Economic inequality, standards of living, and poverty in Russia: measurement and causal dependencies

A. Yu. Sheviakov
A. Ya. Kiruta

This project (No 97-029) was supported
by the Economic Education and Research Consortium

JEL Classification: C14, C33, C43, D31, I31, I32

Alexey Sheviakov, Alexander Kiruta
The Center of Social and Economic Measurements
Russian Academy of Sciences and State Committee RF on Statistics
47, Nahimovsky, Moscow
Tel/fax: (095) 129 07 44, 129 11 22
E-mail: shev@co.ru

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Market reforms in Russia accompanied with sizable inequality and poverty increase, standards of living decrease, and high differentiation of socioeconomic conditions across Russian regions. The official estimates of inequality and poverty substantially underestimate their sizes, whereas alternative estimates by some independent analysts, including those of the Russian Longitudinal Monitoring Survey program, unnecessarily overestimate them. This paper develops and applies new statistical methods in order to obtain significantly more accurate and reliable estimates of inequality, poverty, and standards of living at the regional and the national level. The authors show that the principal source of discrepancies in previous estimates consists in high biases of all family budget survey samples in respect to the general samples in regions and in Russia as the whole, and introduce new techniques for sample bias correction using macroeconomic data. They show that clear understanding of inequality dynamics and differences across regions can be achieved with the use of overall inequality decomposition into normal one (excluding inequality, caused by poverty) and excess one (caused by poverty). With the use of inequality and poverty decomposition by income sources the authors draw recommendations on diversified policy to poverty reduce and make income distribution more equitable.

Acknowledgements: The authors are grateful to Elena Frolova, the head of Goskomstat's Department on Population Surveying and Statistics of Standards of Living, for providing them with initial data, used in the paper. The authors express gratitude to the EERC resource persons Tito Boeri, Katherine Terrel, and are especially thankful to John Earle for helpful advice.

Keywords: Russia, general sample, sample bias, sample data weighting, calibration to macroeconomic data, non-parametric methods, distribution density function, kernel estimation, deflation, equivalence scaling, poverty cut-off, normal inequality, excess inequality, inequality by income sources

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NON-TECHNICAL SUMMARY

The paper aims to obtain clear and complete representation about the behavior patterns of standards of living, economic inequality and poverty in Russia over time and in its regions in cross-sections during reforms. Achievement of these aim depends on solutions of two methodological problems. The first of them is how to estimate and correct deviations of results of household budget sample survey — the principal source of information on socioeconomic differentiation of population — from characteristics of inequality in income and consumption over the whole totality of population, which in statistics is called general sample. The second methodological problem consists in choice of a system of indicators, giving the most informative aggregated representation about regional differences and dynamics of standards of living, inequality, and poverty.

The first problem conditioned by the fact that some households, included into sample survey design, can refuse to be interviewed, and probability of refuse is the more, the higher is household income. So probabilities of getting into sample households with different levels of income are different, and hence the sample income distribution turns out to be biased in respect with income distribution over the general sample. In other words, while the sample seems to be representative from viewpoint of standard statistical criteria, the sample income distribution significantly deviates from income distribution, which we could reveal in total population survey. This means that in order to obtain correct estimates of inequality and poverty we must assign to each household in the sample a weight inversely proportional to probability to get a household of the same type into the sample. In this paper we develop and apply a new methodology for sample data reweighting in order to correct sample bias in respect with the general sample. It bases on comparing sample weighted average per capita indicators of income and expenditure with corresponding indicators taken from macroeconomic balances. The use of this methodology allows us to reveal significant distortions of inequality and poverty magnitudes in Goskomstats official estimates and in alternative investigations, giving contradictory estimates to those by Goskomstat.

With the use of our new techniques we show that in all known household budget survey samples low income groups of population are represented excessively, whereas top income groups are represented more weakly. In addition, in reform process in Russia income distribution acquired a new complicated form, which cannot be described by simple parametric distribution models, traditionally used in statistics. These circumstances was the sources of

distorted inequality and poverty estimates and discrepancies between estimates by Goskomstat, underestimating inequality and poverty magnitudes, and alternative estimates, which overestimated both them.

The second methodological problem contains two different aspects. The first its aspect is how different may be inequality and poverty estimates, basing on different measures for comparisons of incomes and expenditures of various households. We introduce and analyze eight methods for measuring economic differentiation of households, four based on income and four based on expenditure. These measurements made in per capita and adult equivalent representation, taking into account household demographic composition, with and without deflation to comparable expression in dependence on regional differences in purchasing power of money. We show that divergences in inequality and poverty estimates with the use of these eight measurement methods express some essential features of transitory process in Russian economy, and so all these measurement methods are relevant. The second aspect of the problem consists in constructing consistent system of indices of standard of living, inequality, and poverty, creating generalized representation about processes of socioeconomic differentiation of population, and giving efficient tools for analyzing dependencies of these processes on various economic factors. At the first time in Russian statistical practice we investigate regional differences in standards of living with the use of indices of real standard of living, constructed upon the pattern of Sen's index. We apply this index together with Thon's poverty index, which is consistent with Sen's welfare index, but different from Sen's poverty index. The most important innovation in this paper consists in subdivision of overall inequality into normal inequality (in the case of poverty elimination), and excess inequality, related to poverty (defined as relative excess of the overall inequality over the normal one). We show that high overall inequality in Russia is due to excess inequality, caused by extensive poverty, whereas normal inequality magnitudes in Russia and in all Russian regions, excluding Moscow, are comparable with typical inequality magnitudes in European countries. Furthermore, we show that economic explanation of interregional differences in overall inequality magnitudes can be obtained only considering their decompositions into normal and excess inequality magnitudes.

Worldwide researches of dependencies between inequality and economic performance are related to Simon Kuznets' hypothesis that with increase of economy efficiency inequality at first increases, and then decreases, i.e. inequality index plot has form, similar to inverted "U". Many contemporary investigations analyze question, is similar hypothesis true in cross-section

over a representative collection of countries with various levels of economic performance. Productivity of regional economies is highly variable across Russian regions, and they form a representative set for examination of cross-sectional Kuznets' hypothesis. We show that conventional Kuznets' hypothesis in cross-section across the Russian regions statistically rejects. Its failure explains by opposite variations of normal and excess inequality, depending not only on economic performance level, but also on a set of factors, including on unemployment, labor demand, wage arrears, the share of economically active population in the whole population number, income and profit removals from region. But *Kuznets' hypothesis fulfills with high statistical significance, replacing overall inequality by the normal one*. We revealed a new phenomenon of mutual substitution between normal and excess inequality, unknown before. Both normal inequality and excess inequality display strong and robust relationship with economic performance level, but under its variations they vary in opposite directions in such manner that overall inequality does not depends on this level and very weakly depends on other macroeconomic factors. These findings shed new light on the nature of relationships between inequality and economic performance and allow us to develop a new look at the behavior patterns of overall, normal and excess inequality, reformulating Kuznets' hypothesis in cross-section and over time in a more adequate manner.

Analyzing decomposition of inequality and poverty indices by income sources, we show that solution to problem of poverty reduction or elimination in Russia relatively weakly depends on deficit of social transfers, but mainly is caused by restricted opportunities for getting incomes from proper economic activity of population. In fact, about 3/4 of overall poverty in Russia caused by deficits of incomes from wages and salaries, and restricted opportunities for private business undertakings. This finding suggests an idea of diversified policy in order to poverty reduce and to make income distribution more equitable. Idea of diversified policy consists in distributing overall income increment, necessary in order to solve the poverty problem, among various income sources in such proportions that necessary increment of income from each separate income source would be relatively little, and so really attainable. In conclusions to this paper we discuss some mechanisms, which could lead to proportional income increase by main income sources, and so could solve the problem of poverty reduction.

1. Introduction

During the transition in Russia's economy and social sphere there arose a number of new phenomena and processes, which did not obtain sufficiently adequate and complete reflection in statistics, and which gave an origin to dramatic discrepancies of opinions and estimates in analytic papers. The official estimates by Goskomstat foster the impression that income inequality and poverty of the Russia population, after achieving their maxima correspondingly in 1994 and in 1992, was decreasing (with some fluctuations, in particular, with some poverty increase in 1995) up to 1998's crisis. That crisis enlarged poverty, but did not sizably affect the inequality in income[1]. That is in sharp contradiction with several alternative estimates by independent analysts. Such estimates of inequality and poverty of the population in 1994-98 typically are considerably over the estimates by Goskomstat, and represent the tendency of inequality and poverty changes in an opposite manner. In particular, by the results of The Russia Longitudinal Monitoring Survey 1992-96 (RLMS, see T. Mroz et al., 1997), inequality and poverty rapidly rose from 1993 up to 1996. In fact, the inequality and poverty measures, used in estimates by Goskomstat and in the RLMS analysis, were incomparable. The Goskomstat estimates were related to per capita money income, while the RLMS estimates were related to total household income with equivalence scaling (the total income includes, besides the money income, monetary estimation of household natural consumption resources in current regional prices). But inequality and poverty estimates, based on scale-equivalent total income of household's member, are as a rule lower than the estimates, based on per capita income. Therefore the contrast between the results by Goskomstat and by RLMS, if represented in comparable measures, would be striking. In this paper we shall show that both the estimations by Goskomstat and by RLMS were valuably shifted. The former underestimated and the latter overestimated inequality and poverty, but such shifts had different causes, related to methodological differences in data processing and modeling, and to high biases in sample data.

The purposes of this paper are:

a) develop new analytic tools in order to explain the sources of discrepancies in estimates of inequality and poverty in Russia;

[1] In the frameworks of concepts, developed in Section 7, this phenomenon explains by substitution of normal inequality (after excluding inequality related to poverty) by poverty in such manner that overall inequality stays almost immutable.

b) provide accurate measures of inequality, poverty and standard of living in order to obtain a transparent picture of dynamics of social conditions in Russia and its regions during reforms;

c) analyze the determinants of inequality and poverty, and draw policy conclusions in order to poverty reduce and make income distribution more equitable.

The problem of constructing an accurate and transparent picture of socioeconomic conditions in Russia during reforms is very complicated. It concerns the initial data structure, methodology of data processing, methodology of modeling the distributions of standard of living characteristics in the general sample, choice of a system of measures in order to represent and correctly interpret the results. Let us consecutively discuss these principled aspects of the problem, while indicating the crucial points of our approach to the problem solving.

1.1. THE INITIAL DATA STRUCTURE. In our analysis we use the Family Budget Survey (FBS) data by Goskomstat, which covers 49 thousand families and are representative of each region of Russia (in distinction to RLMS). The Goskomstat data up to 1996 contained information only on money incomes and expenditures, but not on disposable natural resources and durables in households. Although now the sample data on natural consumption of the households in 1996-98 are available, we focus our analysis on monetary characteristics of standard of living. A cause of principle of such self-restriction is that the regional poverty lines, estimated by Goskomstat and used in this paper, are defined for money incomes, and cannot be correctly applied to total incomes. An additional cause is that, if the poverty lines in the terms of total incomes even would define with sufficient accuracy, the whole work described in this paper must be implemented before we could turn to estimating inequality and poverty in total income. In view of these causes we leave research of inequality and poverty in total income for a separate paper. An advantage of our analysis restriction is the possibility to make a correct transition from analysis at the regional levels, covering the whole set of regions, to analysis at the national level, ensuring the accuracy of our estimates at the latter. An evident shortcoming is the narrow meaning of economic inequality, poverty and standard of living.

The initial data as in FBS, as well as in alternative specialized surveys, have the following crucial features.

THE DATA BIASES. We reveal and estimate the biases in a family budget survey sample at regional or at national level, comparing variform averages of incomes and expenditures (in total and by their components) over the sample with macroeconomic estimations of corresponding averages over the general sample. This analysis allows us to conclude that in 1994-97 the biases in Goskomstat FBS data increased. In 1995-97 the biases was very high as in the FBS data, as well as in RLMS data and in the data of other specialized surveys. These biases express at first, in high sample underestimation of average per capita money income and expenditure (almost twice in 1996-97), and, at second, in high distortion of proportions between their components in comparison with corresponding estimations in macroeconomic balances. As a consequence, in Goskomstat's surveys the poor (in per capita income) formed 37% of the sample in 1994, 48% — in 1995, 58% — in 1996, 51% — in 1997. However, under a sample data correction, Goskomstat estimates the percentages of poor among the population of Russia as the whole as 22.4% in 1994, 24.7% in 1995, 22% in 1996 and 21% in 1997. In the Russia case proper corrections in the sampling design cannot be implemented by comparison of sample data with the data of population census, because the latter do not contain any information on economic conditions of the population. A choice of a model, based on joint use of sample and macroeconomic data, is the only way to correct the biases in sample data and to estimate economic inequality and poverty in the general sample, as at regional, as well as at national levels. In fact, the biases in regional survey samples are highly variable across the regions of Russia (as in size, as well as in structure), and in order to provide sufficient accuracy of biases correction it is necessary to consider each region separately, taking into account its specific situation.

INSUFFICIENCY OF INCOME DISTRIBUTION ANALYSIS. The next feature of FBS and other data is exceeding of household expenditures over their incomes for large amounts of the sample observations[2]. While in 1994-95 this phenomenon had been observed at the national level in one third of the FBS sample, in 1996-97 it extended to more than half of the sample observations, owing to an increase in payoff arrears and mobility in income. This phenomenon is also highly variable across the regions: for a number of regions the exceeding of

[2] That is no specifically Russian phenomenon. Quoting R. Rector (1998): " in 1995 the Census Bureau claimed that the lowest income fifth (or quintile) of U.S. households had an average income of $8,350. In the same year, however, the Consumer Expenditure Survey of the U.S. Department of Labor showed that the average household, in the same lowest income quintile, spent $14,607". So in 1995 the lowest income fifth of U.S. households had $1,75 in spending for $1,00 of income. The Russian feature is that such phenomena are too widespread.

expenditures over incomes embraces 70-80% of sample observations, and in such observations incomes cover in average of less than 50% of expenditures. A right comprehension of this phenomenon may be attained with use of so-called “forward looking” behavior theory (see M.Freidman, 1957, M.Flavin, 1981, R.Hall, 1978, F.Modigliany and K.J.Cohen, 1961). In particular, according to M.Friedman’s theory, expenditure is a function of permanent, but not of current income. So the higher is mobility in income, the higher is probability of expenditure exceeding income in lower current income groups. Comparing T.Bogomolova and V.Tapilina (1998) estimates with The Economist (1996) ones, we can conclude that in middle 1990s mobility in income in Russia was at least twice more intensive than in U.S.; evidently wage arrears increase such mobility. Outward appearances of dissavings mainly can be thought as rational forward-looking behavior, in anticipation of return to permanent level of income. That is in accordance with surprisingly high saving rates, which can be thought of as precautionary, providing with self-insurance of temporary income reductions.

As a consequence, the inequality in per capita income for many regions is considerably higher than the inequality in per capita expenditure, and poverty in expenditure is consistently lower than poverty in income. These circumstances have valuable implications for estimating economic inequality, poverty and standard of living at the national level, described in Section 8.

1.2. METHODOLOGY OF DATA PROCESSING is one of the principal innovations of this paper. It includes the following four topics.

DATA BIAS CORRECTION. In parametric techniques, widely adopted in Russia, in particular, in Goskomstat’s methodology, the bias correction implements by application of a model of per capita income distribution. The model’s parameters being estimated in such a way that average per capita income coincides with its estimation in macroeconomic balance (the System of National Accounts at the national level, or corresponding regional balance-sheet at the level of a region). After that, correction of all other characteristics (incomes by different sources, expenditures by their kinds) fulfills using obtained “unbiased” income distribution and corresponding macroeconomic data. The balances between differentiated and integral data implement within the frameworks of so-called “differentiated balance of incomes and expenditures” (see Sheviakov and Kiruta, 1986; Kiruta and Sheviakov, 1995; the concept

of "differentiated balance" has a long history and is widely used in Russian economic research, but it seems to be absolutely unknown to Western researchers[3]).

In our methodology we use non-parametric ("free of distribution") techniques of initial data reweighting in order to achieve the best possible accordance between the reweighted sample averages of various indicators of standard of living (see list in Section 2) and corresponding macroeconomic estimations. The idea of this approach consists in the hypothesis that different population strata get into survey samples with different probabilities (the high is per capita income, the rare is getting into sample). The source of this idea was our discussions with Goskomstat's authorities, especially with E. Frolova, the head of the Standard of Living Statistics Board. Our reweighting procedure applies to each observation a weight inversely proportional to probability to find such an observation into the sample. In view of the extremely variable size and character of sample biases across the regions, it is applied separately to each region, and only after that do we aggregate reweighted regional data to the national level.

DATA AGGREGATION. The key principle in our approach to data aggregation at the national level is that each figure in aggregated data must be provided with indication of its regional origin. Instead of aggregating sample data, we aggregate income distribution density functions, obtained by kernel estimations of the distribution densities. That is in absolute contrast with the conventional Goskomstat data aggregations by uniform intervals of per capita income, where regional data are mixed and left and right ends of income distribution are represented in too rough form — with essential loss of initial information. The advantages of our approach, besides the measurement accuracy improving, are new analytic possibilities, allowing us to do what had never been done:

(i) to estimate income and expenditure distributions at the national level, taking into account the regional differences in purchasing power of money (which are very high across the regions);

(ii) to estimate, at the national level, the effects of equivalence scaling of incomes and expenditures in each region;

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[3] Differentiated balance is a method of extending sample data on incomes by their sources and expenditures by their kinds to the general sample in a groupment by some intervals (for ex., by decile intervals) of per capita income distribution over the general sample, using corresponding macroeconomic estimates. The concept of differentiated balance had been introduced by A.Karapetian

(iii) to estimate the joint effects of equivalence scaling and deflating incomes and expenditures to equivalent expression in their purchasing power;

(iv) to analyze the position of a distinguished population group of a region in the general distribution of the population by income (given in per capita or equivalent measure), or by an income component, for example, by per capita income from social transfers; for example, we can show that about 60% of Moscow population belongs to top 10% of Russian population in nominal per capita income, and about 50% belongs to top 10% in per capita income, comparable by purchasing ability; such comparisons across the Russian regions are very interesting; we can apply also these techniques to expenditure or an expenditure component distribution analysis, as well as describe distribution of a distinguished population class among the regions, in particular, distributions among the regions of the poor, rich and middle class.

DATA DEFLATION. Another phenomenon of the reforms in Russia was very high differentiation of regional costs-of-living with very high scattering of regional relationships between mean per capita income and minimal cost-of-living, i. e. poverty cut-off (see Fig.1 in Section 3). In such circumstances, conventional analysis of *nominal* money income distribution at the national level can hardly be considered as correct, but a more correct analysis, taking into account regional differences in cost-of-living, had never been performed. With our techniques of data aggregation at the national level we can easily deflate all data on incomes and expenditures to comparable expression in purchasing ability, given appropriate regional deflators to national (average) levels of consumer prices. A problem is that such regional deflators had never been calculated either by Goskomstat, or by other investigators. In order to solve that problem we construct our deflators on the base of the data on minimal costs-of-living (which Goskomstat calculates monthly, quarterly and yearly for each region and at the national level), correcting those in accordance with the chained regional consumer price inflation rates. The minimal cost-of-living value characterizes only the cost of a collection of goods of primary needs. Therefore, in our construction of deflators the corrections are made, assuming that in regions, where both mean per capita income and minimal cost-of-living are low, the consumer prices of secondary goods are closer to the national price level than the minimal cost-of-living is (see Section 4). The problem of more accurate construction of regional deflators may be the subject of a separate research. Our aims in this paper are to show

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in 1960 and developed by N.Rimashevskaya and her research team. Correct mathematical techniques for constructing differentiated balances had been developed by A.Sheviakov and A.Kiruta (1986).

how much the estimations of inequality are sensitive to deflation of incomes and expenditures, and to derive interregional comparisons by standard of living.

EQUIVALENCE SCALING is conventionally applied to sample data. But in the presence of high sample biases the result of such application has no correct meaning for the general sample (as in the RLMS case). In this paper we do not delve into the questions how equivalence scale must be constructed, but restrict ourselves to applying the RLMS equivalence scale (see Section 3), determined on the base of sample data across six Russian regions, to sample data on each Russian region. In a matter of fact, the equivalence scales worked out in RLMS, OECD, Luxemburg Center, and L.Ovcharova et al. (1999) studies are not essentially different. The poverty and inequality estimations across Russian regions are robust under small variations of equivalence scale, because in Russia typically larger the household, the lower is household per capita income. But as we show in Section 5, the effects of equivalence scaling to poverty estimates are highly variable across the Russian regions.

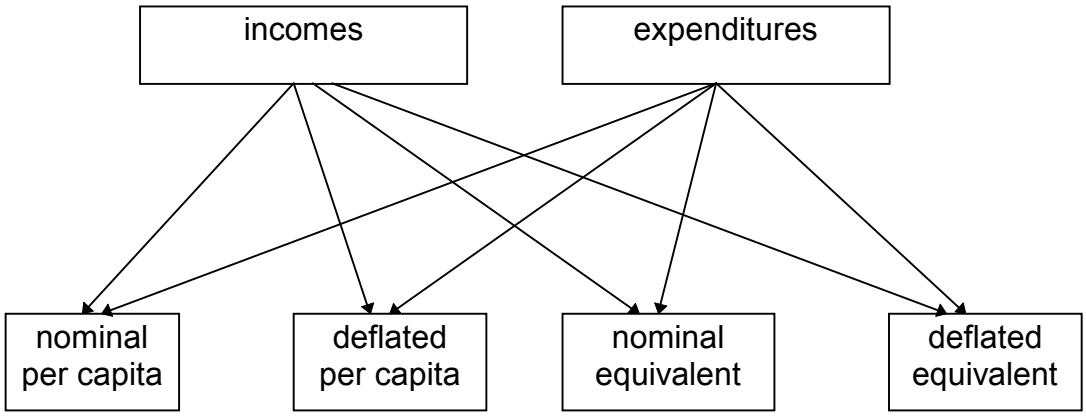
As an advantage, we develop a principally new technique for extending the equivalence scaling results to the general sample. We obtain such an extension, assigning to scale-equivalent income (or expenditure) in each sample observation the same weight, as the weight assigned to this observation in our sample reweighting, providing correction of the sample biases. Then the impact of equivalence scaling to all poverty, inequality and standard of living indices for the general sample can be calculated on the basis of scaled data reweighted in such a manner. Aggregating regional scale-equivalent income (or expenditure) distributions, we obtain estimations of effects of equivalence scaling incomes and expenditures in the general sample at the national level.

