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REVEALING MACROECONOMIC DETERMINANTS OF ALCOHOL ABUSE AND ITS INFLUENCE ON LIFE EXPECTANCY IN RUSSIA

BASIC RESEARCH PROGRAM

WORKING PAPERS

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REVEALING MACROECONOMIC DETERMINANTS OF ALCOHOL ABUSE AND ITS INFLUENCE ON LIFE EXPECTANCY IN RUSSIA

This working paper is devoted to researching inter-regional differences in the volume and structure of alcohol consumption. To find the underlying trends and dependences, we tested hypotheses about the influence of various macroeconomic factors on alcohol consumption in Russia. The tests were completed using regression analysis based on official statistical data. Data on the volume of regional alcohol sales in liters were used as proxy variables because of the shortage of regionally divided statistical data on alcohol consumption. The data on absolute alcohol consumption in each region were obtained from the weighted-average share of spirits in each kind of alcoholic product considered. Thus, we also assessed the role of different products in total alcohol consumption.

At the end of this working paper we assessed the influence of alcohol abuse on population mortality and life expectancy. Valid results were obtained for both male and female parts of the population.

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1.   Introduction

This article is devoted to investigating the differences in regional alcohol consumption in Russia and its influence on human health and longevity. This analysis is based on a regional cross-section data sample collected by the Russian Federal State Statistics Service that is open to the public. Links between health and the factors that, according to our hypothesis, influence it will be tested for consistency using regression analysis.

The urgency of this study stems from the fact that alcohol abuse has been a serious social problem in Russia for quite a long time. This problem leads to a reduced life expectancy (especially for males), as well as to significant differences in life expectancy between men and women that now equals 12 years on average. As noted in several studies (Nemtsov, 2002; Pridemore, 2008; Popov, 2009), at least one third of all deaths in Russia are directly or indirectly associated with alcohol consumption. This also raises the question of how changes in Russia over the past 20 years, including significant changes in household incomes and unemployment, as well as the fundamental expansion of a range of hard and soft drinks (especially beer), impact both the alcohol composition level, as well as life expectancy.

A significant amount of working papers are devoted to assessing the relationship between health indicators and its determinants. It should be noted that studies conducted at the micro level are often characterized by the use of various health indicators, including self-assessments from respondents. However, macro level studies usually use as dependent variables such indicators as life expectancy and various mortality indicators: age-specific mortality, mortality by cause, infant mortality, etc. (Kossova 1991; Ruhm, 2002). Aggregate mortality indicators are convenient to use for cross-section country analysis (Kossova, 1991; Braninerd and Cutler, 2005), as well as for cross-regional analysis within a country (Walberg et al, 1998; Treisman, 2010).

Many scientists around the world have studied the relationship between public health and macroeconomic factors. An analysis of studies in this area suggests that, despite the statistically significant relationship between health outcomes and various macroeconomic parameters (including GDP per capita, unemployment rate, inequality indices, etc.), there are different points of view on the direction of this impact. In particular, most works written before the 1990s note a positive correlation between an improved economic situation and public health (Brenner, 1973, 1975, 1979; Kossova, 1991). A number of papers written mostly during the 1990 show that a relationship between the economic situation and public health is not always evident in the short term (Forbes and McGregor, 1984; Joyce and Mocan, 1993; McAvinchey, 1994). However, empirical studies conducted in developed countries in the early 21st century noted improvements

in health during the economic downturn: at the achieved level of economic development, the relationship between these variables in the short term was negative (Ruhm, 2000, 2003, 2005a, 2005b; Neumayer, 2004).

A positive change in lifestyle during an economic recession is often considered as a factor of correlation between economic development and population health (Ruhm, 2003). For example, a number of recent studies revealed a micro-level shift to a healthy lifestyle, including a reduction in alcohol consumption during hard times (Dee, 2001; Macela et al, 2001; Ruhm and Black, 2002; Ruhm, 2005a). It has been confirmed in many research papers that a reduction in alcohol consumption leads to an almost instantaneous reduction in mortality (Cook and Moone, 1987; Pridemore and Kim 2006, Razvodovsky, 2010). Research has shown that a decrease in alcohol consumption during a recession is explained by a decrease in domestic income (for example, Ruhm and Black, 2002; Johansson et al, 2006). At the same time, an increase in domestic income leads to a decrease in mortality and an increase in average life expectancy (Denisova, 2010).

