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# A Decomposition Analysis of Regional Poverty in Russia

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**Abstract**

This paper applies a new decomposition technique to the study of variations in poverty across the regions of Russia. The procedure, which is based on the Shapley value in cooperative game theory, allows the deviation in regional poverty levels from the all-Russia average to be attributed to three proximate sources; mean income per capita, inequality, and local prices. Contrary to expectation, regional poverty variations turn out to be due more to differences in inequality across regions than to differences in real income per capita. However, when real income per capita is split into nominal income and price components, differences in nominal incomes emerge as more important than either inequality or price effects for the majority of regions.

Keywords: poverty, Russia, regions, decomposition
JEL classification: C15, C43, D31, P36, R12



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## 1. Introduction

The population of Russia, along with many other former Soviet bloc countries, has experienced major changes in living standards during the past decade. Economic liberalization in the early 1990s caused prices to explode, with inflation peaking at more than 30 per cent per month in 1992, and then spurting again after the financial crisis of August 1998. At the same time real GDP fell for much of the period, so by that the end of the century it was less than half the level prevailing a decade earlier.

These economic upheavals are reflected in the figures for the number of Russians living in poverty. Official estimates suggest that the proportion of the population below subsistence level grew dramatically from less than 10 percent in the late 1980s to over 30 percent during 1992 and 1993. After subsiding to around 20 percent, the poverty rate then climbed above 40 per cent following the August 1998 crisis. Although these fluctuations in poverty have a clear and expected link to changes in average real incomes, Shorrocks and Kolenikov (2001) show that this was not the only factor at work; increasing inequality was also a major source of rising poverty during the 1990s, while revisions to the subsistence standard caused a spurious decline in reported poverty rates.[1]

Spatial variation is a second, relatively neglected, dimension of inequality and poverty analysis. Given the size of Russia, and the fact that it covers many climatic and time zones with very different living conditions, it is not surprising to find large regional differences. These are indeed huge. Across the 79 main subregions, prices and poverty rates vary by a factor of more than 4, and nominal incomes by a factor of more than 10.[2] In the poorest regions, mean per capita income has been below subsistence level in recent years, and well over half of the population lives in poverty, even according to the most optimistic estimates. This degree of regional disparity is probably not matched by any other country in the world. Nor was it probably matched by Russia in Soviet

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[1] See also Braithwaite (1997), Klugman and Braithwaite (1998), Commander et al. (1999), and McAuley and Ovcharova for a review of inequality and poverty trends during the 1990s. Milanovic (1998) compares the experience in Russia with that of other transition countries.

[2] This ratio falls to around 8 if the zone neighbouring Chechnya is excluded.

times, when price controls and fiscal redistribution were used to mitigate the 'natural' disparity in regional living standards that have now emerged.[3]

An understanding of the sources of regional differences is therefore crucial to understanding the level and trend of poverty and inequality in the Russian Federation. Yemtsov (2003, Section 2) documents the contribution of increasing regional disparity to the rise in inequality in Russia during the period 1994-2000. This paper focuses instead on the regional dimensions of poverty. Specifically we investigate some of the proximate explanations for variations in poverty across regions, by characterizing regions in terms of per capita income, income inequality and prices, and by showing how the deviations of regional poverty levels from the all-Russia average can be exactly attributed to these three sources.[4] To do so, we make use of a new and powerful decomposition framework based on the Shapley value in co-operative game theory.

The paper is organized as follows. Section 2 provides some essential background to the study of poverty in Russia and its regions. The basic framework and the Shapley decomposition procedure are described in Section 3, followed by a discussion of the lognormal model used to generate counterfactual poverty estimates. The results are reported and discussed in Section 5, and Section 6 concludes.

## 2. Aspects of regional poverty in Russia

Russia has relatively little experience of research on poverty. The concept of poverty was never used in the Soviet Union, but was instead referred to as 'lack of material security'. Although a method for calculating the cost of the 'minimal consumption basket' was developed in the mid 1960s, most of the soviet population was never able to attain this consumption level (Mozhina 1993).

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[3] Berkowitz and DeJong (2002) discuss some of the potential negative consequences of substantial regional variations in living standards and weakly integrated markets.

[4] Dhongde (2003) undertakes a similar analysis of regional poverty in India using a two-factor decomposition.

In late Soviet times, the per capita cost of the ‘minimal consumption basket’ was set at 75 rubles per month, between one-third and one-half of the average income at that time.[5] Some social payments were linked to this level, so it became recognised *de facto* as a type of poverty line, albeit one which was relatively high by international standards. Following the relaxation of price controls in 1992, real incomes fell rapidly and substantially, prompting an urgent search for a new way of measuring and monitoring poverty. With assistance from the World Bank, a new poverty line methodology based on nutritional requirements was developed in 1992, one which took account of regional variation in dietary patterns and food prices. The new subsistence figures also distinguished three main population subgroups: adults (the reference category), children (with an equivalence scale factor of about 0.9), and the elderly (with an equivalence scale factor equal to 0.6). Food expenditure was fixed at 68 per cent of total subsistence needs, with the composition of non-food items left unspecified.[6] Although initially regarded as a temporary poverty standard, the new subsistence levels were legally recognised in 2000 following a number of cosmetic modifications affecting the composition of the standard basket and the frequency of calculation.

As is common practice in other countries, the proportion of the population in poverty (the so-called *poverty rate* or *headcount ratio*) is computed by comparing the monetary value of available resources (which we call ‘nominal income’) with the poverty line. Official poverty figures are calculated by the Russian State Committee on Statistics (commonly known by its Russian acronym, Goskomstat) and are based on fitting a two-parameter lognormal model to data obtained from the household budget survey and other sources. In essence, the variance of the lognormal

[5] The dollar equivalent is difficult to establish as there was no market exchange rate. The official exchange rate for one US dollar was 0.6 rubles, but the black market price was about 3 rubles.

[6] For further details, see McAuley (1997), Klugman and Braithwaite (1998), Korchagina et al. (1998), and Mozhina (1998). Some have argued that the poverty line for Russia remains generous compared to WHO recommendations, since it exceeds the expenditure needed to satisfy minimal nutritional requirements by 45 per cent. Others, including Klugman and Braithwaite (1998, 41), claim that the standard is relatively austere. Rimashevskaya (1997) notes that food may account for up to 80 per cent of expenditures at the subsistence level. Also significant is the fact that the fall in living standards during the 1990s has shifted the nutritional intake of the population towards carbohydrates (roughly speaking, from meat and milk towards bread and potatoes).

is derived from the survey results, while the mean is obtained from aggregate macroeconomic data.[7]

Many criticisms have been levelled against Goskomstat in the past, with respect to both the data acquisition and the procedures employed in the statistical analysis. The lognormal methodology is described in Goskomstat (1998a) and is discussed below in Section 4 and in the Appendix. As regards the core household data, Goskomstat surveys about 48,000 households (containing over 140,000 individuals) in 800 administrative units (similar to counties) of Russia. The survey results were of dubious quality in the early post-reform period. Continued use of the soviet-style sampling frame — based on interviewing workers at large enterprises — was one major deficiency (Rimashevskaya 1997). This and other biases due to sample design and survey non-response led many analysts to believe that the sample under-represented the lower tail of the income distribution and omitted the rich altogether (see Aivazian and Kolenikov, 2001). In collaboration with the World Bank, Goskomstat undertook a programme of sample redesign and rotation from 1994 to 1998 in order to improve the representativeness of the sample (which is now based on the 2 per cent microcensus conducted in 1994). However, the household microdata are still unavailable to researchers, and the methodology reported in Goskomstat (1998a) does not provide many details.

The measurement of household resources and the concept of household welfare has also changed over time. The crude measure of nominal money income used in the early 1990s was later supplemented by figures on home production. Goskomstat abandoned direct questions on income in 1998, using expenditure data instead to construct several measures of welfare (monetary expenditure, consumption expenditure, final consumption, disposable resources, disposable income). Wage and benefit arrears have been a major problem in some years, and another potential source of distortion in the data. If individuals report wages and benefits which should have been received (but were not), then the figures for disposable monthly income are biased upward. On the other hand, if accumulated arrears are occasionally paid off, then wage and

[7] Goskomstat undertakes a special Balance of Incomes and Expenditures of Population, initially designed to estimate the demand for money, but used more broadly to try to reconcile data on income and expenditure data drawn from different sources. See Kim *et al* (2003) for more details.

benefits accrued over several months may be attributed to a single month.[8] Volatility of recorded income is also caused by seasonal fluctuations in agriculture and construction, by the bonuses traditionally paid by Russian enterprises in December, and by the common practice of not fully compensating employees during the summer vacation period.[9]

Published regional data on poverty refer to the 79 primary regions in Russia ('subjects of the federation') which are subdivided into 'republics' (21), 'krays' (6), and 'oblasts' (50), plus the two largest cities, Moscow and St. Petersburg.[10] From 1992 to 1998, poverty lines were recalculated each month, and from 1999 onwards, each quarter, using the local prices in each region.[11] Poverty rates are also reported for all regions on a monthly or quarterly basis (although the monthly data appear to be rather volatile, suggesting a spurious degree of precision).[12] In addition, Goskomstat reports the ratio of the mean income to the poverty line in each region, a figure which typically lies between 2 and 2.5.

The regional pattern of poverty in 1995 is reported in Appendix Table 1 and portrayed in Figure 1.[13] One striking feature is the extent of the variation in poverty rates across the country,

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8 See Lehmann et al. (2001) for an analysis of the distributional implication of wage arrears.

9 Indeed, irregularities in income receipts may have been one of the causes of the extreme volatility of the official poverty rates observed in the early 1990s.

10 Republics are typically defined in terms of the ethnicity of the traditional population and tend to have greater autonomy. Some krays also contain smaller ethnically-based subregions called 'okrugs'. These are often included in data sets as separate units of analysis, along with the krays in which they are nested. An okrug may be regarded in a similar way to, say, the Basque region when treated as part of Spain.

11 Our analysis below is based on the official regional subsistence levels. Subjective poverty lines are also available for broad regional groupings, and tend to show less spatial variation than the official poverty lines: see Milanovic and Jovanovic (1998).

12 The conflict zone republics of Dagestan, Ingush and Chechnya have been excluded from our analysis due to lack of data on income inequality. But they are among the poorest regions: Dagestan, for example, recorded a poverty rate of 71.2 per cent in 1995. Note that the Goskomstat procedures are applied separately to each region and to the Russian Federation, resulting in a poverty rate for all-Russia that is not a weighted sum of the regional values. This inconsistency does not affect our results since we use the Russian figures simply as a reference point from which to measure deviations

13 Although data on poverty are relatively abundant in Goskomstat publications, data on inequality are sparse. Quintile shares (i.e., the income share of the poorest 20 per cent of the population, the next 20 per cent, etc.) are reported by region only for 1995. Given our interest in documenting the contribution of inequality to poverty, we focus on data for 1995. However, the basic conclusions should also apply to other years.

with many regions experiencing poverty rates three or four times the level recorded in the best-off places. The extreme examples are Tuva republic in mid-Siberia with a poverty rate exceeding 70 per cent, and Kemerovo, Tula and Ulyanovsk oblasts with poverty rates around 16 per cent. A second obvious feature is the tendency for the poorer provinces to be found in the south and east, and the less poor provinces to cluster in the north, despite their locational and climatic disadvantages. Clearly, geography is not the only factor at work here: natural resource riches are evidently influential, and other economic and political factors may also play a part. In fact, the diversity of poverty experience and the range of economic and political environments across regions makes Russia a particularly rich and interesting laboratory in which to study the factors which determine poverty.[14]

Figure 1. Headcount poverty rates in Russian regions

To illustrate the degree and scale of diversity in Russia, Table 1 reports summary data on a number of regions.[15] These regions cannot be considered 'representative' in any reasonable sense, but they do serve to indicate the extremes of economic development within Russia. Chelyabinsk is a large industrial centre in the Urals. Magadan is a typical northern region of Russia facing the Pacific Ocean. Moscow is the capital of Russia, and Moscow oblast is the region surrounding Moscow (essentially, the suburbs of Moscow). North Osetia is a national republic in the Caucasus. Pskov is a region between Moscow and St. Petersburg believed to have had the best FDI climate in the country in the late 1990s. Tatarstan is the strongest national republic of Russia, rich with oil; it also has the second largest automobile enterprise, KamAZ. Tuva is the poorest mid-Siberian region, while Tyumen is the main oil and gas extracting region.[16]. Finally, Ulyanovsk is a typical 'red belt' region under communist rule.