1.3. METHODOLOGY OF INCOME DISTRIBUTION MODELING. In 1994-97 striking discrepancies in estimations of inequality in per capita income, based on the same Goskomstat initial data, but obtained by the use of different techniques for estimation of parameters in parametric models of income distribution, were found. For example, I. Kolmakov and T. Velikanova (unpublished report to Goskomstat, 1995) estimated the ratio between incomes of 10% richest and 10% poorest population in 1994 as 27.1. V. Ivanov and A. Suvorov (1997) estimated that ratio in 1996 as 65, while corresponding official Goskomstat estimates were as 15.4 and 13. I. Kolmakov and T. Velikanova used as a distribution model a mixture of two lognormal distributions, the first for distribution of low and “low middle” incomes and the second for distribution of “top middle” and high incomes, estimating the mode of the first

distribution as the sample mode. V. Ivanov and A. Suvorov used lognormal distribution model with the same estimation of its mode. Goskomstat also used lognormal model, but with standard sample estimation of the variance of logarithms of per capita income. All that estimations "correct" the sample bias in such the manner that the model mean per capita income coincides with its macroeconomic estimation, but the alternative to Goskomstat estimations are more sensitive to the sample bias, because the sample mode estimation of distribution density is incorrect. At the same time, in Russian scientific literature there arose a discussion on income distribution form, where opinions that income distribution has a multimodal form had been stated.

Our methodological approach to income distribution modeling is principally new and consists in combining our sample data weighting technique with non-parametric methods of income distribution density estimation (see E. Parzen, 1962, J. van Ryzin, 1972, 1977, E. Wegman, 1972a, 1972b). Using non-parametric methods, we do not make any a priory supposition on distribution form, but, in contrast, we reveal the real form of income distributions in 1994-97. Our estimations are weighted E. Parzen's kernel estimations of densities of distribution. In Section 3 we show that densities of income distributions in 1994-97 had complicated and volatile structure of peaks in left part and slopes to the right of the main mode. So they seem to have no evident explanation by a model in parametric form; in particular, such distribution densities have no satisfactory approximations by lognormal or by a mixture of two lognormal distribution densities. This is just why the parametric models give so different results. We shall show that Goskomstat's models significantly underestimate the inequality and poverty in per capita income, while the alternative models exceedingly overestimate them. An additional advantage of our methodology is the unified approach to revealing and representing distributions of incomes and expenditures with the use of different measures: per capita, scale-equivalent, per capita equivalent in purchasing power, both scale-equivalent and equivalent in purchasing power (see formulae in Section 3).

1.4. SYSTEM OF MEASURES AND INDICES FOR REPRESENTATION OF RESULTS. For the first time in Russian statistics experience, we represent the economic conditions of population by eight measures:



In fact, all these measures are relevant, reflecting different aspects of the situations at the regional and at the national levels. Moving from left to right in this picture, we obtain better and better statistical indicators — lower and lower estimates of inequality and poverty, and higher and higher estimates of standard of living, but, when the statistical indices look good, the mood of the people may not.

In order to characterize the socioeconomic situations at the regional and at the national levels we use in this paper an extended system of indices of inequality, poverty and standard of living, described in Section 4. Our most principal innovation is introducing the index of standard of living (W), based on A. Sen's (1976) theory, and the index of poverty (P), based on D. Thon's (1979) approach, closely related with A. Sen's theory of standard of living, but different to A. Sen's poverty index. We chose D. Thon's index, because of its very nice economic interpretation. It coincides with the increment, which the standard of living index would obtain in the case, when incomes (expenditures) of all the poor would be enhanced to the level of minimal cost-of-living (poverty cut-off), represented as the share of the minimal cost-of-living. In fact, there are real cases, when the value of poverty index and the percentage of poor in the whole number of population change in the opposite manner. Besides, the poverty index gives more fine and correct indications of the poverty magnitude than its conventional representation as the percentage of poor.

We estimate the values of each inequality index (Gini or another) in our system of indices on the base of each given measure, and the values of poverty indices P, H — on the base of each given deflated measure. The differences in tendencies of inequality and poverty changes in 1994-97, expressed with the use of different measures, are sudden and reflect the features of transitory processes in Russia. Our indices of standard of living are based on combined use of deflated per capita incomes and expenditures. In regional analysis we use in addition standard

of living and inequality indices in “normal” expression, corresponding to the hypothetical case, when poverty would be eliminated. That is important in order to estimate the possible effects of poverty elimination (or even reduction), and show that so-called excess inequality is completely due to excess poverty.

2. Analysis of biases in family budget survey data: model specification

The problem of evaluation of the true economic inequality and poverty magnitude is related to estimation of distributions of income and consumption indicators in the general sample (that is the population totality as the whole). Sampled survey data always contain some biases, typically in the direction of overestimation of the share of the poor in the population totality and underestimation of the inequality in income and consumption. In case, when such biases are significant, in order to obtain correct estimates of economic inequality, poverty and real standard of living, it is necessary to calibrate the sampled survey data to the data from alternative sources of economic statistics. Such macroeconomic data are retail sales and volumes of services, banking statistics, tax inspection data, statistics of wages and salaries, statistics of social payments, and so on. All them characterize income and expenditure in the general sample. When the discrepancies between the sample estimates and these data are over the probable statistical divergences, they give reliable additional information in order to correct the sample bias, because they are related to regular methods of registration and account of the money flows.

During reforms the problem of biases in the budget survey data turns out very sharp, and that concerns not only the Federal Budget Surveys (FBS) by Goskomstat [4], but also the longuitudinal survey RLMS (Lakshin and Mroz, 1997, Mroz et al., 1997) and several special surveys, such as the one used in EERC report by L. Ovcharova et al. (1999). At all RLMS waves, excluding October 1996, income from social transfers accounts for more than 30% of total income of the households surveyed (Mroz et al., 1997, tab.2); decrease of its share to 27.1% at the last wave was evidently related to arrears of social payments. However, by Goskomstat's data the share of social transfers in money income of Russia's population as a whole was ranged as 13-17% in 1992-97. We can conclude that the most part of RLMS samples (in 1992-93, as well as in 1994-96) had been composed of a population part, exclusively highly depending on social transfers. Therefore, the inequality and poverty

[4] There exists very simple way to understand how much the regional FBS samples are biased: it consists in comparing the number of cars per 100 persons in the FBS samples with the registered number of cars per 100 persons in property of each region population. The discrepancies between the FBS and registered figures are approximately the same as the discrepancies between the sample averages and macroeconomic estimates of indicators of standard of living, used in our method of calibrating the sample data to the macroeconomic ones.

estimations by the RLMS data characterize in the main the dynamics of conditions for that specific part of the population, but not for the population as a whole.

The FBS data, which cover 49 thousands of households and are representative for each of Russia's regions, are more correct in the structure of the population monetary income and expenditure (in the exact meaning that the differences, measured by formula (11) below, in the FBS case are lower than in the RLMS case). But they also contain systematic biases, and those biases significantly increased in 1994-97. In 1996-97 the estimation of the population per capita money income by the FBS sample data was as 1.7 times below the corresponding estimation by the data of macroeconomic statistics (on the average across the whole set of regions). For a number of regions the former was more than twice below the latter, and for Moscow the former was as 4 times lower than the latter.

By opinions of some researchers, the data of family budget surveys by Goskomstat represent only the economic situation of a part of the population, which includes from 65 % up to 85 % of the population totality. However, a regression analysis we carried out has shown that the indicators of inequality and poverty, based on the regional FBS sample data on incomes and expenditures, allow us to explain the variances of several macroeconomic indicators across the whole set of Russia's regions with surprising precision. In particular, 92-97% of the variances across the regions of macro-economic estimations of mean per capita money income, cost of living and comparable mean per capita income (deflated to common for all regions constant prices) are explained by the FBS data. Hence the FBS sample biases have a definite pattern, and we can consider such results as an implicit confirmation of the alternative viewpoint that the FBS data are highly representative, despite the biases. Such implicit confirmation seems to be strong, because the economic situations and the population conditions in the regions are highly variable.

In that viewpoint, the difficulties of revealing the information, contained in the Goskomstat sample data, are caused by the fact that the different groups of the population are represented in these data by no means proportionally. The opinions that the Goskomstat data are insufficiently representative are caused by ignorance of that fact. Such ignorance led to misinterpretations and incorrect using of these data. Indeed, the groupment of the sample data into income decile intervals in Goskomstat's publications have nothing like the "traces" of income decile intervals of the general sample in the Goskomstat sampled data.

Typically the groups of population with different income standards get into budget survey samples with different probabilities. After sorting the sample data $(y(i))_{i=1}^{N}$ in order of non-decrease, so that $y(i) \le y(i+1)$, standard definition of the sample k-th decile for $k = 1, \dots, 9$ has the form

$$q(k) = y([kN/10] + 1), \qquad (1)$$

where N is the number of observations, $y(i)$ is income (or some another indicator) for i-th element of the sample in ordering by non-decrease, and $[x]$ is the maximal integer number not greater than x. But this definition is correct only under the hypothesis that probability $p(k)$ to get into sample for a representative of k-th decile group of the general sample is equal to 1/10 for each $k = 1, \dots, 10$. In the general case, when such the probabilities $p(k)$ are different (it seems natural to suppose that $p(1) > p(2) > \dots > p(10)$), the trace of true k-th decile of the general sample in our sample may be estimated as

$$q(k) = y([s(k)N]+1), \qquad s(k) = \sum_{i=1}^{k} p(i)/\sum_{1}^{10} p(j), \qquad k = 1,\dots,9, \qquad (2)$$

where $s(k)$ is the share in the sample of the set, consisting of all respondents with income below k-th decile of income distribution among the general totality of population.

The probabilities $p(k)$ or the shares $s(k)$ may be estimated by assigning to each observation $y(i)$ a weight $w(i)$ in such a way, that two conditions would be fulfilled:

(i) the weights must be as uniform as possible;

(ii) weighted average income

$$M(y,w) = \sum_{i=1}^{N} w(i)y(i) \qquad (3)$$

(or a number of other weighted means over sample) must be as close to its macroeconomic estimate as possible. At the intuition level the first condition requires that the correction of the initial data be as small as possible, and the second condition requires fulfilling the balance, which of course fulfils over the general sample. At the theoretical level these conditions express statistical hypothesis that the balance condition (3) over the general sample is sufficient in order to reveal the probabilities $p(k)$.

After such reweighting $s(k) = n(k)/N$, where $n(k)$ is number of observations in the sample, such as $\sum_{i=1}^{n(k)} w(i) \approx k/10$, and the sets of observations with numbers

$$\{1, \dots, n(1)\}, \{n(1)+1, \dots, n(2)\}, \dots, \{n(9)+1, \dots, N\}$$

represent the traces of decile intervals of income distribution among the general sample into the sample under consideration.

This is the idea of revealing and correcting the sample bias by comparison of weighted averages of several sample indicators of income and consumption with corresponding per capita indicators, estimated by the data of macroeconomic statistics. The reason of this approach is the evident fact that the mean value of each per capita indicator over the general sample must be equal to per capita value of corresponding indicator, estimated by macroeconomic data. In fact, for the general sample we have a system of balances, which describes the basic relationships between indicators of standard of living at macro-level with distributions of the same indicators at micro-level. The more number of indicators we use, the more is probability that the corresponding balance conditions, taken jointly, are sufficient in order to reveal the probabilities to get into the sample for various representatives of the general sample.

The System of National Accounts represents the balances of macroeconomic indicators at national level. In fact, Goskomstat now calculates a system of accounts, including the accounts of the households, for each region. Moreover, Goskomstat calculates for each region quarterly and yearly balance-sheets of population income and expenditure with more detailed representation of incomes by their sources and outlays by their kinds. These balance-sheets, constructed by means of the data, characterizing the economic conditions of population in each region at macro-level, and coordinated with the regional accounts, give the additional information, which is necessary in order to analyze the biases in family budget survey data. The sample data are corrected by calibrating these macro-data. The list of macro-data used to calibrate the regional sample data consists of the following items of these balance sheets:

1) mean per capita income of region's population;
2) mean per capita income of population from wages and salaries;
3) mean per capita income of population from social transfers;
4) mean per capita income of population from ownership, property and enterprise activity;
5) mean per capita expenditure of region's population (as the sum of consumer expenditure, taxes and obligatory payoffs);
6) mean per capita outlay to foods;
7) mean per capita outlay to non-food commodities;

8) mean per capita outlay to services.

In fact, in calculations of the balance-sheets both the FBS and macroeconomic data are used. The calculation consists in estimation of makeweights to the FBS data in order to coordinate them with the volumes of retail sales and services, overall statistics of really paid wages and salaries by enterprises and organizations, statistics of social payments, tax inspection data, and banking statistics. The coordination performs in such way that all the balance conditions over the general sample fulfils under small statistical divergences. Such coordination, covering the gaps between the FBS estimations and estimations by regular observing and accounting the money flows, makes the resultant figures more reliable than the initial FBS data, and accurately reflecting the incomes by sources and expenditures by their kinds in the general sample.

In order to make the idea of sample bias correction more clear, let us consider at first one-dimensional problem of sample data reweighting, when we take into account only difference between the sample mean per capita income

$$m = (1/N) \sum_{i=1}^{N} y(i)$$

and macroeconomic estimate of mean per capita income M (the first indicator in our list), $m<M$. The general case we shall consider below. If the maximal observation $y(N) \le M$, then the information contained in the sample is not enough for our calibration procedure. But typically $y(N) > M$, and we can assume that this inequality fulfills. In that case we can determine the weights $w(i)$ as solution to the following problem

$$\sum_{i=1}^{N} w(i) \log (1/ w(i)) \rightarrow \max, \quad (4)$$

$$\sum_{i=1}^{N} w(i) = 1, \quad (5)$$

$$\sum_{i=1}^{N} w(i)\, y(i) = M. \quad (6)$$

The entropy maximization criterion (4) realizes the requirement (i) that the weights must be as uniform (that is close to $1/N$), as possible. Constraint (5) is normalization condition. In the one-dimensional problem of data reweighting our requirement (ii) is replaced by exact coincidence of weighted average (3) with the macroeconomic estimate

$$M(y, w) = M$$

and constraint (6) is the balance condition.

Solution to the problem (4)-(6) has the form

$$w(i) = a \cdot \exp(b \cdot y(i)) \,, \qquad (7)$$

where parameters a, b are determined by conditions (5), (6); in our assumptions, $b>0$ è the weights (7) increase with increasing $y(i)$.

Consideration of data reweighting problem in multi-dimensional form allows us to make the procedure more precise by taking into account the structural differences between the sample data and corresponding macroeconomic evaluations by components of income and expenditure. The general methods of processing the non-grouped (primary) budget survey data provide us with tools to reestablish the distributions of indicators of standard of living among the general sample in each of the regions with the most possible precision, and then to reestablish such distributions at the national level.

Now let us describe the general multi-dimensional model of reweighting the sample data of budget survey in a region. Such sample data consist of the sequence of observations $(\boldsymbol{x}^k, \boldsymbol{a}^k)$, $k = 1,..., N$, where vector $\boldsymbol{x}^k = (x_i^k)$ represents all data on income and expediture of respondent k by components and in sums, $\boldsymbol{a}^k$ consist of socio-demographic characteristics of respondent and its household, N is the sample volume. The observations are included in the sequence in order of non-decreasing per capita income $y^k = x^k_1$.

Given the vector $\boldsymbol{c} = (c_i)$ of corresponding mean per capita data from regional macroeconomic balance-sheet of incomes and expenditures by components and in total, the sample bias may be measured by the Euclidean distance

$$|| \ (1/N) \sum_1^N \boldsymbol{x}^k - \boldsymbol{c} \ || \,.$$

This bias basically is caused by non-uniform probability for population groups with different standard of living to be represented in the sample. In order to correct this bias we must assign to each observation a weight w_k, so that to minimize the criterion

$$\beta \cdot || \ \sum_1^N w_k \boldsymbol{x}^k - \boldsymbol{c} \ || \ + \ \sum_1^N w_k \log w_k \,. \qquad (8)$$

$$\text{under conditions} \quad \sum_1^N w_k = 1, \ \ w_k \ge 0. \qquad (9)$$

Second member in (8) is criterion (4) taken with negative sign, because now we replaced maximization by minimization. Such addition into criterion (8) is necessary in order to make the weights as uniform as possible. First member in (8) is Euclidean distance between weighted average

$$M(\boldsymbol{x}, w) = \sum_{k=1}^N w_k \boldsymbol{x}^k \qquad (10)$$

and the vector of macro-data $\boldsymbol{c}$, taken with a multiplier $\beta > 0$, which control the relationship between two our goals: to minimize the distance

$$|| M(\boldsymbol{x}, w) — \boldsymbol{c} || \tag{11}$$

and to make the weights w_k as close to $1/N$ as possible. The value of multiplier β is the subject of an additional choice. In the one-dimensional case, if we put $\beta = b$, where b is corresponding parameter in solution (7) to problem (4)-(6), then the solution to problem (8), (9) will coincide with (7). In the general case we must choose the value of β in such a way that any small its variation does not decrease the value of the distance (11) in corresponding solution to problem (8), (9). Analyzing the Lagrange function of problem (8), (9), we can show that the general solution has the form

$$w_k = a \cdot \exp(\beta < \boldsymbol{x}^k, \boldsymbol{v} >), \tag{12}$$

where $\boldsymbol{v}$ is a vector with $|| \boldsymbol{v} || = 1$, $< \boldsymbol{x}^k, \boldsymbol{v} >$ is the Euclidean scalar product, and parameter a is determined by condition (8). If in the solution the distance (11) is not equal to zero, then

$$\boldsymbol{v} = (\boldsymbol{c} — M(\boldsymbol{x}, w)) \cdot || \boldsymbol{c} — M(\boldsymbol{x}, w) ||^{-1}, \tag{13}$$

else it may be represented as a limit of vectors with a structure, when the system of weights $w = (w_k)$ approximates the solution.

Let us remember that if y^k is per capita income of k-th respondent, then the sample quantile of order q by standard definition is y^m, where $m = [qN]+1$. After the sample weighting we can determine the trace of true income distribution quantile of order q as $\xi(q) = y^{p+1}$, where $p = p(q)$ is the greatest number such that $\Sigma_{k=1}^{p} w_k \le q$. The trace in the sample of true j-th decile group consists of respondents with per capita income

$$\xi((j — 1)/10) \le y^k < \xi(j/10), \tag{14}$$

and the sample estimates of per capita income $y(j)$ and and vector $x(j)$ — complete collection of per capita indicators of income and expenditure for this group — must be determined as weighted averages

$$y(j) = \Sigma_k \, w_k y^k / \Sigma_k w_k, \qquad \boldsymbol{x}(j) = \Sigma_k \, w_k \boldsymbol{x}^k / \Sigma_k w_k, \tag{15}$$

where the sums are taken over all k with y^k in the interval (14). The share of true j-th group trace in the sample is proportional to probability $p(j)$ for its members to be found in the survey,

and as a rule it does not equal to 1/10: typically for low income groups it is considerably greater than 1/10, and for high income groups it is considerably lower than 1/10.

In order to represent the results of the model application we can directly use such shares as it is shown in the following table.

Tab. 1. Allocation of FBS sample in relation to true deciles of income distribution in the general totality of population (Russia as the whole, 1996)

	1	2	3	4	5	6	7	8	9	10
Estimated decile of the general sample	176.6	269.5	341.1	410.6	481.7	579.4	716.5	966.7	1543.5	—
Percentage of the sample observations below the decile	23.9	43.4	55.4	66.0	74.1	81.3	87.9	93.9	99.0	100.0
Percentage of the sample observations in between-deciles interval	23.9	19.5	12.0	10.6	8.1	7.2	6.6	6.0	5.1	1.0

In this table the “true” deciles are the estimated deciles of the union of the reweighted regional samples in 1996 over the set of all Russian regions (taken with weight, corresponding to the share of each region population in the whole number of Russian population). So Tab. 1 represents in aggregated form at the national level the implications of our results across the regions.. It shows that over Russia as the whole 23.9% of all sample observations represent 10% of the Russian population with lower incomes, 19.5% of observations represent the next “true” decile group of income distribution in Russia, and so on. The greater is income in a decile group of the population, the lower is the share of sample observations, representing this group, so that the 10th decile group is represented only by 1% of the sample observations. Such circumstances had never been taken into account in previous investigations, but they implicitly played a dramatic role as origin of discrepancies of opinions and estimates concerning economic inequality and poverty. Really we have an analogous table for each Russian region for each considered year. The shares of different groups in the FBS samples considerably vary across the regions, as well as in time, but in a matter of principle their behavior patterns are similar to that, shown in tab. 1.

