and quality, (10) lack of necessary clothing and footwear for all family members for the winter months, (11) inability to by fruit for children, (12) inability to provide money for their children for catering at school, (13) inability to buy sweets and toys for children, and (14) inability to buy the necessary clothing for children as they grow.

In the third stage, the quality of life coefficient was calculated. Next, we totaled the deprivations and conducted a frequency analysis. It proved that the share of households with 10 or more deprivations is extremely small, 1.8 % in total.

The quality of life coefficient was calculated according to the method proposed by Gordon (1995): those households which had 0 deprivations from the index were assigned the value 14, those which had one deprivation −13, and so on. Figure 1 presents the distribution of households by quality of life index.

Using dispersion analysis (ANOVA) and logistic regression analysis, the dividing line for the two groups (great or minimal deprivation) was identified. In other words, we found a deprivation index value at which intergroup differences are maximized and intra group differences are minimized. For this, subsamples of respondents were identified with consistently increasing numbers of deprivations. For the dependent variable, the dichotomous variables of numbers of deprivations described above were used. The independent variables were the per capita household incomes used for consumption and the number of adults and number of children in each household. While constructing the model, households that had more and relatively fewer numbers of deprivations were compared. For example, in the first model two groups of respondents were compared: those who had no deprivations, and those who had one or more deprivations. In the logistic regression

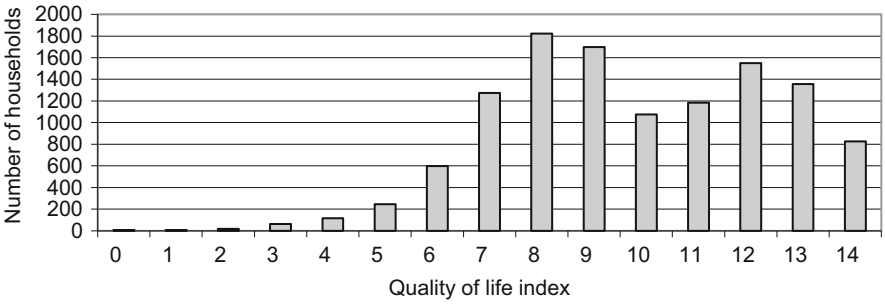

Fig. 1 Distribution of households by quality of life index, N = 11,837

model, the dependent variable was a dichotomous variable for deprivation, and the independent was disposable household income, number of adults and number of children in the household. The dispersion and logistic regression showed one and the same result—a quality of life index value of 8 was the optimal placement for the dividing line. These procedures allowed us to determine the line dividing income groups using scientifically recognized methods, instead of assigning it arbitrarily.

In total, 14 logical binary models were constructed. The binary model determines in which group of the quality of life index the household belongs, depending on per capita income used for consumption and the number of adults and number of children in the household. For example, the first group includes households with a quality of life value greater than 4 and the second group a value less than 4. The assessment of the binary logical models for defining dividing lines for households into groups was conducted by the scheme demonstrated in Fig. 2.

We will review each stage in full. Stage 1 is construction of the model and calculation of probability. For the development of a binary logistic model, the predicted dependent variable was presented as a binary (taking only two values by type of household). In the binary model, the probability with which the household may be placed in one group or the other is determined. The predicted type of household is identified by the probability value p: if $p > 0.5$, the household is attributed to the first group, if $p < 0.5$, the household is attributed to the second group.

The calculation of predicted probability was conducted using SPSS 11.0 software for processing statistical data using the following formula (Formula 1):

$$p = \frac{1}{1 + e^{-z}} \tag{1}$$

$$z = a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3 + e,$$

where x1 is the logarithm of per capita income used for consumption;
x_2 is the number of adults in the household;
x_3 is the number of children in the household.

Stage 2 is verification of authenticity and accuracy. Verification of authenticity and accuracy of the model was performed using the Nagelkerke R Square measures of definiteness. Then, using the approximation of similarity function, the quality of the regression model was evaluated. The credibility of this measure is twice the value of the negative logarithm of this function (−2LL).

Stage 3 is verification of the significance of the equation and obtained coefficients. While constructing the model, only those factors that truly have an impact on

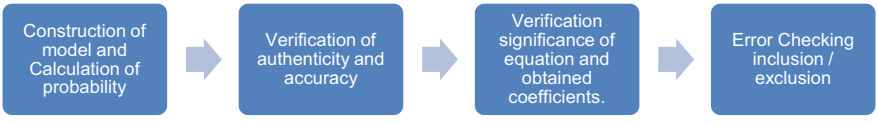

Fig. 2 Identifying lines for dividing households into groups

distinguishing the household income group were selected. Assessment of the impact factor on the dependent variable was determined through the assessment of the statistical significance of the coefficient corresponding to this factor. Verification of the significance of the estimated coefficients was performed using Wald's statistics (Formula 2):

$$W_i = \left(\frac{\beta_i}{S_{bi}}\right)^2, \tag{2}$$

where: W_i is Wald's statistic;
β_i is the estimated coefficient;
S_{bi} is the standard error of β_i coefficient;
i—is the number of factors.