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[14] See also the discussion of regional poverty variations in Braithwaite (1997) and the analysis of regional differences by Mikheeva (1999).

[15] The data used here and elsewhere in this paper is drawn from the CEFIR regional dataset which contains several hundred regional indicators from 1970 onwards. The CEFIR dataset is itself based primarily on the annual publications of Goskomstat for Russian regions: see, for example, Goskomstat (1998b).

[16] Actually, oil is extracted in Khanty and Mansy autonomous okrug, and gas is extracted in Yamal and Nenets autonomous okrug within Tyumen oblast.

Table 1. Selected regions and selected characteristics.

The data in Table 1 reflect the expected relationship between regional poverty rates and per capita incomes. As already mentioned, poverty rates in Russia are calculated by comparing the monetary value of resources of every household with the corresponding poverty line. More generally, each of the commonly used indices of poverty can be expressed in the form $P = \pi(F, z)$ where $F$ is the distribution function for adult equivalent household incomes across individuals and $z$ is the poverty standard for a single adult. Since the distribution $F$ is fully characterized by its mean, $\mu$, and Lorenz curve, $L$, the poverty indicator can also be expressed in the form:

(1) $$P = P(L, \mu, z),$$

for some suitable function $P(.)$. This indicates that regional poverty levels are completely determined by three factors: income inequality, as captured by the Lorenz curve; nominal income per capita; and the subsistence level for a single adult, which reflects regional price variations. It is therefore worth exploring the importance each of these proximate sources of poverty if only to confirm, or counter, the common presumption that average income is the dominant influence on poverty.

For many purposes it is convenient to go one step further, by combining the mean income and poverty line into a single variable representing average real income. If, as is commonly assumed, the poverty level remains the same when the poverty line and all incomes are subject to the same proportional adjustment, equation (1) may be rewritten:

(2) $$P = \bar{P}(L, \mu/z).$$

Note that equations (1) and (2) apply not only to the headcount poverty rate but to any standard poverty index. Later we report results for two indices FGT1 and FGT2 drawn from the Foster *et al*. (1984) class:

(3) $$FGT_\alpha = \int_{-\infty}^{z} \left(\frac{z-x}{z}\right)^\alpha dF(x), \quad \alpha \geq 0$$

with parameters corresponding to $\alpha = 1$ and $\alpha = 2$.

One advantage of confining the analysis to the two factors indicated in equation (2), is that it permits a graphical representation of the link between inequality and poverty in Russian regions as shown in Figure 2. The horizontal axis indicates the mean income to poverty line ratio as reported by Goskomstat, while the vertical axis gives the value of the Gini index of inequality.[17] Also drawn are the lines connecting the inequality-mean income combinations that yield a certain fixed poverty rate in the context of a two parameter lognormal model. The reference provided by these 'iso-poverty' contours makes it easy to understand the proximate causes of variations in poverty rates across regions.

Figure 2. Real income and inequality across regions of Russia

Disregarding Moscow city, which is clearly an outlier with regard to both mean income and inequality, it is interesting to note the economic and geographic clustering of Russian regions on the graph. In the top right corner, close to the point labelled TY, are found the resource rich Siberian regions including Tyumen oblast, Krasnoyarsk kray known for aluminium production and nickel exports, and Kemerovo oblast producing coal. St. Petersburg, the second largest Russian city, is also located within this group. The other end of the income spectrum on the far left side of the graph is occupied by the poorest regions of Siberia and the Far East, with real incomes little above that of Tuva and, as a consequence, poverty rates exceeding 50 per cent. The group of regions with a Gini value of about 0.3 separates into two principal clusters. The first, represented by the points TA and UL on the graph covers Tatastan and the relatively rich 'red belt' regions: Ulyanovsk, Lipetsk, Tula, Smolensk, and Kursk oblasts. A second group, below and to the left of the point labelled PS, contains the poorer regions along the Volga river and in the south, such as the republics of Mari El, Mordovia, Kalmykia and Karachaevo-Cherkessia.

The following sections explore in more detail the way in which inequality interact with nominal incomes and prices to generate the observed poverty levels. In particular, we seek to establish the quantitative contributions of these three factors to poverty in each region.

[17] See Section 4 and the Appendix for details of the Gini calculations. Note that under the lognormality assumption, all inequality measures are increasing functions of the variance of logarithms, and hence monotonic transformations of the Gini coefficient. The iso-poverty contours are derived using the relation between mean income and inequality given in Appendix equation (A7).

## 3. The decomposition framework

The framework of analysis used in this paper has its origins in the decomposition of changes in poverty into growth and redistribution components proposed by Datt and Ravallion (1992) and others. Figure 3 illustrates the basic principles in the context of the headcount poverty rate. Given a poverty line $z$, the initial income distribution represented by the distribution function $F_0$ generates the poverty rate $p_0$ , which falls to $p_1$ when the distribution changes to $F_1$. The move from $F_0$ to $F_1$ can be regarded as the combination of two effects: a pure proportionate growth effect captured by the rightward shift of the distribution function from $F_0$ to $F$ (since the horizontal axis has a logarithmic scale); and a pure redistribution effect (holding mean income constant) corresponding to the shift from $F$ to $F_1$. This allows the total change in poverty, $p_1 - p_0$, to be decomposed in a similar fashion, with $p - p_0$ representing the contribution of income growth and $p_1 - p$ indicating the redistribution component. In the situation portrayed in Figure 3, the two effects reinforce each other to produce a significant reduction in the headcount poverty rate; but the same analysis can also be applied in less favourable circumstances.

Figure 3. Growth-redistribution decomposition of the poverty rate

Expressed in the notation of equation (1), this procedure allows the change in poverty:

(4) $$\Delta P = p_1 - p_0 = F_1(z) - F_0(z) = P(\mu_1, L_1, z) - P(\mu_0, L_0, z),$$

to be decomposed into the income growth and redistribution effects given respectively by

(5a) $$p - p_0 = P(\mu_1, L_0, z) - P(\mu_0, L_0, z);$$

(5b) $$p_1 - p = P(\mu_1, L_1, z) - P(\mu_1, L_0, z).$$

The problem with this specification is that (5a) indicates the marginal effect of the change in mean income with the distribution held constant at the *initial* configuration while (5b) computes the marginal impact of redistribution holding mean income constant at the *final* level. One can equally well generate a decomposition with the ceteris paribus conditions interchanged, and since there is no logical reason for preferring one configuration over the other, symmetry arguments suggest that the two effects should be averaged to yield the income effect:

(6a) $\frac{1}{2}[P(\mu_1, L_0, z) - P(\mu_0, L_0, z)] + \frac{1}{2}[P(\mu_1, L_1, z) - P(\mu_0, L_1, z)]$

and the redistribution component

(6b) $\frac{1}{2}[P(\mu_0, L_1, z) - P(\mu_0, L_0, z)] + \frac{1}{2}[P(\mu_1, L_1, z) - P(\mu_1, L_1, z)].$

Expressions (6a) and (6b) turn out to be the contributions associated with the level and distribution of income in a two-way Shapley decomposition of the change in poverty. The Shapley decomposition is inspired by the classic co-operative game theory problem of dividing a pie fairly, the Shapley solution to which assigns to each player her marginal contribution averaged over all possible coalitions of agents.[18] The reinterpretation described in Shorrocks (1999) considers the various factors (*n* in total, say) which together determine an indicator such as the overall level of poverty, and assigns to each factor the average marginal contribution taken over all the *n*! possible ways in which the factors may be 'removed' in sequence. The particular attractions of this technique are that the decomposition is always exact and that the factors are treated symmetrically.

Figure 4 illustrates how the Shapley procedure can be applied to the decomposition of the change in poverty into three components corresponding to the change in mean income, inequality, and the poverty line. The six possible downward routes correspond to the six possible ways in which, starting from the final position, each of the factors can be reset in sequence at their original values.

Figure 4. Shapley decomposition

Shorrocks and Kolenikov (2001) apply the three-way Shapley decomposition to changes in poverty in Russia since 1985. The application here to spatial, rather than temporal, differences in poverty requires a reinterpretation of the analysis. The base level distribution indicated earlier by the subscript 0 now refers to a suitable reference distribution, which we choose to correspond to the whole of Russia, although it could equally well be a specific region such as Moscow city. With all-Russia as the base, the Shapley decomposition contributions indicate the contributions

[18] See, for example, Moulin (1988, Chapter 5) for a discussion of the Shapley value, originally developed by Shapley (1953).

to poverty associated with deviations of mean income etc. from the Russian level. This is done later for the three-factor decomposition into nominal income, inequality and poverty line (or regional price) effects.[19] To facilitate graphical representation, we also report results for the two-way Shapley decomposition into real income and inequality components, the formula for which corresponds to equation (6) with the poverty line suppressed (or absorbed into $\mu$).

## 4. The lognormal model

To apply the Shapley decomposition framework requires answers to counterfactual questions such as 'what level of poverty would Moscow experience if Moscow had the same average income as Novosibirsk' (or the same income as Russia as a whole). Answers to these questions could be calculated directly from a representative household dataset for Russia, but this is not currently available. However, income quintile data are occasionally published by Goskomstat for Russian regions, and the basic methodology for constructing these data are known (see Goskomstat 1998a). So it is possible to reconstruct the Lorenz curve for each region which, together with information on mean incomes, enables the Shapley approach to be applied.

The distributional data reported by Goskomstat, including quintile shares, Gini values and poverty rates, are obtained by fitting a two-parameter lognormal model (denoted here by $LN(\mu,\sigma)$) to the raw data. In essence, household budget survey data are used to estimate the variance of logarithms parameter $\sigma$, while the mean income values are set with regard to aggregate balance sheet information.[20] Then all inequality measures are calculated as functions of the variance of logarithms, while the poverty rate is given by the percentile of the lognormal distribution corresponding to the poverty line.

[19] Yemtsov (2003, p 7.) notes that using regional subsistence levels as the price deflator gives quite different results from using the regional CPI series because the CPI is based on a different basket of goods. For our purposes, the cost of a basket of goods consumed by the poor is a better reflection of the relevant price variations across regions. In his study of China, Hussain also makes use of regionally constructed poverty lines, but reports that most of the regional variation is due to non-price factors Hussain (2003, p. 7).

[20] It should be borne in mind that the estimates of per capita income obtained from the balance sheets greatly exceed the figures derived from the household budget data: se Yershov (1998).

While there is little or no support for the lognormal model as a parametric representation of income distribution,[21] once the procedures employed by Goskomstat are recognised, it is impossible to do better than reconstruct the lognormal distributions underlying the published data. Making use of the basic properties of the lognormal outlined in the Appendix, the variance of log incomes was derived from the quintile shares reported by Goskomstat, by averaging over the four estimates obtained by applying equation (A11) to the income shares recorded for the bottom 20, 40, 60, and 80 per cent of the population.[22]

Combining these figures for the variance of log incomes with data on per capita income and on the average value of the poverty line produces estimates of the headcount poverty rate in each region which can be compared with the rates published by Goskomstat. While the two sets of figures are broadly similar, there are some significant discrepancies (see Appendix Table 1). The reasons for the discrepancies are not immediately evident, although the most likely explanation is that different adjustments have been applied to the figures for regional income per capita compared to those used to compute regional poverty rates.

Support for our approach is provided by Table 2, which reports the results of regressing the published headcount poverty rates on our estimated values. The poverty rate itself should not be used as the dependent variable, because it is bounded between zero and one. So we use the probit transformation of the published headcount ratio, $\Phi^{-1}(H)$, on the LHS and the probit transformation of our estimate, $\Phi^{-1}(\hat{H})$, on the RHS[23].