3. Non-parametric estimations of income distributions and data aggregation at the national level

There are known different non-parametric methods for estimation of distribution density function: J. van Ryzin's histogram method (1973, 1977), E. Parzen's (1962) kernel estimates, Fourier series methods and so on (see a survey by E. Wegman, 1972a, 1972b). Our experiments with different techniques had shown that E. Parzen's kernel estimates are better in our case. The kernel density estimate has the form

$$f(x) = (1/Nh) \sum_{i=1}^{N} K((x - X_i)/h) , \qquad (16)$$

where $X_1, X_2, \ldots, X_N$ — the sample observations, and $K(\cdot)$ is a bell like function satisfying some regularity conditions. In particular $h^{-1}K(y/h)dy$ is probability measure for each $h>0$, and the functions $h^{-1}K(y/h)$ converge to Dirac's δ - function in 0 when $h \downarrow 0$. In formula (16) each observation has weight $1/N$. In our case with observations having different weights w_i it transforms into formula

$$f(x) = (1/h) \sum_{i=1}^{N} w_i K((x - X_i)/h) . \qquad (17)$$

After application of the reweighting procedure described in the previous section, the formula (17) gives an estimation of income distribution density in the general sample for each region and may be directly used for computation of diverse indices of inequality and poverty.

We can easily modify the formula (17) in order to investigate the effects of income equivalent scaling in dependence on composition of the households:

$$f^{sc}(x) = (1/h) \sum_{i=1}^{N} w_i K((x - X_i^{sc})/h) , \qquad (18)$$

where $X_i^{sc} = q(m_i)X_i$ is equivalent per capita income in observation i, m_i is the size of the household in this observation and $q(m_i)$ is multiplier to per capita income in chosen equivalence scale. Comparison of estimations of income distribution density by the formulae (17) and (18) displays the effect of equivalent scaling to income differentiation ***in the general sample***. In recent Goskomstat publications the scale with multipliers

$$q(m) = m^{0.27}$$

is used. In our computations we use the RLMS equivalence scale, which is close to that of Goskomstat and characterized by the following table:

household size, m	1	2	3	4	5 and more
scale economy	1	1.78	2.42	2.99	3.53
multiplier $q(m)$	1	1.124	1.240	1.338	1.487

Let us denote by $f_k(x)$ and $f_k^{sc}(x)$ the kernel estimates of income distribution density in region k by formulae (17) and (18). If ν_k is the share of region k population in the general totality of population in Russia, then corresponding income distribution densities at the federal level can be computed by formulae

$$f(x) = \sum_k \nu_k f_k(x) , \qquad (19)$$

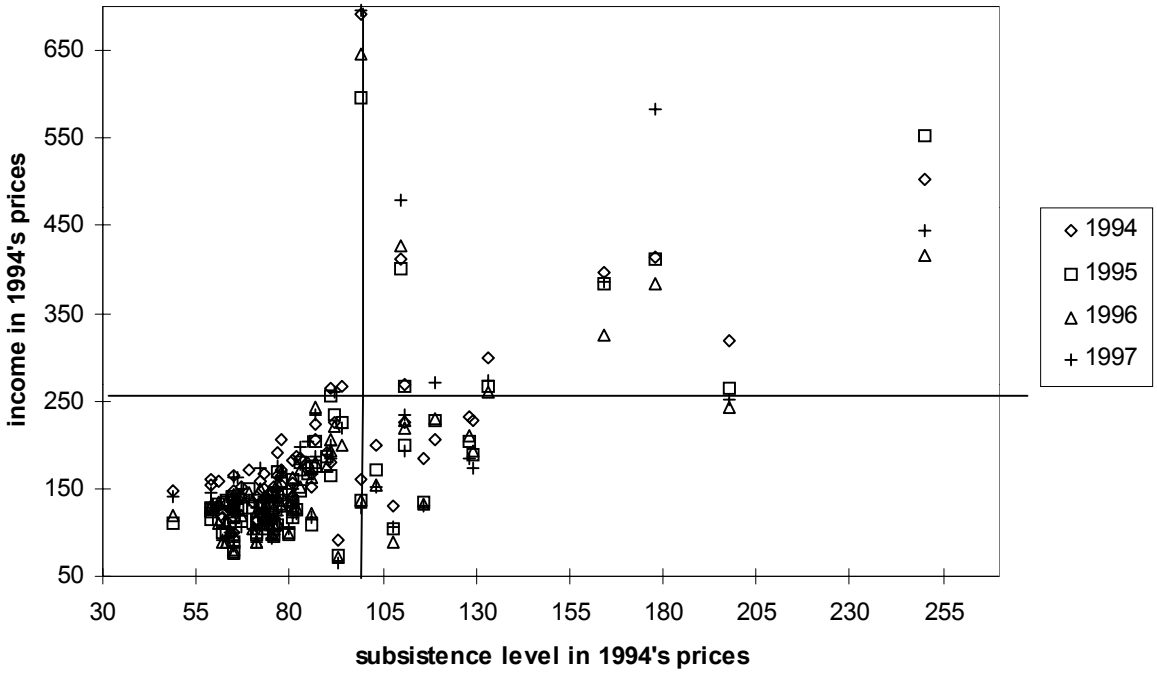
$$f^{sc}(x) = \sum_k \nu_k f_k^{sc}(x) . \qquad (20)$$

This is our approach to data aggregation at the federal level, which is essentially different to the standard approach in Goskomstat calculations. In Goskomstat practice, the aggregated data at the federal level result from grouping regional sample data by some intervals of per capita income. The choice of income scale for such grouping impacts on resultant income distribution estimates: in a typical case of grouping by uniform intervals the aggregated representation of the left part of income distribution turns out to be too coarse and distribution seems to be close to lognormal. In our non-parametric approach we can avoid such misrepresentation and show that true income distribution is far being lognormal.

In 1994-97 the significant stratification of regions of Russia by cost and standard of living was formed as a result of non-uniform movement of inflation rates. While the swing of living costs across the regions is as 4-5 times, an evaluation of the population economic differentiation in Russia by analysis of *nominal* money income distribution is hardly to be considered as correct. Deflating the incomes in regions by regional consumer prices indices considerably decreases the income inequality estimates.

In order to explain the nature of effects, related to cost-of-living dispersion across the regions, at Fig. 1 a dissipation diagram of average per capita population incomes in regions versus values of regional minimal costs-of-living is presented. All indicators are given in constant 1994 prices and vary from 1994 to 1997. The absence of direct dependence between population income and minimal cost-of-living in regions brings out to the swing of money income purchasing ability across the regions as 7-9 times.

Fig. 1. Dissipation diagram of average per capita incomes of population in regions of Russia in 1994-97 in dependence on minimal cost-of-living in regions (in constant 1994's prices)



Now let $d_k = c_k/c_R$ be deflator of consumer prices defined as the ratio of cost-of living index c_k in region k to cost-of-living index in Russia as the whole in average c_R . Income y in region k with density $f_k(y)$ after reduction to comparable value in purchasing power transforms into income $x = y/d_k$, giving contribution into general density of distribution equal to $\nu_k f_k(xd_k)d_k$. So general distribution density function of deflated income (with account for differences of income purchasing power across the regions) has the representation

$$f_R^D(x) = \sum_k \nu_k f_k(xd_k)d_k \,. \qquad (21)$$

The last formula may be rewritten similarly to (19) as

$$f_R^D(x) = \sum_k \nu_k f_k^D(x) \,, \qquad (22)$$

introducing regional functions of distribution density of deflated income

$$f_k^D(x) = f_k(xd_k)d_k \,. \qquad (23)$$

We can also combine income deflation with equivalent scaling in estimation

$$f_R^{D\,sc}(x) = \sum_k \nu_k f_k^{sc}(xd_k)d_k \,, \qquad (24)$$

corresponding to formula (20).

In practical construction of kernel estimates for income distribution density it seems more convenient to work out with data in logarithmic form $\log(X_i)$ instead of X_i, $i = 1, \ldots, N$. After that data transformation we can use standard normal kernel $K = N(0, 1)$ with experimental choice of sufficiently small h in our kernel estimates. In figures 2, 3 below the estimations in form

$$f_N(\log x) = (2\pi)^{-1/2} h^{-1} \sum w_i \exp(-0.5((\log x - \log X_i)/h)^2) \qquad (25)$$

are used with h=0.12. We can obtain corresponding estimations of distribution density of per capita income by transformation

$$f_L(x) = f_N(\log x)/x \,. \qquad (26)$$

Indeed we construct both estimates, for distribution of logarithm of per capita income and for distribution of per capita income. But in the latter case we modify the choice of kernel with the use of kernel depending on observation X_i in form

$$K((x - X_i)/h, X_i) = (2\pi)^{-1/2} X_i^{-1} \exp(-0.5[(x - X_i)/(hX_i)]^2) \,. \qquad (27)$$

Such modification is necessary, because the right tail-end of empiric income distribution is very dissipated. With such kernel estimations, the graphs, shown in figures 4-7 (h=0.1), are more smooth and robust than in case of estimations in form (25) with consequent transformation (26).

The distribution densities of logarithm of per capita income shown in figures 2 and 3 are far from being normal, as well as the distribution densities of per capita income shown in figures 4-7 are far from being lognormal. In Goskomstat practice till now the lognormal distribution model was used. However, our analysis shows that such a model roughly cuts the left and right tail-ends of income distribution. Just because the official estimates of income inequality and poverty in 1994-97 are ***significantly understated*** as we shall show in section 8. In fact, the income distributions in 1994-97 have complicated structure of peaks in left part and complicated structure of slopes to the right of the main mode, which seems to have no evident explanation by a model in parametric form.

The figures 2-7 show that the structure of density of income distribution (in nominal and comparable terms) has definite tendency to clustering population into groups with different adaptation ability to reforms. The principal modes of distribution densities of logarithm of per

capita income in figures 2-3 become the more and more sharpen and spilt with formation of additional modes at the left and right tails. Considering the figures 6-7, we can conclude that population has been divided into three groups: the first, poorest group with incomes almost not increasing in respect with inflation rates, the second group with incomes following the inflation rates with some delay, and the third, the most provided group with incomes rising not slowly than the inflation rates, and perhaps rapidly. The first and the second groups concentrate around corresponding per capita income distribution modes, and the third group corresponds to highly spread right part of income distribution.

The bumps on the lower tails of distributions in figures 4-7 correspond to concentrations of the poorest population of Russian regions with standards of living below the median of ranking the regions by standards of living, which we shall consider in the next section. Therefore these bumps reflect an essential feature of income inequality in Russia during reforms.

To complete this section let us note that our analysis with the use of kernel estimations (16) without data reweighting confirms that the structures of distribution densities, shown in figures 2-7, correctly reflect the properties of the initial samples, and are not induced by data reweighting. The technique of estimation of expenditure distribution at the national level is the same as that for income distribution considered in this section. It is used in obtaining the results of the following sections.

Fig. 2. Kernel estimations of densities of distribution of logarithm of nominal per capita income in 1994-97

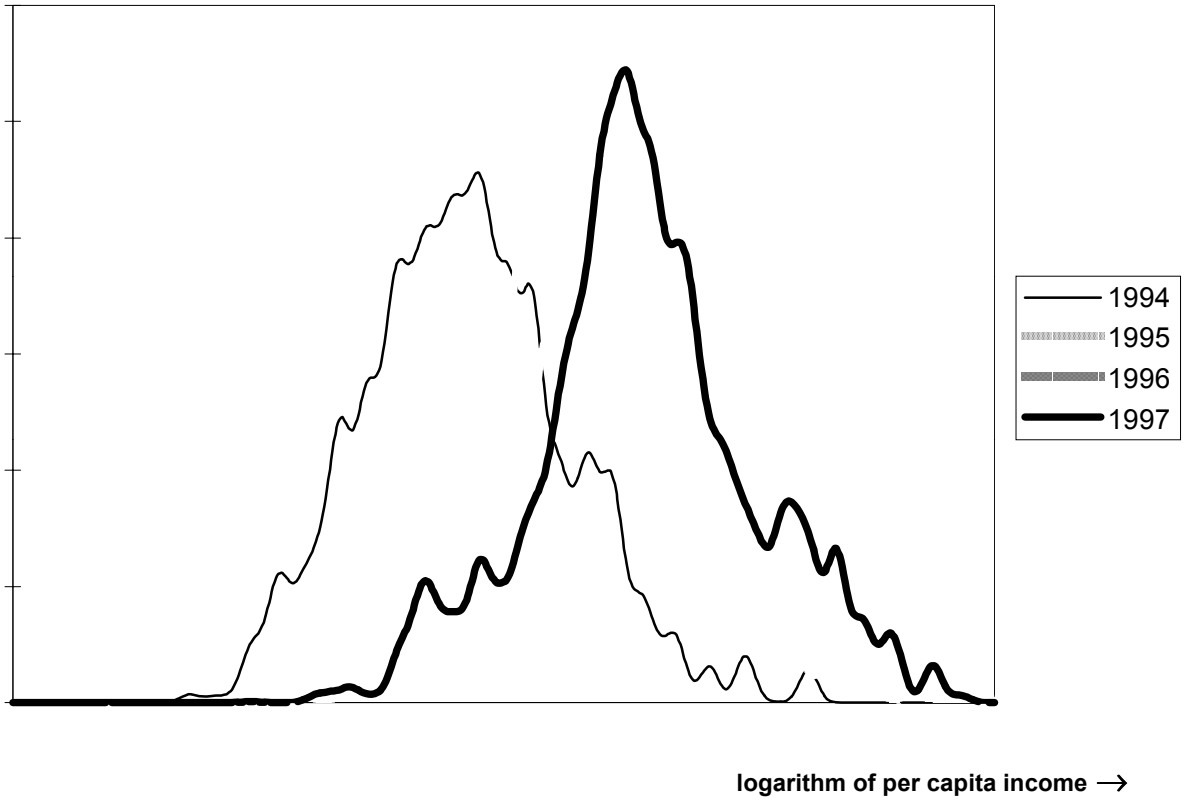


Fig. 3. Kernel estimations of densities of distribution of logarithm of deflated per capita income in 1994-97 in constant 1994's prices

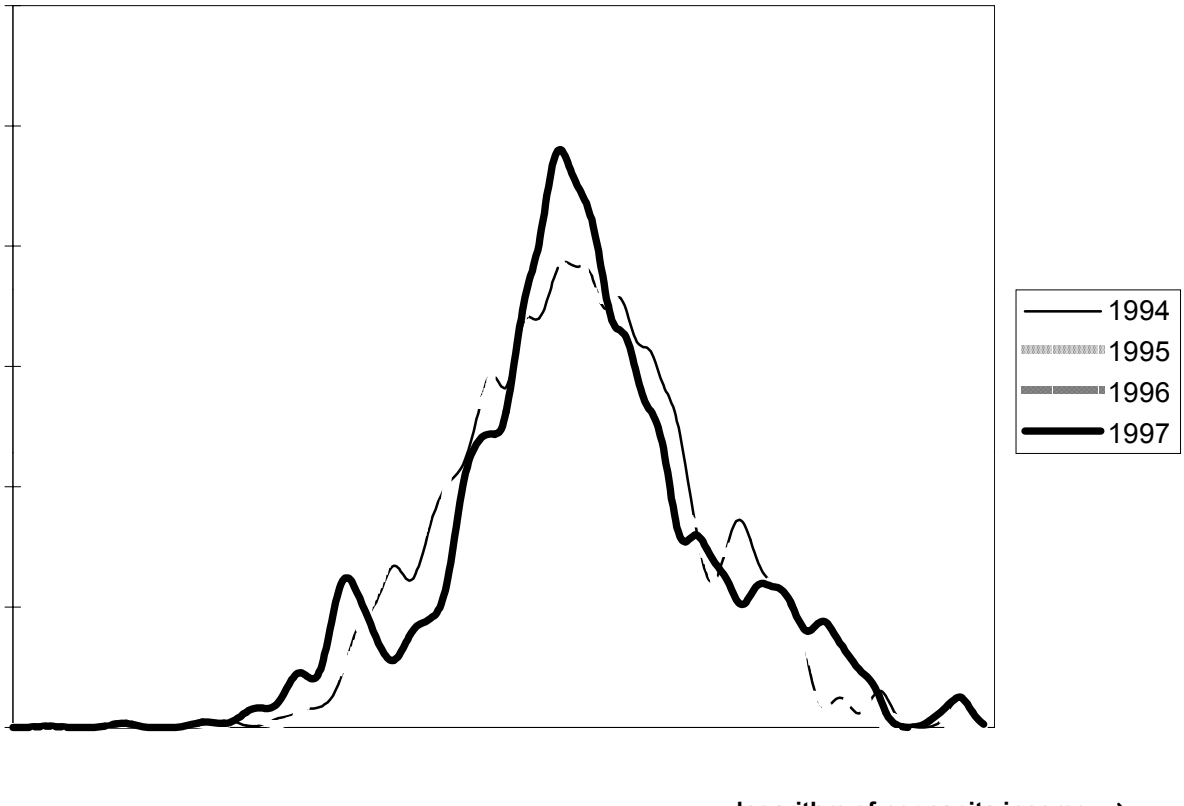


Fig. 4. Kernel estimations of densities of distribution of deflated per capita income in 1994-97 in constant 1994's prices, the left parts of the graphs

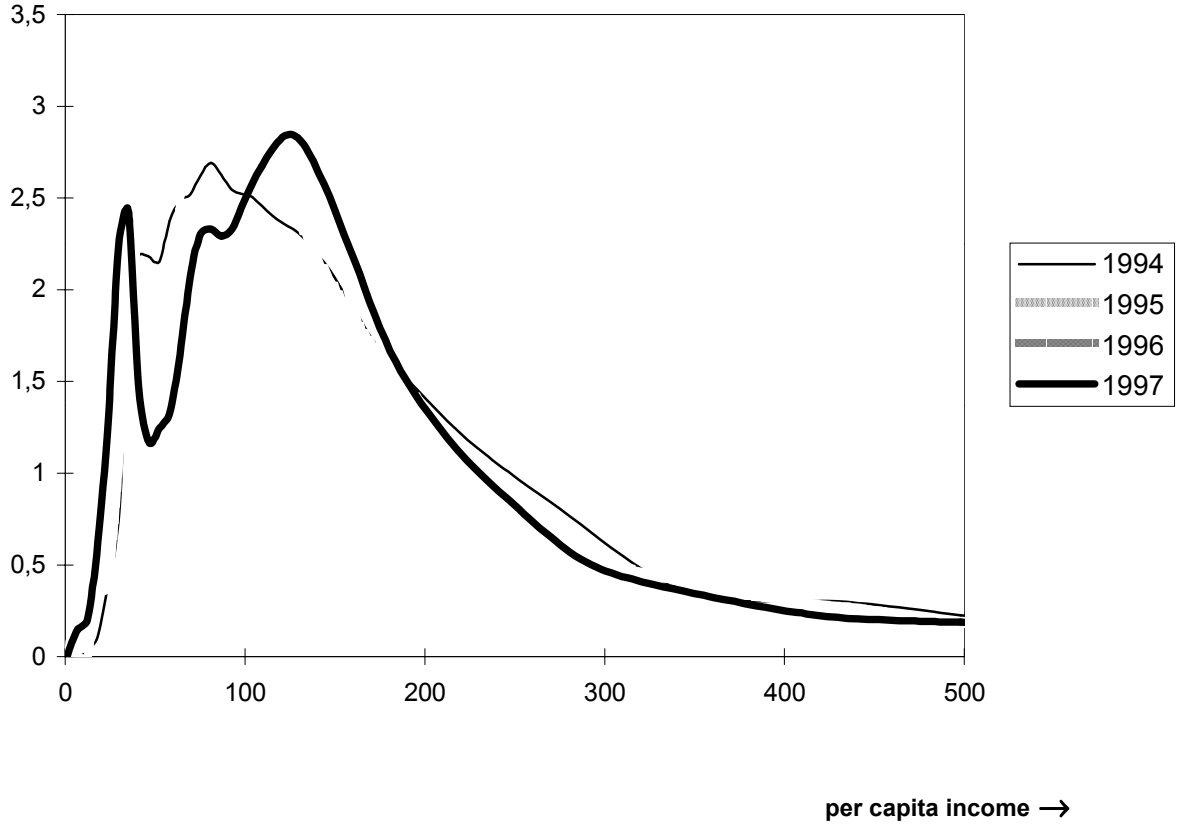


Fig. 5. Kernel estimations of densities of distribution of deflated per capita income in 1994-97 in constant 1994's prices, the right parts of the graphs

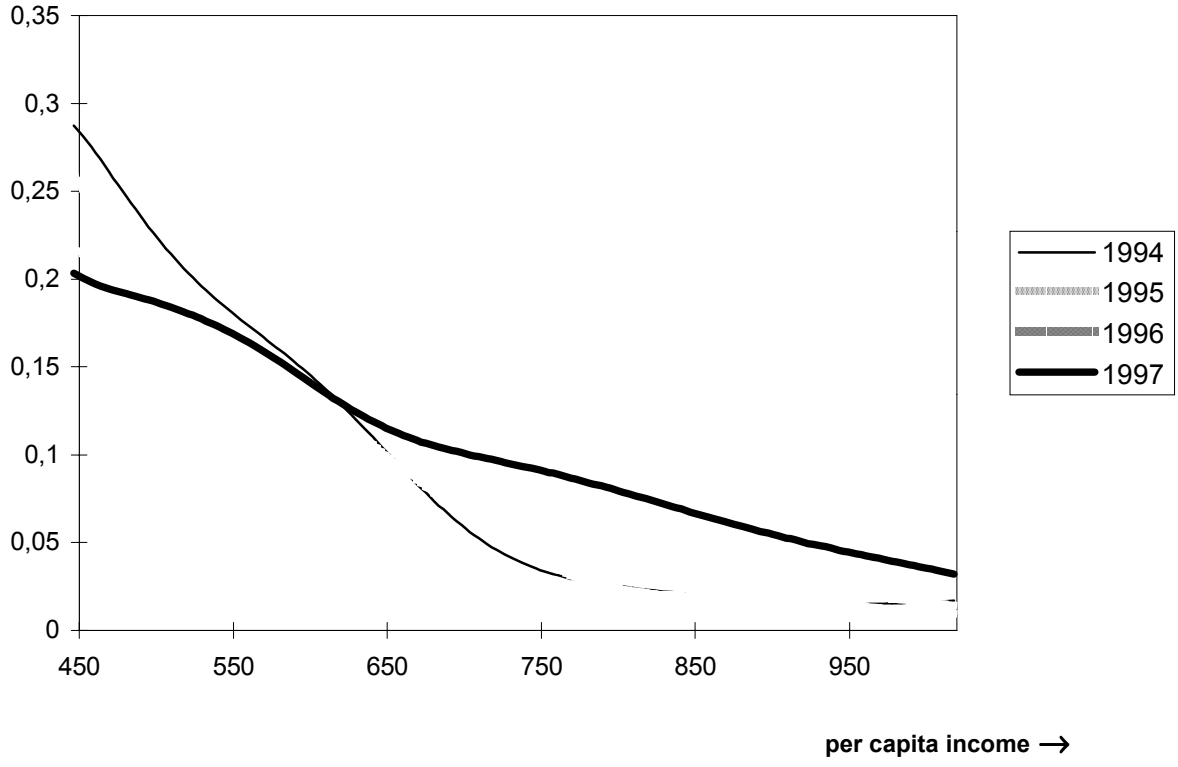


Fig. 6. Kernel estimations of densities of distribution of nominal per capita income in 1994-97, the left parts of the graphs

