Statement of the Problem

Since time immemorial with the emergence of agrarian societies, the economic surplus became large enough to support more complex and less meritocratic systems of stratification. Even in ancient societies of hunters and gatherers which are characterized by more or less equal income distribution in principle the beginnings of stratification already existed.

The relevance of the study of income distribution in modern society and associated inequality and poverty must be seen as part of fundamental relationship between equality of incomes and economic effectiveness. The main argument in favor of an equal distribution of income is that such distribution is required to maximize the satisfaction the needs of the consumer or the marginal utility. The argument in favor of income inequality is that equality undermines the incentives to labor activity, investment, risk and thus decreasing the amount of disposable income.

V. Pareto [1], after study of the significant empirical material on the inequality of the personal income distribution in many countries of the world, put forward a hypothesis about a certain «naturalness» and stability of such disparities, explaining this by the psychological circumstances. A number of modern scholars [2-4] also share this point of view adducing both theoretical and empirical evidence in favor of this.

If you take a statement about the stability of the income distribution as a starting point, and that the household income properly may not be considered as a random variable [2], the income can be considered as a certain events system mapping, which leads to stationary distribution with the «fat» right tail. We assume that one of the possible causes of emergence such a system is, in most cases social ones, namely: social structure leading to quite stable socio-economic stratification in society.

Formation of modern economic relations in Kazakhstan is accompanied by profound changes in the social structure of society and by the deepening of its differentiation. New classes are forming: owner class, middle class and others Each of them is differed by income levels, the manner and quality of life, social psychology and degree of social solidarity, socio-cultural values and political orientations, models of economic behavior, and the formation, stability and the maintenance of social order in the society depends on all that.

All these factors determine the relevance of our research.
Proceeding from the above the main objectives of this study are as follows:

- A development of a simple (one-dimensional) hierarchical normative model of socio-economic stratification at the initial condition that social stratification is of a «steady-state» nature where the variable is the ability of individuals to appropriation or, if you like, earning income. This ability aggregates, as a whole, the various characteristics of social strata (power, property, wealth, education, qualifications etc) and is realized in quantitative expression by personal income obtained, and also depends on the location of the individual in the social structure;

- On the basis of the developed model with the number of strata from 5 to 10 to calculate and construct Gini coefficient and Lorenz curve and to carry out a comparison with the corresponding indicators calculated from the statistical data;

- On the basis official data of the Agency on statistics of the Republic of Kazakhstan concerning the living standards, wages, household surveys in dynamics for 2003-2012 [5] to fit the developed normative model for revelation the dynamics of mobility between strata and the development of sustainability or transformation criteria for social structure of Kazakhstan society.

**Practical Contribution of the Study**

Without an analysis of the society social structure it is impossible to understand the genuine essence of socio-economic relationships and processes in the sphere of economy, their social consequences for the whole society and specific population groups. A detection of characteristics of both upward and downward mobility between the strata of the society of Kazakhstan, and also knowledge of sustainability or transformation parameters of the Kazakhstan socio-economic structure will give a possibility to develop an appropriate set of recommendations, measures and actions, allowing to escape the negative consequences of one or another adverse events and trends in the socio-economic conditions of the Kazakhstan population. In addition, given the ineffectiveness of the institutional organization of income distribution mechanism in a transforming economy of Kazakhstan, analysis the causes of this ineffectiveness could lead to recommendations for institutional changes associated with existing socioeconomic stratification and the differentiation of the population by income.

**Literature Review**

D. Grusky gives the following definition stratification system notion: “..."stratification system” refers to the constellation of social institutions that generate observed
inequalities...The key components of such systems are (1) the institutional processes that define certain types of goods as valuable and desirable, (2) the rules of allocation that distribute those goods across various positions or occupations, and (3) the mobility mechanisms that link individuals to positions and generate unequal control over valued resources...” [6]. The inequality of modern systems is produced by two processes. The first are the jobs, occupations, and social roles in society that first matched to ”reward packages” of unequal value, and, the second are the individual members of society that then are allocated to the positions defined and rewarded in that manner. Most researchers characterize stratification systems in terms of discrete classes or strata whose members are similarly advantaged or disadvantaged with respect to various assets that are deemed fundamental. Inequalities in honor or power are frequently regarded as the most fundamental sources of class formation, while the distribution of economic assets is seen as purely secondary. Many of the rewards (e.g., income, honor) are principally allocated through the jobs or social roles that individuals occupy, and one can therefore measure the standing of individuals by classifying them in terms of their social positions.

In [7] four social layers were identified: the upper, middle, basic and lower, and desocialized «social bottom» that, in general, is applicable in the case of Kazakhstan too. The upper layer includes the real ruling class. The middle layer is a germ of a middle layer in the Western sense of the term. According to various estimates in the CIS countries the upper and middle layers is not more than a quarter of the economically active population, unlike developed countries, where the middle class is the basic part of the population and plays a major stabilizing role. The basic layer can be assigned more than 2/3 of the society. Its distinctive feature is the overall setting that is expressed in adjustment to changing conditions in order to survive and preserve the achieved status. The lower layer closes the main, socialized part of society. Distinctive features of its representatives are low activity potential and inability to adapt to the harsh socio-economic conditions of the transition period. Social bottom is mainly characterized by the isolation from the social institutions of society, reimbursable inclusiveness in specific criminal and semi-criminal institutions. «Social bottom» is closely associated with the lower layer of the society.