Table 2. Regression results on regional poverty rates

[21] Kloek and van Dijk (1978) found that at least four parameters are typically required to characterize income distribution adequately. See also Ryu and Slottje (1999) for a recent review. Using a semi-parametric model of income distribution, Aivazian and Kolenikov (2001) conclude that the lognormal model does not adequately describe Russian data, and suggest that income distribution in the reform era has tended to flatten out the mode of the distribution and to produce fatter tails.

[22] These estimates were in almost perfect correspondence with each other, differing only in the third decimal point for most regions, i.e. within the accuracy of the published quintile data, which is given to two decimal points.

[23] See e.g. Fox (1997). Note that in the lognormal framework the RHS of the regression equation is linked directly to mean income and inequality via Appendix equation (A7).

Table 2 reports the results obtained with the single regressor, and a second regression with a large set of covariates including economic, demographic, and geographic variables taken from the regional database. A number of alternative specifications were tried, with the Akaike information criterion selecting the simplest bivariate regression. The $R^2$ value of 0.88 indicates that the basic lognormal model is reasonably accurate, and the absence of significant additional variables in the second regression means that we cannot improve substantially on the simple specification. The results also imply that our estimate of the poverty rate based on the income to poverty line ratio and the variance of logarithms tends to fall below the published Goskomstat figure by several percentage points. Moscow, for instance, would have a poverty rate of 15.8 per cent according to the model, compared to the published figure of 19.1 per cent.

This systematic bias may be due in part to the neglect of population heterogeneity. The growth-redistribution framework described in Section 3 presupposes a homogeneous population and a single poverty line. When the per capita poverty line depends on household composition — as is the case with the minimum subsistence level in Russia — incomes should be adjusted to take account of composition differences, either by expressing household income as a multiple of the corresponding subsistence level (in which case the poverty line $z$ becomes equal to 1), or by converting all household incomes into, say, the equivalent incomes for a single adult (in which case the poverty line $z$ is the single adult standard for that region). In the absence of more disaggregated data we are unable to undertake either of these corrections and are obliged instead to treat the data for each region as if they were a homogeneous sample. However, this or any other source of systematic bias should not have a major impact on our empirical results since the contributions in the Shapley decomposition are obtained by averaging over *differences*, and these differences are unaffected by a systematic bias unless it is substantially non-linear.

## 5. Results

To illustrate how the methods outlined in previous sections can be applied to the Russian regional data, consider the poverty rate for Moscow city, which we estimate to be 15.8 per cent. A natural baseline is provided by the comparable figure of 30.7 per cent for Russia as a whole, again derived from the lognormal model. The higher real income per capita helps explain why Moscow has a lower poverty rate, but this is offset by the greater inequality evident in Table 1. As the poverty rate for Moscow is below that for the whole country, the income effect clearly dominates. But what are the relative magnitudes of the two opposing influences?

Table 3. Poverty rates for Moscow under alternative scenarios

Table 3 summarizes the results of estimating the poverty rate that Moscow would have experienced (in 1995) under a number of alternative hypothetical scenarios. The top line shows that if inequality in Moscow remained the same, but real income per capita fell to the average level for Russia, then the poverty rate would be expected (on the basis of the lognormal model) to treble from 15.8 per cent to 47.6 per cent, a rise of 31.8 points. Keeping average income at the new (lower) value, and allowing inequality in Moscow to fall to the Russian level, causes poverty in Moscow to fall to the baseline figure of 30.7 per cent, a second round drop of 16.9 points. In this sequence, therefore, the 14.9 point difference between the poverty rates in Russia and Moscow can be attributed to a combination of -31.8 points due to higher incomes in Moscow and 16.9 points due to higher inequality. However, reversing the order in which the two Moscow values are changed to the all-Russia levels alters these figures a little. As seen in the first column and second row of Table 3, the corresponding contributions would be 12.6 points due to inequality and -27.6 points to per capita income. The Shapley procedure takes the average of these two scores, so that the contributions of the two factors are calculated as:

$$S_{real\ income} = \tfrac{1}{2}(15.8 - 47.6) + \tfrac{1}{2}(3.1 - 30.7) = -29.7\%$$

$$S_{inequality} = \tfrac{1}{2}(15.8 - 3.1) + \tfrac{1}{2}(47.6 - 30.7) = 14.8\%$$

The net effect is to estimate that the poverty rate in Moscow city is 29.7 points lower than in Russia because of the high average level of incomes, but 14.8 points higher as a result of greater income inequality — figures which seem to be in broad correspondence with any reasonable assessment of the quantitative impact of these two factors.

Table 4: Shapley decomposition of poverty rate, selected regions

Similar numbers were calculated for each of the regions and are reported in Appendix Table 1. For the sample of regions reproduced in Table 4, the contributions of the two factors tend to operate in opposite directions, showing that high income regions usually have high inequality and vice versa, although this may reflect the choice of regions in the sample. The contributions for Tyumen are qualitatively similar to those of Moscow city, but dampened in magnitude. In contrast, Pskov is almost the mirror image of Moscow, with a large enhancement of the poverty rate due to low average income (25.5 points) mitigated significantly by low inequality (-11 points). Tartastan and Ulyanovsk benefit from both higher than average incomes and lower than average inequality; but the reverse is true for Tuva, one of only four regions where below average real income and above average inequality both contribute towards the higher poverty rate.[24]

Figure 5. Shapley decomposition of the poverty rate

While the level of real income is the dominant influence in most of the above examples, there are many regions for which this is not the case. Indeed, inspecting the full set of numbers reported in Appendix Table 1 and portrayed in Figure 5, reveals that the magnitude of the inequality contribution is greater than the real income effect in half of the cases (37 out of 75).[25] This finding runs counter to much received wisdom. In Russia, as elsewhere, discussion of policies for poverty alleviation tend to focus almost exclusively on income growth, neglecting the potential role of redistribution or, at the very least, the need to ensure that growth is not accompanied by adverse distributional movements.[26]

Table 5: Shapley decomposition of FGT1 and FGT2 poverty indices, selected regions

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[24] The very high poverty rate in Tuva is mainly caused by the low average level of real income. While this is partly due to low nominal incomes, income per capita is not exceptionally low (see Table 1). What distinguishes Tuva is that low nominal incomes are compounded by high prices, and hence a high poverty line. See Table 6 below for details of the separate nominal income and poverty line effects.

[25] The absence of a clear pattern in Figure 5 would be more evident if Moscow is excluded as an outlier. Note that the preponderance of points in the bottom right quadrant reflects the fact that per capita income and income inequality in most regions are both below the level for the Russian Federation, the latter due in part to the fact that income inequality in Russia as a whole combines intra-regional income variations with inter-regional inequality.

[26] For recent contributions to this debate, see van der Hoeven and Shorrocks (2003) and Shorrocks and van der Hoeven (2004)

The Shapley decomposition procedure can be applied to any poverty index. In order to test whether the magnitudes of the poverty contributions are robust to the choice of indicator, a similar exercise was undertaken with the FGT1 and FGT2 poverty indices. The results reported in Table 5 show that, broadly speaking, the Shapley contributions are scaled down versions of the corresponding numbers in Table 4. This is confirmed for the full sample of 78 observations reported in Appendix Tables 1 and 2, which yield a correlation coefficient exceeding 95 per cent for the headcount and FGT1 indices (for both the real income and inequality contributions) and a figure of about 90 per cent for the correlation between the headcount and FGT2 indices.

The relationship between the results for these alternative indices is not very surprising for two reasons. First, the index formulae ensure that the value of the FGT2 index is always less than the corresponding FGT1 value, which in turn is less than the headcount index. For this reason, the values of the contributions reported in Table 5 are expected to be smaller than those in Table 4. Secondly, application of our lognormal model implies that the sign of each of the contributions depends only on the deviations of the lognormal parameters from their values for Russia, and will therefore be the same for all poverty indices.[27]

Less expected, perhaps, is the fact that the shift from the poverty rate to FGT1 and onto FGT2 attenuates the real income contribution more than the inequality component, so that the magnitude of the inequality effect becomes relatively larger. In fact, for the FGT1 index the magnitude of the Shapley contribution for inequality is greater than the magnitude of the real income term for more than 60 per cent of the regions (48 out of 75); for the FGT2 index the inequality contribution dominates in over 70 per cent of the cases (54 out of 75).[28] This progressive shift in relative importance of the inequality contribution is a reflection of the greater emphasis on inequality in the FGT1 and FGT2 poverty indices, and will therefore appeal to those who recognise the deficiencies of the statistical properties of the poverty rate. It also adds considerable weight to the above comments regarding the importance of redistribution instruments in poverty alleviation.

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[27] Excluding perverse situations arising, for instance, when the poverty line exceeds mean income. In this case an increase in inequality can cause the headcount poverty rate to fall.

[28] The figures for North Osetia in Tables 4 and 5 well illustrate this trend, switching from a significantly higher real income contribution for the headcount poverty rate, to a marginally higher real income contribution for the FGT1 index, and then a bias towards inequality for the FGT2 measure.

As explained in Sections 2 and 3, there are good reasons for separating out the impacts of nominal income per capita and prices on regional poverty, rather than combining them in a single factor representing real income per capita. There are two possible ways in which the individual contributions can be identified. The first treats nominal income, prices, and inequality as three separate factors and applies the three-way Shapley decomposition illustrated in Figure 3. It should be noted, however, that the Shapley contributions of the 'unaffected' factors are not typically preserved when one factor is subdivided into subsidiary factors. In the current context this means that the inequality contribution in the three-way decomposition is not expected to remain the same as that reported in Tables 4 and 5. The alternative procedure involves a sequential Shapley decomposition in which contributions are first assigned to real income and inequality (as done above), and then the real income contribution is reallocated between nominal income and price effects. This latter 'hierarchical' decomposition involves another level of complexity in programming, so this paper confines attention to the first way of proceeding.[29]

Table 6: Three factor decomposition of the poverty rate.

The results for the three-way decomposition of the poverty rate are reported in Table 6 for our subsample of regions and in Appendix Table 3 for all regions. The move from two to three factors has a small and fairly predictable impact on the Shapley contribution of inequality, tending to reduce the magnitude of this component by about 5 per cent. Separating out the price effects also tends to give more prominence to the influence of nominal incomes. For the full set of 75 regions, for instance, nominal income per capita is the single most important contribution in 43 cases, compared to 14 regions for which inequality is the most important influence, and 18 regions for which prices (as reflected in the subsistence level) is the dominant factor. The number of regions for which prices are the principal determinant of the poverty rate is surprisingly large, and contains roughly equal numbers of places where prices are higher than average (such as Magadan; see Table 6) and lower than average (such as Ulyanovsk). However, it should also be noted that

[29] The authors have developed a STATA software package to handle certain types of Shapley decompositions. This can be downloaded from the STATA applications website, http://ideas.uqam.ca.

the price level is the least important of the three factors in half of the regions listed in Appendix Table 3.[30]

Table 7: Three factor decomposition of FGT1 and FGT2 indices, selected regions.

Corresponding results for the three-way decomposition of the FGT1 and FGT2 indicies are reported in Table 7 and Appendix Table 3. The results confirm the pattern found for the headcount poverty rate. Although deviations of nominal income per capita from the Russian average is the single most important determinant of poverty, all three factors have a significant impact on poverty in most regions.

## 6. Summary and conclusion

This paper has sought to understand and explain variations in poverty across the regions of Russia in terms of differences in income per capita, inequality, and price levels. The basic approach is similar to that used to decompose changes in poverty over time into 'growth' and 'redistribution' components. However we allow for three potential sources of poverty variations (rather than two) and apply a powerful new decomposition technique based on the Shapley value in co-operative game theory. In the context of this paper, the Shapley procedure considers the marginal impact on poverty of eliminating one source of regional differences (say, price variations) and computes the average of the marginal impacts over all the possible ways in which regional characteristics are replaced in sequence by the average levels for Russia as a whole.

