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**MORTALITY CRISIS IN RUSSIA REVISITED:
EVIDENCE FROM CROSS-REGIONAL COMPARISON¹**

Vladimir Popov²

ABSTRACT

This paper provides evidence from cross-regional comparisons that the Russian mortality crisis (mortality rate increased from 1.0% to 1.6% in 1989-94 and stayed at a level of 1.4-1.6% thereafter) was caused mostly by stress factors (increased unemployment, labor turnover, migration, divorces, income inequalities), and by the increase in unnatural deaths (murders, suicides, accidents), but not so much by the increase in alcohol consumption (even though it also increased due to the same stress factors). Health infrastructure of a region had a positive impact on life expectancy only in regions with high income inequalities (large share of highest income group).

¹ I am grateful to Larry King and Anatoly Vishnevsky for enlightening discussions and to two anonymous referees for helpful comments.

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Introduction

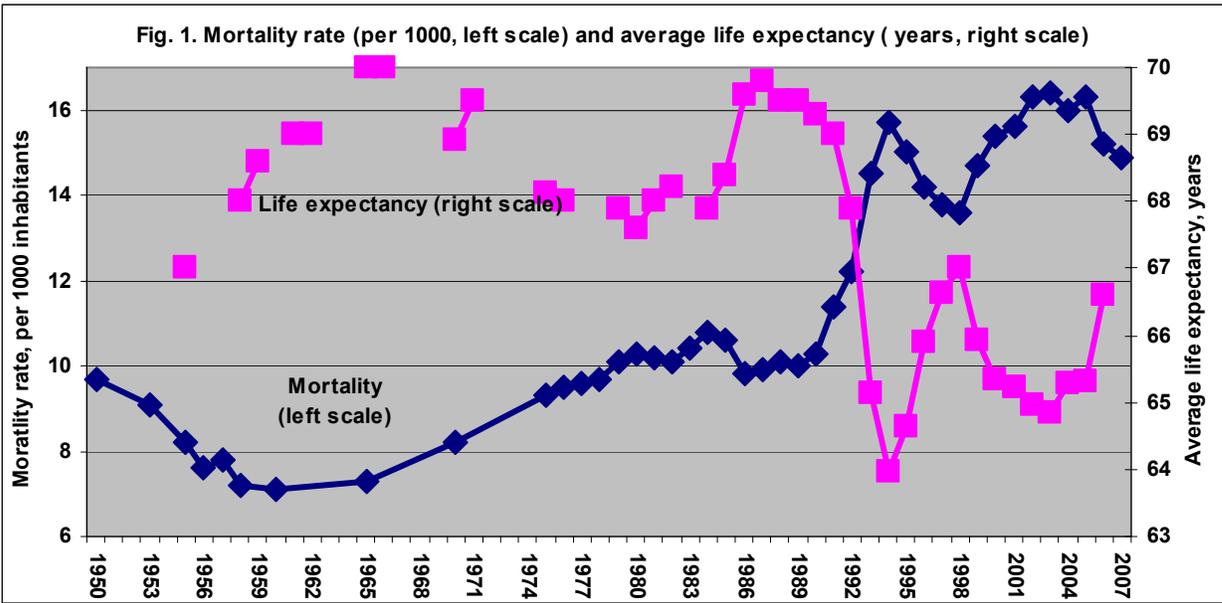
This paper is an attempt to use the new evidence for the analysis of the Russian mortality crisis of the 1990s (mortality rate increased from 1.0% to 1.6% in 1989-94 and stayed at a level of 1.4-1.6% thereafter). It appears that the peak of mortality was reached in 2003-05, and that it started to subside afterwards (fig. 1), so we now have the full dataset to analyze the dramatic upsurge in mortality rate from the beginning to the end. It is argued that the dramatic increase in mortality in the first half of the 1990s was only weakly associated with the deterioration of the health care system, and was due mostly to stress factors (caused by increased labor turnover, migration, divorces, income inequalities), and increase in unnatural deaths (murders, suicides, accidents), but not so much to the increase in alcohol consumption during the transition. Cross-regional differences in the health care facilities (number of doctors, nurses, hospital beds, etc.) did not have much of an impact on life expectancy. After the collapse of the free health care system that existed in the Soviet Union, legal and illegal user fees became common in the 1990s and beyond, so the poor part of the population could not take advantage of the health care facilities anyway. To be more precise, health infrastructure of a region had a positive impact on life expectancy only in regions with high income inequalities (large share of highest income group).

Overview of the literature

Transition to the market economy and democracy in the 1990s in Eastern Europe and former Soviet Union countries caused a dramatic increase in mortality, shortened life expectancy, led to the depopulation. The steep upsurge in mortality and the decline in life expectancy in Russia were the biggest ever recorded anywhere in peacetime and in the absence of catastrophes, such as wars, plague or famine. Mortality rate increased by 60%, from 1.0% to 1.6%, whereas life expectancy went down from 70 in 1987 to 64 in 1994 (fig. 1). In fact, mortality increased to the levels never observed in the 1950s-1980s, i.e. for the period of at least 40 years. One has to go as far back as 1940 to find the mortality rates higher than in

1995-2005 (the data for the 1941-49 period – second world war and the postwar reconstruction – are absent). It should be mentioned that output fell by 45% in 1989-98 and that other social indicators, such as crime rate, murder rate, suicide rate, income inequalities deteriorated sharply as well.

The increase in mortality in Russia consisted of two periods: initial mortality hike with a peak in 1994 with subsequent decline, and later increase of mortality after 1998 financial crisis until 2003 (see fig.1). The mortality rise after the August 1998 crisis (1998-2003) still needs to be explained. Output was growing since 1999 and unemployment rate was on the decline, so at least one of the stress factors was not contributing to new mortality upsurge. However, the sharp decline in real incomes that occurred after the August 1998 crisis could have become a major stress factor itself, even though its direct impact (via deterioration of nutrition) on mortality could have been limited. Besides, income inequalities, labor turnover and migration indicators, divorce rate did not show any signs of decline after the 1998 crisis and before 2002-03. After 2002-03 not only unemployment continued to decline, but also divorce rate started to fall.



Source: Goskomstat.

It is also noteworthy that there was no increase in mortality during the 2008-09 recession, although the reduction of output and real incomes was significant – over 10% from peak to trough on a monthly basis, and unemployment rate increased from 5.4% in May 2008 to 9.4% in February 2009. Perhaps, in recent two decades of transition people have already adjusted to stress (and those that failed to adjust died out), so economic downturns are no longer associated with the increase in mortality.