Studies on the impact of unemployment on mortality give even more controversial results. In particular, according to research conducted in Finland (Jantti et al, 2000), during high rates of unemployment in the country, no increase in mortality was recorded. At the same time a number of Russian studies have revealed an increase in mortality rates during periods of unemployment (Walberg et al 1998; Periman and Bobak, 2009; Denisova, 2010). The results of studies based on micro-data have proven that people who lose their jobs start to drink more alcohol (Popov, 2009; Denisova, 2010).

There is no doubt as to the negative impact of alcohol on health, mortality, and life expectancy, which is reflected in works by both Russian and foreign authors. At the same time, it should be noted that the results of studies that were conducted in different countries revealed a different nature of relationship between alcohol consumption and mortality. In particular, a number of works conducted in the US, UK, Sweden, Germany, Spain, and Japan record positive effects from alcohol consumption on reducing the risks of death from cardiovascular disease. This relationship has U-shaped (Marmot et al, 1981; San Jose, 2003; Arriola, 2009) or J-shaped (Rehm and Sempos, 1995; Skog, 1996; Keil et al, 1997; Kitamura et al, 1998) curve. However, in other studies authors notice a linear relationship between alcohol consumption and mortality (Andersson et al, 1988; Murray and Lopez 1997; Nicholson et al, 2005; Johansson et al, 2006). It should be noted that, in studies based on Russian data, the relationship between alcohol consumption and mortality is linear (Nicholson et al, 2005; Kharchenko et al, 2005).

Research papers investigating the impact of the structure of alcohol consumption on mortality rates are most interesting for our study. There are currently two points of view on this issue: some authors link the deterioration of public health with an increase in total alcohol consumption (Kauhanen et al, 1997; Krasovski, 2008), while still others argue that only heavy alcohol consumption has a negative effect on health and mortality indicators (Leon et al, 2007; Popov, 2009; Razvodovsky, 2010).

The popularity of the point of view supporting the relative harmlessness of lower-grade alcoholic drinks has resulted in an increase in the supply of such drinks in countries with heavy alcohol consumption (Khalturina and, 2006; Nuzhniy and Rozhanets, 2007). It should be noted that this opinion contradicts the position of the World Health Organization (WHO): In official WHO documents, the transition from strong to weak drinks while maintaining the same overall level of alcohol consumption is not discussed. Thus, the WHO believes that the damage depends on the amount of alcohol consumed, and not on the form in which it is consumed (Krasovski, 2008). This position is clearly expressed in the WHO paper (WHO, 1998). Today, the influence of the structure of alcohol consumption on the population's health in Russia is understood only very poorly (Nemtsov, 2009).

Taking into account both the results of the above review and statistical results confirming the explosive growth in the production and consumption of beer in Russia, the following hypotheses are verified in this paper:

1) Regarding a change in the structure of alcohol consumption in Russia in recent years and a substantial increase beer as a fraction in overall structure of alcohol consumption.

2) Regarding the absence of low-grade alcoholic beverages as a replacement for high-grade alcohol beverages in most regions of Russia, despite the fact that absolute consumption of the former has increased.

3) Regarding the relationship between the consumption of low-grade alcoholic beverages and average life expectancy in Russia.

2.   Model description

2.1   Data base description

In this part of the research we describe the main variables that are considered to be determinants of alcohol consumption and health. This will help us to quantitatively assess whether this link between the volume and structure of alcohol consumption determinants and health is consistent and how those variables influence population health. The main variables used in this research are described in Table 2.1 (below).