We apply this framework to 1995 aggregate regional data on incomes per capita, income inequality, and average subsistence levels (as a proxy for local prices). The lognormal model which Goskomstat uses to estimate poverty rates and inequality statistics conveniently allows us to plot the real income per capita for each region against the Gini index of inequality as a prelude

[30] The regions with higher prices and the most important price contributions are in the Far East, while the low price regions are agricultural areas in the red belt south of Moscow. The places with the highest inequality contributions tend to be the industrial regions in the European part of Russia and the Urals, although the pattern is not particularly strong.

to a more detailed decomposition analysis. The lognormal model also provides the vehicle for estimating the hypothetical marginal factor contributions required in the Shapley decomposition.

The two-way decomposition yields estimates of the contributions of real income per capita and income inequality to poverty in each region. The results turn out to be somewhat surprising. Contrary to received wisdom, and despite the very large differences in per capita income, inequality has a greater impact on the poverty rate than real income per capita in about half of the regions. Other commonly used poverty indices give even more prominence to inequality variations vis-á-vis real income differences. However, when real income per capita is separated into nominal income and price components, nominal income differences are seen to be more important than either inequality or price effects for the majority of regions. Thus it would appear that price variations partially offset the impact of nominal income levels on regional poverty levels.

This initial study confines attention to three proximate sources of poverty differences: income per capita, inequality, and local prices. However the basic decomposition framework can be extended to address the geographical, economic and political factors that help account for poverty variations across regions. We intend to explore the contribution of these more fundamental sources in future research.

## Appendix: Properties of the lognormal distribution

A random variable $x$ is said to follow a *lognormal* distribution (written $x \sim LN(\mu,\sigma^2)$) if ln $x$ is normally distributed. This appendix outlines some useful properties of the lognormal distribution. For further details see Aitchison and Brown (1957).

The density of a lognormal distribution with the mean of logs parameter $\mu$ and the variance of logs parameter $\sigma$ is given by

(A1) $$f_{LN(\mu,\sigma^2)}(x) = \frac{1}{x\sqrt{2\pi\sigma^2}}\, e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}$$

where $x > 0$ is interpreted as income in our context. The cdf of a lognormally distributed variable is

(A2) $$CDF_{LN(\mu,\sigma^2)}(z) = \int_0^z \frac{1}{x\sqrt{2\pi\sigma^2}} \exp\left[-\frac{(\ln x-\mu)^2}{2\sigma^2}\right] dx = \Phi\left(\frac{\ln z-\mu}{\sigma}\right)$$

and can again be obtained from the standard results for Gaussian variables.

The expected value of a lognormally distributed variable is

(A3) $$\mu_1 = \int_0^\infty \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left[-\frac{(\ln x-\mu)^2}{2\sigma^2}\right] dx = e^{\mu+\frac{\sigma^2}{2}}$$

and depends on both the 'location' parameter $\mu$ and the 'scale' parameter $\sigma$. The variance of the lognormal variable is

(A4) $$\int_0^\infty \left(x - e^{\mu+\frac{\sigma^2}{2}}\right)^2 f_{LN(\mu,\sigma^2)}(x)\, dx = e^{2\mu+\sigma^2}\left(e^{\sigma^2}-1\right) = (\mathrm{E}x)^2 \left(e^{\sigma^2}-1\right)$$

with higher order moments following the pattern

(A5) $$\mu_k \equiv \int_0^\infty x^k f_{LN(\mu,\sigma^2)}(x)\, dx = \exp\left[k\mu + \frac{k^2}{2}\sigma^2\right]$$

Given the poverty line $z$, the poverty rate (or headcount ratio) is obtained immediately as:

(A6) $$H = CDF_{LN(\mu,\sigma^2)}(z) = \Phi\left(\frac{\ln z-\mu}{\sigma}\right),$$

which can be linked via (A3) to information on mean income, so that

(A7) $$H = \Phi\left(\frac{\ln z - \mu}{\sigma}\right) = \Phi\left(-\frac{\ln\frac{mean\ income}{poverty\ line}}{\sigma} + \frac{1}{2}\sigma\right)$$

One advantage of this explicit formula for the poverty rate is that it helps us to appreciate the complex (and highly non-linear) way in which the mean income, inequality, and poverty line factors interact to determine the level of poverty.

To construct Lorenz curves and other indices of poverty for lognormally distributed incomes, it is necessary to calculate incomplete moments corresponding to the integrals in (A3)–(A5) with a finite upper bound. Aitchison and Brown (1957) provide a theorem which can be restated as

(A8) $$\int_0^z x^k f_{LN(\mu,\sigma^2)}(x)\,dx = \mu_k\, CDF(z|\mu + k\sigma^2, \sigma^2) = \mu_k \Phi\left(\frac{\ln z - \mu - k\sigma^2}{\sigma}\right)$$

Using this result, the Lorenz ordinate associated with the population proportion $q \in [0, 1]$ and the corresponding income level $z$ can be written:

(A9) $$L(q) = \frac{1}{\mu_1}\int_0^z x f_{LN(\mu,\sigma^2)}(x)\,dx = \Phi\left(\frac{\ln z - \mu - \sigma^2}{\sigma}\right)$$

where $q = \Phi\left(\frac{\ln z - \mu}{\sigma}\right)$ via (A2). Eliminating $z$ yields

(A10) $$L(q) = \Phi\left(\frac{\ln z - \mu - \sigma^2}{\sigma}\right) = \Phi(\Phi^{-1}(q) - \sigma)$$

or, equivalently,

(A11) $$\sigma = \Phi^{-1}(q) - \Phi^{-1}(L(q)),$$

the relationship used in this paper to estimate σ from published data on quintile shares. Common measures of inequality can be computed immediately, as they depend only on the ‘scale’ parameter σ. For example, the Gini index for a lognormal distribution is given by

(A12) $$Gini = 2\Phi(\sigma/\sqrt{2}) - 1,$$

the rule used to generate the Gini values reported in Table 1 and elsewhere.

The Foster et al (1984) class of indices specified in equation (3) contains the headcount index *H* given in (A7), which corresponds to α = 0. Using (A8), the indices corresponding to α = 1 and α = 2 may be computed as:

(A13) $$FGT1 = \int_{-\infty}^{z} \frac{z-x}{z} f_{LN(\mu,\sigma^2)}(x)\, dx = H - \frac{1}{z}\int_{-\infty}^{z} x\, f_{LN(\mu,\sigma^2)}(x)\, dx = H - \frac{\mu_1}{z}\Phi\left(\frac{\ln z - \mu - \sigma^2}{\sigma}\right)$$

(A14) $$FGT2 = \int_{-\infty}^{z} \left(\frac{z-x}{z}\right)^2 f_{LN(\mu,\sigma^2)}(x)\, dx = H - \frac{2\mu_1}{z}\Phi\left(\frac{\ln z - \mu - \sigma^2}{\sigma}\right) + \frac{\mu_2}{z^2}\Phi\left(\frac{\ln z - \mu - 2\sigma^2}{\sigma}\right)$$

**References**


Aitchison, J., and J.A.C. Brown (1957): *The Lognormal Distribution with Special Reference to its Uses in Economics*. (Cambridge: Cambridge University Press).

Aivazian S.A., and S.O. Kolenikov (2001): 'Poverty and expenditure inequality in Russia', *EERC Working Paper No. E01-01*, EERC, Moscow.

Berkowitz, D. and D.N. DeJong (2002): 'Integration: An empirical assessment of Russia', mimeo, University of Pittsburgh.

Braithwaite, J.D. (1997): 'The old and new poor in Russia', in J. Klugman (ed.), *Poverty in Russia. Public Policy and Private Responses*. (Washington D.C.: World Bank).

Commander, S., A. Tolstopiatenko, and R. Yemtsov (1999): 'Channels of Redistribution: Inequality and Poverty in the Russian Transition', *Economics of Transition* 7, 411–47.

Datt, G. and M. Ravallion (1992): 'Growth and redistribution components of changes in poverty measures - a decomposition with applications to Brazil and India in the 1980s', *Journal of Development Economics*, 38, 275-296.

Dhongde, S. (2003) 'Spatial decomposition of poverty in India', paper presented to WIDER conference on Spatial Inequality in Asia, Tokyo, March 2003.

Foster, J. E., J. Greer and E. Thorbecke (1984): 'A class of decomposable poverty indices', *Econometrica*, 52, 761-765.

Fox, J. (1997): *Applied regression analysis, linear models, and related methods*. (Thousand Oaks C. A.: SAGE).

Goskomstat (1998a): *Metodologicheskie Polozheniya po Statistike* (The Methodological Regulations on Statistics), vol. 1. Moscow (in Russian).

Goskomstat (1998b): *Regiony Rossii* (The Regions of Russia). Moscow (in Russian).

van der Hoeven and Shorrocks (eds.) (2003): *Perspectives on Growth and Poverty*. (Tokyo: United Nations University Press).

Hussain, A. (2003): ‘Urban poverty in China: Measurement, patterns and policies’, International Labour Office, Geneva, January 2003.

Kim, B-Y., S. Nikolaenko and I. Verbina (2003): ‘Availability and quality of Russian household data’, WIDER discussion paper, forthcoming.

Kloek, T., and H. K. van Dijk (1978): ‘Efficient estimation of income distribution parameters’. *Journal of Econometrics,* , 61–74.

Klugman, J. and J. Braithwaite (1998): ‘Poverty in Russia during the transition: An overview’, *The World Bank Research Observer,* 13, 37-58.

Korchagina, I.I., L.N. Ovcharova and E.V. Turuntsev (1998): ‘Indicators of poverty in transitional Russia’, EERC Working Paper, No. 98/04.

Lehmann, H., J. Wadsworth and R. Yemtsov (2001): ‘Wage arrears and the distribution of earnings in Russia’, mimeo, May 2001.

McAuley, A. (1997): ‘Russia and the Baltics: Poverty and poverty research in a changing world’, in E. Øyen, S.M. Miller and S.A. Samad (eds.), *Poverty: A Global Review* (Oslo: Scandinavian University Press).

McAuley, A. and L. Ovcharova (2003): ‘Changes in the Level and Differentiation of Personal Incomes: Russia, 1991-2000’, WIDER Discussion Paper, forthcoming.

Mikheeva, N. (1999): ‘Differentiation of social and economic situation in the Russian regions and problems of regional policy’, EERC Working Paper No. 99/09.

Milanovic, B. (1998): *Income, Inequality, and Poverty during the Transition from Planned to Market Economy* (Washington, D.C.: World Bank).

Milanovic, B. and B. Jovanovic (1998): ‘Change in the perception of the poverty line during times of depression: Russia 1993-96’, Working Paper on Poverty, Income distribution, safety nets, micro-credit, No. 2077, World Bank, Washington.

Moulin, H. (1988): *Axioms of Cooperative Decision Making*. (Cambridge: Cambridge University Press).

Mozhina, M. (1993): ‘The Methodological Issues in Subsistence Level Determination’, *Economist*, 2, 1993 (Russian journal, *not* the Western magazine).

Mozhina, M. (1998): ‘Changes in the level of living of the Russian population over the years of reform’, in *Level of the Living Standard, Savings of the Population, Index of Consumer Confidence, Fiscal Relations between Moscow and the Regions*, US Treasury Office, 1998.

Rimashevskaya, N. (1997): ‘Poverty trends in Russia: A Russian perspective’, in J. Klugman (ed.), *Poverty in Russia. Public Policy and Private Responses*. (Washington D. C.: World Bank).

Ryu, H. K. and D. J. Slottje (1999): ‘Parametric approximations of the Lorenz curve’, in J. Silber (ed.), *Handbook of Income inequality Measurement* (Dordrecht: Kluwer Academic Publishers).

Shapley, L. (1953): ‘A value for n-person games’, in: H. W. Kuhn and A. W. Tucker (eds.), *Contributions to the Theory of Games, Vol. 2* (Princeton, N.J.: Princeton University Press).

Shorrocks, A. F. (1999): ‘Decomposition procedures for distributional analysis: A unified framework based on the Shapley value’ mimeo, University of Essex.