Hence, there is even more reason to consider the 1990-2003 fall in life expectancy as the exceptional development. The unique part of the transition story that does not have analogues in other countries was associated with the comprehensive market-type reforms – these reforms added another shock to the shock of democratization. Deregulation of prices and ensued changes in relative prices led to the mass reallocation of capital and labor that contributed greatly to stress factors – increased unemployment, migration, labor turnover, divorces, and income inequalities. However, the general rule here was that countries with stronger institutions, either democratic (like EE), or authoritarian (like China and Vietnam) managed to cope with the stress factors better than the others. Besides, only authoritarian regimes (China is the number one example) managed to choose and implement the strategy of gradual transition, that allowed to stretch the required restructuring – reallocation of capital and labor – over a considerable period of time and thus to mitigate stress associated with unemployment, migration, labor turnover (Popov, 2007).

As a rule, countries which proceeded with more gradual reforms (from China to Uzbekistan and Belarus) managed also to preserve institutional capacity and to avoid completely or at least mitigate the collapse of output and the increase in mortality (Popov, 2000; Popov, 2007). China and Vietnam did not have any transformational recession during transition and life expectancy in these countries was growing constantly (although in China – very slowly, as compared to the previous period and to other countries with similar levels of GDP per capita and life expectancy – see Lu, 2006). Besides, in countries with strong institutions, there is at least one case (Cuba), where the reduction of output (about 40% in 1989-94) did

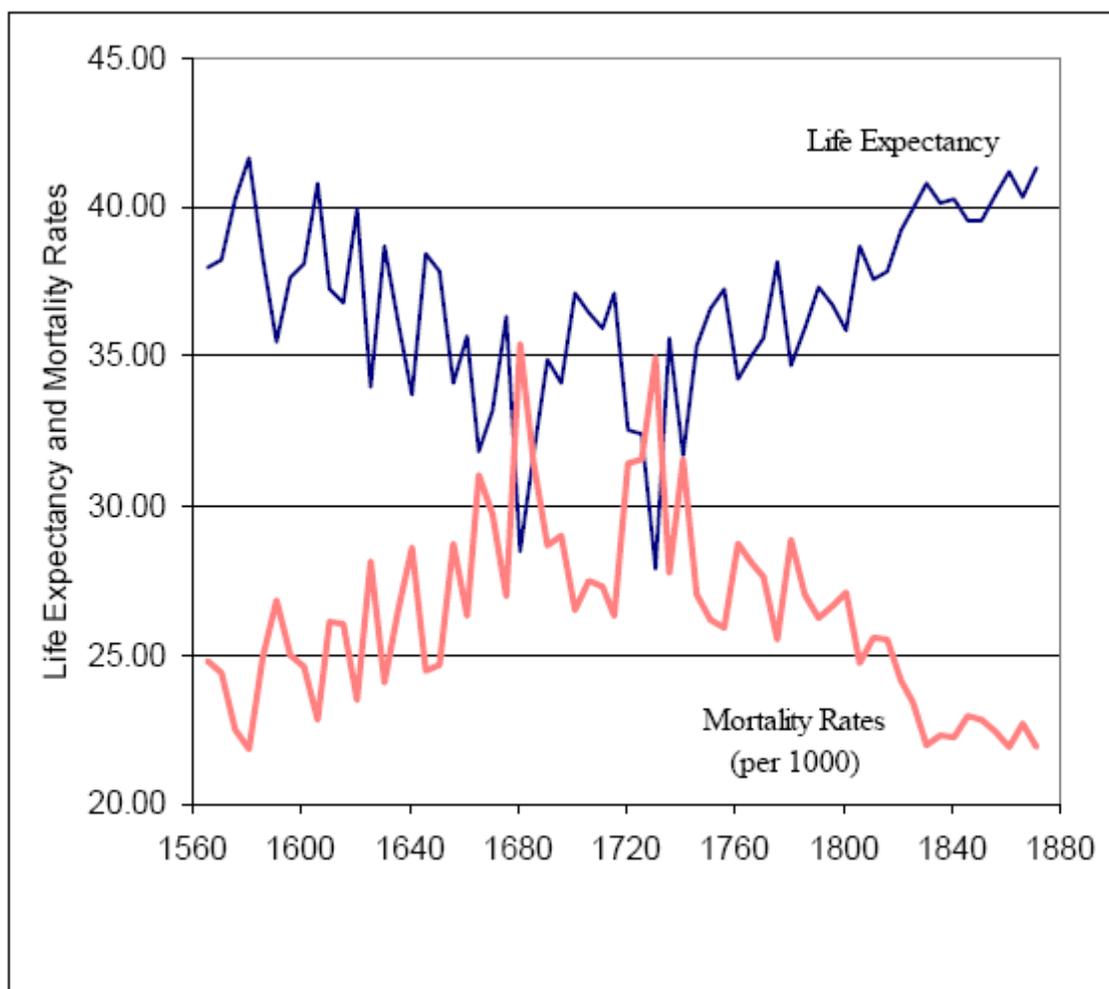
not translate into a mortality crisis life expectancy in Cuba increased from 75 years in the late 1980s to 78 years in 2007.

The increase in mortality in post-communist countries is truly exceptional and unprecedented development that has only a few analogues in history. One is the transition from Paleolithic to Neolithic age about 7000 to 3000 B.C., when the life expectancy fell by several years (Galor and Moav, 2004) – possibly due to the change in diet and lifestyle (transition from hunting and gathering to horticulture and husbandry). Another comparable case – the increase in mortality during the Enclosure policy and Industrial Revolution in Britain, which is even better documented (fig. 2) – from the 16th to the 18th century life expectancy fell by about 10 years – from about 40 to slightly over 30 years (Wrigley and Schofield, 1981) due to changes in the lifestyle, increase in income inequalities and impoverishment of the masses. Other cases of the reduction of life expectancy due to social changes – without wars, epidemics and natural disasters (say, for the black population of the American South after the abolition of slavery in 1865) – are very few and do not involve a fall of life expectancy by 6 years for the whole population of a large country (Cornia, 2004).

The dramatic increase in mortality that occurred during transition (most pronounced for middle aged men group and caused mostly by cardiovascular diseases) cannot be fully explained by “material” factors like the fall in real incomes leading to poor nutrition, deterioration in the quality of the environment and health care system, alcoholism and smoking (Shapiro, 1995; Leon, Chenet, Shkolnikov, Zakharov, Shapiro, Rakhmanova, Vassin, McKee, 1997). It was pointed out that the change in the diet (from meat and milk products to bread and potatoes) cannot cause the increase of cardio-vascular diseases, that the emissions of pollutants actually decreased with the collapse of industrial output, and that the major impact of deterioration of health care, smoking and alcoholism (as well as changes in the diet) should result in increased mortality only with the lag of at least several years, that was evidently not the case (Cornia, 1997; Cornia, Paniccchia, 2000).