On the results of sociological surveys in Kazakhstan [8] in total 67.7% of respondents lives due to labor income including additional and casual earnings, just 8.9% of the respondents has the entrepreneurial income. It should be noted that 71.6% of respondents identify themselves as middle class. According the data of the statistics Agency of Kazakhstan [5c] in the structure of average per capita
incomes of population the share of labor income for the period 2007-2011 changed insignificantly and was 80.4% to 81.6% of the total income, including payment for hire from 69.3% to 71.3%, from self-employment and entrepreneurship from 9.5% to 11.4%, while the share of property income was during this same period only 0.4-0.7 percent.

Taking into account the aforementioned studies [7, 8] for the purposes of normative modeling the partition onto 5-6 strata can be used which also corresponds to the current statistical practice surveys on living standards by splitting on the 5 quintiles with the construction of the Lorenz curves and Gini coefficient [5].

The most common tools for the study of the personal income distribution inequality are the Lorenz curve and Gini coefficient. As they are calculated on the basis of the observed data on statistics of income then obtained figures were subjected numerous attempts to modeling, due to certain economic or other assumptions [9]. The mentioned collection of papers contains both previously released several fundamental and review articles by leading experts in the field of research and papers of assessment and modeling of the income distribution and Lorenz curves (including generalizations and extensions), and modern research in this field.

Modern state-of-art the problem of inequality and of various indicators of its measurement and modeling are described in the review [10] and the papers [11, 12] in details. Since there are currently about two dozen Lorenz models available in the literature for fitting grouped income distribution data then a general method to construct parametric Lorenz models of the weighted product form is offered in [13]. The Gini index is a summary statistic that measures how equitably a resource is distributed in a population; income is a primary example. In addition to a self-contained presentation of the Gini index, paper [14] gives two equivalent ways to interpret this summary statistic: first in terms of the percentile level of the person who earns the average dollar, and second in terms of how the lower of two randomly chosen incomes compares, on average, to mean income. Inequality measures can be considered as tests of fairness in an economy [15]. Rather than focusing on outcomes which are snapshot measures, it is argued, that we should be interested in whether the underlying process is “fair”. Consistent estimation of income inequality is considered in [16] where the problem of bias in measuring of inequality is analyzed. A new approach to measurement of stratification and between-group inequality is presented in paper [17]. It is shown that when two groups are involved, the impact of stratification on between-group inequality
can be measured by a simple comparison of the two cumulative distribution functions. This approach allows an interpretation of stratification in terms of probabilities and paves the way for a neat and simple graphical illustration. The paper [18] proposed for the measuring of income concentration so-called Herfindahl index. It, unlike the Gini index, takes uneven distribution as an axiom and its changes reflect changes in the ratio of the share of individual groups in total income. Its growth is directly indicating a growing concentration.

The Surplus Theory of Social Stratification [19] explains inequality of wealth in terms of (1) the fugitivity of wealth not needed to sustain the production of more wealth, (2) the tendency of wealth to flow into the hands of those who are already disproportionately wealthy, and (3) the ability of workers in an industrial society to retain a greater share of the wealth they produce than workers in societies with more primitive technologies. Size distributions of wealth from societies at different levels of technology can be fitted by a family of gamma distributions, whose shape parameter is related to a society's level of technology. The Surplus Theory implies a stochastic process that generates gamma-like distributions. Analysis of this process, the Inequality Process, explains many facts about size distributions of personal wealth. Further development of given approach is presented in [20] where introduced in previous paper the One Parameter Inequality Process (OPIP) long predates the Saved Wealth Model (SWM). The OPIP and other versions of the Inequality Process explain many aspects of wealth and income distribution.

Mathematical modeling of Russian economy based on explicit description of social stratification is proposed in [21]. Each stratum from ten allocated strata has its own demographic characteristics. The work describes economic functions of stratum, dynamics of their demographic structure, and interaction of stratum. On the basis of the stratum’ description the national and regional economic models are built.

The paper [22] discusses the problems of inequality and income distribution modeling. It provides a «calibration» the Gini index that allows interpreting adequately indicators stratification of society and determining which their values provide the steady development of the economy. These relative indicators can characterize the state of fairness in income distribution and the structure of society as the institutional structure.

Starting from the observation that wage scales and numbers of employees of different levels scale [23] applies the theory of Hierarchical Modular Systems to derive a system for just income distribution. The only input is the scale parameters Q and R of the wage scale and the employees, the total number of
inhabitants N, and the available income E (by which it means the portion of the national gross product
used for private consumption). The system then determines the number of levels, the distribution of the
population over the levels, and the distribution of the available income over the levels.