Shorrocks, A. and R. van der Hoeven (eds.) (2004): *Growth, Inequality and Poverty: Prospects for Pro-poor Economic Development.* (Oxford: Oxford University Press).

Shorrocks, A. F., and S. Kolenikov (2001): ‘Poverty trends in Russia’, mimeo

Yemtsov, R. (2003): ‘Quo vadis?: Inequality and poverty dynamics across Russian regions in 1992-2000’, WIDER Discussion Paper 2003/67.

Yershov, E. (1998): ‘Unnoticed money incomes in regional household surveys’, in *Level of the Living Standard, Savings of the Population, Index of Consumer Confidence, Fiscal Relations between Moscow and the Regions*, US Treasury Office, 1998.

Table 1. Characteristics of selected regions

| | Region | Poverty rate | Nominal income | Gini | Average subsistence level | Population | Share of urban population | Population density | Mean July temperature | Mean January temperature |
|---|---|---|---|---|---|---|---|---|---|---|
| | | per cent | rubles | per cent | rubles | thousands | per cent | per sq km | | |
| CH | Chelyabinsk | 27.9 | 415 | 33.2 | 254 | 3700 | 81.3 | 41.8 | 15.8 | -17.4 |
| MA | Magadan | 24.6 | 961 | 37.4 | 570 | 279 | 87.1 | 0.5 | 11.5 | -26.9 |
| MW | Moscow city | 19.1 | 1804 | 56.2 | 328 | 8717 | 100.0 | 320.3 | 20.4 | -6.3 |
| MO | Moscow oblast | 31.2 | 395 | 27.2 | 259 | 6626 | 79.7 | 138.7 | 18.4 | -8.3 |
| NO | North Osetia | 42.8 | 319 | 30.1 | 233 | 659 | 69.5 | 82.7 | 20.6 | -3.2 |
| PS | Pskov | 42.7 | 340 | 30.2 | 273 | 835 | 65.1 | 14.8 | 18.5 | -5.4 |
| TA | Tatarstan | 22.1 | 394 | 33.8 | 192 | 3755 | 73.4 | 55.6 | 17.7 | -15.9 |
| TU | Tuva | 73.2 | 314 | 43.3 | 359 | 308 | 48.1 | 1.8 | 15.8 | -25.2 |
| TY | Tyumen | 19.2 | 1085 | 44.3 | 394 | 3157 | 76.1 | 2.2 | 11.3 | -26.3 |
| UL | Ulyanovsk | 16.3 | 312 | 30.2 | 154 | 1492 | 72.6 | 39.6 | 19.1 | -13.8 |
| RF | Russian Federation | 24.7 | 515 | 40.7 | 264 | 148306 | 73.0 | 8.6 | 17.7 | -13.2 |

Source: Goskomstat 1998b, except for the Gini values calculated by the authors.

Table 2. Regression results for regional poverty rates

| | Basic regression | | Extended regression | |
|---|---|---|---|---|
| dependent variable: probit transformation of published poverty rate | coefficient | standard error | coefficient | standard error |
| probit transformation of poverty rate from lognormal model | 0.873** | 0.038 | 0.8** | 0.061 |
| ln population density | | | 0.017 | 0.018 |
| mean temperature in January | | | -0.005 | 0.003 |
| mean temperature in July | | | 0.003 | 0.008 |
| gross Regional Product per capita, thousands | | | -0.003 | 0.005 |
| life expectancy at birth | | | -0.001 | 0.007 |
| share of population younger than working-age | | | 0.017 | 0.009 |
| share of population older than working-age | | | 0.011 | 0.007 |
| share of social and cultural expenditures in the regional budget | | | -0.002 | 0.003 |
| ILO unemployment rate | | | 0.005 | 0.004 |
| constant | -0.100** | 0.023 | -0.754 | 0.475 |
| number of observations | 76 | | 73 | |
| R-squared | 0.88 | | 0.9 | |

** indicates significance at 1 per cent level.

Data source: CEFIR regional dataset based on Goskomstat 1998b; data for 1995 except for temperatures.

Table 3. Poverty rates (per cent) for Moscow under alternative scenarios

| | real income per capita | | | |
|---|---|---|---|---|
| income inequality | Moscow level | Russian average | difference | mean difference |
| Moscow level | 15.8 | 47.6 | -31.9 | 29.7 |
| Russian average | 3.1 | 30.7 | -27.6 | |
| difference | 12.6 | 16.9 | | |
| mean difference | 14.8 | | | |

Table 4: Shapley decomposition of the poverty rate, selected regions

| Region | poverty rate | | Shapley contributions | |
|---|---|---|---|---|
| | reported | estimated | real income | inequality |
| Chelyabinsk | 27.9 | 30.4 | 8.8 | -9.1 |
| Magadan | 24.6 | 33.8 | 7.1 | -4.0 |
| Moscow city | 19.1 | 15.8 | -29.7 | 14.8 |
| Moskow oblast | 31.2 | 26.8 | 12.7 | -16.7 |
| North Osetia | 42.8 | 38.1 | 19.4 | -12.0 |
| Pskov | 42.7 | 45.3 | 25.5 | -11.0 |
| Tatarstan | 22.1 | 19.8 | -2.3 | -8.7 |
| Tuva | 73.2 | 71.8 | 39.3 | 1.8 |
| Tyumen | 19.2 | 21.0 | -13.9 | 4.2 |
| Ulyanovsk | 16.3 | 15.5 | -1.8 | -13.4 |
| Russian Federation | 24.7 | 30.7 | 0.0 | 0.0 |

Table 5: Shapley decomposition of FGT1 and FGT2 poverty indices, selected regions

| Region | FGT1 Shapley contributions | | FGT2 Shapley contributions | |
|---|---|---|---|---|
| | real income | inequality | real income | inequality |
| Chelyabinsk | 3.6 | -5.2 | 1.8 | -3.2 |
| Magadan | 3.1 | -2.4 | 1.6 | -1.5 |
| Moscow city | -13.7 | 9.1 | -8.1 | 6.3 |
| Moskow oblast | 4.7 | -8.8 | 2.3 | -5.1 |
| North Osetia | 7.9 | -7.4 | 4.1 | -4.6 |
| Pskov | 10.9 | -7.4 | 5.8 | -4.8 |
| Tatarstan | -0.9 | -4.4 | -0.4 | -2.5 |
| Tuva | 24.0 | 1.9 | 16.0 | 1.6 |
| Tyumen | -5.8 | 2.3 | -3.2 | 1.4 |
| Ulyanovsk | -0.6 | -6.3 | -0.3 | -3.4 |
| Russian Federation | 0.0 | 0.0 | 0.0 | 0.0 |

Table 6: Three factor decomposition of the poverty rate

| Region | reported poverty rate | estimated poverty rate | Shapley contributions nominal Income | inequality | poverty line |
|---|---|---|---|---|---|
| Chelyabinsk | 27.9 | 30.4 | 10.8 | -9.1 | -2.1 |
| Magadan | 24.6 | 33.8 | -27.6 | -3.3 | 33.9 |
| Moscow city | 19.1 | 15.8 | -35.4 | 13.8 | 6.6 |
| Moskow oblast | 31.2 | 26.8 | 13.8 | -16.6 | -1.1 |
| North Osetia | 42.8 | 38.1 | 25.8 | -11.5 | -6.9 |
| Pskov | 42.7 | 45.3 | 23.7 | -11.1 | 1.9 |
| Tatarstan | 22.1 | 19.8 | 11.9 | -8.3 | -14.6 |
| Tuva | 73.2 | 71.8 | 24.5 | 1.8 | 14.8 |
| Tyumen | 19.2 | 21.0 | -28.7 | 3.8 | 15.2 |
| Ulyanovsk | 16.3 | 15.5 | 21.0 | -11.6 | -24.7 |
| Russian Federation | 24.7 | 30.7 | 0.0 | 0.0 | 0.0 |

Table 7: Three factor Shapley decomposition of FGT1 and FGT2 indices, selected regions

| | FGT1 | | | FGT2 | | |
|---|---|---|---|---|---|---|
| Region | nominal income | inequality | poverty line | nominal income | inequality | poverty line |
| Chelyabinsk | 4.4 | -5.2 | -0.8 | 2.3 | -3.2 | -0.4 |
| Magadan | -13.6 | -2.2 | 16.4 | -8.0 | -1.5 | 9.6 |
| Moscow city | -16.8 | 9.0 | 3.3 | -10.2 | 6.4 | 2.0 |
| Moskow oblast | 5.1 | -8.8 | -0.4 | 2.5 | -5.1 | -0.2 |
| North Osetia | 10.7 | -7.3 | -2.9 | 5.6 | -4.6 | -1.6 |
| Pskov | 10.1 | -7.4 | 0.8 | 5.4 | -4.8 | 0.5 |
| Tatarstan | 4.7 | -4.3 | -5.7 | 2.4 | -2.5 | -2.8 |
| Tuva | 14.8 | 1.9 | 9.0 | 9.8 | 1.6 | 6.1 |
| Tyumen | -12.8 | 2.2 | 7.0 | -7.2 | 1.5 | 4.0 |
| Ulyanovsk | 8.5 | -6.0 | -9.5 | 4.5 | -3.5 | -4.8 |
| Russian Federation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Appendix Table 1: Shapley decomposition of the poverty rate, all regions

| Region | poverty rate | | Shapley contributions | |
|---|---|---|---|---|
| | reported | estimated | real income | inequality |
| Adygeya republic | 46.4 | 59.0 | 33.4 | -5.1 |
| Bashkortostan republic | 32.4 | 33.9 | 11.9 | -8.7 |
| Buryat republic | 55.2 | 55.7 | 24.0 | 1.0 |
| Altai republic | 26.2 | 35.0 | 10.0 | -5.8 |
| Kabardino-Balkar republic | 42.5 | 46.5 | 26.5 | -10.8 |
| Kalmyk republic | 60.3 | 59.3 | 39.1 | -10.5 |
| Karachaevo-Cherkess republic | 45.7 | 54.0 | 33.0 | -9.7 |
| Karelia republic | 23.6 | 24.9 | 9.8 | -15.6 |
| Komi republic | 19.2 | 21.2 | 2.0 | -11.6 |
| Mari-El republic | 43.2 | 45.7 | 30.3 | -15.3 |
| Mordovia republic | 34.7 | 38.4 | 24.7 | -17.0 |
| Sakha (Yakutia) republic | 29.2 | 31.9 | 9.1 | -8.0 |
| North Osetia republic | 42.8 | 38.1 | 19.4 | -12.0 |
| Tatarstan republic | 22.1 | 19.8 | -2.3 | -8.7 |
| Tuva republic | 73.2 | 71.8 | 39.3 | 1.8 |
| Udmurtia Republic | 26.1 | 42.0 | 24.3 | -13.0 |
| Khakasia republic | 25.3 | 22.3 | 6.5 | -14.9 |
| Chuvash republic | 27.3 | 24.1 | 12.6 | -19.3 |
| Altai kray | 33.7 | 34.1 | 10.8 | -7.4 |
| Krasnodar kray | 32.4 | 31.8 | 4.4 | -3.4 |
| Krasnoyarsk kray | 24.2 | 24.9 | -9.5 | 3.7 |
| Primorskii kray | 31.8 | 29.8 | 14.4 | -15.3 |
| Stavropol kray | 39.6 | 35.8 | 9.3 | -4.2 |
| Khabarovsk kray | 29.4 | 35.8 | 18.1 | -13.1 |
| Amur oblast | 37.9 | 42.7 | 9.9 | 2.1 |
| Arkhangelsk oblast | 26.9 | 27.5 | 13.1 | -16.4 |
| Astrakhan oblast | 32.3 | 38.7 | 21.9 | -13.9 |
| Belgorod oblast | 19.9 | 18.1 | -3.2 | -9.5 |
| Bryansk oblast | 22.7 | 23.4 | 7.5 | -14.8 |
| Vladimir oblast | 27.9 | 30.5 | 18.2 | -18.4 |
| Volgograd oblast | 33.2 | 34.3 | 18.2 | -14.6 |
| Vologda oblast | 20.1 | 21.8 | 2.5 | -11.5 |
| Voronezh oblast | 23.1 | 21.5 | 1.2 | -10.5 |
| Ivanovo oblast | 33.7 | 32.0 | 17.3 | -16.0 |
| Irkutsk oblast | 32.3 | 32.9 | 7.1 | -4.9 |
| Kaliningrad oblast | 26.6 | 31.4 | 16.0 | -15.3 |
| Kaluga oblast | 26.6 | 26.6 | -0.7 | -3.5 |
| Kamchatka oblast | 22.7 | 30.2 | 3.6 | -4.1 |
| Kemerovo oblast | 16.1 | 16.9 | -10.4 | -3.4 |
| Kirov oblast | 32.0 | 33.1 | 20.1 | -17.7 |