The upsurge in mortality also cannot be explained by the “demographic echo” theory – the increase in mortality in 1989-94 was merely an echo of the decrease that occurred during Gorbachev anti-alcoholic campaign in 1985-87 (Avdeev, Blum, Zakharov, Andreev, 1998). The echo in this case seems to be several times larger than the initial shock.

Fig. 2. Mortality Rates and Life Expectancy (at birth) in the Course of Early Urbanization: England 1540-1870



Source: Galor and Moav, 2004, citing Wrigley and Schofield, 1981.

Whereas most experts would agree that the deterioration of the diet and degradation of the health care system, as well as increase in deaths from external causes (accidents, murders, suicides) contributed to the general increase in mortality in Russia and many other post-communist countries, they mostly would not regard them as the primary factors. Today, it seems like there are two major competing theories – one states that the transition mortality crisis is generated by stress factors, another attributes the rise in mortality to alcohol consumption.

Stress factors are associated with the transition to the market economy and are given by the rise in unemployment, labor mobility, migration, divorces, and income inequalities (Cornia, 1997; Cornia, Paniccia, 2000). King, Stuckler, and Hamm (2006) argued that mass privatization programs created psychological stress which directly resulted in higher mortality. The major theory that competes today with the stress-related explanation of the upsurge in mortality is the increase in alcoholism (Leon, Chenet, Shkolnikov, Zakharov, Shapiro, Rakhmanova, Vassin, McKee, 1997; Vishnevsky, Shkol'nykov, 1999; Pridemore, 2008). The evidence from the comparison of Russia's regions allows shedding some additional light on the contribution of these factors to the increased mortality.

The most successfully performing regions, such as resource regions, demonstrated high elasticity of employment on output and relatively (as measured against the magnitude of the reduction of output) high unemployment rates (Popov, 2001a). Such a pattern suggests that there was probably a tradeoff between performance and employment downsizing restructuring, and there was a price to pay for better performance in the form of higher relative increase in unemployment (per unit change in output) resulting from restructuring. In absolute terms the levels of unemployment in the better performing regions are very close to national average despite the more favorable dynamics of output. Another “price of success” is the higher labor mobility and the growth of income inequalities. Gini coefficient of income distribution does not seem to depend on performance: regions with smaller declines in industrial output in the 1990s did not exhibit lower income inequalities. As a result, it turns out that relatively better off regions in terms of output change were relatively

worse off in terms of stress factors leading to higher increases in mortality and greater reductions of life expectancy (Walberg, 1998).

The major alternative explanation attributes the rise in mortality to the increased consumption of alcohol that really occurred in the early 1990s according to official data and even in the late 1980s, during the anti-alcoholic campaign, – according to unofficial estimates (fig. 4). Deaths from alcoholic poisoning are often regarded as the better indicator of alcohol consumption (because part of the alcohol is produced illegally and smuggled). These deaths per 100,000 of inhabitants increased from 10 in 1990-91 to nearly 40 in 1994 and exceeded the number of deaths due to suicide and murders (fig. 4). Later, however, by 2007, the rate of these alcohol related deaths fell to the late Soviet levels, even though total mortality rate remained considerably above the late Soviet levels (figs. 1, 4). The increase in the intake of alcohol, in turn, is attributed to the decline in relative prices of spirits in the early 1990s. It was shown that the demand for alcohol, like the demand for other goods, is negatively affected by price and positively – by personal income (Andrienko, Nemtsov, 2006).

Data and methods

The dependent variable is the change in life expectancy in 1990-2003³. The explanatory variables could be divided into three groups:

1. Objective conditions (climate proxied by average January temperature, degree of urbanization, population density, and Far East and Moscow dummy variables).

³ It was suggested by one of the referees that mortality crisis in Russia was primarily constituted by the increase of mortality at working ages. Mortality below age 15 years and after 70 years (women) was declining after 1991. Life expectancy at birth is affected not only by mortality at working ages but also by infant and child mortality and also by old-age mortality. As a result, changes in life expectancy at birth are confounded by changes in child mortality having the opposite direction compared to adult ages. Hence, age-adjusted mortality at working ages (15-60 or 20-60 years) or life expectancy at working ages may be a better choice of mortality indicator for studies of Russian mortality crisis.

It would be interesting to analyze what are the factors affecting age-adjusted mortality at working ages (15-60 or 20-60 years) or life expectancy at working ages, but this data are not available in the regional breakdown. Instead I introduced another independent variable – share of population at working age in 1998 (in the middle of the period). It turned out to be insignificant in all specifications. Besides, an argument could be made that stress and alcoholism affects the elderly and children as well – elderly on obvious reasons, children – because in stressed families with high alcohol consumption children are exposed to greater health risks.

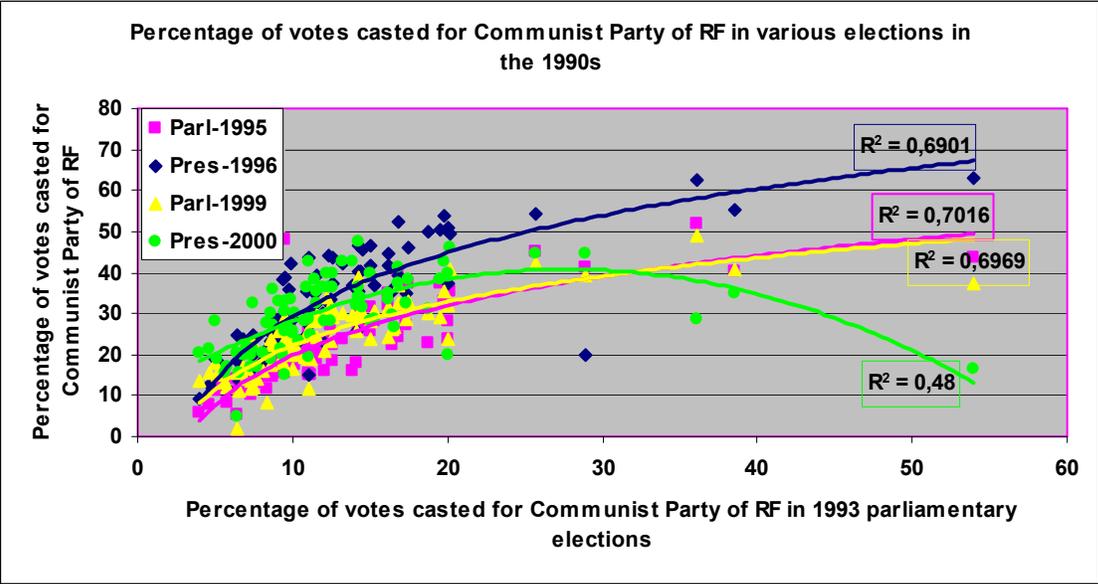
2. Economic variables (investment and incomes) and indicators of the institutional capacity of the regional governments (crime murder levels increase and share of small enterprises in regional employment adjusted for the degree of urbanization). Murders, of course, affect mortality directly, but they are also good indicators of the institutional capacity of the state (monopoly on violence – see Popov, 2001a,b, 2007). The share of small enterprises in total employment characterizes the ability of the regional government to create a law and order business environment (Popov, 2001a,b). This institutional capacity is needed to manage restructuring and associated stress.
3. Stress indicators – increase in labor mobility and unemployment, migration, divorces, income inequality and poverty.
4. Level of alcohol consumption and increase in this level.
5. Health care system deterioration proxied by the change in the number of doctors per capita.
6. Political orientation of the regional governments proxied by the percentage of votes received by the communists in the elections of the 1990s.