Research Methodology

(a) The Data

For the study, the project will use the official data published by the Agency on statistics of the
Republic of Kazakhstan [5a-5c] for 2003-2012, covering the results of surveys 12 thousand households
regarding the characteristics of the living standards, as well as statistical yearbooks of the labor payment
in the Republic of Kazakhstan.

Money income of households is the sum of monetary funds received by members of households in
the form of wages, income from business activities, social transfers (pensions, scholarships, allowances
and other payments), interest, dividends and other income from property, other money income. The
relevant data from statistical yearbooks on income differentiation contain the following necessary
information to us: population with low incomes; basic indicators of poverty; the distribution of income by
deciles groups; the distribution of incomes by quintiles groups.

Data from the statistical yearbooks on labor payment contain information on wages in the whole
Republic, by regions and industries, by size of enterprises, by staff categories and groups of employment,
the distribution of the salaries sizes accrued etc. The choice of wages for analysis is explained due to the
fact that its share prevails in total income and is over 70% stable. Despite the shortcomings of national
statistics (ignoring the effect of inflation, a significant increase in uncertainty in the variations of wages
within the last quantile group), it may be suitable to study the temporal dynamics of inequality and
differentiation in official salaries.

(b) The Model

Previously we can outline the model by the following:

A structure of society is described by hierarchical set of strata \{S_1, \ldots, S_i, \ldots, S_n\} where \(i = 1, \ldots, n\) \((n = 5 \div 10 \text{ but it can be variable})\);

In the first approximation every stratum appropriates the same share of aggregate society income
(this parameter can be variable too, in principle);
Each stratum has occupation numbers $O_i$, where $O_1 < O_2 < \ldots < O_n$ (in certain sense we can use instead of “$<$” the symbol “$\ll$”), $\sum_{i=1}^{n} O_i = N$, $N$ is total population;

The ability of the individual to the appropriation of income is the main parameter of the model, and its value depends on a location in stratified structure of society;

For the jumping of the individual up (to richer stratum) he/she should overcome some difference between strata (it can be called income barrier) depending on his accumulated income, or he/she can drop down (to poorer stratum) when there is a lack of income to stay in current stratum. This phenomenon can be called a vertical mobility;

Differentiation within one stratum can be described by a function of ability to appropriation that depends on inverse manner from “the distance” to the centers of appropriation in the stratum (functional form can be as exponential or any inverse dependence with cut parameter due to multiplicity of appropriation centers, or any other decreasing function). In this case some movement within the stratum reflects a horizontal mobility.

It is expected to conduct numerical experiments modeling the distribution of income and the corresponding mobility, and to construct and calculate normative Lorenz curve and Gini index, or any other needed coefficients.

An estimation of the model would be done by the comparison with the beforehand calculated inequality coefficient from the observed statistical data on income differentiation in Kazakhstan. During this stage it is assumed the using of known fitting criteria.

Close to our approach method was presented in [23] where the theory of hierarchical modular systems is used. The essence of the approach is the following. There exist $N$ elements of the system are distributed over $L$ levels which are numbered from 0 up to $L - 1$. Occupation number of the level $k$ is $n_k$ with sum of $n_k$ equals $N$. To each level $k$ value $v_k$ is assigned. The values are modular in the sense that $M = v_{k+1}/v_k$ does not depend on $k$. The value of the level $k$ may then be expressed in terms of $v_0$ as $v_k = M^k v_0$. Main conclusion of the author that there is enough wealth in the society that nobody should live in poverty. And further more concrete issues follow in application to Germany (the author is German): “It may be argued that it is not necessary to distribute the available income over the whole population and
that babies for instance don't need an income of their own. However, the ‘age pyramid’ would certainly look different if every baby had an allowance of 900 EUR per month.”

(c) **Interpretation**

If we consider that existing social stratification is natural then the modeling (normative aspect) and fitting (positive aspect) of the processes in stratified society allows assessing a possible social and economic impact on future development of country, and to develop practical recommendations and activities aimed on mitigation the alleged negative effects of such differentiation of the population. The second issue is that instead of rather artificial income partition into quantiles (quintiles or deciles) in welfare statistics we could get more close to reality understanding of socioeconomic stratification causes and processes.

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**Plan/schedule of work**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Stage</th>
<th>Dates</th>
<th>Proposed Results</th>
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<tr>
<td>1</td>
<td>Literature review; Gathering, sampling and adjustment of necessary statistical data; Development of normative model;</td>
<td>1st quarter</td>
<td>Detailed literature review; Structured and adjusted data sets; Preliminary normative model;</td>
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<td>Development of normative model; Processing of statistical data and calculation of relevant inequality indicators and personal income distributions;</td>
<td>2nd quarter</td>
<td>Complete normative model; Inequality indicators; Personal income distributions;</td>
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<td>3</td>
<td>Numerical experiments with normative model; Comparison with calculated inequality indicators; Calculation of mobility parameters;</td>
<td>3rd quarter</td>
<td>Results of numerical modeling; Results of comparison; Mobility parameters;</td>
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<td>Estimation of model results; Assessment of project; Final report;</td>
<td>4th quarter</td>
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