| | | | | |
|---|---|---|---|---|
| Kostroma oblast | 30.5 | 33.8 | 6.5 | -3.3 |
| Kurgan oblast | 50.4 | 53.1 | 33.5 | -11.1 |
| Kursk oblast | 20.2 | 25.6 | 8.8 | -13.9 |
| Leningrad oblast | 29.1 | 29.2 | 15.2 | -16.7 |
| Lipetsk oblast | 18.6 | 17.4 | 2.0 | -15.4 |
| Magadan oblast | 24.6 | 33.8 | 7.1 | -4.0 |
| Moskow oblast | 31.2 | 26.8 | 12.7 | -16.7 |
| Murmansk oblast | 22.0 | 23.9 | 4.5 | -11.3 |
| Nizhny Novgorod oblast | 22.0 | 23.7 | 4.8 | -11.8 |
| Novgorod oblast | 22.8 | 26.0 | 8.5 | -13.2 |
| Novosibirsk oblast | 39.8 | 41.0 | 20.6 | -10.3 |
| Omsk oblast | 29.7 | 22.5 | 4.2 | -12.4 |
| Orenburg oblast | 49.3 | 49.6 | 30.7 | -11.8 |
| Oryol oblast | 22.7 | 25.9 | -1.4 | -3.5 |
| Penza oblast | 30.2 | 30.4 | 14.8 | -15.1 |
| Perm oblast | 25.7 | 26.8 | 3.6 | -7.5 |
| Pskov oblast | 42.7 | 45.3 | 25.5 | -11.0 |
| Rostov oblast | 33.4 | 33.9 | 15.5 | -12.4 |
| Ryazan oblast | 24.4 | 23.6 | 9.5 | -16.6 |
| Samara oblast | 21.2 | 22.3 | 2.5 | -11.0 |
| Saratov oblast | 35.3 | 37.1 | 20.4 | -14.1 |
| Sakhalin oblast | 24.6 | 29.9 | 19.5 | -20.3 |
| Sverdlovsk oblast | 29.5 | 30.1 | 9.5 | -10.1 |
| Smolensk oblast | 19.8 | 22.0 | 4.2 | -13.0 |
| Tambov oblast | 22.0 | 20.3 | 1.0 | -11.4 |
| Tver oblast | 28.6 | 28.3 | 12.0 | -14.5 |
| Tomsk oblast | 30.6 | 29.8 | 5.0 | -6.0 |
| Tula oblast | 16.2 | 20.7 | 2.8 | -12.9 |
| Tyumen oblast | 19.2 | 21.0 | -13.9 | 4.2 |
| Ulyanovsk oblast | 16.3 | 15.5 | -1.8 | -13.4 |
| Chelyabinsk oblast | 27.9 | 30.4 | 8.8 | -9.1 |
| Chita oblast | 66.5 | 66.6 | 33.1 | 2.8 |
| Yaroslavl oblast | 21.3 | 12.2 | -5.8 | -12.8 |
| Moscow city | 19.1 | 15.8 | -29.7 | 14.8 |
| St. Petersburg city | 20.0 | 16.0 | -11.3 | -3.4 |
| Russian Federation | 24.7 | 30.7 | 0.0 | 0.0 |

Appendix Table 2: Shapley decomposition of FGT indices, all regions

| Region | FGT1 | | FGT2 | |
|---|---|---|---|---|
| | real income | inequality | real income | inequality |
| Adygeya republic | 16.6 | -4.3 | 9.7 | -3.1 |
| Bashkortostan republic | 4.9 | -5.2 | 2.6 | -3.2 |
| Buryat republic | 12.6 | 0.8 | 7.7 | 0.6 |
| Altai republic | 4.3 | -3.5 | 2.3 | -2.2 |
| Kabardino-Balkar republic | 11.4 | -7.4 | 6.1 | -4.9 |
| Kalmyk republic | 17.6 | -8.4 | 9.8 | -5.9 |
| Karachaevo-Cherkess republic | 14.8 | -7.3 | 8.2 | -5.1 |
| Karelia republic | 3.6 | -8.1 | 1.8 | -4.6 |
| Komi republic | 0.8 | -5.9 | 0.4 | -3.4 |
| Mari-El republic | 12.0 | -10.1 | 6.2 | -6.5 |
| Mordovia republic | 9.4 | -10.2 | 4.8 | -6.2 |
| Sakha (Yakutia) republic | 3.7 | -4.7 | 2.0 | -2.9 |
| North Osetia republic | 7.9 | -7.4 | 4.1 | -4.6 |
| Tatarstan republic | -0.9 | -4.4 | -0.4 | -2.5 |
| Tuva republic | 24.0 | 1.9 | 16.0 | 1.6 |
| Udmurtia Republic | 9.9 | -8.3 | 5.2 | -5.3 |
| Khakasia republic | 2.4 | -7.6 | 1.2 | -4.3 |
| Chuvash republic | 4.5 | -9.7 | 2.2 | -5.5 |
| Altai kray | 4.5 | -4.5 | 2.4 | -2.8 |
| Krasnodar kray | 1.9 | -2.0 | 1.0 | -1.3 |
| Krasnoyarsk kray | -4.1 | 2.1 | -2.2 | 1.3 |
| Primorskii kray | 5.4 | -8.4 | 2.7 | -5.0 |
| Stavropol kray | 4.1 | -2.6 | 2.2 | -1.7 |
| Khabarovsk kray | 7.2 | -7.8 | 3.7 | -4.8 |
| Amur oblast | 4.7 | 1.5 | 2.8 | 1.0 |
| Arkhangelsk oblast | 4.9 | -8.7 | 2.4 | -5.1 |
| Astrakhan oblast | 8.7 | -8.5 | 4.5 | -5.3 |
| Belgorod oblast | -1.2 | -4.7 | -0.6 | -2.7 |
| Bryansk oblast | 2.8 | -7.6 | 1.4 | -4.3 |
| Vladimir oblast | 6.6 | -10.0 | 3.3 | -5.9 |
| Volgograd oblast | 7.1 | -8.5 | 3.6 | -5.1 |
| Vologda oblast | 1.0 | -5.9 | 0.5 | -3.4 |
| Voronezh oblast | 0.5 | -5.4 | 0.2 | -3.1 |
| Ivanovo oblast | 6.5 | -9.0 | 3.3 | -5.3 |
| Irkutsk oblast | 3.0 | -3.0 | 1.6 | -1.9 |
| Kaliningrad oblast | 6.1 | -8.6 | 3.1 | -5.1 |
| Kaluga oblast | -0.3 | -2.0 | -0.2 | -1.2 |
| Kamchatka oblast | 1.5 | -2.4 | 0.8 | -1.5 |
| Kemerovo oblast | -4.0 | -1.7 | -2.0 | -1.0 |
| Kirov oblast | 7.4 | -10.0 | 3.7 | -5.9 |

| | | | | |
|---|---|---|---|---|
| Kostroma oblast | 2.8 | -2.0 | 1.5 | -1.3 |
| Kurgan oblast | 14.6 | -8.2 | 8.0 | -5.6 |
| Kursk oblast | 3.3 | -7.4 | 1.7 | -4.3 |
| Leningrad oblast | 5.6 | -9.0 | 2.8 | -5.3 |
| Lipetsk oblast | 0.7 | -7.3 | 0.3 | -4.0 |
| Magadan oblast | 3.1 | -2.4 | 1.6 | -1.5 |
| Moskow oblast | 4.7 | -8.8 | 2.3 | -5.1 |
| Murmansk oblast | 1.7 | -5.9 | 0.9 | -3.4 |
| Nizhny Novgorod oblast | 1.8 | -6.2 | 0.9 | -3.6 |
| Novgorod oblast | 3.2 | -7.0 | 1.6 | -4.1 |
| Novosibirsk oblast | 8.7 | -6.6 | 4.6 | -4.2 |
| Omsk oblast | 1.6 | -6.4 | 0.8 | -3.6 |
| Orenburg oblast | 13.1 | -8.3 | 7.0 | -5.6 |
| Oryol oblast | -0.6 | -1.9 | -0.3 | -1.2 |
| Penza oblast | 5.6 | -8.3 | 2.8 | -4.9 |
| Perm oblast | 1.5 | -4.2 | 0.7 | -2.5 |
| Pskov oblast | 10.9 | -7.4 | 5.8 | -4.8 |
| Rostov oblast | 6.2 | -7.3 | 3.2 | -4.4 |
| Ryazan oblast | 3.4 | -8.5 | 1.7 | -4.8 |
| Samara oblast | 1.0 | -5.7 | 0.5 | -3.3 |
| Saratov oblast | 8.1 | -8.5 | 4.1 | -5.2 |
| Sakhalin oblast | 6.9 | -10.9 | 3.4 | -6.3 |
| Sverdlovsk oblast | 3.8 | -5.7 | 2.0 | -3.4 |
| Smolensk oblast | 1.6 | -6.6 | 0.8 | -3.7 |
| Tambov oblast | 0.4 | -5.7 | 0.2 | -3.3 |
| Tver oblast | 4.6 | -7.8 | 2.3 | -4.6 |
| Tomsk oblast | 2.1 | -3.4 | 1.1 | -2.1 |
| Tula oblast | 1.0 | -6.4 | 0.5 | -3.6 |
| Tyumen oblast | -5.8 | 2.3 | -3.2 | 1.4 |
| Ulyanovsk oblast | -0.6 | -6.3 | -0.3 | -3.4 |
| Chelyabinsk oblast | 3.6 | -5.2 | 1.8 | -3.2 |
| Chita oblast | 19.4 | 2.7 | 12.6 | 2.2 |
| Yaroslavl oblast | -2.0 | -5.8 | -1.0 | -3.1 |
| Moscow city | -13.7 | 9.1 | -8.1 | 6.3 |
| St. Petersburg city | -4.3 | -1.7 | -2.2 | -1.0 |
| Russian Federation | 0.0 | 0.0 | 0.0 | 0.0 |