All indicators are taken from Goskomstat (*Regiony Rossii*), unless otherwise specified. Goskomstat database contains data on 89 regions, but not all data for each region are available. The increment indicators are for the period under investigation – 1990-2003, except for the following. The increase in per capita vodka sales per capita is measured from 1997 to 2003 because there is no data. The same applies to the increase in poverty levels (1994-2003), inequality increase (the ratio of the share of 20% of the wealthiest to the share of 20% of the poorest population in total income – 1995-2003). The change in regional investment (as compared to Russian average) is measured from 1990 to 1998, since 1998 was the lowest point of decline in investment in most regions. And the change in real incomes is measured from 1990 to 1999 because the trough in real incomes was reached in 1999, the next year after the currency crisis of August 1998 that led to the dramatic devaluation of the ruble and reduction of real incomes. Both investment and real incomes recovered after 1998 and 1989 respectively,

but this gradual (and in case of investment – incomplete) recovery allegedly⁴ was less important for the change in life expectancy than the sharp reduction in the first half of the 1990s.

The level indicators are for the middle of the period in question – 1997. The exception is the labor turnover variable which is available only for 1995. The unemployment level variable for 2003 is used in the regression explaining the increase in sales of alcohol in 1997-2003. The share of votes casted for communists is measured by the results of 1996 presidential elections, but other elections of the 1990s were not very different in this respect (fig. 3).

Fig. 3. Percentage of votes casted for the Communist Party of RF in various elections in the 1990s



Source: Central Electoral Commission of RF.

⁴ This assumption is later tested and confirmed.

AVTEMP, average temperature in January 1997, has a predictable negative effect on life expectancy change, suggesting that in cold regions due to the collapse of the infrastructure during transition it was more difficult to contain the rise in mortality. *URB*, the share of urban population on January 1, 1997, had a negative impact on life expectancy because economic restructuring was taking place mostly in urban areas. *FAREAST*, dummy variable for the regions of the Far East, perhaps surprisingly, influenced life expectancy positively – probably because the largely migrant population of the region (in the second and third ancestor generations virtually everyone was a migrant) retained the higher capacity to cope with stress factors. *MOSCOW*, Moscow dummy variable had a negative impact on the change in life expectancy (the magnitude of restructuring in Moscow is the highest in the country and stresses are numerous).

INVincr, investment in 1998 as a % of 1990, had a predictable positive impact (better infrastructure and job prospects), but *Yincr*, personal real incomes in 1999 as a % of 1990, had a negative impact on life expectancy, suggesting that stress played a prominent role in influencing changes in mortality, so that regions with higher growth of real incomes (i.e. more rapid restructuring) had to pay a high price in the form of greater increases in mortality.

Institutional capacity indicators, share of small enterprises in total employment in 1997 adjusted for the degree of urbanization, *SMent* (the higher it is, the better is business climate in the region), increase in crime rate in 2003 as compared to 1990, *CRIMEincr*, and increase in the number of murders per 1000 inhabitants in 2003 as compared to 1990, *HOMIClevelINCR*, had predictable (positive and negative respectively) impact on life expectancy. The influence of *CRIMEincr* and *HOMIClevelINCR* was not only direct – greater mortality from crimes and murders, but also indirect – a proxy for worsening of the capacity of regional governments to cope with stress factors and a proxy for stress factors (insecurity) themselves.

Stress factors had the greatest effect on life expectancy change. Labor turnover (hiring and layoffs) as a % of employment (*LABmob*), Gini coefficient of income inequalities in 1997 (*GINI97*), share of richest 20% of the population in total income in 2003 (*SHrich03*), share of poorest 20% of the population in total income in 2003 (*SHpoor03*), ratio of the share of richest 20% to the share of poorest 20% of the population in 2003 (*INEQ03*), increase in the number of immigrants to the region per 10,000 of inhabitants in 2003 as compared to 1990 (*MIGRgrINCR*), increase in the number of divorces per 1000 of inhabitants in 2003 as compared to 1990 (*DIVrateINCR*) – all these stress factors affected negatively and significantly changes in life expectancy.

Gini coefficient takes into account the deviation of income shares of all income groups from the absolutely even income distribution line and so it is a better way to measure inequalities as compared to the indicators of the share of 20% richest and 20% poorest population in total income. The Gini coefficients for the regions, however, are available only for 1997 (they are taken not from Goskomstat that does not report Gini for the regions, but from the research paper by Shevyakov and Kiruta, 1998) and not to waste this information it is used together with the other indicators of income inequalities.

The method is to run cross-regional regressions to see, if this could shed light on the major causes of the increase in mortality. I first regress changes in life expectancy on all available explanatory variables – objective conditions, economic restructuring and institutional degradation, stress indicators, vodka sales, health care system deterioration and political orientation of the regional governments. It turns out that all of them are significant, if included separately, and some are correlated with the other. In particular, increase in vodka sales is strongly correlated with labor mobility and other stress factors. If the increase in alcohol consumption is also driven by stress factors, like the decrease in life expectancy, it is reasonable to consider the residuals from the equation that explains alcohol consumption and to use these residuals as an explanatory variable in the equation for life expectancy change. Such an exercise would help testing whether the exogenous (not driven by stress) increase in the consumption of alcohol affects life expectancy or not.

Results: initial conditions, economic restructuring, stress and alcohol consumption

Overall, initial and objective conditions (climate, urbanization, regional dummies for the Far East and Moscow), institutional capacity of the regional governments (share of employment at small enterprises, crime rate and murder rate), economic indices (investment and income), stress factors (labor turnover, migration, divorces, income inequalities, crime), and health care system developments (even without alcohol consumption indicators) explain over 80% of the regional variations in changes in life expectancy in 1990-2003 (table 1).