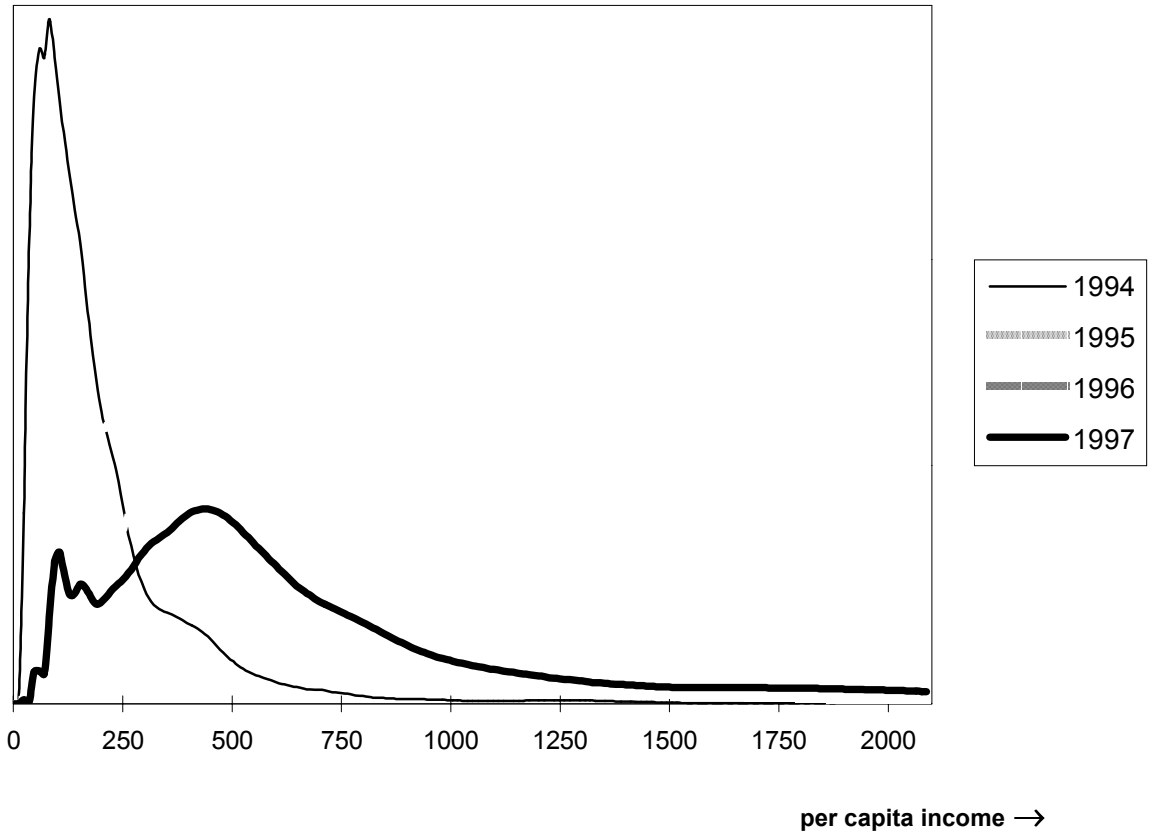
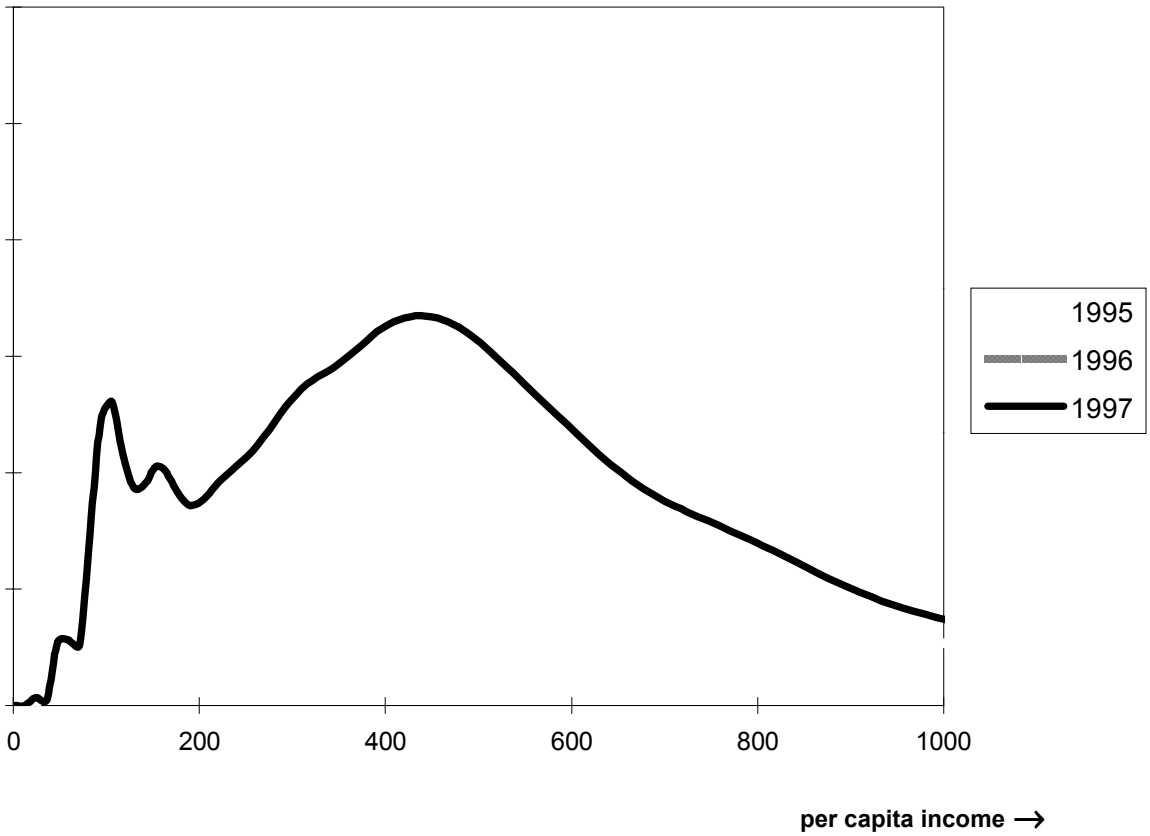


Fig. 7. More detailed left parts of nominal income distributions in 1995-97



4. Stratification of Russian regions in standards of living, economic inequality and poverty

The measures of economic inequality, real standard of living and poverty obviously are represented in the form of special indices, which have transparent economic interpretations and reflect the properties of income and expenditures indicators distributions, essential for the problems understanding and for decision making.

The most often used inequality index is so called coefficient of differentiation F — the ratio of mean income (or mean expenditure) in top decile group to mean income (or mean expenditure) in bottom decile group. In addition to this index we consider decile coefficient of differentiation D — the ratio between 9-th and 1-st deciles of income (or expenditure) distribution.

A. Sen (1976) introduced index W of real standard of living. It is related to the Gini index G, constructed on distribution of real (appropriately deflated) income by relationship

$$W = M(1 - G), \tag{28}$$

where M is the index of mean per capita income over the whole population. Index W can be defined as the doubled place under the generalized Lorenz curve $GL(q)$, $q \in [0,1]$.

Degree of the population economic inequality does not relate directly with the poverty magnitude. Correspondingly, increase of inequality during transformation does not necessarily imply a rise of poverty magnitude. The key to the poverty measurement problem is relative changes of real standard of living. It seems to be very natural to measure the poverty magnitude by the increment, which the real standard of living index W would obtain in the case of full poverty elimination:

$$\Delta W = WN - W,$$

where WN is the value of index W, which it would obtain in the case, when incomes of all the poor would be enhanced up to cost-of-living at poverty cut-off. The indices of normal inequality GN, FN are defined as the values of indices G, N in that case.

The ratio

$$P = \Delta W/Z\ , \tag{29}$$

where Z is the cost-of- living at poverty cut-off, may be represented as a weighted sum (or integral) of the gaps between Z and per capita incomes over all poor population. Therefore P is correctly defined poverty index in accordance with theoretical principles of such indices construction. In fact, it coincides with poverty index, introduced by Domenique Thon (1979). In addition to this poverty index we shall consider a conventional characteristic of poverty magnitude — the percentage H of the poor in the general totality of the population. In distinction to index P it does not depend on gaps between Z and per capita (or equivalent) income among the poor.

In Tables 2-3 below, summary characteristics of social sphere conditions in the regions in 1994-97 are presented. The indices W shown in these tables constructed on the base of Sen's index with some modifications, which we shall now describe.

In distinction to Sen's construction, we take into account not only incomes, but incomes and expenditures. In the situation, when expenditure inequality is considerably lower than income inequality, such an extension of Sen's construction contributes essential improvements to estimates of real standard of living in regions.

In the case of grouping population income and expenditure indicators into n groups, when each group contains $100/n$% of population (in our case $n = 10$), our index of real standard of living has the form

$$W^k = \Sigma_j \, 2(n - j + 1)\, p^k (y_j^k + e_j^k)/(n(n+1)) \,, \qquad (30)$$

where k is number of region, j is number of group, y_j^k is mean income of j-th group in region k, e_j^k is corresponding mean expenditure, and p^k is deflator, which transforms the income and expenditure indicators into comparable form (to common units of account). This deflator we compute as

$$p^k = z_R / (z^k \cdot p \cdot W^0) \,, \qquad (31)$$

where z_R , z^k are the average over Russia as a whole and regional costs of living at poverty cut-off, p is the summary index of consumer prices in the current year to 1990 for Russia as a whole, and W^0 is index of real standard of living of the population in 1990 (it is computed with using formula (33) on the basis of decile grouping the population as the whole with $p^0 = 1$).

Actually the indices in Tab. 2-3 contains two important additional corrections in order to improve their ability to reflect real conditions. At first, for each region k two adjacent decile groups, for which

$$y_j{}^k < z^k < y_{j+1}{}^k ,$$

are regrouped in such the way, that the first of new groups contains only poor population and the second consists of population with per capita income over poverty cut-off; the corresponding weight coefficients $(n — j + 1)$ in (30) are appropriately modified, as well as the mean income and expenditure indicators. At second, for regions, where both mean per capita income and minimal cost-of-living are less that average ones over Russia as a whole, the z^k are corrected through formula

$$Z^k = z^k + (\mu^k/\mu)\cdot(z_R — z^k) , \qquad (32)$$

where μ^k, μ are mean per capita incomes in region k and in Russia as a whole, and z_R is average over Russia minimal cost-of-living; as the result we obtain

$$z^k < Z^k < z_R ,$$

and we compute indices (30) for such regions with use of Z^k instead of z^k. The last modification is necessary in order to correlate standards of living in regions, where both population incomes and costs of living are low, with standard of living in regions, where population incomes are high, with sufficient accuracy. A justification of such approach consists, at first, in the fact that in rich regions population consumes commodities and services, which prices are not reflected in minimal cost-of-living indicators, and which are not available for population of regions with low incomes and minimal costs-of-living. Second, the fact that the population of regions, where both incomes and minimal costs-of-living are low, feels an additional social deprivation related to restricted possibilities of mobility, is taken into account in such correction.

Tab. 2. Ranks and the population real standard of living indices for the Russia regions in 1994-97
(standard of living in 1990 in Russia as whole in average = 100%)

Regions	Ranks of regions in ordering by decreasing of real standard of living				indices of real standard of living			
	1994	1995	1996	1997	1994	1995	1996	1997
Karelia Republic	4	5	18	18	100.2	93.9	77.6	84.3
Komi Republic	12	10	32	36	85.6	88.1	69.7	70.8
Arkhangelsk region	30	33	49	55	75.6	67.3	61.0	60.6
Vologda region	18	14	11	20	83.2	82.9	80.6	81.9
Murmansk region	16	12	10	11	84.9	86.3	82.5	89.4
Sanct-Petersburg	5	6	2	3	99.1	93.2	127.7	130.4
Leningrad region	32	34	20	28	74.3	65.1	76.7	75.7
Novgorod region	23	21	8	19	78.7	74.5	83.3	83.1
Pskov region	58	59	58	61	61.5	54.1	55.4	53.2
Bryansk region	36	44	38	53	72.2	61.7	65.3	60.9
Vladimir region	47	57	50	40	66.4	57.9	60.7	68.2
Ivanovo region	68	61	61	65	54.2	53.5	52.3	49.6
Kaluga region	13	19	21	30	85.6	77.0	76.0	74.2
Kostroma region	31	22	35	45	74.5	74.1	67.7	63.9
Moscow	1	1	1	1	224.2	202.6	212.5	226.7
Moskow oblast	15	42	30	39	85.2	62.0	70.3	69.6
Oryol region	9	18	19	14	87.3	77.5	77.2	87.0
Ryazan region	43	50	41	37	67.4	60.1	64.1	70.5
Smolensk region	26	29	28	31	76.9	69.9	72.7	74.2
Tver region	38	46	42	33	71.4	61.1	63.8	72.1
Tula region	8	17	15	29	89.4	77.6	78.6	74.7
Yaroslavl region	7	9	13	13	90.5	89.5	79.4	87.0
Mariy El Republic	49	68	71	67	65.8	47.5	41.7	48.3
Mordovia Republic	66	63	65	58	56.2	50.6	48.1	56.9
Chuvash Republic	65	64	67	69	57.3	50.4	47.5	46.0
Kirov region	41	36	39	43	68.9	64.2	64.3	65.9
Nizhny Novgorod region	21	26	14	34	80.0	70.8	79.0	71.7
Belgorod region	14	23	12	23	85.2	72.9	80.4	81.2
Voronezh region	46	43	37	16	66.5	62.0	67.3	86.4
Kursk region	53	45	54	59	64.4	61.6	58.2	55.3
Lipetsk region	29	25	6	5	76.2	71.8	86.2	107.7
Tambov region	56	32	57	38	64.2	67.4	55.8	70.1
Kalmykia-Halmg Tangch Republic	69	73	72	72	54.1	37.0	39.4	41.6
Tatarstan Republic	20	27	24	27	82.1	70.0	74.5	75.8
Astrakhan region	60	48	59	63	59.7	60.6	53.3	51.1
Volgograd region	52	53	52	54	64.6	59.3	59.3	60.8
Penza region	59	58	63	64	60.0	56.0	49.3	51.0
Samara region	24	28	16	24	78.1	69.9	78.4	77.9
Saratov region	51	55	60	62	65.1	58.3	52.6	51.8
Ulyanovsk region	6	35	25	7	91.5	64.9	73.4	95.5
Adygeya Republic	70	66	68	71	53.8	50.3	47.5	45.6
Dagestan Republic	76	76	75	76	34.4	28.9	28.6	26.7
Kabardin-Balkar Republic	72	71	69	70	50.1	44.8	47.1	45.6
Karachayevo-Cherkesk Republic	75	72	73	73	41.3	41.2	39.2	38.2
North Osetia Republic	73	60	55	49	49.2	54.0	57.0	61.7
Krasnodar territory	37	41	29	21	72.2	62.7	72.2	81.6
Stavropol territory	50	52	45	41	65.4	59.7	62.8	66.9

Rostov region	42	40	27	9	67.8	63.5	72.8	92.0
Bashkortostan Republic	57	56	48	50	62.2	58.2	61.8	61.6
Udmurt Republic	40	24	43	47	71.2	71.9	63.7	62.7
Kurgan region	63	67	70	60	57.4	47.7	46.9	54.4
Orenburg region	61	62	51	57	59.7	52.3	59.8	58.7
Perm region	39	39	7	17	71.4	63.6	86.1	85.8
Sverdlovsk region	19	13	22	25	82.4	84.2	75.3	77.6
Chelyabinsk region	34	15	26	35	73.4	82.1	73.1	71.0
Altay Republic	25	69	66	42	77.0	46.9	48.1	66.8
Altay territory	54	47	62	66	64.3	60.9	51.7	49.2
Kemerovo region	3	4	5	15	109.4	104.5	88.4	86.6
Novosibirsk region	44	65	47	44	66.6	50.3	61.9	64.7
Omsk region	33	37	23	10	74.2	63.8	74.9	90.8
Tomsk region	22	16	9	6	79.5	80.9	83.3	96.7
Tyumen region	2	2	3	2	117.2	118.1	120.4	130.8
Buryatia Republic	67	70	64	68	54.9	44.8	48.5	46.9
Tyva Republic	74	75	76	75	47.4	35.5	27.0	29.5
Khakasia Republic	27	30	46	12	76.7	69.4	61.9	87.7
Krasnoyarsk territory	10	3	4	4	86.4	111.9	96.0	111.5
Irkutsk region	35	49	17	32	72.3	60.5	78.0	73.2
Chita region	71	74	74	74	53.3	35.7	37.0	36.9
Sakha (Yakutia) Republic	28	7	44	8	76.4	91.1	63.2	92.2
Primorsk territory	45	51	36	48	66.5	59.9	67.3	62.0
Khabarovsk territory	48	54	34	51	65.9	59.1	68.3	61.6
Amursk region	62	20	33	26	58.6	76.1	69.5	77.4
Kamchatka region	11	8	31	22	86.2	90.8	70.1	81.5
Magadan region	55	11	53	56	64.2	87.4	59.0	59.0
Sakhalin region	64	38	56	46	57.3	63.8	56.6	63.6
Kaliningrad region	17	31	40	52	83.8	68.2	64.1	61.3

The picture of differences in standard of living across the regions, presented in Tab. 2, turns out surprisingly chaotic. Regional indices of real standards of living, and corresponding places in yearly rankings of Russia regions by standards of living, impetuously varies over time, and these variations have different amplitudes and directions. Such behavior can be explained as a result of rapid changes in factors, impacting on regional standards of living. In 1994, the situation was determined by high inflation rates, very non-uniform by regions, and by redundant federal budget expenditures. In 1995 stratification of regions changed under impact of restrictive monetary and budget policy, oriented to financial stabilization. In 1996, the crucial role was played by payoffs arrears crisis, whose impact has been felt up to now.

The next table shows the regional stratification in 1997 in socioeconomic conditions in more detail.