Appendix Table 3: Three factor Shapley decompositions, all regions

| Region | headcount poverty rate | | | FGT1 | | | FGT2 | | |
|---|---|---|---|---|---|---|---|---|---|
| | nominal income | inequality | poverty line | nominal income | inequality | poverty line | nominal income | inequality | poverty line |
| Adygeya republic | 40.3 | -4.9 | -7.2 | 20.4 | -4.1 | -3.9 | 12.1 | -3.1 | -2.4 |
| Bashkortostan republic | 23.2 | -8.2 | -11.8 | 9.9 | -5.1 | -5.1 | 5.3 | -3.2 | -2.7 |
| Buryat republic | 16.3 | 1.0 | 7.7 | 8.5 | 0.8 | 4.1 | 5.2 | 0.6 | 2.5 |
| Altai republic | 24.0 | -5.4 | -14.3 | 10.6 | -3.4 | -6.5 | 5.9 | -2.2 | -3.6 |
| Kabardino-Balkar republic | 35.9 | -10.0 | -10.1 | 15.8 | -7.1 | -4.8 | 8.7 | -4.8 | -2.7 |
| Kalmyk republic | 45.9 | -9.8 | -7.6 | 21.2 | -8.0 | -3.9 | 12.0 | -5.8 | -2.3 |
| Karachaevo-Cherkess republic | 43.7 | -8.7 | -11.7 | 20.4 | -6.9 | -6.0 | 11.6 | -4.9 | -3.6 |
| Karelia republic | -13.8 | -14.4 | 22.4 | -5.3 | -7.9 | 8.7 | -2.7 | -4.7 | 4.5 |
| Komi republic | -12.4 | -11.1 | 13.9 | -4.7 | -5.8 | 5.4 | -2.4 | -3.4 | 2.8 |
| Mari-El republic | 39.0 | -13.9 | -10.2 | 16.1 | -9.6 | -4.5 | 8.6 | -6.4 | -2.5 |
| Mordovia republic | 32.9 | -15.7 | -9.5 | 12.9 | -9.9 | -3.9 | 6.8 | -6.2 | -2.0 |
| Sakha (Yakutia) republic | -28.0 | -6.4 | 35.6 | -13.4 | -4.2 | 16.7 | -7.8 | -2.8 | 9.7 |
| North Osetia republic | 25.8 | -11.5 | -6.9 | 10.7 | -7.3 | -2.9 | 5.6 | -4.6 | -1.6 |
| Tatarstan republic | 11.9 | -8.3 | -14.6 | 4.7 | -4.3 | -5.7 | 2.4 | -2.5 | -2.8 |
| Tuva republic | 24.5 | 1.8 | 14.8 | 14.8 | 1.9 | 9.0 | 9.8 | 1.6 | 6.1 |
| Udmurtia Republic | 26.8 | -12.8 | -2.7 | 11.0 | -8.3 | -1.1 | 5.8 | -5.3 | -0.6 |
| Khakasia republic | 5.2 | -15.0 | 1.4 | 1.9 | -7.6 | 0.5 | 0.9 | -4.3 | 0.2 |
| Chuvash republic | 26.4 | -17.2 | -15.9 | 10.1 | -9.3 | -6.0 | 5.2 | -5.5 | -3.0 |
| Altai kray | 19.5 | -7.1 | -9.0 | 8.3 | -4.4 | -3.9 | 4.5 | -2.8 | -2.1 |
| Krasnodar kray | 17.1 | -3.2 | -12.8 | 7.5 | -2.0 | -5.7 | 4.1 | -1.3 | -3.1 |
| Krasnoyarsk kray | -6.0 | 3.7 | -3.5 | -2.6 | 2.1 | -1.5 | -1.4 | 1.3 | -0.8 |
| Primorskii kray | -2.4 | -15.2 | 16.6 | -0.9 | -8.4 | 6.3 | -0.4 | -5.0 | 3.2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stavropol kray | 21.5 | -4.0 | -12.4 | 9.6 | -2.6 | -5.6 | 5.3 | -1.7 | -3.1 |
| Khabarovsk kray | -1.2 | -13.0 | 19.3 | -0.5 | -7.8 | 7.7 | -0.3 | -4.8 | 4.0 |
| Amur oblast | 2.5 | 2.1 | 7.4 | 1.2 | 1.5 | 3.5 | 0.7 | 1.0 | 2.1 |
| Arkhangelsk oblast | 0.9 | -16.5 | 12.3 | 0.3 | -8.7 | 4.5 | 0.2 | -5.1 | 2.3 |
| Astrakhan oblast | 26.1 | -13.6 | -4.6 | 10.5 | -8.4 | -1.9 | 5.5 | -5.3 | -1.0 |
| Belgorod oblast | 12.0 | -9.0 | -15.6 | 4.7 | -4.6 | -5.9 | 2.4 | -2.7 | -3.0 |
| Bryansk oblast | 19.9 | -13.8 | -13.4 | 7.7 | -7.4 | -5.1 | 4.0 | -4.3 | -2.6 |
| Vladimir oblast | 26.1 | -17.3 | -9.1 | 9.9 | -9.8 | -3.5 | 5.0 | -5.9 | -1.7 |
| Volgograd oblast | 23.7 | -14.1 | -6.0 | 9.3 | -8.3 | -2.4 | 4.8 | -5.1 | -1.2 |
| Vologda oblast | 1.6 | -11.5 | 1.0 | 0.6 | -5.9 | 0.4 | 0.3 | -3.4 | 0.2 |
| Voronezh oblast | 18.4 | -9.6 | -18.0 | 7.4 | -5.2 | -7.1 | 3.9 | -3.1 | -3.6 |
| Ivanovo oblast | 27.3 | -14.9 | -11.1 | 10.7 | -8.7 | -4.5 | 5.6 | -5.3 | -2.3 |
| Irkutsk oblast | -6.0 | -4.8 | 13.0 | -2.6 | -2.9 | 5.6 | -1.4 | -1.8 | 3.0 |
| Kaliningrad oblast | 16.5 | -15.3 | -0.5 | 6.3 | -8.6 | -0.2 | 3.2 | -5.1 | -0.1 |
| Kaluga oblast | 7.7 | -3.4 | -8.5 | 3.2 | -1.9 | -3.5 | 1.7 | -1.2 | -1.9 |
| Kamchatka oblast | -27.0 | -3.4 | 30.0 | -12.8 | -2.2 | 14.1 | -7.3 | -1.5 | 8.1 |
| Kemerovo oblast - | -13.0 | -3.4 | 2.5 | -5.0 | -1.7 | 1.0 | -2.5 | -1.0 | 0.5 |
| Kirov oblast | 17.0 | -18.0 | 3.4 | 6.2 | -10.0 | 1.3 | 3.1 | -5.9 | 0.6 |
| Kostroma oblast | 13.5 | -3.3 | -7.1 | 5.9 | -2.0 | -3.1 | 3.2 | -1.3 | -1.7 |
| Kurgan oblast | 36.6 | -10.8 | -3.4 | 16.1 | -8.1 | -1.6 | 8.8 | -5.6 | -0.9 |
| Kursk oblast | 24.7 | -12.5 | -17.2 | 9.9 | -7.0 | -6.9 | 5.2 | -4.3 | -3.5 |
| Leningrad oblast | 17.5 | -16.5 | -2.5 | 6.5 | -9.0 | -0.9 | 3.3 | -5.3 | -0.5 |
| Lipetsk oblast | 14.3 | -14.6 | -13.1 | 5.3 | -7.2 | -4.7 | 2.7 | -4.0 | -2.3 |
| Magadan oblast | -27.6 | -3.3 | 33.9 | -13.6 | -2.2 | 16.4 | -8.0 | -1.5 | 9.6 |
| Moskow oblast | 13.8 | -16.6 | -1.1 | 5.1 | -8.8 | -0.4 | 2.5 | -5.1 | -0.2 |
| Murmansk oblast | -17.7 | -10.3 | 21.2 | -7.1 | -5.7 | 8.6 | -3.7 | -3.5 | 4.5 |
| Nizhny Novgorod oblast | 14.3 | -11.4 | -10.0 | 5.6 | -6.1 | -3.8 | 2.8 | -3.6 | -1.9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Novgorod oblast | 8.7 | -13.2 | -0.2 | 3.3 | -7.0 | -0.1 | 1.6 | -4.1 | 0.0 |
| Novosibirsk oblast | 22.7 | -10.2 | -2.2 | 9.6 | -6.6 | -1.0 | 5.1 | -4.2 | -0.5 |
| Omsk oblast | 8.8 | -12.2 | -4.8 | 3.3 | -6.3 | -1.8 | 1.7 | -3.6 | -0.9 |
| Orenburg oblast | 26.0 | -12.2 | 5.0 | 11.0 | -8.5 | 2.2 | 5.9 | -5.6 | 1.2 |
| Oryol oblast | 13.8 | -3.3 | -15.4 | 5.9 | -1.9 | -6.5 | 3.2 | -1.2 | -3.5 |
| Penza oblast | 27.3 | -13.7 | -13.9 | 10.9 | -8.0 | -5.6 | 5.7 | -4.9 | -2.9 |
| Perm oblast | 3.6 | -7.5 | 0.1 | 1.4 | -4.2 | 0.0 | 0.7 | -2.5 | 0.0 |
| Pskov oblast | 23.7 | -11.1 | 1.9 | 10.1 | -7.4 | 0.8 | 5.4 | -4.8 | 0.5 |
| Rostov oblast | 22.7 | -11.9 | -7.7 | 9.2 | -7.1 | -3.2 | 4.8 | -4.4 | -1.6 |
| Ryazan oblast | 21.1 | -15.5 | -12.8 | 8.0 | -8.2 | -4.8 | 4.1 | -4.8 | -2.4 |
| Samara oblast | 3.9 | -10.9 | -1.4 | 1.5 | -5.7 | -0.5 | 0.7 | -3.3 | -0.3 |
| Saratov oblast | 24.9 | -13.7 | -4.8 | 9.9 | -8.4 | -2.0 | 5.2 | -5.2 | -1.0 |
| Sakhalin oblast | -15.0 | -17.8 | 32.0 | -5.9 | -10.4 | 12.3 | -2.9 | -6.3 | 6.4 |
| Sverdlovsk oblast | 1.2 | -10.1 | 8.3 | 0.5 | -5.7 | 3.3 | 0.2 | -3.5 | 1.7 |
| Smolensk oblast | 16.1 | -12.3 | -12.5 | 6.2 | -6.5 | -4.8 | 3.2 | -3.8 | -2.4 |
| Tambov oblast | 22.7 | -10.0 | -23.1 | 9.4 | -5.5 | -9.3 | 5.0 | -3.3 | -4.8 |
| Tver oblast | 20.6 | -13.8 | -9.3 | 8.0 | -7.7 | -3.6 | 4.1 | -4.6 | -1.8 |
| Tomsk oblast | 2.1 | -6.0 | 2.9 | 0.9 | -3.5 | 1.2 | 0.5 | -2.1 | 0.6 |
| Tula oblast | 12.2 | -12.5 | -9.8 | 4.6 | -6.4 | -3.7 | 2.3 | -3.7 | -1.8 |
| Tyumen oblast | -28.7 | 3.8 | 15.2 | -12.8 | 2.2 | 7.0 | -7.2 | 1.5 | 4.0 |
| Ulyanovsk oblast | 21.0 | -11.6 | -24.7 | 8.5 | -6.0 | -9.5 | 4.5 | -3.5 | -4.8 |
| Chelyabinsk oblast | 10.8 | -9.1 | -2.1 | 4.4 | -5.2 | -0.8 | 2.3 | -3.2 | -0.4 |
| Chita oblast | 9.5 | 2.9 | 23.4 | 5.6 | 2.8 | 13.7 | 3.7 | 2.2 | 8.9 |
| Yaroslavl oblast | 3.7 | -12.7 | -9.6 | 1.3 | -5.8 | -3.3 | 0.6 | -3.1 | -1.6 |
| Moscow city | -35.4 | 13.8 | 6.6 | -16.8 | 9.0 | 3.3 | -10.2 | 6.4 | 2.0 |
| St. Petersburg city | -11.0 | -3.4 | -0.3 | -4.2 | -1.7 | -0.1 | -2.1 | -1.0 | -0.1 |