Table 1. Cross-region regressions: factors of change in life expectancy in Russia's regions in 1990-2003, robust estimates, T-statistics in brackets, constant is not shown

Dependent variable – change in life expectancy in 1990-2003, years

Equations, # of variables/variable	1, N=64	2, N=62	3, N=62	4, N=62	5, N=62	6, N=63	7, N=63
Average temperature in January 1997, degrees	-.059*** (-2.99)	-.037** (-2.06)	-.030 (-1.62)	-.028 (-1.53)	-.039** (-2.29)	-.043*** (-2.75)	-.052*** (-3.39)
Share of urban population, 1997, %		-.062*** (-3.19)	-.056*** (-3.55)	-.056*** (-3.33)	-.062*** (-4.58)	-.066*** (-3.80)	-.066*** (-4.02)
Dummy variable for Far East regions		1.07** (2.50)	0.83* (1.90)	0.90** (2.02)	1.01** (2.40)	1.42*** (3.26)	1.38*** (3.40)
Moscow dummy			-7.37*** (-4.66)	-6.35*** (-3.29)	-7.61*** (-5.05)	-4.91** (-2.47)	-5.78*** (-2.87)
Investment in 1998 as a % of investment in 1990	.014*** (4.22)	.008** (2.52)	.009** (2.11)	.008** (2.30)	.008** (2.43)	.008*** (3.32)	.008*** (3.72)
Real personal income In 1999 as a % of 1990			-.024* (-1.71)	-.02 (-1.33)	-.025** (-2.19)		
Share of employment at small enterprises (adjusted for the share of urban population in the region), 1997, %		.064* (1.68)	0.10** (2.50)	.77* (1.76)	0.88** (2.39)		
Crime rate in 2003 as a % of 1990		-.001 (-1.48)				-.004* (-1.68)	-.004* (-1.82)
Increase in the number of murders per 1000 of inhabitants in 2003 as	-10.4*** (-2.99)	-11.1*** (-4.41)	-12.0*** (-4.98)	-12.4*** (-5.01)	-13.5*** (-5.42)	-13.4*** (-6.15)	-13.7*** (-6.17)

a compared to 1990							
Labor turnover as a % of employment in 1995	-.071*** (-3.90)	-.057** (-3.13)	-.054*** (-2.92)	-.033* (-1.78)	-.060*** (-3.20)	-.035* (-1.66)	-.028 (-1.28)
Gini coefficient of income inequalities in 1997		-.084*** (-3.21)	-.092*** (-3.81)	-.093*** (-3.74)	-.101*** (-3.99)	-.099*** (-3.35)	-.090*** (-3.17)
Ratio of the share of richest 20% to the share of poorest 20% of the population in 2003, squared		-.016*** (-3.94)					
Increase in the number of immigrants to the region per 10,000 of inhabitants in 2003 as compared to 1990, %	-.006** (-2.33)	-.004** (-2.26)	-.003* (-1.72)	-.003 (-1.39)	-.004*** (-2.24)	-.005** (-2.37)	-.005** (-2.32)
Number of divorces per 1000 of inhabitants in 2003 as a % of 1990	-.47*** (-3.87)	-.37*** (-3.65)	-.42*** (-3.94)	-.42*** (-3.85)	-.40*** (-4.30)	-.35*** (-4.36)	-.34*** (-4.23)
Sales of vodka per capita in 2003, liters				-0.51** (-2.06)		-0.69*** (-3.22)	-0.74*** (-3.60)
Number of doctors per 10,000 inhabitants in 2003		-.39*** (-5.39)	-.31*** (-6.28)	-.30*** (-5.44)	-.31*** (-6.88)	-0.28*** (-5.18)	-.30* (-4.98)
Interaction term = Number of doctors * Share of richest 20% in income		.009*** (5.62)	.008*** (6.36)	.007*** (5.49)	.007*** (7.03)	.006*** (-5.27)	.006*** (5.05)
Interaction term = Number of doctors * Communist vote					.0007* (1.89)	.0007** (2.09)	.0007** (2.16)
Adjusted R ²	60	80	81	83	83	84	85

*, **, *** - Significant at 10%, 5% and 1% level respectively.

Alcohol consumption. (Nemtsov, 2002) attributes as much as 1/3 of total deaths in Russia to alcohol related causes (including indirect), which is much higher than official estimates (less than 4% deaths from causes directly related to alcohol consumption), a view widely held by Western experts. “Despite the improving situation, one-third of all deaths in Russia

are directly or indirectly related to alcohol, requiring intervention at a variety of levels” (Pridemore, 2008). These are the highest available estimates that many experts question. Official statistics reports that only 3% of all deaths are caused by alcohol (alcohol poisoning, liver cirrhosis, alcoholism, and alcoholic psychosis). Anatoly Vishnevsky (personal communications) attributes about 12% of all deaths to alcohol-related causes⁵.

It seems obvious that increased alcohol consumption contributed to the rise of deaths due to external causes – accidents, murders, suicides (fig. 4). In 2002 the death rates from external causes in Russia was not among the highest, but *the* highest in the world (table 2). There is also an apparent correlation between alcohol consumption and death rate from all causes, but this does not necessarily imply causation.

First, there is a controversy what is the impact of increase in the intake of alcohol on cardiovascular diseases. A recent study by Spanish researchers (Arriola et al., 2009) – 10 year survey of 41000 people aged 29-69, found that, compared with male non-drinkers, those that drank before but later quit drinking have 10% less chance of having heart problems, those that drink small amount (less than 0.5 gram everyday) have 35% less chance, those drinking moderately (5-30 gram everyday) has 54% less chance, and big drinkers (30-90 gram a day) and alcoholics (more than 90 gram a day) have 50% less chance of having heart problems.