Tab. 3. Ranking the Russian regions by real standard of living in 1997
(average standard of living in 1990 in Russian Federation as the whole = 100%)

rank	Region	W	WN	G	GN	P	F	FN
1	Moscow	226.7	232.4	0.478	0.470	0.058	28.0	18.4
2	Tyumen region	130.8	136.8	0.525	0.505	0.094	45.9	16.1
3	Sanct-Petersburg	130.4	133.0	0.380	0.370	0.040	12.0	8.8
4	Krasnoyarsk territory	111.5	116.8	0.429	0.406	0.083	23.1	9.6
5	Lipetsk region	107.7	110.2	0.360	0.349	0.039	11.7	8.1
6	Tomsk region	96.7	105.3	0.445	0.402	0.136	28.4	8.6
7	Ulyanovsk region	95.5	99.9	0.361	0.338	0.070	14.0	6.8
8	Sakha (Yakutia) Republic	92.2	97.2	0.458	0.433	0.077	30.3	10.4
9	Rostov region	92.0	97.9	0.392	0.360	0.092	15.0	6.9
10	Omsk region	90.8	99.7	0.456	0.410	0.140	30.4	8.7
11	Murmansk region	89.4	94.0	0.375	0.345	0.071	26.4	9.4
12	Khakasia Republic	87.7	93.7	0.410	0.377	0.093	21.6	7.4
13	Yaroslavl region	87.0	94.7	0.403	0.360	0.121	18.5	7.0
14	Oryol region	87.0	94.6	0.403	0.360	0.121	19.0	7.6
15	Kemerovo region	86.6	94.5	0.396	0.352	0.124	22.0	6.6
16	Voronezh region	86.4	94.4	0.424	0.380	0.126	25.3	8.4
17	Perm region	85.8	96.1	0.467	0.411	0.163	29.5	8.4
18	Karelia Republic	84.3	93.1	0.411	0.361	0.140	23.6	7.1
19	Novgorod region	83.1	94.4	0.464	0.401	0.178	23.2	7.5
20	Vologda region	81.9	90.7	0.422	0.371	0.138	19.0	6.7
21	Krasnodar territory	81.6	90.1	0.421	0.370	0.135	25.4	7.5
22	Kamchatka region	81.5	89.4	0.427	0.381	0.124	20.2	7.7
23	Belgorod region	81.2	88.7	0.406	0.361	0.118	15.4	6.4
24	Samara region	77.9	85.8	0.385	0.336	0.123	15.6	6.1
25	Sverdlovsk region	77.6	85.8	0.389	0.338	0.130	16.9	6.1
26	Amursk region	77.4	92.4	0.533	0.450	0.236	50.3	9.2
27	Tatarstan Republic	75.8	85.8	0.421	0.359	0.158	21.9	6.5
28	Leningrad region	75.7	83.4	0.351	0.301	0.122	10.2	4.7
29	Tula region	74.7	84.6	0.409	0.346	0.155	16.4	5.8
30	Kaluga region	74.2	84.4	0.376	0.310	0.161	14.1	5.1
31	Smolensk region	74.2	86.2	0.427	0.351	0.190	22.3	6.2
32	Irkutsk region	73.2	85.1	0.437	0.362	0.187	20.0	6.0
33	Tver region	72.1	81.7	0.394	0.331	0.151	15.1	5.5
34	Nizhny Novgorod region	71.7	80.0	0.354	0.297	0.131	10.1	4.6
35	Chelyabinsk region	71.0	80.0	0.362	0.300	0.142	13.7	5.1
36	Komi Republic	70.8	82.2	0.439	0.367	0.179	29.8	7.3
37	Ryazan region	70.5	81.9	0.399	0.324	0.179	18.4	5.6
38	Tambov region	70.1	80.5	0.396	0.327	0.164	22.2	6.2
39	Moskow oblast	69.6	75.0	0.250	0.209	0.086	5.9	3.3
40	Vladimir region	68.2	76.0	0.328	0.272	0.122	11.4	4.6
41	Stavropol territory	66.9	79.7	0.422	0.335	0.202	19.6	5.5
42	Altay Republic	66.8	78.5	0.390	0.310	0.184	23.0	5.4
43	Kirov region	65.9	79.3	0.414	0.321	0.212	20.9	5.4
44	Novosibirsk region	64.7	74.4	0.332	0.260	0.154	11.6	4.1
45	Kostroma region	63.9	77.7	0.405	0.307	0.217	16.3	4.7
46	Sakhalin region	63.6	74.0	0.391	0.317	0.163	19.9	5.6
47	Udmurt Republic	62.7	76.6	0.417	0.317	0.220	17.4	5.2
48	Primorsk territory	62.0	74.2	0.363	0.272	0.192	14.2	4.3
49	North Osetia Republic	61.7	77.2	0.428	0.317	0.245	22.9	5.2
50	Bashkortostan Republic	61.6	74.6	0.397	0.301	0.205	18.0	5.1
51	Khabarovsk territory	61.6	76.1	0.408	0.303	0.229	22.1	5.1
52	Kaliningrad region	61.3	75.5	0.401	0.297	0.224	18.9	5.1

53	Bryansk region	60.9	76.3	0.421	0.311	0.243	16.7	4.9
54	Volgograd region	60.8	73.4	0.373	0.278	0.199	15.3	4.4
55	Arkhangelsk region	60.6	74.8	0.381	0.276	0.224	18.1	4.4
56	Magadan region	59.0	76.4	0.501	0.380	0.275	56.1	7.8
57	Orenburg region	58.7	74.6	0.425	0.307	0.251	25.0	5.2
58	Mordovia Republic	56.9	71.4	0.335	0.219	0.229	16.2	3.8
59	Kursk region	55.3	71.6	0.384	0.258	0.257	15.5	4.3
60	Kurgan region	54.4	72.2	0.432	0.295	0.281	28.5	4.9
61	Pskov region	53.2	71.2	0.382	0.240	0.284	16.5	3.7
62	Saratov region	51.8	70.3	0.401	0.253	0.292	20.7	4.3
63	Astrakhan region	51.1	70.1	0.399	0.249	0.299	18.4	4.1
64	Penza region	51.0	70.0	0.415	0.264	0.299	19.6	4.4
65	Ivanovo region	49.6	68.9	0.359	0.201	0.305	13.9	3.3
66	Altay territory	49.2	69.0	0.390	0.229	0.313	17.2	3.7
67	Mariy El Republic	48.3	68.3	0.394	0.230	0.316	21.5	3.9
68	Buryatia Republic	46.9	71.9	0.504	0.307	0.395	41.0	5.1
69	Chuvash Republic	46.0	70.2	0.458	0.262	0.381	27.6	4.4
70	Kabardin-Balkar Republic	45.6	71.2	0.474	0.270	0.403	28.7	4.3
71	Adygeya Republic	45.6	69.2	0.423	0.228	0.373	24.0	3.6
72	Kalmykia-Halmg Tangch Republic	41.6	69.7	0.480	0.242	0.444	35.0	3.9
73	Karachayevo-Cherkesk Republic	38.2	68.3	0.489	0.236	0.474	34.4	4.1
74	Chita region	36.9	69.2	0.543	0.271	0.510	62.0	4.6
75	Tyva Republic	29.5	67.5	0.570	0.228	0.600	93.9	4.2
76	Dagestan Republic	26.7	64.2	0.390	0.070	0.592	15.2	2.0

W — index of real standard of living
WN — the value of index of real standard of living in the case of complete poverty elimination, i.e. incomes and expenditures of all poor are enhanced up to poverty cut-off
G — half-sum of Gini indices of differentiation on income and on expenditure
GN — the value of the same index **G** in the case of complete poverty elimination
P — poverty index on income and expenditure, defined as in formula (2), but with use of our construction of index **W**
F — ratio of mean income in 10-th group to mean income in 1-st group, as times
FN — ratio of mean income in 10-th group to minimal cost-of-living, i.e. the **F** value in the case of complete poverty elimination

Comparison between the two last columns of Tab. 3 shows that poverty elimination would significantly reduce income inequality. Taking in account the data in 3-rd and 4-th columns about corresponding Gini indices diminishing, we can assert that for the absolute majority of regions poverty elimination would reduce economic inequality of population to the scale typical for European countries. But this finding does not mean that the increase in inequality was due to changes on the bottom end only, not on the top. While the changes on the bottom end were very significant, the changes on the top end of income distribution were also highly relevant. We shall analyze these changes in Section 7, where we elaborate a new look at the behavior patterns of overall inequality, normal inequality, excluding poverty, and excess inequality, related to poverty.

5. Evaluations of poverty in the Russian regions: the scaling effects

The estimates, considered in the previous section, are obtained without income and expenditure adjustment to household size. However, our techniques permit to compute all indicators and indices in the case of such adjustment in accordance to given equivalence scales for every region. In order to explain the magnitude of such adjustment effects we use the RLMS equivalence scale, common for all regions (see section 3). The impact of adjustment to the size of households on the estimates of the poor percentages and poverty indices is highly variable across the regions. Such variability of the scaling effect is due to regional differences in the composition of the poor from households of different size. In the case of poverty indices it is additionally due to regional differences in inequality in per capita income and equivalent income among the poor. But generically, effect of equivalence scaling on all poverty indices consists in downward shift of their graphs in respect with graphs of indices, constructed without equivalence scaling. Fig. 8 shows typical picture of such effect. In this figure the graphs of percentages of the poor with adjustment Hsc and without adjustment H to the size of the households in dependence on the values of index W in 1997 are shown. We see from this picture that with some fluctuations the ranking of regions by poverty magnitude follows inverse ranking by real standard of living and the movements of indices H and Hsc are in principle isotonous. The corresponding results for 1994-96 are similar.

The relationships between poverty indices Psc and P with and without adjustment to the size of the households in dependence on real standard of living index W are also similar to the picture in fig. 8. In order to make clear the relationship between indices H and P in fig. 9 the graphs of these indices in dependence on W in 1997 are shown. They are rather like the general tendencies of movement in dependence on real standard of living, but index P gives a more contrast picture of differences in poverty magnitude between the regions.

Fig. 8. Percentages of poor with (Hsc) and without (H) income equivalent scaling in dependence on index W in 1997

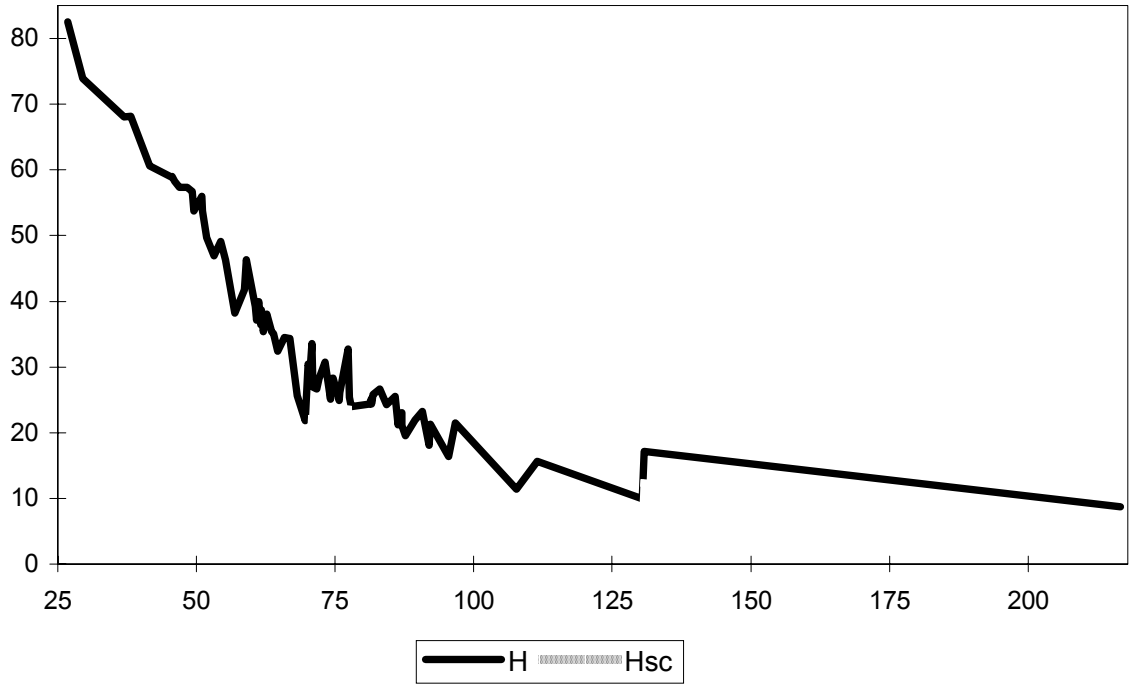
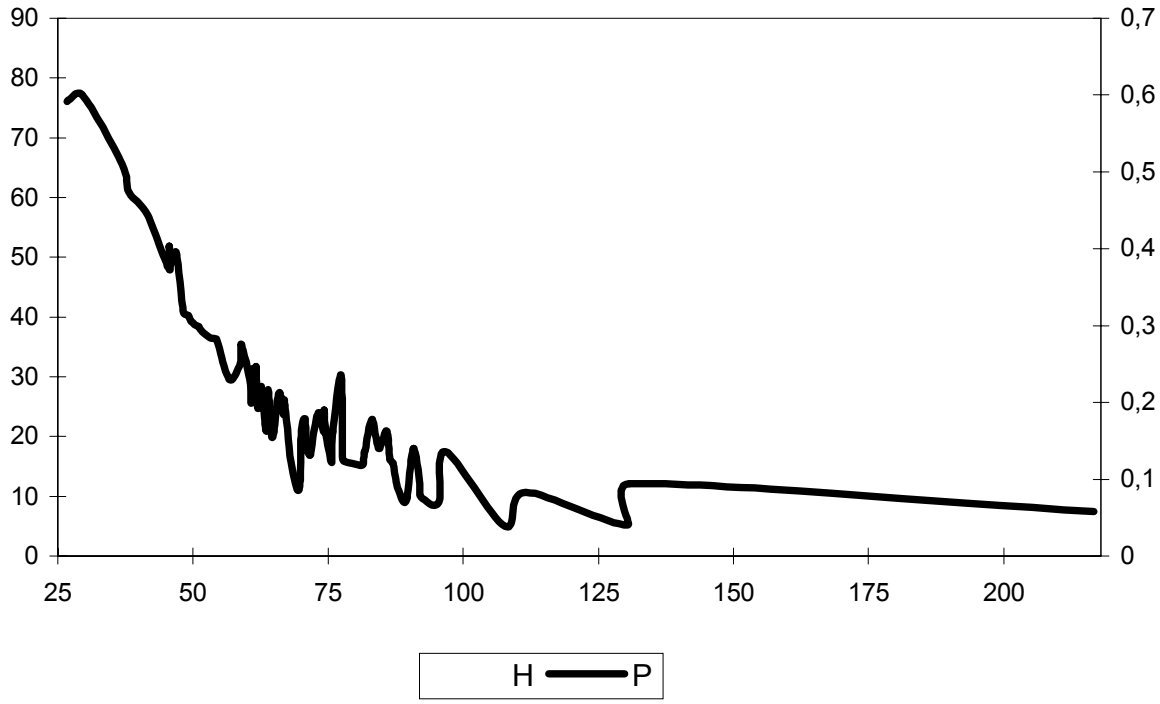


Fig. 9. Indices H (left scale) and P (right scale) in dependence on W in 1997



6. Decomposition of inequality and poverty estimates by income sources

A correct answer to the question, whether the observable breaks in the incomes of various groups of the Russian population are unduly large, is not obvious. The high differentiation of the incomes from enterprise activity, property and ownership, basically, is a normal property of a market economy. The estimates, shown in Tab. 3, allow us to conclude that the problem of overcoming the unjustified inequality of incomes in principle comes down to the problem of poverty elimination or even of poverty reduction.

Decomposition of the indices of inequality and poverty into components in correspondence with the income decomposition into its main constituents allows to analyze the relative role and changes in intensity of impact of the factors, causing inequality and poverty. The decomposition of overall Gini index is obtained from the Lerner and Yitzhak (1984, 1985) formula, which is linear in income. Corresponding decomposition of the poverty index is new (probably at the first time it had been used by A.Kiruta and A.Sheviakov, 1996). But it obtains with the use of Lerner and Yitzhak formula, because poverty index depends on the Gini index of inequality among the poor (see for details A. Sheviakov, A. Kiruta, 1999).

In 1990, as A.Kiruta and A.Sheviakov (1996) had shown, 76.8 % of overall inequality in income was caused by differentiation of wages and salaries, 7.2 % — by differentiation of social transfers and 16 % — by other factors. Corresponding estimates for 1994-97 are shown in Fig. 10 and Fig. 11. We can conclude that inequality in income from social transfers decrease and, in contrast to widespread opinion, social transfers reduce the general inequality in income. The growth of overall inequality is mainly due to increase of inequality in incomes from enterprise activity, property, ownership and other factors.

Fig. 10. Contributions by income components (as percentages of overall Gini index value) into the Russian population inequality in per capita money income

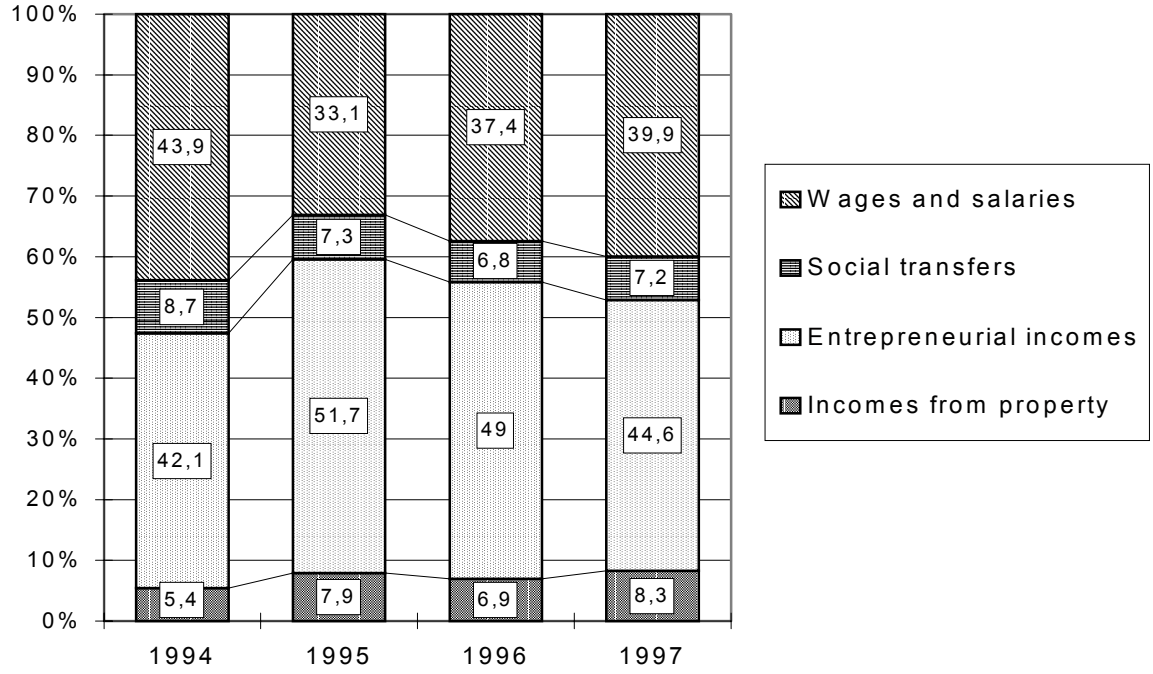


Fig. 11. Gini indices of the Russia population inequality in per capita income by income sources

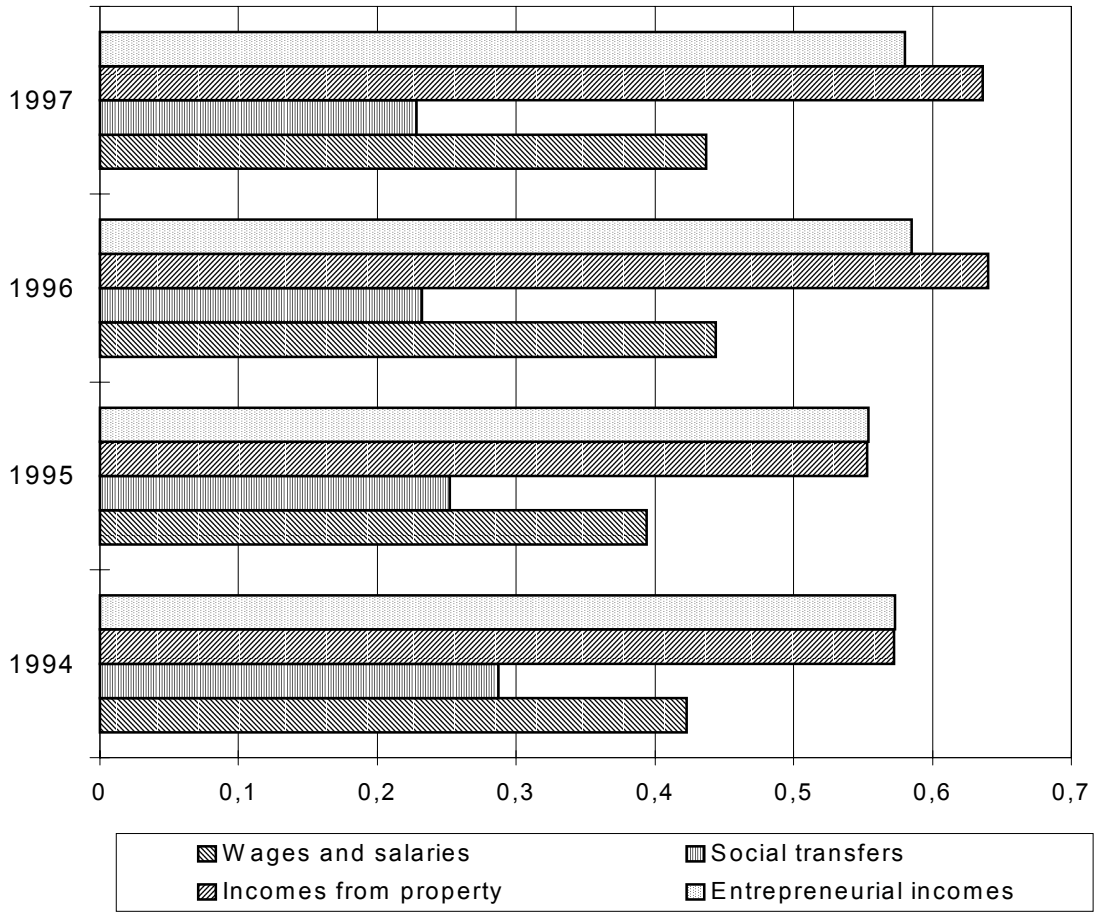


Fig. 12. Contributions of income deficits by income sources to poverty magnitude, as percentages of overall poverty index