Figure 1: Headcount poverty rates in Russian regions

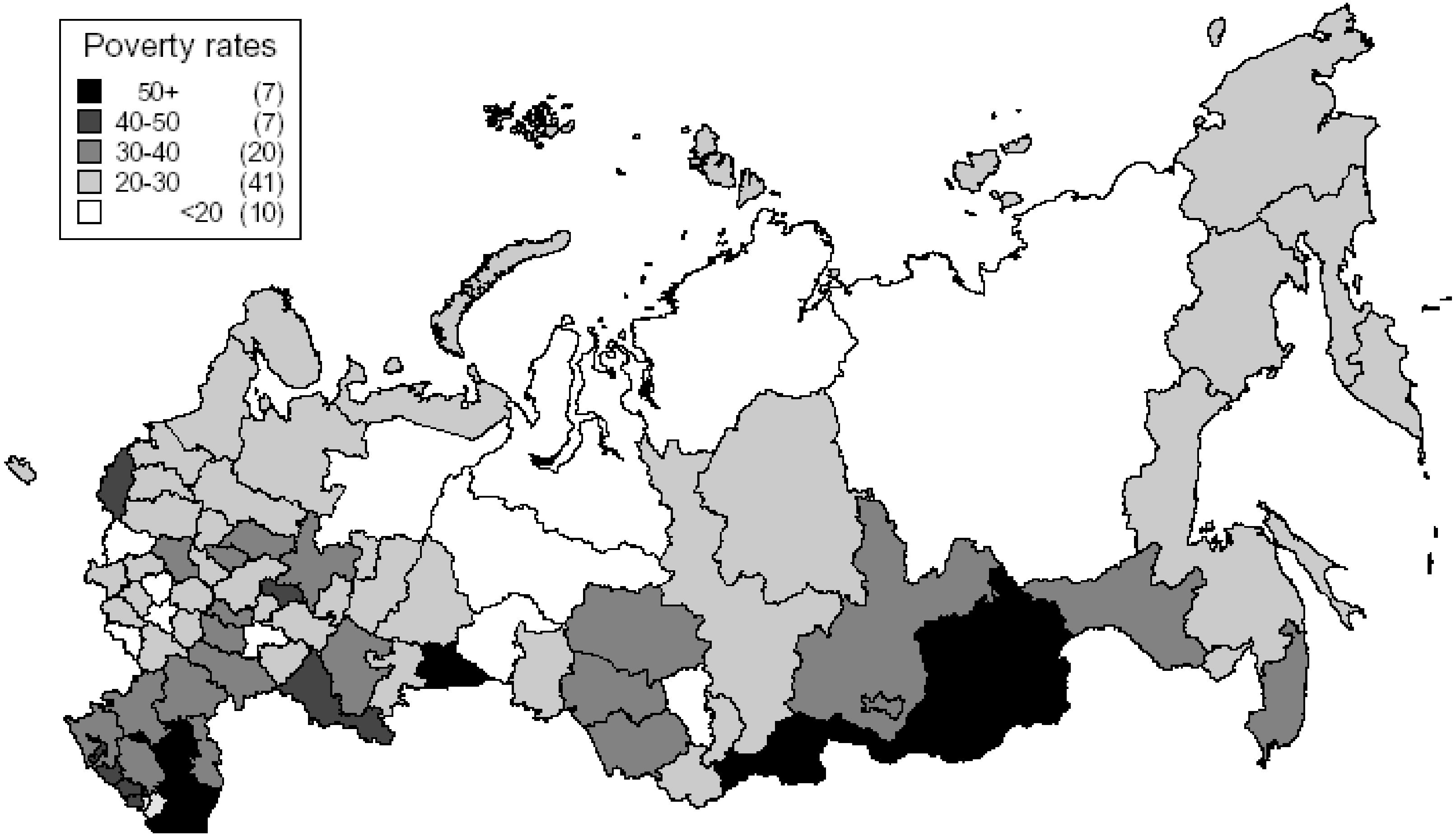

Figure 2: Poverty contour map for Russian regions

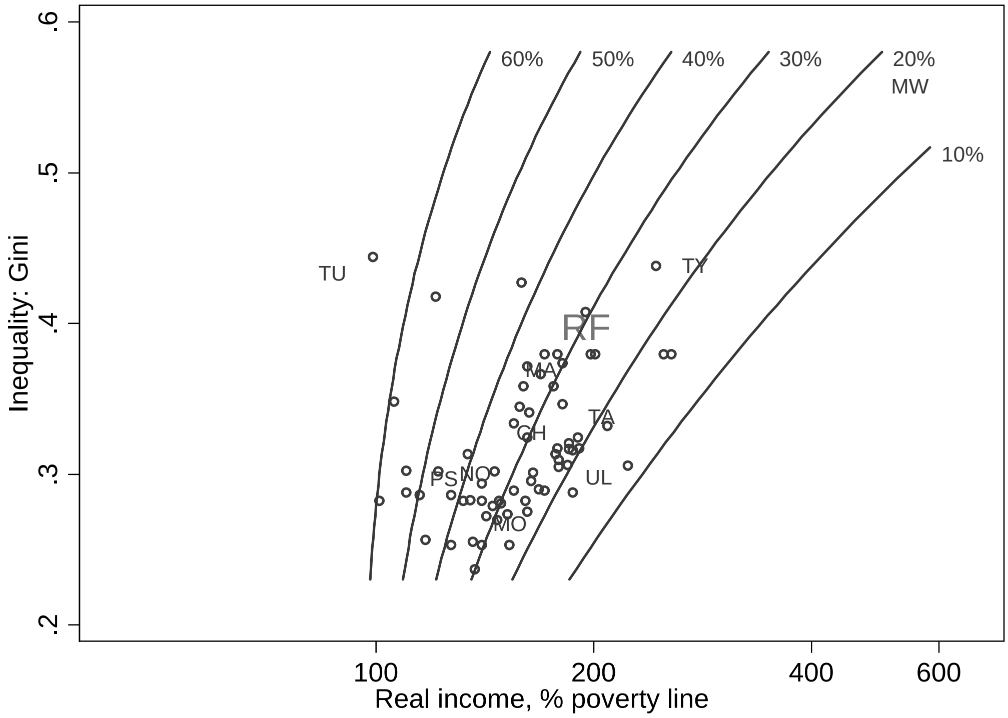

Figure 3: Growth-redistribution decomposition of the poverty rate

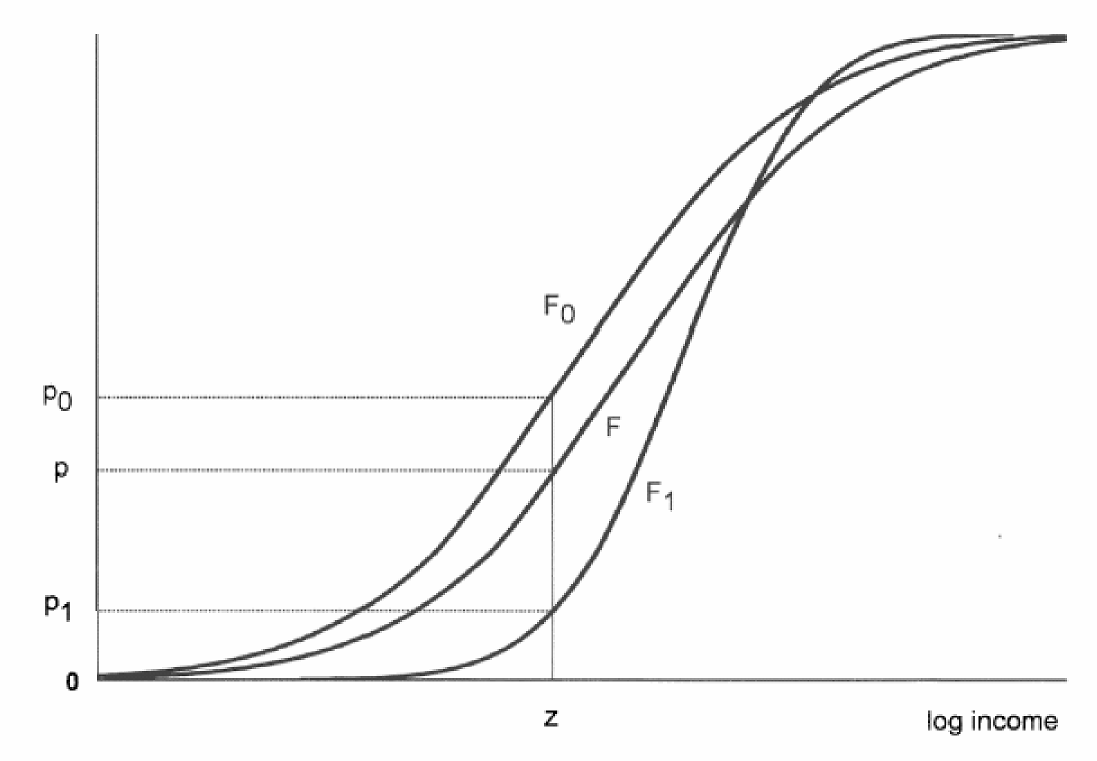

Figure 4: Three-way Shapley decomposition

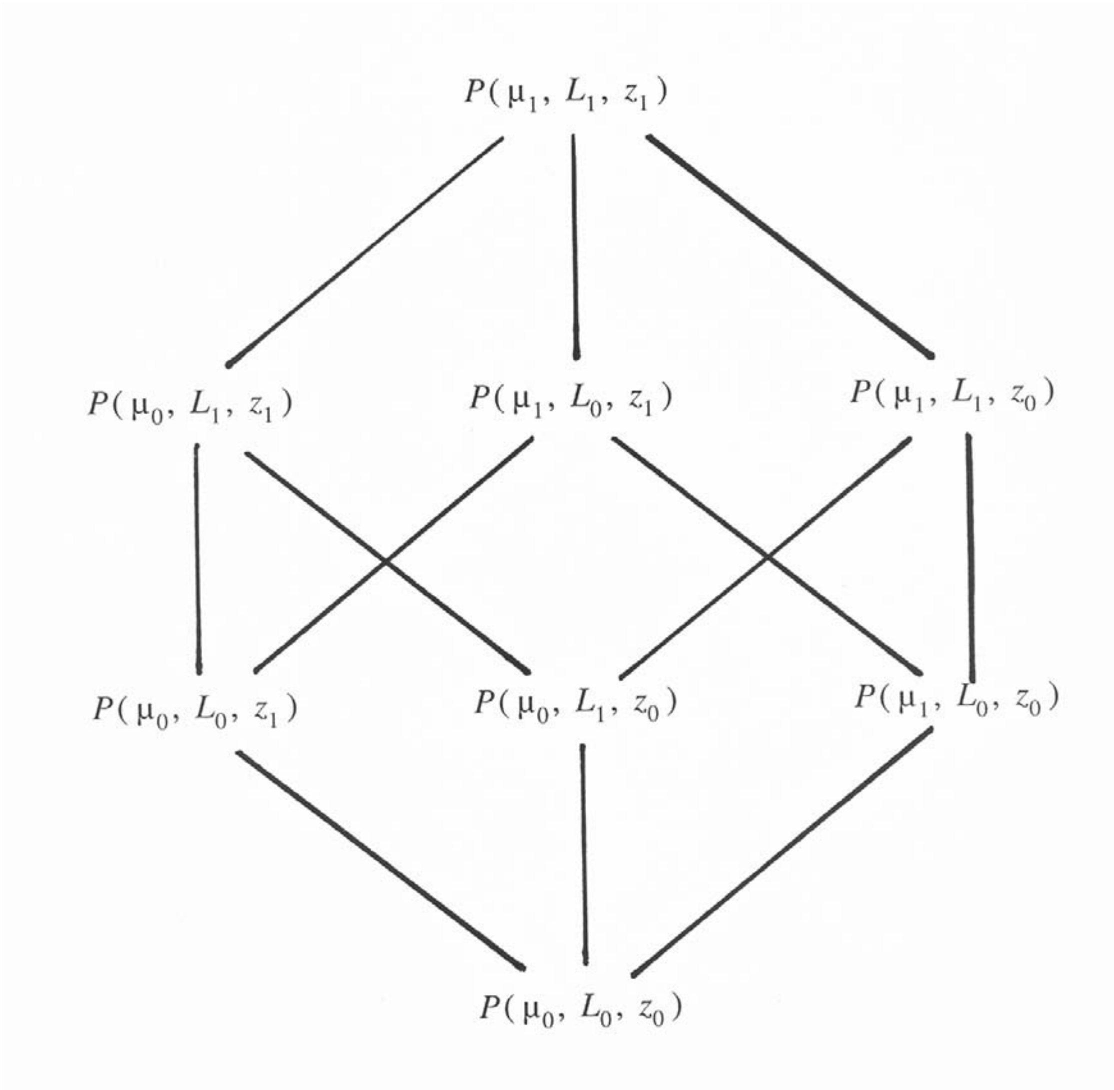

Figure 5: Shapley decomposition of the poverty rate