Stage 4; in addition to tests for assessing the quality of the equation, an approach based on the calculation of prediction errors is used to test the predictive ability the model: error of inclusion; error of exclusion. According to the scheme presented above, 14 binary logistic models were counted and evaluated. Most of the models were not statistically significant, which is likely explained by the weak influence of the independent variables on the dependent variable.

In considering the dependent variable as the number of households with a quality of life index which is 9 or higher (first value) and households with a quality of life index less than 9 (second value), we have obtained an equation with a good level of significance for the equation itself, the equation coefficients and errors of inclusion and exclusion.

The Table 2 shows the calculation of the binary logistic model for quality of life groups (<9 points and >9 points). We can see that in this model the Nagelkerke R Square coefficient is low (0.207). However, relying on the basis of Gordon's methodology, this Table 2 is acceptable for further use and application of the model.

The Wald statistics, estimating the value of coefficients of regression equation for χ-distribution, is shown in Table 3. All of this model's coefficients are statistically significant with confidence probability of 99 %. This means that all of the selected variables have a significant impact on the dependent variable.

Stage 5 is verification of the line for division into two groups by constructing contingency tables. The conducted estimations of division into poor/non-poor by

Table 2 Evaluation of binary logistic model for quality of life groups (<9 points and >9 points)

Omnibus tests of model coefficients				
		Chi-square	df	Sig.
Step 1	Step	2001.695	3	0.000
	Block	2001.695	3	0.000
	Model	2001.695	3	0.000
Model summary				
Step	−2 Log likelihood	Cox&Snell R Square	Nagelkerke R Square	
1	14,405.995	0.156	0.207	

Table 3 Binary logistic model of binary quality of life groups (<9 points and >9 points)

Variables	B	S.E.	Wald	df	Sig	Exp(B)
LOG	1.725	0.058	882.338	1	0.000	5.613
KOL_DET_D	−0.091	0.022	17.535	1	0.000	0.913
KOL_VZ	−0.083	0.020	17.324	1	0.000	0.921
Constant	−16.880	0.605	777/591	1	0.000	0.000
Classification						
Observed				Predicted		
				Life quality groups (<9 points and >9 points		Percentage correct
				Group of low life quality	Group of high life quality	
Step 1	Quality of life groups (<9 points and >9 points)	Group of low life quality		3896	1948	66.7
		Group of high life quality		1921	4072	67.9
	Overall percentage					67.3

Table 4 Contingency table of the quality of life index and poverty level at the minimum subsistence level

Quality of life index	Poverty by minimum subsistence level		In total
	Poor	Non poor	
0	50.0 %	50.0 %	100.0 %
1	75.0 %	25.0 %	100.0 %
2	47.1 %	52.9 %	100.0 %
3	30.2 %	69.8 %	100.0 %
4	29.6 %	70.4 %	100.0 %
5	21.5 %	78.5 %	100.0 %
6	13.7 %	86.3 %	100.0 %
7	7.9 %	92.1 %	100.0 %
8	6.9 %	93.1 %	100.0 %
9	4.2 %	95.8 %	100.0 %
10	3.4 %	96.6 %	100.0 %
11	1.7 %	98.3 %	100.0 %
12	1.0 %	99.0 %	100.0 %
13	0.5 %	99.5 %	100.0 %
14	0.1 %	99.9 %	100.0 %
In total	4.9 %	95.1 %	100.0 %

absolute income are dominant in the group of up to 3 deprivations. When dividing by the relative income, the poor dominate in the group up to 10 points.

Table 4 shows that the optimal value of the quality of life index is 5, which corresponds to 8 deprivations. Its further growth (i.e. an increasing number of goods to which the household has access) to a great extent is not reflected in a division of the population into "poor" and "non-poor" (by the minimum subsistence level).

Thus, based on use of regression analysis, the trait for division into groups by deprivation was determined.

3 Results

Based on Gordon's methodology, we divided all of these households into four groups. The group "non poor," which includes households with high quality of life index values, consisted of 40.5 %. This is the group into which households with few deprivations (i.e. with a high life quality index) and high income were included (Fig. 3).

The group "poor" (25.5 %), includes households with low income values and standard of living index values. Households that are poor both in terms of income and in terms of the presence of the minimum required material goods were included into this group.