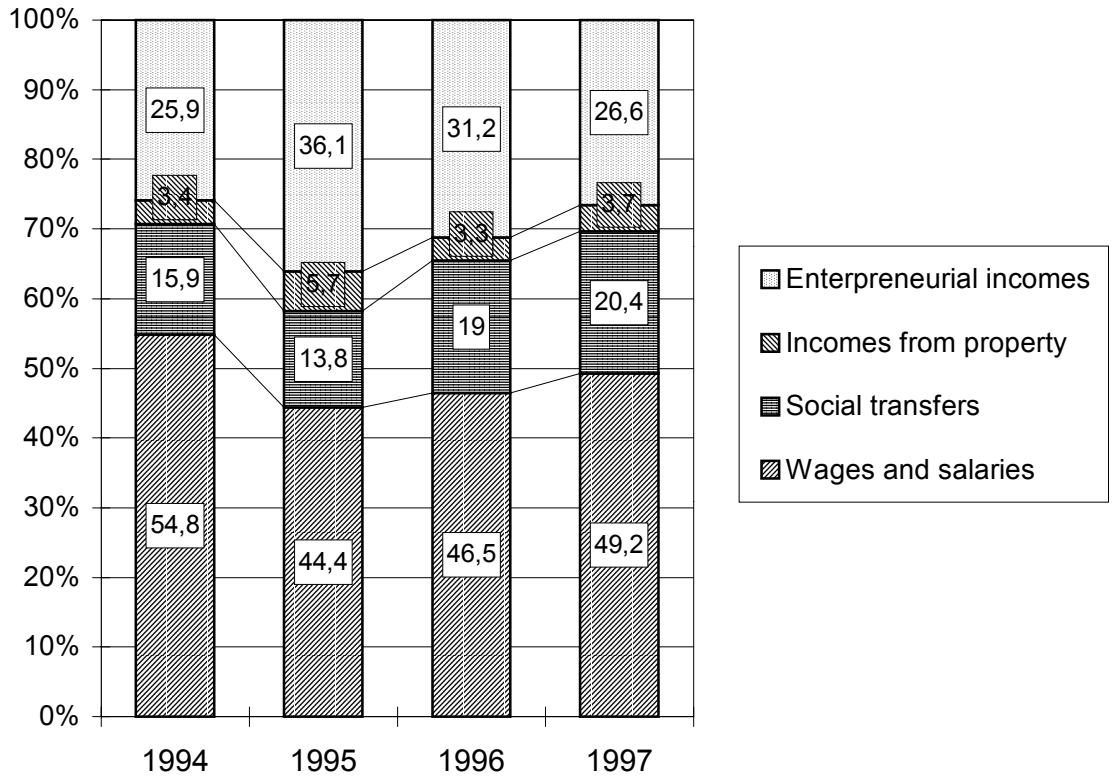
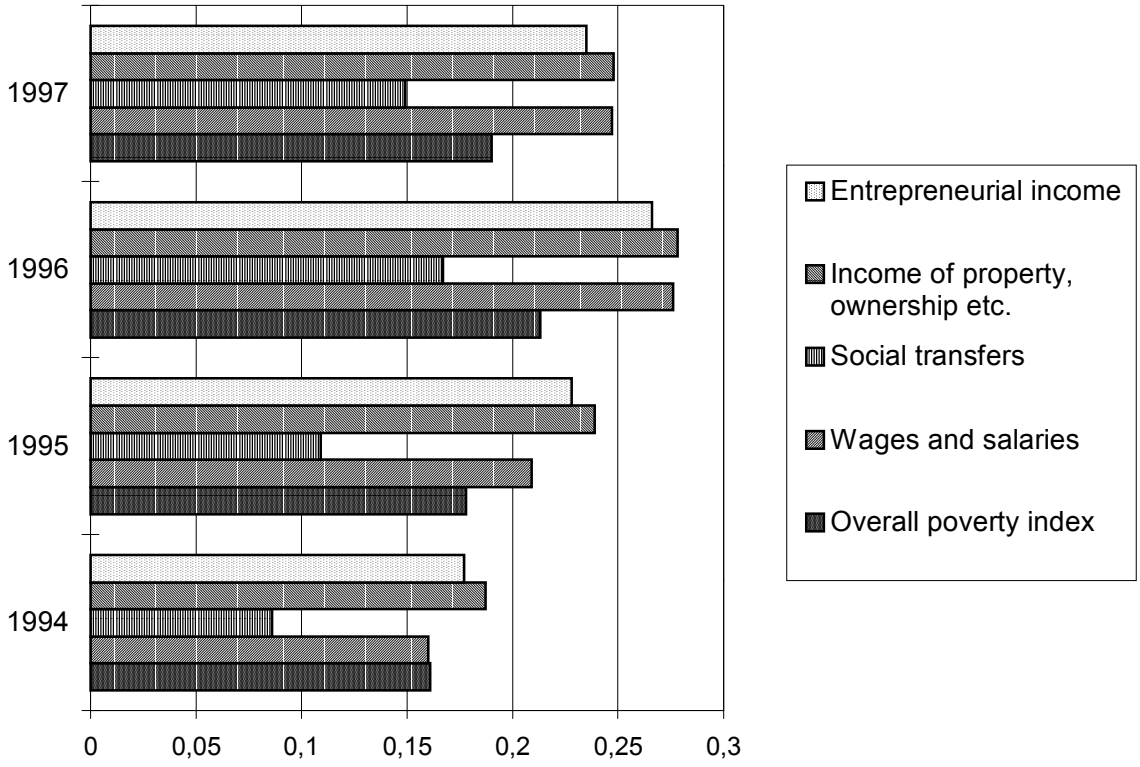


Fig 13. Poverty indices by income sources and overall poverty index



In its turn, the problem of poverty in Russia is by no means reduced to deficit of social transfers, as it is shown in Fig. 12. About 80% of the general poverty magnitude in 1997 was caused by low incomes from wages and salaries and by low opportunities to receive additional incomes from individual labor activity, personal part-time farm and small business.

In following three tables we give estimates of social cost of poverty elimination in Russia and estimates of possibilities to decompose the poverty elimination problem into partial problems of enhancing population incomes by different income sources.

Table 4. The cost of poverty elimination in Russia: the sums of money income deficits in poor households (in current prices)

	by official data		by our estimates		
	Trillions of roubles	in % of the whole population money income	trillions of roubles	in % of the whole population money income	in % of the factual volume of social transfers
1994			11.4	3.1	23.2
1995	36.0	3.8	44.6	4.9	37.3
1996	42.0	3.0	79.0	5.9	41.8
1997	41.8	2.6	76.5	4.8	31.7

The solution to the poverty elimination problem does not mean that whole income deficit in poor households must be covered by social transfers: such households have different deficits related to different income sources. Let us take as the base for determining poverty lines by income sources the factual structure of per capita income in households with per capita income, equal to overall poverty cut-off. Then solution to the poverty elimination problem may be represented as enhancing each constituent of the poor per capita income to the base per capita income from correspond income source. So we obtain a decomposition of solution to the poverty elimination problem by different income sources. Such decomposition is presented in the next two tables.

Table 5. Income increments by income sources, sufficient for poverty elimination in Russia

	1994		1995		1996		1997	
	in % of overall population income	Trillions of rubles	in % of overall population income	trillions of rubles	in % of overall population income	trillions of rubles	in % of overall population income	Trillions of rubles
Wages and salaries	1.7	6.2	2.2	19.8	2.7	36.8	2.4	37.6
Social transfers	0.5	1.9	0.7	6.2	1.1	14.8	1.1	15.5
Income from enterprise activity	0.8	2.9	1.7	16.1	1.9	24.8	1.3	20.5
Income from property, ownership etc.	0.1	0.4	0.3	2.5	0.2	2.6	0.2	2.9
Total income	3.1	11.4	4.9	44.6	5.9	79.0	4.8	76.5

Table 6. Income increments in percents by income sources, sufficient for poverty elimination

	1994	1995	1996	1997
Wages and salaries	3.5	5.7	6.8	5.5
Social transfers	3.4	5.1	7.9	6.5
Income from enterprise activity	2.3	4.2	4.6	3.6
Income from property, ownership etc.	2.3	4.3	3.8	2.9

In result, with extending the opportunities for poor households to realize proper economic activity, our primary estimates of the social transfers deficit as 32-42% of their factual volume can be reduced to 5-8%. Such reduction obtains in result of distributing necessary overall income increment among all income sources, including necessary increments of wages and salaries, income from business undertaking, income from property and ownership. Under redistribution of income increase by income sources income increment by each source, necessary for poverty elimination, does not exceed growth rate in successful emerging economies, and so it is really attainable.

7. Factors determining inequality and poverty

It is well known that contemporary world-wide statistical evidence forces to reject the Kuznets inverted U-shape hypothesis both over time, as well as in cross-sectional comparisons, whereas poverty tends consistently to decrease with economic growth. In many discussions on this topic (see for ex. Mizoguchi et al., 1991) the opinions that in inequality analysis the different tendencies of changes in top and low income classes are mixed, and that such mixing complicates the matters, had been pointed out. Some discussants especially mention biases of samples and corresponding underestimation of the Gini index, computed from FBS, as sources of misinterpretations. We overcame the difficulties related with biases of samples, and now we can analyze relationships between inequality and macroeconomic indicators with additional accuracy.

Our approach to the problem is based on distinguishing normal component GN of the Gini index G (see its definition in Section 4). In fact, the overall Gini index depends mainly on two factors: the normal inequality GN and poverty index P. In explicit expression this dependence has the form

$$G = (Z/M)\cdot P - (\Delta M/M)\cdot(1 - GN) + GN , \qquad (33)$$

where M is mean per capita income, Z is poverty cut-off, and ΔM is the increment of mean per capita income in the case, when incomes of all the poor would enhanced up to poverty cut-off, because by definitions in Section 4, formulas (31), (32),

$$P = (M/Z)(G - GN) + (\Delta M/Z)(1 - GN) . \qquad (34)$$

The formula (33) applies at the regional level. At the national level the decompositions (33), (34) are meaningful only for the indices, basing on deflated income distributions, defined as in Section 3. Corresponding Gini index we denote as GD. But in order to compare normal inequality with standard Gini index G, we introduce a new index GNn of normal inequality in nominal income. We define it as Gini index in respect with the aggregation at the national level of regional income distributions, when incomes of all the poor in each region would enhance to corresponding regional poverty line.

During transition in Russia there were three short waves of movement of inequality and poverty. Two first waves are shown in Fig. 14. The third wave arose after 1998's crisis. Each poverty increase was followed by increase of normal inequality. In the first wave, the poverty

after shocking splash in 1992 decreased, whereas in conditions of high inflation the factual and normal inequality rose isotonously: that was process of forming new top income class. The peak of normal inequality in 1994 was related with governmental budget expenditures, when the budget deficit was the higher over all the years of reforms. The second wave was related with restrictive budget and monetary policy, which involved again increasing of poverty up to its peak in 1996 (the crisis of arrears) and reduction of normal inequality in 1995 with subsequent slow increasing in 1996-97. Thus observed movement of the inequality index G was the result of interaction between two different factors: the dynamics of poverty and normal inequality.

Of course, the Russian transition experience is too short for analyzing the questions, concerning Kuznets' hypothesis over time, but cross-sectional analysis across the Russia regions turns out to be very interesting.

It is no surprising that across the Russia regions the Gini index has correlation neither with logarithm of per capita gross regional product, nor with logarithm of standard of living index W, as it is shown in Figs. 15, 16. And rejection of cross-sectional Kuznets' hypothesis is common, moreover the behavior of G seems to be direct opposite. But both indices GN and P have reliable and reciprocally complementary dependencies on logarithms of per capita GRP and standard of living index W.

Fig. 14. Trends of inequality, normal inequality (left scale) and poverty (right scale) in money income at the national level

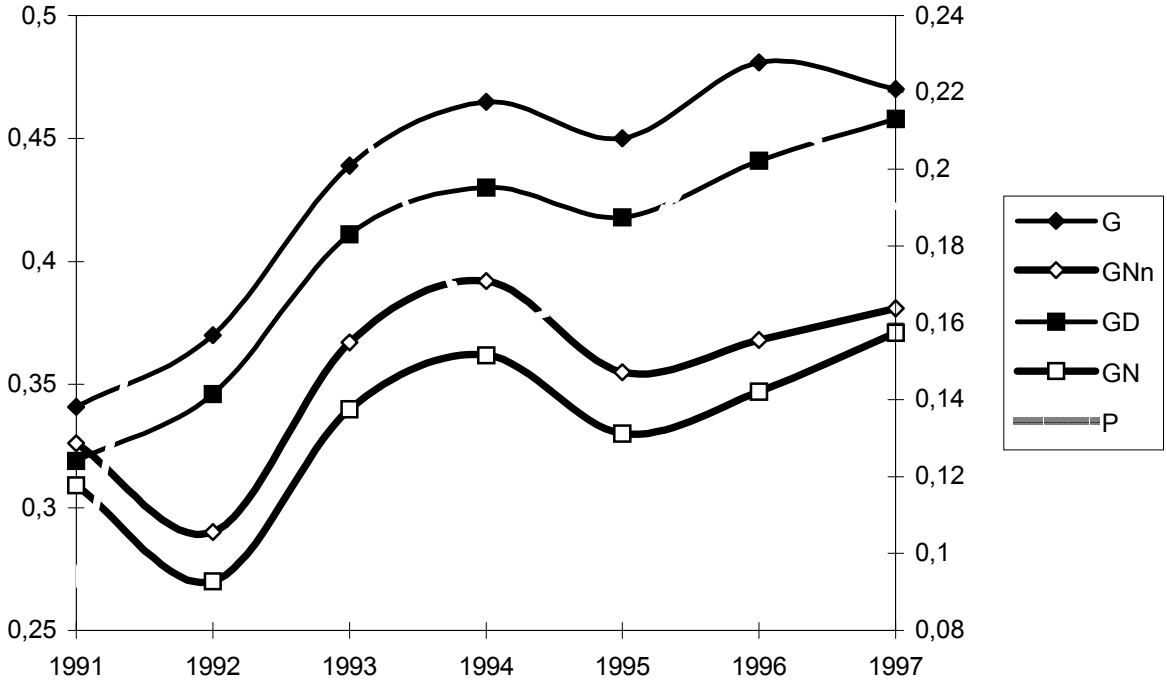
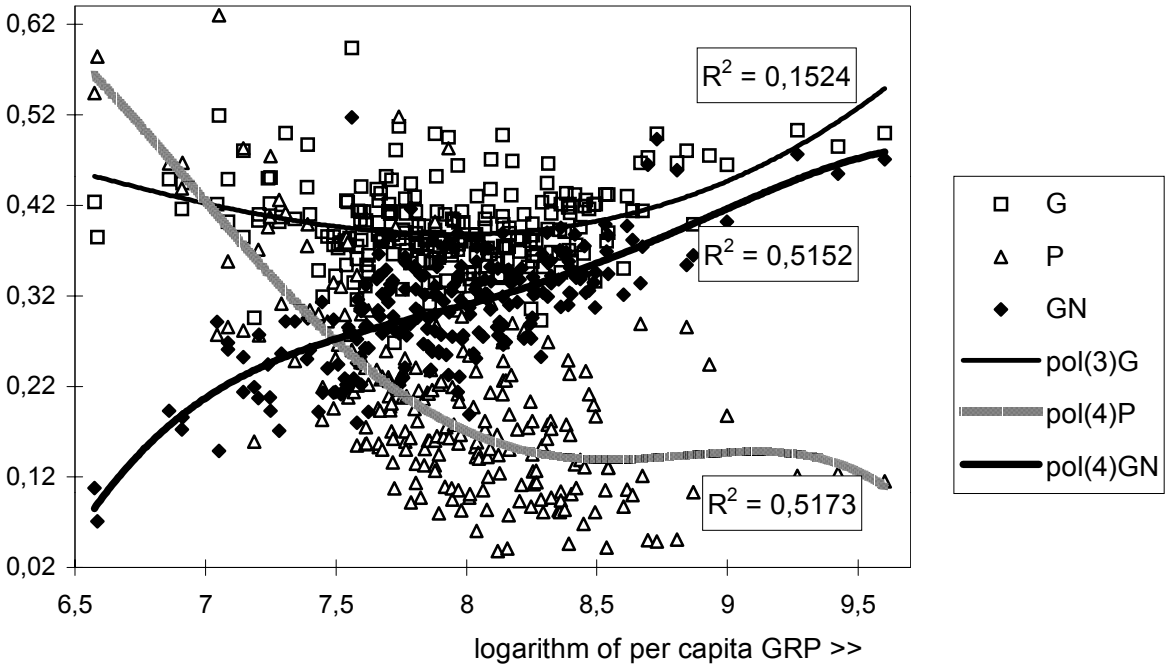
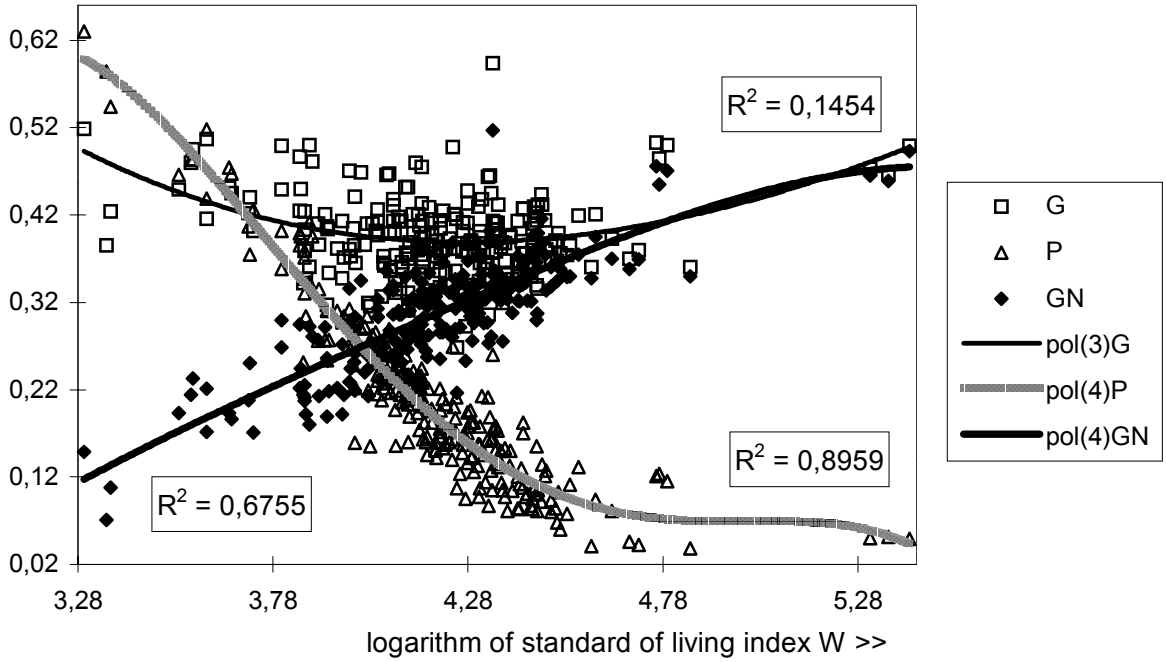


Fig. 15. Normal inequality GN, poverty P and factual inequality G in dependence on logarithm of per capita GRP in 1994-96 (in constant 1994's prices)



The thick curves are polynomial regressions on logarithm of per capita GRP

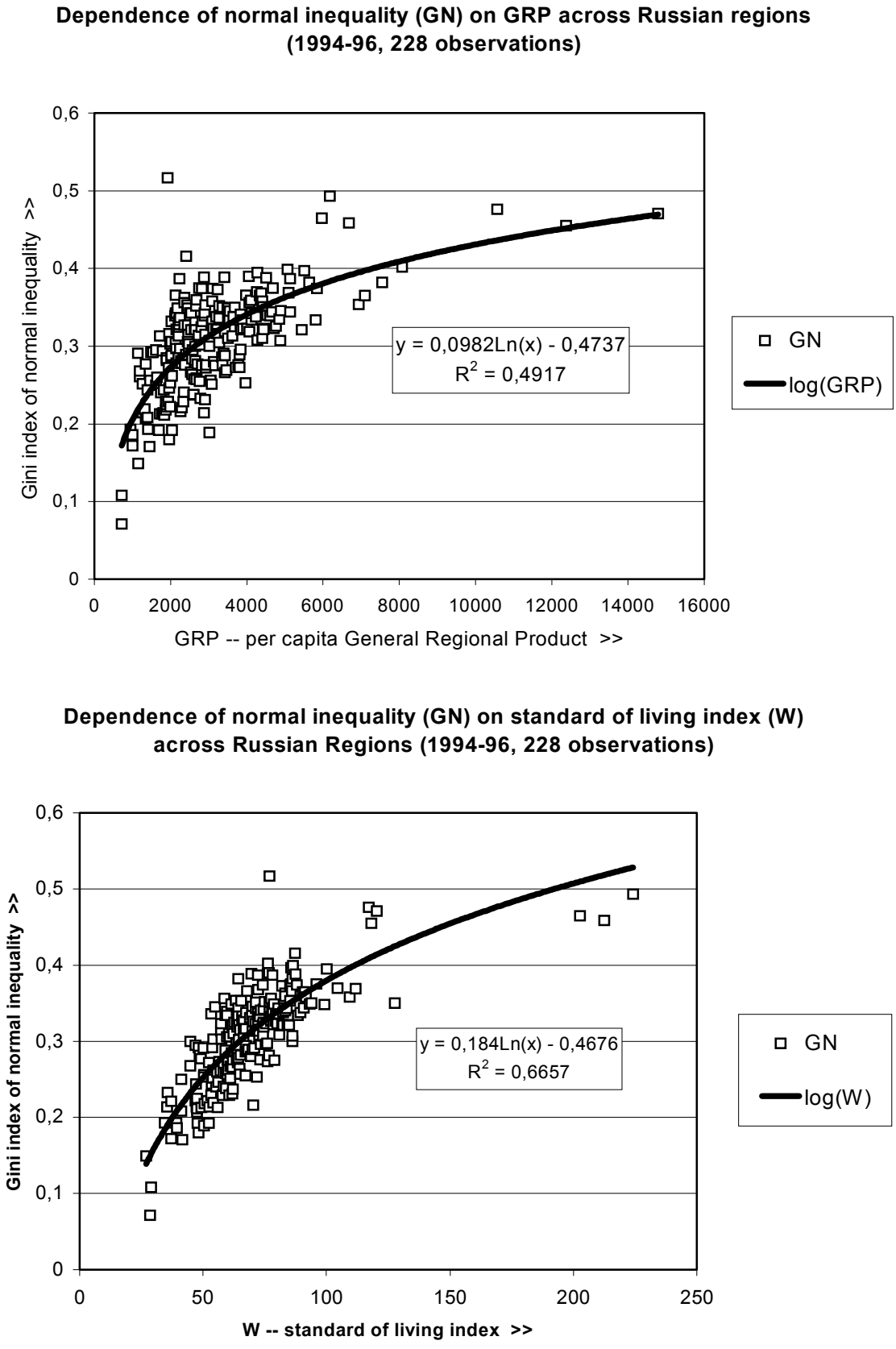
Fig. 16. Normal inequality GN, poverty P and factual inequality G in dependence on logarithm of standard of living index in 1994-96



logarithm of standard of living index W ⟶

The thick curves are polynomial regressions on logarithm of W

Fig. 17. Dependencies and trends of the normal inequality GN on per capita GRP and standard of living index across the Russian regions in 1994-96



Almost concave and almost linear trends of GN in Figs. 15, 16 after returning to absolute scales will concave and like to the left half of inverted U as in the Kuznets' hypothesis, as it is shown in Fig. 17. We can conclude that although the conventional Kuznets' hypothesis fails, *its modification by replacing the overall inequality* G *by the normal inequality* GN *is true in cross-section across the Russian regions.* It fulfills not only year to year, but also in extension of cross-sectional comparisons over 1994-97 (we don't shown the data on 1997 in Figs. 15-17 in order to do not overload the pictures, but after their addition the dependencies stay the same).