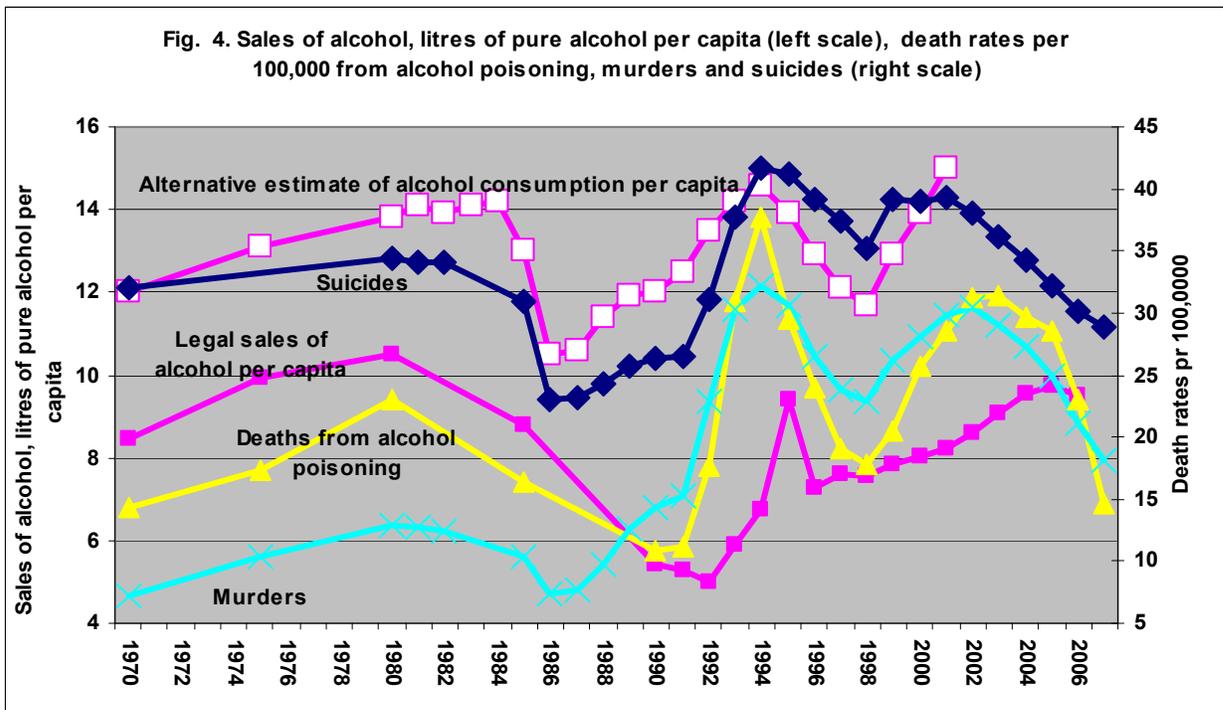
Second, there are some periods, when per capita alcohol consumption and death rate were moving in opposite directions – in 2002-07 deaths rates from external causes, including murders, suicides, poisoning, were falling against the background of rising alcohol consumption. Similar inconsistencies exist for the period of the 1960s: from 1960 to 1970 alcohol consumption increased from 4.6 to 8.5 liters per capita according to official

⁵ There is a belief that many doctors in Russia under the pressure from relatives of the deceased do not indicate the true reason of death (alcoholic poisoning) putting cardio-vascular diseases (the #1 cause of deaths) as the cause of death into the death certificate. But the true scale of such a misreporting is hardly known.

statistics (and from 9.8 to 12 liters according to alternative estimates), whereas life expectancy did not change much – 69 years in 1960, 70 in 1965, 69 in 1970.

And third, the levels of per capita alcohol consumption, according to official statistics and alternative estimates, in the 1990s were equal or lower than in the early 1980s, whereas death rate from external causes doubled and total death rate increased by half (compare figs. 1 and 4). It appears, therefore, that we observe a simultaneous increase in variables (total death rate and death rate from external causes, as well as alcohol consumption) that are all driven by another factor, which is very likely stress.

Fig. 4. Sales of alcohol, liters of pure alcohol per capita (left scale), death rates per 100,000 from alcohol poisoning, murders and suicides (right scale)



Source: For death rates – WHO database and Goskomstat; for legal sales of alcohol – Goskomstat; for alternative estimates of alcohol consumption – Demoscope, No. 263-264, Oct. 30 –Nov. 12, 2006.

Table 2. Number of deaths from external causes per 100,000 inhabitants in 2002 – countries with highest rates

Country/Indicator	Deaths from external causes, total	Including deaths from			
		Accidents	Suicides	Murders	Other*
Russia	245	158	41	33	11
Sierra-Leone	215	148	10	50	7
Burundi	213	64	7	18	124
Angola	191	131	8	40	13
Belarus	172	120	38	13	0
Estonia	168	124	29	15	0
Kazakhstan	157	100	37	20	0
Ukraine	151	100	36	15	0
Cote D'Ivoire	148	86	11	27	24
Colombia	134	36	6	72	19
Niger	133	113	6	14	0

*Deaths due to unidentified external causes, wars, police operations, executions. Totals may differ slightly from the sum of components due to rounding.

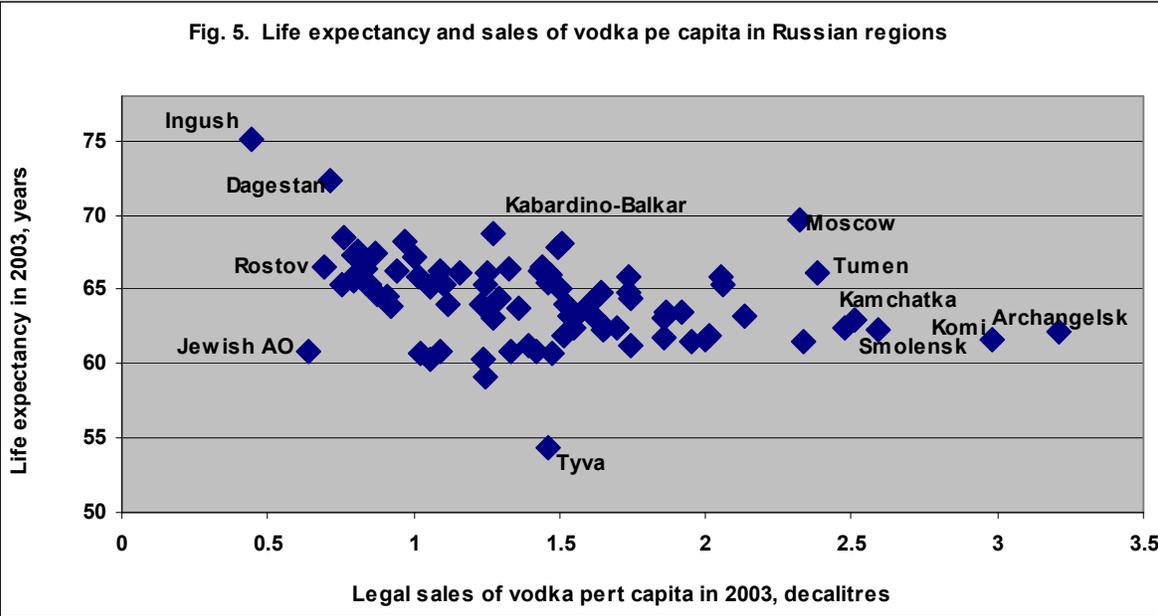
Source: WHO (<http://www.who.int/entity/healthinfo/statistics/bodgbddeathdalyestimates.xls>)

Cross regional comparisons give additional argument. There is a negative relationship (fig.5) between the levels of vodka consumption and the level of life expectancy by region – high vodka consumption and low life expectancy in Northern and Eastern resource regions (with a lot of restructuring and a lot of stress) and low vodka consumption and high life expectancy in southern regions, especially in Northern Caucasus (with low levels of restructuring and less stress). Again, one possible explanation would be that higher alcohol consumption leads to higher mortality (lower life expectancy), but the other explanation is that higher stress has two effects – it reduces life expectancy and drives up alcohol consumption, which by itself does not contribute to higher mortality.