The group "leaving poverty" is the group with high incomes, but low quality of life index values (9.6 %). At the time of the survey, members of this group are not poor in terms of income, and if their income stays high, in time they will be able to purchase the minimum required goods and their quality of life level will grow. Then they will leave the ranks of the poor in terms of deprivation. Such a situation may arise when the poor, for example, finds a job, and consequently his income

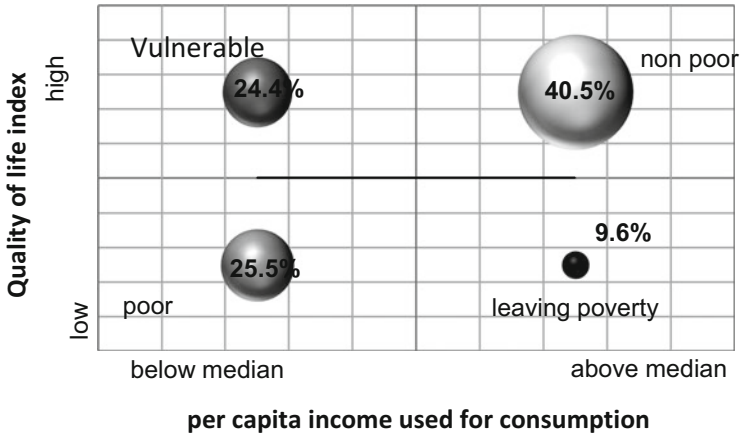

Fig. 3 Stratification of population of the Republic of Kazakhstan in 2009 by the features "income-deprivation"

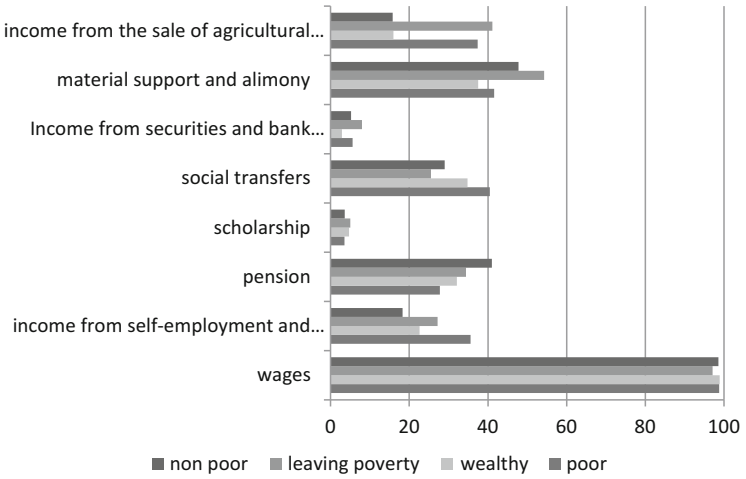

Fig. 4 Percentage of households by income groups, N = 11,837

increases; however, some time is needed to be able to buy items from the list of basic necessities and raise the standard of living.

The group "vulnerable" is 24.4 %, a group with low-income, but a high quality of life index. At the time of survey, members of this group are not experiencing deprivations, but if their income remains low, then over time they will begin to abandon them. Such a situation occurs if, for example, income is sharply reduced (due to job loss, divorce, etc.), but the people with savings may temporarily maintain their usual lifestyle. Likewise, this situation may occur in conditions when there is good access to quality social services (healthcare, education, infrastructure, clean drinking water, etc.).

We will consider the profile of the previously-defined four groups. More than 97 % of households in all the population groups note wages as a source of income. 40.1 % of "poor" and 26.0 % of "wealthy" households receive social transfers (TSA benefits and social assistance) as one of the sources of income (Fig. 4). For 41.1 % of households "leaving poverty" and 37.4 % of "poor" households, another source of income is selling agricultural products. At the same time, this type of income is found in only 2.8 % of "wealthy" families. 35.6 % of poor, 18.3 % of non-poor and 21.8 % of "wealthy" households have income from self-employment and entrepreneurial activities. Here we would like to draw attention to a logical contradiction, which is connected, in our view, to the fact that, firstly, it would be more correct to divide the income from entrepreneurship and self-employment activities, and secondly, to review the methodology for classification of the population as self-employed.

Analysis of the presence of additional housing (in addition to the main residence) shows that it is 6 times more often present in non-poor households than poor (Fig. 5). That is, this indicator characterizes the level of welfare of the family and can be used in future studies to separate higher-income groups.