We suppose that our finding is a matter of principle. Our new hypothesis is that the failure of conventional Kuznets' hypothesis in international comparisons was due to mixing of inequality caused by poverty and the normal inequality in conventional inequality measurements: behavior pattern of the normal inequality in cross-section must be consistent with Kuznets' view-point.

Inequality behavior over time is more complicated, because it is affected by various exogenous and endogenous shocks (in particular, by policy shocks), but we can suppose that, excluding the shock effects, the behavior of the normal inequality must be close to Kuznets' pattern. Perhaps it would be more correct to suppose that with growth of per capita GDP (or standard of living index) the normal inequality rises, then, achieving its maximum, it slightly decreases and stabilizes at some equilibrium level. And after that the remainder of inequality related with poverty reduces, implying reduction and stabilization of the overall inequality. The fluctuations of the normal inequality and poverty are typically related with economical and political cycles, but they can also be related with endogenous tatonnement of inequality equilibrium.

In the Russia case, under almost permanent GDP reduction, we observe over time reliable tendency to the normal inequality increase and poverty reduction after each shock. The economy adaptation after crises with production increase in separate sectors with surprising quickness returns the normal inequality to its tendency to rise.

In the rest of this section we focus on cross-sectional analysis. Our principal question is what are the causes of the scattering of GN and P around their trends in Figs. 15-17. They may be particularly due to some irregularities in definitions of regional poverty lines: it seems that the poverty lines could be redefined in such manner that scattering in Figs. 15-16 (especially in Fig. 16) would be reduced. An alternative hypothesis is that they can be explained by regional

economic features, such as unemployment rate, relationship between demand and supply at the regional labor market, wage arrears, consumer price level and so on. In the following tables 7, 8 some results of analysis of trends and movements around trends are presented; all the trends are fourth degree polynomials on logarithm of per capita gross regional product.

Tab. 7. Characteristics of trends on logarithm of per capita GRP and deviations from trends for poverty index and indices of excess inequality and poverty in cross-section over 1994-97

	P	**(G—GN)/GN**	**(WN—W)/W**
Trend			
R squared	0.516	0.752	0.591
F statistic	79.6	226.5	107.9
Deviation from trend			
log(*unempl/vacancy*)	0.234 (2.890)	0.093 (0.998)	0.238 (2.955)
wage arr./grp	0.090 (1.060)	0.160 (1.634)	0.165 (1.955)
inc/grp	—0.522 (—6.278)	—0.524 (—5.447)	—0.448 (—5.428)
price defl.	0.511 (5.361)	0.416 (3.775)	0.430 (4.537)
R squared	0.509	0.388	0.455
F statistic	77.4	47.4	62.4
Total explained variance			
R squared	0.762	0.848	0.777
F statistic	118.1	206.1	128.5

The values of t-statistics are shown in the parentheses below the regression coefficients.
All variables are standardized to have zero mean and standard deviation equal to 1.
The number of observations is 304.

Tab. 8. Characteristics of trends on logarithm of per capita GRP and deviations from trends for normal inequality indices, and factual and normal standard of living indices in cross-section over 1994-97

	GN	**FN**	**W**	**WN**
Trend				
R squared	0.517	0.440	0.401	0.337
F statistic	79.9	58.8	50.1	38.0
Deviation from trend				
inc/grp	0.791 (11.877)	0.902 (17.245)	0.883 (20.842)	0.849 (15.887)
price defl.	—0.533 (—8.006)	—0.583 (—1.151)	—0.771 (—8.181)	—0.694 (—2.990)
R squared	0.576	0.736	0.835	0.736
F statistic	204.5	420.3	762.4	419.7
Total explained variance				
R squared	0.795	0.852	0.901	0.825
F statistic	192.1	285.9	452.1	233.3

In tab.7 we introduced two new indices: excess inequality (G — GN)/GN, measuring how much the factual inequality exceeds the normal one, and excess poverty (WN — W)/W = (Z/W)·P, measuring the increment, which overall standard of living level would obtain in result of poverty elimination. Of course, the second name is conditional, but it seems to be warrantable, because the lower is the poverty line Z in respect with the Gini equally distributed equivalent W, the higher is probability that observed poverty P is transitory or voluntary. These two new indices have more strong trends on logarithm of per capita GRP than all our other indices, and the strongest trend has excess inequality, but in respect with logarithm of W their trends are rather weak in comparison with trend of the poverty index P.

The most significant variable, explaining the movements around trends in Tabs. 7, 8, is *inc/grp* — the share of population income in gross regional product, which highly varies across the regions. That finding is very important, because in political discussions the redundancy of governmental redistribution of revenues in favor of poor regions is often pointed out. There are two principal channels of removals of profits and revenues from the regions: the first is related with property rights and the second is related with federal taxation. Both tax takings in a region and the balance of accounts of the regional budget with the federal one are positively connected with normal inequality and negatively connected with poverty. And of course the federal subsidies to the regional budget are connected with them in opposite manner. But the ratio *inc/grp* impacts to normal inequality and poverty in the same directions, and the money inflows into regions from the federal budget do not weigh down its effect. Hence our result shows that the total removals of profits and revenues from regions affect to poverty, normal and excess inequality, and standards of living stronger than the money inflows, related with secondary federal redistribution. In fact, there are many regions with low per capita GRP and relatively low share *inc/grp*, lower than in a number of regions with more successful economic conditions. Therefore we can conclude that entrepreneurial removals of profits and revenues from regions are in a matter of fact in our explanation of poverty, and excess and normal inequality across the regions.

The second explaining variable by its significance is *price defl.* — the interregional deflator of consumer prices, deflated by mean inflation rate in Russia as the whole in order to measure the regional differences in price levels only, excluding the common movement of consumer prices in Russia over 1994-97. Its impact is banal: the higher is level of prices, the higher are poverty and excess inequality in relationship to their trends, and the lower are normal inequality and standard of living in relationship to their trends. The number of unemployed economically

active persons per vacancy in tab. 7 — *unempl/vacancy*, — characterizing the situation at the regional labor market, — very highly varies across the regions. Its logarithm is significant in explanation of deviations of poverty and excess poverty indices from their trends, but that significance is essentially lower than in the cases of *inc/grp* and *price defl*. Finally, wage arrears, represented in tab. 7 by explaining variable *wage arr./grp*, turn out to be insignificant in explanation of movements of our indices around their trends. This variable is defined as the ratio of total amount of extra charged but did not paid wages (over all economy sectors at the end of year) to the gross regional product.

The problem of satisfactory explanation of population socioeconomic conditions in regions in the terms of macroeconomic indicators is complicated by multi-correlation between possible explaining variables and multiple feedback, no sufficiently evident a priori. In order to avoid these difficulties we apply the method of principal components to a collection of macroeconomic indicators, shown in Tab.9. The explanation of our socioeconomic indices by the first five principal components is described in Tab.10.

The first principal component is related mainly with level of gross regional product, represented in Tab.9 by three variables: *grp/cap* — per capita GRP, log(*grp/cap*) — its logarithm, and log(*GRP*) — logarithm of GRP (all them are expressed in constant 1994' prices); the last variable is included in order to take into account the regional economy scale effects. The first component has relatively high negative correlation with unemployment rate, the number of unemployed persons per vacancy, demographic load to employed persons (measured as the ratio of the total number of region's population to the number of employed persons), and with *inc/grp.* The last variable we used and described above. Its negative correlation with first component means that generically the higher is (per capita) GRP, the higher is the share of the revenue and profit removals in GRP (the correlation coefficient between *inc/grp* and log(*grp/cap*) is — 0.52, almost equal to correlation coefficient between *inc/grp* and the first principal component and significant with probability 0.001), what is consistent with our previous analysis. Besides that, the first principal component has also significant positive correlation with variables *wage arrears* — total amount of wage arrears in comparable expression as the result of deflation by regional consumer price deflators to consumer price level in average over Russia as the whole in 1994, and *inc.ind.* — mean per capita income of region's population in comparable expression, obtained in the same manner. The latter positive correlation is natural, but the former may provoke a perplexity. However, it also has a natural explanation. The higher is (per capita) GRP, the higher is total volume of

wages (or mean wage per employed person). And we could obtain non-positive correlation between wage arrears and GRP only if the share of wage arrears in GRP would sufficiently negatively correlated with GRP (or with the first principal component), but such negative correlation turns out to be too low.

Tab. 9. Characteristics of the first five principal components

	Loads to factors by principal components					**explained variance, %**
	1	2	3	4	5	
grp/cap	0.839	0.032	0.375	—0.167	0.154	89.8
Unemployment rate	—0.647	0.335	0.296	—0.143	0.461	85.2
wage arr./inc	0.160	0.921	—0.190	0.146	—0.166	95.8
unempl./vacancy	—0.573	0.267	0.364	0.031	0.339	64.8
defl.wage arr./empl.	0.382	0.826	—0.209	0.251	—0.122	95.0
wage arr./grp	—0.191	0.785	0.220	—0.104	0.006	71.2
wage arrears	0.608	0.498	—0.343	0.118	0.375	89.0
log(*grp/cap*)	0.928	—0.000	0.262	—0.194	0.003	96.8
log(*GRP*)	0.801	—0.223	—0.155	—0.123	0.372	86.9
Demograph.load	—0.752	0.045	—0.318	—0.193	0.197	74.4
inc/grp	—0.534	—0.064	0.541	0.568	—0.007	90.5
inc.ind.	0.648	—0.292	0.231	0.591	0.180	93.9
price defl.	0.295	0.271	0.772	—0.309	—0.221	90.0
explained total variance, %	37.6	21.5	13.4	7.8	6.1	86.4

The second principal component is related mainly with wage arrears, represented in Tab.9 by four variables: *wage arr./inc*, *defl.wage arr./empl*., *wage arr./grp* and *wage arrears*. The first of them is the ratio of total amount of wage arrears to population income, and the second is the amount of wage arrears per employed person in comparable expression. The third and fourth variables had been described above. The explanation of positive correlation between variable "*defl.wage arr./empl*." and the first principal component is the same as above, in the case of *wage arrears*.

Tab. 10. Explanation of indices of socioeconomic conditions across the regions over 1994-97 by the first five principal components of the collection of macroeconomic indicators.

	Correlation coefficients and the shares of explained variance (%) by principal components					**Total explained variance, %**
	1	2	3	4	5	
W	0.691 47.7	—0.281 7.9	0.268 7.2	0.498 24.8	0.219 4.8	92.5
WN	0.590 34.8	—0.248 6.2	0.378 14.3	0.515 26.5	0.312 9.7	91.5
G	—0.201 4.0	0.092 0.8	0.459 21.1	0.168 2.8	0.150 2.3	31.0
GN	0.764 58.4	—0.173 3.0	0.219 4.8	0.359 12.9	—0.010 0.0	79.0
P	—0.759 57.6	0.249 6.2	0.144 2.1	—0.249 6.2	0.091 0.8	72.9
F	—0.147 2.2	0.394 15.5	0.514 26.4	—0.040 0.2	0.220 4.8	49.1
FN	0.634 40.2	—0.198 3.9	0.407 16.6	0.516 26.6	0.229 5.2	92.6
RkW	—0.725 52.6	0.192 3.7	—0.126 1.6	—0.229 5.2	—0.141 2.0	65.1
SW	0.695 48.3	—0.296 8.8	0.227 5.2	0.511 26.1	0.213 4.5	92.9
SWN	0.639 40.8	—0.274 7.5	0.306 9.4	0.530 28.1	0.278 7.7	93.5
SG	0.176 3.1	0.070 0.5	0.471 22.2	0.214 4.6	0.137 1.9	32.2
SGN	0.681 46.4	—0.167 2.8	0.225 5.1	0.365 13.3	—0.049 0.2	67.7
SP	—0.714 51.0	0.262 6.9	0.225 5.1	—0.213 4.5	0.148 2.2	69.7
SF	—0.150 2.3	0.393 15.4	0.531 28.2	—0.037 0.1	0.183 3.3	49.5
SFN	0.631 39.8	—0.217 4.7	0.387 15.0	0.540 29.2	0.219 4.8	93.4
SRkW	—0.708 50.1	0.209 4.4	—0.096 0.9	—0.257 6.6	—0.146 2.1	64.1

The definitions of all indices in this table, besides RkW, are given in Section 4;

The indices without “s” before index name correspond to measurements in per capita terms, and the indices with “s” before index name corresponds to measurements in the terms of the RLMS equivalence scale;

(s)RkW is rank of region in ordering the regions by *decreasing* of standard of living index (s)W, and therefore its correlation with the first principal component is negative

The third principal component is related with regional level of consumer prices in interaction with the ratio *inc/grp*. The fourth principal component is related with the mean per capita income in comparable expression, also in interaction with the ratio *inc/grp*. The fifth principal

component is related mainly with unemployment, represented by two variables: *unemployment rate* and *unempl./vacancy*, and it is positively connected with *wage arrears* and log(*GRP*) .

The strongest explanations we obtained for the indices of normal inequality sFN, FN (with use and without use of equivalence scaling). They measure how much would the gap between incomes of 10% richest and 10% poorest population in the case when incomes of all the poor would enhanced up to poverty line, as well as for the indices sW, W, sWN, WN of the factual and normal standards of living. The explanation strengths of the behavior patterns of the indices GN and P are close to those obtained in analysis of trends and deviations from trends, and they are somewhat lower for the indices sGN and sP, estimated after equivalence scaling. The most weak explanations we obtained for the Gini induces of factual inequality G, sG; for the indices of factual inequality F and sF the explained shares of variance are somewhat more than for G, sG, but the explanations also are weak.

Taking into account more extensive analysis of rank correlation, we can draw the following principled conclusions.

1. Observed inequality (expressed in various measures) in a matter of principle has no a satisfactory explanation by macroeconomic indicators without its decomposition into normal inequality and inequality, related with poverty. Low level of per capita GRP or mean per capita income does not diminish inequality, but deepens poverty in such manner that overall inequality stays high.

2. The patterns of behavior of the normal inequality and poverty are highly reliable and consistent with standards of living. Each relevant economic correlate of standard of living is relevant correlate of the normal inequality with the same sign, and it is relevant correlate of poverty with the opposite sign. Increase of standard of living generically does not diminish overall inequality, but reduces poverty and substitutes the excess inequality, related with poverty, by the normal one. In particular, we can conclude that in the Russian case the normal inequality does not achieved its “saturation” level, when an increase of standard of living implies a reduction of overall inequality (as result of poverty reduction), and perhaps a reduction of normal inequality. We hypothesize that in a matter of principle a reliable reduction of overall inequality can be achieved only after achieving a “saturation” level of normal inequality. It almost surely will be over an equilibrium level, meaning inequality equilibrium as a situation, when there are no socially and economically motivated forces, able to change inequality magnitude.

In analysis of rank correlates with the use of more extensive list of factors we find that domestic and foreign investments, level of industrial production, development of financial system, the share of export in industrial output, foreign trade balance are the factors, consistently increasing standards of living and normal inequality, reducing poverty, and having no significant connection with overall inequality. Inversely, per capita tax takings in comparable expression and balance of accounts of regional budget with federal budget are positively connected with normal inequality, and negatively connected with poverty and overall inequality. These finding confirm the concepts developed in this Section.

8. Estimations at the national level and their comparisons with estimations by Goskomstat and RLMS

1. We summarize all our findings on inequality and poverty at the national level in the following table.

Tab. 11. Summary estimates of economic inequality and poverty of population in Russia in 1994-97

		Without scaling in dependence on household size				After adjustment to household size with the use of the RLMS equivalence scale			
		1994	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Money incomes :									
— nominal	**F**	21.5	18.7	25.3	23.3	17.5	15.4	21.9	20.5
	D	8.5	7.8	8.7	10.0	7.1	6.5	7.6	8.7
	G	0.465	0.450	0.481	0.470	0.437	0.430	0.456	0.447
— deflated	**F**	15.9	14.2	21.3	23.2	13.7	12.3	18.2	19.8
	D	7.7	7.1	9.0	9.4	6.6	6.1	7.5	8.2
	G	0.430	0.416	0.441	0.458	0.404	0.391	0.414	0.430
Population with per capita income below poverty cut-off (%)	**H**	23.6	27.4	31.1	27.6	14.2	18.5	20.0	17.4
mean per capita income deficit in poor households (%)		31.3	32.6	37.9	37.6	27.3	27.0	37.1	37.9
Poverty index	**P**	0.161	0.178	0.213	0.190	0.086	0.105	0.139	0.124
Money expenditures :									
— nominal	**F**	17.3	16.3	14.7	16.5	15.3	14.4	13.1	14.5
	D	7.5	7.1	6.1	6.9	6.6	6.2	5.4	6.1
	G	0.452	0.444	0.436	0.457	0.428	0.421	0.412	0.433
— deflated	**F**	14.8	13.2	11.5	12.6	12.8	11.5	10.1	10.9
	D	7.4	6.9	6.0	6.4	6.3	5.9	5.1	5.6
	G	0.421	0.407	0.392	0.408	0.394	0.381	0.365	0.380
Population with per capita expenditures below poverty cut-off (%)	**H**	24.7	30.5	31.9	26.6	14.0	18.3	17.1	15.5
mean per capita expenditure deficit in poor households (%)		30.0	31.3	29.5	29.2	26.9	26.7	26.9	25.5
Poverty index	**P**	0.158	0.175	0.169	0.152	0.084	0.103	0.087	0.081

Notations:

F — differentiation coefficient: the ratio of income (expenditure) of top 10% to income (expenditure) of bottom 10% of population
D — ratio of 9th decile of distribution to its 1st decile
G — Gini index
H — percentage of the poor
P — poverty index (see definitions in Section 4)

With the use of new techniques developed in this research we obtained diverse characterizations of inequality and poverty in Russia during reforms, which give rather not evident picture of the dynamics of economic inequality and poverty of population. The estimates of inequality and poverty sizes with the use of indices, based on various measures of income and expenditure, are sizably different. And tendencies of inequality and poverty changes over time, expressed in terms of various indices, also are significantly different. Such diversification of the estimates reflects the following features of transition processes in Russia.

1) *Increasing share of population with expenditures significantly exceeding incomes*. In terms of per capita measures of poverty corresponding effects are expressed not in estimates of percentages of the poor in income and expenditure, but in poverty indices: while in 1994-95 the values of such indices based on per capita incomes and expenditures was close, in 1995-96 the indices based on expenditures P = 0.169, 0.152 are significantly lower than corresponding indices based on incomes P = 0.213, 0.190. In terms of scale-equivalent measures of poverty corresponding effects are expressed both in indices H and P, but in the latter the differences are more contrast: in 1996-97 in terms of equivalent income P = 0.139, 0.124, while in terms of equivalent expenditure P = 0.087, 0.081. The last values are in sharp difference of corresponding estimates in terms of per capita income P = 0.213, 0.190.

The impact of expenditures above the incomes to inequality estimates displays in all our indices of inequality based on all our eight measures of the population economic conditions. Most sharply such impact displays by the values of index F: while in terms of nominal per capita income in 1994-97 it takes the values 21.5, 18.7, 25.3, 23.3, in terms of nominal per capita expenditures the corresponding values are 17.3, 16.3, 14.7, 16.5; while in terms of deflated equivalent per capita income the values of F are 13.7, 12.3, 18.2, 19.8 with significant increasing in 1996-97, the corresponding values in terms of expenditures are 12.8, 11.5, 10.1, 10.9 without such increasing, and on the contrary with almost decreasing tendency.

2) *High regional differences in living costs, with decreasing correlation between cost and standard of living*. In our findings it is expressed in differences between inequality estimates, based on nominal and deflated measures of the population economic conditions. In terms of per capita income the values of index F in 1994-97 in nominal measurement was 21.5, 18.7, 25.3, 23.3, while in deflated measurement the corresponding values were 15.9, 14.2, 21.3, 23.2. So we find that the significant deflation effect in 1994-95 had been leveled in 1996-97 as the result of rapid increase of inequality measured in terms of per capita income

deflated to comparable purchasing power across the regions. In terms of scale-equivalent income the revealed tendency looks the same, taking into account the reduction impact of equivalence scaling to all the inequality indices: in nominal measurement the values of index F was 17.5, 15.4, 21.9, 20.5, while in comparable measurement the corresponding values was 13.7, 12.3, 18.2, 19.8 — with convergence of the former and the latter estimates. The revealed behavior of the Gini indices is similar.

The impact of deflation to estimates of inequality in expenditure is highly distinct in view of circumstances considered above in point 1). In terms of expenditures, as in per capita, as well as in equivalent measurement, the effect of deflation is non-decreasing. In per capita measurement the values of index F without deflation was 17.3, 16.3, 14.3, 16.5, and with deflation — 14.8, 13.2, 11.5, 12.6; in equivalent measurement they were correspondingly 15.3, 14.4, 13.1, 14.5, and 12.8, 11.5, 10.1, 10.9 — approximately with the same gap between estimates in nominal and deflated measurement in each year.