A closer look reveals that the indicator of the increase in sales of vodka per capita in 1997-2003, *VODKAincr*, is not significant, when included into the RHS. The level of vodka consumption, *VODKA03* – sales of vodka per capita in decaliters in 2003 – affected changes in life expectancy negatively, but most probably due to its correlation with stress indicators,

in particular – with labor mobility (see fig. 4 below), so inclusion of both variables in the same regression on the RHS sometimes makes *LABmob* insignificant (last equation in table 1). When vodka consumption is included separately, without the other control variables (labor mobility, crime rate increase, real income change, share of employment at small enterprises), it is significant (see table 1).

Fig. 5. Life expectancy and sales of vodka per capita in Russian regions



Source: Goskomstat.

It is possible that this high correlation between labor mobility in 1995 and vodka consumption per capita in 2003 ($R = 0.58$, see fig. 3) is just spurious because the correlation with vodka consumption in 1997 is only 0.26 and with the increase in vodka consumption in 1997-2003 – 0.38. However it is also possible that the increase in the vodka consumption is driven by the same stress factors that contribute to higher mortality: 50% of cross-regional variations in the increases in per capita sales of vodka in 1997-2003, *VODKAincr*, after controlling for the density of the population, *POPdens*, and the level of sales that existed in the beginning of the period, *VODKA97*, are explained by exactly the same stress indicators

that were discussed previously – unemployment level in 2003, *UNEMPL03*, labor turnover in 1995, *LABmob* (no data for later years), increase in migration inflows to the region in 2003 as compared to 1990, *MIGRgrINCR*, increase in inequalities (the ratio of the richest group to the poorest in 2003 as compared to 1995, *INEQincr*), and the increase in the share of population living below the poverty line in 2003, as compared to 1994, *POVERTYincr*. The equation below is the best one that was found to explain changes in vodka sales in 1997-2003:

$$\begin{aligned} \mathbf{VODKAincr} = & -1.2 - 0.65\mathbf{VODKA97} + 0.002\mathbf{POPdens} + 0.03\mathbf{UNEMPL03} + \\ & (3.88) \quad (-5.74) \quad (2.90) \quad (1.97) \\ & +0.001\mathbf{MIGRgrINCR} + 0.05\mathbf{INEQincr} + 0.04\mathbf{LABmob} + 0.008\mathbf{POVERTYincr} \\ & (2.48) \quad (1.66) \quad (6.40) \quad (1.69) \end{aligned}$$

(N=75, R² = 0.49, robust standard errors, t-statistics in brackets all coefficients significant at 10% level or less)

Similar equation can be obtained to explain the *level* of vodka consumption in 2003:

$$\begin{aligned} \mathbf{VODKA03} = & -0.6 + 0.001\mathbf{MIGRgrINCR} + 0.03\mathbf{INEQ03} + 0.043\mathbf{LABmob} + 0.01\mathbf{URB} \\ & (2.58) \quad (1.76) \quad (1.76) \quad (4.49) \quad (2.43) \end{aligned}$$

(N=79, R² = 0.41, robust standard errors, t-statistics in brackets all coefficients significant at 10% level or less)

If the residuals from the two equations above (explaining the level and increase in the sales of vodka) are introduced into the RHS of the best equation to explain changes in life expectancy, it turns out that these residuals have predicted (negative) sign and are statistically significant. That is to say, there is still evidence that regional variations in the consumption of alcohol, even if they are not determined by stress factors, have a negative effect on life expectancy. This impact, however, is rather modest – the coefficient linking life expectancy change in years and vodka sales per capita in decaliters is about 0.5, i.e. for life expectancy to fall by 1 year sales of vodka per capita have to increase by about 20 liters a year. Obviously, the size of the

effect is too small to explain the decline in life expectancy by 5 years on average with average sales of vodka of 14-15 liters.

Deterioration of the health care system. The impact of health care system developments on life expectancy is rather weak and cannot be traced, if the indicators of the capacity of health care system (number of doctors, mid-level medical personnel, hospital beds, and polyclinics patient capacity) are included into the RHS as a linear variables – this result is similar to (King, Stuckler, and Hamm, 2006). However, if the number of doctors per capita is interacted with the inequalities variables and communist vote variable, the coefficients become significant. The best equation is the one before the last in table 1 (equation No. 6) and is reorganized below in such a way as to make the impact of the number of doctors explicit:

$$\Delta LE = CONST + CONTR + DOCT03(.0007COMMvote + .006SHrich03 - .28),$$

(all coefficients, including control variables, are significant at 10% or less, $R^2=0.84$, $N=63$),

where

DOCT03 – number of doctors per 10,000 inhabitants in 2003,

SHrich03 – share of richest 20% of the population in total income in 2003,

COMMvote – share of votes cast for the communist candidate at 1996 presidential elections, % (strongly correlated with the share of votes cast for communists at other presidential and parliamentary elections – see “data and methods” section).

There is a threshold in this regression: the equation implies that the number of doctors per capita had a positive impact on changes in life expectancy not always, but only under certain conditions: (1) when the share of the highest income group is high enough – close to 40% and over, and (2) when the share of votes cast for communists is high enough. The interpretation is quite straightforward – high capacity of health care facilities had a favorable impact on life expectancy only if there were enough rich people in the region that could afford to pay for this health care and/or if the regional government was distributing the health care services in a egalitarian way (proxied by the communist vote variable). In fact the coefficient of the **COMMvote** variable is so small, that it cannot counteract the inequalities effect, if the share of

the richest 20% in total income is lower than 35% – in this case the impact of the greater number of doctors on life expectancy is always negative, even if all 100% of voters vote for communists.