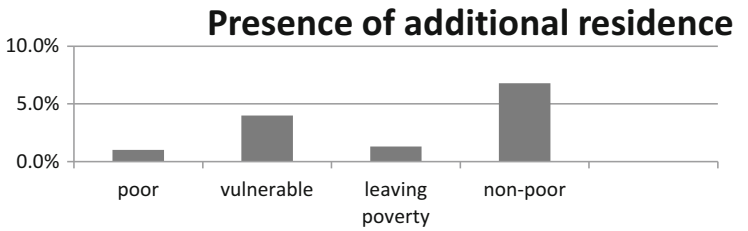

Fig. 5 Proportion of households with additional housing accommodation in addition to the main, N = 11,837

Table 5 Distribution of stratified groups by type of residence, N = 11,837

	Type of residence						
	Astana	Rural area	Cities	Town	Small town	Almaty	In total
Poor	0.2	85.8	6.1	3.6	3.7	0.6	100.0
Vulnerable	1.2	32.1	44.9	10.3	5.4	6.1	100.0
Leaving poverty	0.9	81.8	6.8	3.0	6.2	1.3	100.0
Non poor	3.5	21.2	47.3	9.3	4.5	14.2	100.0

According to the data presented in Table 5, the concentration of the different groups can be seen with the breakdown of the type of residence. The poor households predominantly (85.8 %) live in rural areas. Consequently, in addressing poverty (both in terms of income and deprivation), the Government should focus primarily on solving the problems in the countryside. The vulnerable group (i.e. those who have low income, but very few deprivations) is concentrated in rural areas (32.1 % of households in this group) and large cities (44.9 %). Here it is necessary for Government to pay attention to the creation of conditions to improve the quality of life through the creation of free access to quality education and training, public access to affordable and good quality food, including vegetables and fruit, medicines, etc. The group "leaving poverty" is also concentrated in rural areas (81.8 % households). These households have incomes above the median; nevertheless, they experience many deprivations. Such a situation could arise, for example, if the income of household members has increased only recently. If their income is quite high, in time they will move into the "non-poor" category. Those "leaving poverty" experience deprivation due to poor infrastructure; therefore, to support this group, it is necessary to pay attention to the social infrastructure in the villages.

The distribution of the studied groups when broken down by the head of household's level of education shows that this individual's education also affects family income (Table 6). 83.3 % of households whose heads have no education are "poor" or "vulnerable." 44.8 % of households in which the head has secondary professional education are included into the group "poor" or "vulnerable". Here we can assume that the insufficient quality of secondary professional education or poor

Table 6 Distribution of stratified groups by type of residence, N = 11,837

Groups	Has no education	High professional	General education	Compulsory general education	Secondary	Primary professional	Secondary professional	Degree	In total
Poor	58.3	30.9	29.4	42.4	29.0	20.4	11.0		25.5
Vulnerable	25.0	22.7	22.0	21.2	27.1	24.4	21.4	7.1	23.0
Leaving poverty		17.7	14.0	12.1	9.3	9.1	6.1		9.6
Non poor	16.7	28.6	34.6	24.3	34.7	46.1	61.5	92.9	42.0
In total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

orientation to the needs of the market demands the Ministry of Education of Kazakhstan's attention.

Meanwhile, 61.5 % of households in which the head has higher education, and 92.9 % of families with a head who has a degree are "non-poor" and "wealthy". Thus we have evidence that providing access to quality professional and higher education will enable the income level of the country to increase and bring a new level in the quality of life.

4 Conclusion

Thus, on the basis of a one-time survey of living standards, limited but important information about the population structure (its division into certain strata, in this case by two characteristics—income and deprivation) has been obtained. Using this technique, it was possible to identify not only the categories of the poor and the non-poor, but also categories of the vulnerable and those leaving poverty. Research on the dynamic structure of the population could track the changes occurring in society and possibly evaluate the effectiveness of the social programs taking place. The advantage of this approach, in our view, lies in the fact that: (a) it can take into account public opinion (list of deprivations), (b) its poverty line has been set in a scientific way, and (c) it provides some insight into the dynamics of poverty, as it allows attribution to, in addition poor and non-poor groups, vulnerable and leaving poverty categories. A cursory analysis of the profile of each group identified a number of directions for public policy: support for professional education (which is the foundation for a decent income level for an individual), development of social infrastructure (water supply, roads, gas supply, child development centers, centers of cultural and leisure activities, kindergartens), solutions to problems in villages (primarily through the provision of infrastructure and conditions for the development of the agricultural sector), and solutions to the problems of providing housing to the population.

The development and implementation of strategies for effective social policy on the basis of targeted support for each population group with regard to its needs will allow Kazakhstan to more effectively address issues of poverty and income inequality and increase the quality of life of its population.

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