Revealed distinctions in impact of deflation to inequality estimations, based on incomes and expenditures, are due to increasing variability across the regions of the share of population with expenditures exceeding incomes. In fact, the harder the economic situation in a region, the higher is the share of population with incomes exceeding expenditures. But the hard situation in a region does not, without fail, mean that the standard of living is low. It can mean, for example, excess arrears in payoffs to population (in wages, salaries and social transfers), and in 1996-97 it typically meant that.

3) *Dynamic changes of socioeconomic stratification of population*. As we have shown in Section 3, income distributions (in nominal and deflated measurements) have volatile form with increasing clustering of poor, population with "low-middle" income and population with relatively high income. In Tab. 11 it is expressed by high differences between indices F and D in all our eight measures. Such differences are related to extremely high differentiation of incomes and expenditures in extreme groups of population: among bottom 10% of population and among top 10% of population. This fact has never before been revealed by other researchers.

The picture presented in tab. 11 is obtained for the first time in Russian statistics experience. It describes the features of the transitional process in Russia at the national level, which can not be revealed and interpreted without regional analysis, representing one of the key conceptual aspects of our methodological approach.

2. Our estimations of changes of the inequality in income and poverty indicators for the population of Russia during reforms, manifest important discrepancies as with the official estimations by Goskomstat, as well as with the RLMS estimations (Lakshin, Mroz, 1997, Mroz et al. 1997), as it is shown in the following two tables.

Table 12. Comparison of our estimates of inequality in nominal per capita income and poverty in per capita income with the official data by Goskomstat[1]

	by the Goskostat official data			by the project authors estimates		
years	**F**	**G**	**H**	**F**	**G**	**H**
1991	4.5	0.260	—	8.9	0.341	14.3
1992	8.0	0.289	33.5	12.4	0.370	33.5
1993	11.2	0.398	31.5	15.0	0.439	31.5
1994	15.4	0.412	22.4	21.5	0.465	23.6
1995	13.5	0.381	24.7	18.7	0.450	27.4
1996	13.0	0.375	22.0	25.3	0.481	31.1
1997	13.2	0.375	21.0	23.3	0.470	27.6

[1] The Goskomstat data on poverty are result of aggregation of regional estimates at the national level; in the authors methodology poverty estimates are related to distribution of deflated per capita income in the national general sample and coincides with aggregation of regional estimates

F — the ratio between income of 10% the richest and income of 10% the poorest population

G — the Gini index of income inequality

H — percentage of population with per capita income below poverty cut-off

Table 13. Our estimates of inequality and poverty in equivalent money income and expenditure in comparison with corresponding RLMS estimations with the same equivalence scale, but applied to total income

	Gini indices of inequality in scale equivalent nominal measures			Percentages of poor			Gini indices of inequality in equivalent deflated measures	
	RLMS	**Our estimates**		**RLMS**	**Our estimates**		**Our estimates**	
	Total income	**money income**	**money expendi-ture**	**total income**	**money income**	**Money expendi-ture**	**money income**	**money expendi-ture**
1992	0.409	—	—	11.1	—	—	—	—
1993	0.387	—	—	13.6	—	—	—	—
1994	0.418	0.437	0.428	17.2	14.2	14.0	0.404	0.394
1995	0.434	0.430	0.421	29.5	18.5	18.3	0.391	0.381
1996	0.492	0.456	0.412	36.3	20.0	17.1	0.414	0.365
1997	—	0.447	0.433	—	17.4	15.5	0.430	0.380

As we have said in the introduction, the distinctions of our estimates from the estimates by Goskomstat and RLMS are related to different causes. The Goskomstat estimates are

"unbiased" by calibration of lognormal modesl of income distribution to macroeconomic estimates of mean per capita income at the national level. The distinctions occur, because such "unbiasing" is incorrect in view of significant distinction of true income distribution from the lognormal one. The Goskomstat lognormal model roughly cuts the concentrations of true income distribution density in left and right ends of distribution. As a result, the Goskomstat model roughly underestimates inequality and poverty in per capita income in 1994-97. The alternative parametric estimates (F = 27.1, H =35 in 1994 by I. Kolmakov and T. Velikanova; F=65 in 1996 by V. Ivanov and A. Suvorov, 1997), mentioned in point 3 of the introduction, roughly overestimate the inequality and poverty, because they are hardly dependent on the sample bias, using the sample estimate of income distribution mode without any sample bias correction. Our non-parametric estimations with sample bias correction by data reweighting overcome the arbitrariness and other difficulties, arising in the cases of the application of parametric approaches.

In order to correctly understand distinctions of our estimates from the RLMS ones, shown in the Tab. 13, let us note at first that in the both cases the poverty estimates are obtained by applying the same poverty lines, as they were defined by Goskomstat. But Goskomstat's definition of poverty line can be correctly applied only to money incomes and expenditures, but not to total incomes. Accurate estimates of poverty in total income must be related to a special investigation of corresponding poverty line definition. At second, the inequality and poverty estimates, based on total income, must be lower than corresponding estimates, based on money income; we can suppose that, being made with sufficient accuracy, they would be close to (or not over) our estimations of inequality and poverty in expenditure. All the RLMS estimates are sample estimates without any sample bias correction. Considering Tab. 13, we immediately see that the RLMS results sharply overestimate the percentages of poor in 1995-96 and the value of the Gini index of inequality in nominal equivalent total income in 1996. The overestimation of this index value in 1995 looks little, but in our comparison we must take into account the fact that the measurements of total income smooth the differences in money income; the figures at the right side of Tab. 20 seems to be more correct. We leave more accurate investigation of inequality and poverty in total income for a subsequent research.

9. Conclusion: principled findings and policy implications

The relationship between the economic efficiency and income distribution has traditionally occupied an important position in economic analysis. In this paper we developed new techniques in order to enhance accuracy of measurements of economic inequality, poverty and standards of living. We introduced also some new concepts and measures in order to achieve correct understanding the patterns of inequality and poverty behavior over time and in cross-section, and draw implications on policy to poverty reduce.

We had shown that in the FBS samples low income groups of population are over-represented, while high-income groups are under-represented, nevertheless sufficiently in order to obtain satisfactory approximations to income (or expenditure) distributions over the general samples at the regional and the national levels. Such approximations are obtained by sample data reweighting with subsequent kernel estimations of densities of the distributions. Besides enhancing accuracy of conventional estimations and analysis of inequality and poverty, our techniques to correct the biases in the FBS samples has provided us with new opportunity to estimate and analyze normal inequality, in the case of poverty elimination, and excess inequality, related to poverty, with accuracy, sufficient in order to draw new conceptual conclusions. Let us summarize the most principled findings, obtained in this paper with the use of our new methods.

OVER TIME CHANGES OF INEQUALITY AND POVERTY. We had shown in Section 7 that correct understanding of over time inequality changes in Russia during reforms is related with distinguishing between normal inequality and poverty changes. Since beginning reforms, inequality was rapidly risen during three years, up to achieving its local maximum in 1994. But that rise has heterogeneous causes: in 1992 it was related to shock poverty increase and normal inequality reduction, but thereupon it was due to normal inequality growth under poverty reduction. That was period of privatization, formation of new economic relations and new class of rich. After 1994, inequality in income was fluctuating in dependence on political and economical circumstances, without distinct tendency, if we take into account not only inequality in income, but all inequality measures, considered in Section 8.

Two subsequent local maxima of poverty in income were related to crises in 1996 and 1998. Some rise of poverty has begun in 1995 under some reduction of both the overall and normal inequality, but 1996's crisis of arrears does not affected the normal inequality, which again

began to increase in 1996 and continued its slow growth up to summer of 1998. That is consistent with changes of poverty in expenditure, which attained its second (after 1992) local maximum in 1995 and then was decreasing in 1996 and 1997. The 1998 August crisis highly affected both normal inequality and poverty, but not considerably enhanced overall inequality: the poverty increase has been compensated by the normal inequality reduction. In 1999 new cycle of normal inequality slow growth under slow poverty reduction began.

The substitution between poverty and normal inequality, under small variation of overall inequality, turns out to be highly relevant phenomenon. After achieving some "saturation" level, the overall inequality seems to be almost immutable, whereas the shares of overall inequality, related to normal inequality and poverty, mutate in dependence on economical and political circumstances. Such phenomenon is especially striking in cross-section across the Russian regions.

NORMAL INEQUALITY AND KUZNETS' HYPOTHESIS IN CROSS-SECTION. We could not found economic factors, satisfactory explaining regional differences in overall inequality. The best our result in Section 7 consists in explaining 31% of the variance of Gini index, and 49% of the variance of index F (see also Appendix 3). Of course, conventional Kuznets' hypothesis in cross-section across the Russian regions fails, but it fulfils, when we replace the overall inequality index G (or F) by the normal inequality index GN (or FN). The behavior pattern of the index GN in dependence on per capita gross regional product (or on standard of living index) is similar to left half of inverted U (the behavior of FN is similar). Economic factors, considered in Section 7, explain 92.6% of the variance of FN, 79% of the variance of GN, 76% of the variance of poverty index P, 84.8% of the variance of excess inequality index (G — GN)/GN, and 77.7% of the variance of excess poverty index (WN — W)/W. Moreover, poverty index has strong polynomial trend on logarithm of standard of living index explaining 89% of the regional poverty differences.

It turns out that the regional differences in overall inequality are significantly lower than the differences in poverty and normal inequality. Modulo intrinsic differences, unexplainable by economic factors, normal inequality and poverty turn out to be mutual substitutes: the more is poverty, the lower is normal inequality, under small differences in overall inequality. And, in inverse order, the higher is normal inequality, the lower is poverty, or excess inequality, related to poverty. At the national and at the regional levels each increase in standard of living is

related to some increase of normal inequality and corresponding reduction of poverty, both they change more significantly than overall inequality changes.

We can conclude that in distinction of overall inequality the normal one does not attained its "saturation" level, and for the most part of Russian regions it is far being "saturated". Normal inequality in Russia as the whole, as well as in absolute majority of Russian regions is not over the overall inequality size, typical for European countries. In a principle of matter inequality in Russia seems to be more similar to inequality in U.S. (G = 0.466, F = 15 in 1992), than to inequality in European countries, but normal inequality exceeds overall inequality in U.S. only in two Russian regions: Moscow and oil exporter Tyumen region. Excluding these two regions and a few number of autonomous republics and Siberian regions, the Gini indices of overall inequality in Russian regions are below the Gini index for U.S., but for many regions the F ratio is significantly over the F ratio for U.S. The gaps between the values of F and FN ratios show how deep is poverty in many regions, and how much the poors are differentiated by incomes. Comparing that with reliable tendency to normal inequality growth under GRP or standard of living increase, we can conclude that a large part of the poor in Russia consists of occasionally poor, whose poverty was forced by unfavorable economic factors.

INEQUALITY AND POVERTY BY INCOME SOURCES. Analysis in Section 6 confirms the last conclusion. Among various income sources the lowest inequality and poverty is due to social transfers. There exists a problem of shortage of social transfers, because over 1994-96 poverty, related to deficit of social transfers, was increasing, with slight reduction in 1997, under which poverty size has been retained over its size in 1994-95. But inequality in income from social transfers was permanently decreasing, and contribution of the social transfer deficit into overall poverty was increasing in 1995-97. The shortage of social transfers was determining only 20.4% of overall poverty in 1997. The strongest factor determining poverty is shortage of wages and salaries: its contribution into overall poverty was fluctuating between 44.4% and 54.8%. The second factor by the share of its contribution into overall poverty is related to restricted possibilities to realize entrepreneurial activity (in particular, bad conditions for small business). Two these factors jointly determine 75-80% of overall poverty (they are mutual substitutes in inequality and poverty determination). In contrast to widespread viewpoint, social transfers in Russia were reducing overall inequality and poverty. The most part of overall inequality in 1994-97 has been related to inequality in income from entrepreneurial activity (42.1-51.7%) and to inequality in wages and salaries (33.1-43.9% of overall inequality). Inequality and poverty in incomes from property, ownership and other

sources were very high, but these factors had moderate impact to overall inequality and the smallest impact to overall poverty.

EXCESS POVERTY AND INEQUALITY conventionally are considered as matters of some subjective appraisals or normative judgements. However, it seems to be natural to suppose that equity of income distribution would must make excess inequality, defined as excess of overall inequality over the normal one, (G — GN)/GN, either independent on normal inequality, or perhaps positively connected to it. It seems also being natural, if the variations of overall and normal inequality across the regions would have isotonous tendencies with some moderate fluctuations of overall inequality around its tendency in dependence on occasional variations of excess inequality. We can say that we statistically recognize the presence of excess poverty and inequality in cross-section, if these two conditions distort. In fact the excess inequality index has no correlation with overall inequality, but it has significant negative correlation with the normal one, whereas overall inequality has no a definite tendency across the regions and is too weakly correlated to the normal one.

The situation looks as, if income distribution has been more closed to laisser faire than directed to equitability: the lower is gross regional product, the more excess inequality substitutes the normal one without a definite tendency to overall inequality reduce. While commonly the poorer are regions, the more are federal subsidies and transfers, they did not compensated high regional differences in poverty magnitude. As we noted in Section 7, removals of revenues and profits from regions, related to entrepreneurial activity and distribution of property rights, have more strong impact to excess inequality and poverty across the regions than secondary federal redistribution of revenues. Besides, the low earnings in many regions are related to unemployment, shortage of labor demand, wage and social transfer arrears, and interregional wage differentials. In addition, low per capita incomes are significantly related to regional features of demographic loads to employed persons. Significant positive rank correlation of domestic and foreign investment levels with standards of living and normal inequality magnitudes are ambiguous: the more are short-run profitability of investments, the more are investment inflows, and the more are the shares of revenue and profit removals from gross regional product.

INEQUALITY EQUILIBRIUM, EQUITY AND NEW VIEWPOINT ON KUZNETS' HYPOTHESIS. There are various economical, political and social forces affecting income distribution. However, there are possibilities to give a phenomenological description of

inequality equilibrium. An interesting concept of stable wealth distribution introduced by A. Robson (1992). A.Kiruta and B.Yefimov (1993, 1998) developed a somewhat different concept of social equilibrium, related to mathematical models of distribution justice. In order to obtain the most general description of distribution equity they introduced a concept of individual social tension function in dependence on individual's position in the overall distribution. Social equilibrium is defined as a Pareto efficient distribution with social tensions equal to zero for all the members of society. They had shown that the possibility to attain a social equilibrium depends on behavior of individual tension functions at the Pareto boundary of the set of all admissible distributions. If this behavior permits to improve the positions of the society members with the maximal non-zero social tensions, then each equilibrium point in the competition between efficiency and equity is social equilibrium. An inequality equilibrium concept may be not less useful than the market equilibrium concept, especially it may be useful in studies of relationship between the economic efficiency and the equity of income distribution.

These notes jointly with our findings on Kuznets' hypothesis in cross-section suggest a new look at inequality behavior patterns. Our new hypotheses consist in the following.

1. The failure of the conventional Kuznets hypothesis can be explained by two causes. The first consists in excess inequality variations, when excess inequality is defined as relative exceeding of overall inequality over the normal one. Such variations are consistent with economic development (especially with economic inefficiency), but depend on society tolerance to poverty, expressed in endogenous distribution mechanism, when it provides with lower opportunities the society members with low status. The mixture of the excess and normal inequality in overall inequality measurement makes overall inequality almost independent on macroeconomic factors.

The second cause is tendency to inequality equilibrium. Overall income distribution is in a process of tatonnement of an inequality equilibrium. Using well-known conceptions of the theory of dynamical systems, we can say that inequality equilibrium can be either attracting, or unstable, and tatonnement process can have cycles and a domain of erroneous behavior, also either attracting, or unstable. Hence, in a matter of principle, many fluctuations of overall inequality, unexplainable by macroeconomic factors, can be generated by endogenous tatonnement mechanism. However poverty cut-off depends on macroeconomic factors and on income distribution in such manner that the normal and excess inequality and poverty have

consistent tendencies in dependence on macroeconomic factors; endogenous fluctuations of overall inequality cannot destroy these tendencies, but can only force some fluctuations around them.

2. As in cross-section, as well as over time the normal inequality behavior has definite pattern, satisfactory explainable by macroeconomic factors (taking into account exogenous shocks over time). The normal inequality behavior pattern in cross-section is the same as or close to the pattern, which Kuznets' hypothesis attributes to overall inequality (with the only possible difference, related to stabilization of normal inequality at the right end of cross-section sample).

3. In general case behavior of normal inequality over time may be rather complicated. In order to understand it correctly we must consider two different cases.

A tatonnement process is said efficient if each income distribution trajectory converges to a stable equilibrium. If endogenous tatonnement of inequality equilibrium is efficient, then in conditions of economical growth normal inequality increases, until it attains a "saturation" level — its turning point. Then it slightly reduces and stabilizes at an equilibrium level. Its behavior pattern over time is like to inverted U, as in Kuznets' hypothesis, only before attaining its equilibrium level. After normal inequality stabilization the behavior patterns of overall and excess inequality are decreasing in result of poverty reduction, up to attainment of inequality equilibrium. Income distribution in such inequality equilibrium can be considered as equitable.

In this case before stabilization of normal inequality its trend is concave and trends of poverty and excess inequality are convex. This "ideal" picture can be slur over by exogenous shocks.

4. If tatonnement mechanism is inefficient or economic conditions are unstable, then endogenous fluctuations of both overall and normal inequalities will be observed, normal inequality having a definite and consistent dependence on economic factors. In that case typically there exists an overall inequality "saturation" level, depending on tatonnement mechanism, after attaining which the normal and excess inequality become mutual substitutes, whereas overall inequality cannot considerably raise, but can move downwards with following return to its "saturation" level. The "saturation" level can be shifted by an exogenous shock, but under attainment this level, the normal and excess inequalities are significantly more sensitive to exogenous shocks than the overall one.

Perhaps these suppositions can be formally proved, using an appropriate dynamical model.

DIVERSIFIED POLICY TO POVERTY REDUCE AND MAKE INCOME DISTRIBUTION MORE EQUITABLE. The principal problem of Russian economy is how to reduce poverty. We had shown that poverty reduction is related to the factors, raising normal inequality. Besides, we had argued that the raise of normal inequality opens opportunities for further poverty and excess inequality reduction. A list of factors, affecting normal inequality and poverty is given in Section 7. Each factor, raising normal inequality, reduces poverty and raises standard of living, and inversely, each factor, reducing normal inequality, raises poverty and reduces standard of living.

Let us remind that inequality in expenditure is between overall and normal inequalities in income, and poverty in expenditure is below poverty in income. We interpreted this fact as a result of differences between current and permanent incomes; hence we can conclude that both inequality and poverty in permanent income are below those related to current income. Therefore economic instability is an additional factor, raising overall inequality and poverty over their potential levels under more stable conditions. The factors, supporting instability, are inter-enterprise arrears, wage arrears and redundant exterior debts. Taking distinctions between potential and factual inequality, poverty and standards of living, we can suppose that socioeconomic situations, as well as economy productivity in Russia as the whole and in its regions could be more favorable, if policy would be more efficient. This conclusion is consistent with analysis in Section 7 with the use of principal components. Indeed, the second principal component, related to wage arrears, contributes in explanation of the total variance of macroeconomic factors significantly more than in explanations of the variances across the regions of normal inequality, poverty and standards of living.

Roughly speaking, there are two aspects of poverty reduction problem: the first is related to mechanisms, determining income distribution, and the second is related to economic efficiency. Regional differences in per capita gross regional product determine only about half of normal inequality and poverty variances across the Russian regions; the second half of these variances are related to distribution mechanisms. There exist some feedback between income distributions by income sources and economic efficiency; especially income distributions by such income sources as wage, salary and entrepreneurial activity can significantly impact to economic efficiency.

As we had shown in Section 6, the poverty reduction problem is not problem of considerable enhancing the social transfers, and so it is not problem of considerable enhancing the taxes. Idea of diversified policy to poverty reduce consists in distributing necessary overall income increment among various income sources in such way that necessary increments by income sources will be relatively little (less than GDP growth rate in middle 90's in Poland, for example), and so really attainable. Such diversified policy will make also income distribution more equitable, extending opportunities of earnings for the poor. It consists at first in a system of measures in order to enhance incomes from wages and salaries, entrepreneurial activity, property and other sources, and make earnings more stable, and in second in enhancing the social transfers, using raise of taxes takings induced by raise of earnings. A system of measures in order to realize such policy corresponds to analysis of factors, determining inequality and poverty, and can be outlined as the following.

1. To stimulate labor demand, create new working places, perhaps with using part-time job.

2. To create conditions for enhancing the share of wage in gross revenues of enterprises (now this share is too low).

3. To create favorable conditions for small business, and home production of commodities for sale.

4. To create favorable and equitable conditions for inflow of investments and development of financial system.

5. To reduce wage and inter-enterprise arrears, eliminate inter-enterprise barter.

6. To control removals of revenues and profits from regions, especially from poor regions.

7. To put social transfers in dependence on demographic loads to employed persons.

Estimates in Section 6 show that enhancing income from wages and salaries by 6-7% jointly with enhancing income from entrepreneurial activity by 4-5% are sufficient for overall poverty reduction by 75%, if these increments of incomes by sources would obtained by the poor. The measures listed above highly depend on tax policy. Let us note that tax privileges to small business generated in 1989-91 a boom of small entrepreneurial activity, which had been strangled in 1992 not by inflation, but by tax reform (it is possible to prove that without this tax reform the inflation rate December 1992/December 1991 would been about 1/3 of its value). An appropriate discrimination of tax rates is one of possible ways to stimulate the raise of earnings.

An essential obstacle to production increase in Russia is low consumer demand. The measures in order to poverty reduce would enhance consumer demand, opening opportunities for the demand increase and production growth, which would involve raise of taxes takings without any enhancing tax rates. In result the opportunities to enhance the social transfers would create. In contrast to widespread opinions, the economic efficiency and the equity of income distribution are not inconsistent, if we interpret equity as inequality equilibrium under stable economic growth.

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