Overall, it turns out that health care facilities in Russia in 1990-2003 were contributing to the increase in life expectancy only in regions with very high income inequalities, high share of richest income group in total incomes, whereas in other regions the impact of the greater number of doctors per capita on life expectancy was negative, if any. It remains to be said that in 2003 there were only 10 regions, in which the share of the top 20% of the population in total income exceeded 45% – a necessary condition to enjoy the positive impact of the higher number of doctors on life expectancy (given the actual percentages of the votes cast for communists).

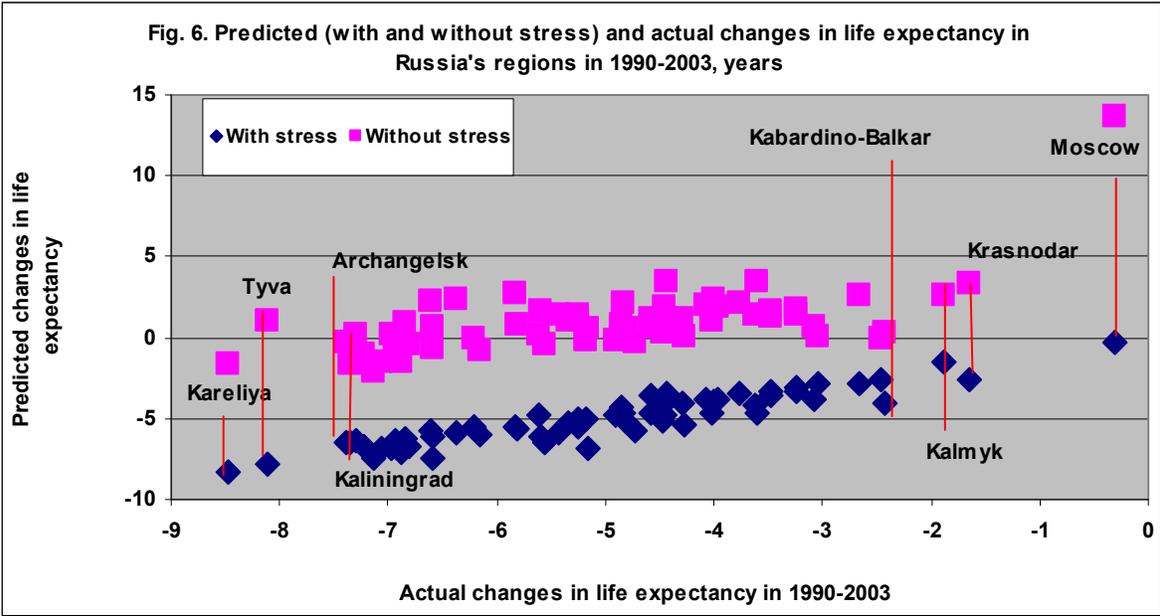
Besides, the impact of the health care system capacity on life expectancy change was extremely modest as compared to the impact of the stress factors that definitely predominated.

Concluding comments

To reiterate, Russian mortality crisis of the 1990s was caused by the shock-therapy type marketization of the economy that led to mass reallocation of labor in the course of industrial restructuring and to the dramatic rise of stress factors – income inequalities, unemployment, labor turnover, migration, crime, and divorces, that were mostly responsible for the unprecedented 60% increase in mortality rate. Alcohol consumption, although strongly correlated with the mortality rate, most likely was not the important cause of it, but was determined by the same stress factors, as the mortality rate itself. Deterioration of the health care facilities had only a modest impact on life expectancy and only in regions with low share of rich population and non-equitable political orientation (low share of votes casted for communists).

Hence, it is exactly the role of stress factors in mortality rise that makes the Russian case unique. Consider predicted changes in life expectancy (according to the regression equation in the column before the last one in table 1) and hypothetical changes that would have occurred, if the stress factors were absent (no increase in crime and homicide rate, in migration, labor turnover, divorces, income inequalities). These two indicators (predicted changes in life expectancy with and without stress factors) are plotted on the chart below against actual changes in life expectancy that are shown on the horizontal axis (fig. 6). It turns out that without the stress factors life expectancy would be higher by 2003 in every single region by about 5 years on average. In fact, without stress factors life expectancy that has actually fallen by 9 to 0.1 years (on average – 5 years) in 1990-2003, would increase in most of the regions (in all except 15), so that on average it would have been 1 to 2 years higher in 2003 than in 1990. Not a great record for 13 years, but at least no reduction in life expectancy that actually occurred.

Fig. 6. Predicted (with and without stress) and actual changes in life expectancy in Russia's regions in 1990-2003, years



Source: Goskomstat (Regiony Rossii) and author's calculations.

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APPENDIX. List of variables

deltaLE - increase in life expectancy in 1990-2003, years,
AVTEMP - average temperature in January 1997,
URB – share of urban population on Jan. 1, 1997
POPdens – density of the population in 1997, persons per 1 sq. km,
FAREAST – dummy variable for the regions of the Far East,
MOSCOW – dummy variable for Moscow,
INVincr – investment in 1998 as a % of 1990,
Yincr – personal real incomes in 1999 as a % of 1990,
SMent – share of employment at small enterprises (adjusted for the share of urban population in the region) in 1997,
UNEMPL03 – level of unemployment in 2003, %,
LABmob – labor turnover (hiring and layoffs) as a % of employment in 1995,
GINI97 – gini coefficient of income inequalities in 1997 (unofficial estimate, Shevyakov, Kyruta, 1998),
SHrich03 – share in of richest 20% of the population in total income in 2003, %,
SHpoor03 – share in of poorest 20% of the population in total income in 2003, %,
INEQ03 – ratio of the share of richest 20% to the share of poorest 20% of the population in 2003,
INEQincr – ratio of richest 20% to the share of poorest 20% of the population in 2003 minus the same ratio in 1995,

POVERTYincr – percent of people below the poverty line in 2003 minus the same percent in 1994, p.p.

MIGRgrINCR – increase in the number of immigrants to the region per 10,000 of inhabitants in 2003 as compared to 1990,

DIVrateINCR – increase in the number of divorces per 1000 of inhabitants in 2003 as compared to 1990,

CRIMEincr – crime rate in 2003 as a % of 1990,

HOMIClevelINCR – increase in the number of murders per 1000 inhabitants in 2003 as compared to 1990,

VODKA03 – sales of vodka in decaliters per capita in 2003,

VODKA97 – sales of vodka in decaliters per capita in 1997,

VODKAincr — increase in sales of vodka in decaliters per capita in 1997-2003,

DOCT03 – number of doctors per 10,000 inhabitants in 2003,

COMMvote – share of votes cast for the communist candidate at 1996 presidential elections, % (strongly correlated with the share of votes cast for communists at other presidential and parliamentary elections).