Table 2.1

Main variables used in this research

Variable	Source	Comments
Life expectancy (for region's population in whole and for men and women separately)	Russian Federal State Statistics Service	The number of years that a newborn human in particular region is supposed to live in the event that during his lifetime the mortality rate would be the same as this year.
Mortality rate from reasons directly or indirectly connected with alcohol consumption	Russian Federal State Statistics Service	Death from temulence, suicide, homicide, external causes, and transportation accidents. The mortality rate is calculated as the number of deaths per 100,000 living in a particular region
Population size	Russian Federal State Statistics Service	Population size in a particular region in particular year
Income per capita	Russian Federal State Statistics Service	Income per capita is the annual population income divided by 12 (months) and by the average annual population size
Energy consumption per capita	Russian Federal State Statistics Service	(Electric) energy consumption per capita is a quotient from division of total regional energy consumption by average annual population size
Average unemployment figures during the year	Russian Federal State Statistics Service	Average number of unemployed in a particular year per 1.000 individuals living in particular region.
Population density	Russian Federal State Statistics Service	Average number of people living on 1 sq km of territory for a particular region
Urbanization rate	Russian Federal State Statistics Service	Ratio of urban population to total population in a particular region
Gini coefficient	Russian Federal State Statistics Service	The Gini coefficient characterizes the degree of deviation of the line of actual distribution of the total money from the line of their uniform distribution. Gini coefficient varies from 0 to 1, where 1 is total inequality
Male population	Russian Federal State Statistics Service	Ratio of male population to total population in a particular region
Vodka and liqueurs	Russian Federal State Statistics Service	Sales of alcoholic beverages during the year in physical terms (in liters)
Champagne and sparkling wine	Russian Federal State Statistics Service	
Wines	Russian Federal State Statistics Service	
Cognacs, brandy and brandy spirits	Russian Federal State Statistics Service	
Beer	Russian Federal State Statistics Service	
Commodity names	Russian Federal State Statistics Service	Retail sale of main product types during particular year, in thousands rubles

Based on data from the Russian Federal State Statistics Service: www.gks.ru

The title of "Commodity names" includes a wide range of products, including staple foods, beverages, cigarettes, durables, household appliances, luxury goods, etc. Alcoholic beverages were put in the table under separate titles. While commodities amount to 1000 rubles, sales volumes of alcoholic beverages are measured in physical terms (in liters) to make it easier to compare alcohol consumption in different regions. Income per capita and energy consumption per capita by region are proxies of population wealth.

The life expectancy and mortality rate from reasons directly (temulence) or indirectly (suicide, homicide, external cause, and transport accidents) connected with alcohol consumption are considered to be proxies of population health. Apart from objective factors (climate, gens),

the population's health is influenced by subjective ones, which are consequent to an unhealthy lifestyle. While life expectancy is an index that is formed under the long-term impact of population health determinants, death from temulence, in fact, comes in a mere few hours (quite a short-term result) after alcohol overconsumption. This peculiarity of the mortality index is the reason why it is more suitable for the analysis of extremely negative unhealthy lifestyle consequences. It is supposed that there is a strong correlation between alcohol consumption and mortality rate from reasons connected with alcohol abuse.

We used alcohol sales indices (in physical terms, by alcohol type: beer, wine, vodka, etc.) to assess alcohol consumption, because we were short of data about actual alcohol consumption. We assumed that the amount of alcohol sold during the year approximately equals the amount of alcohol consumed during this period. Also we took the alcoholic content in each beverage (vodka and liqueurs – 40%, champagne and sparkling wine – 11%, wines – 14%, cognacs, brandy and brandy spirits – 40%, beer – 4%) to calculate the weight average amount of absolute (or "pure") alcohol, sold in a particular region.

2.2   Analysis of volume and structure of alcohol consumption in the regions of Russia

In 2008, "pure" registered alcohol consumption in Russia averaged 8.9 liters per capita. This result implies that the level of alcohol abuse in Russia is relatively high because:

- According to the WHO, the critical and dangerous level of absolute alcohol consumption nationwide is 8 liters per year per capita[4].

- Due to a lack of data on the population's age structure, we calculated the alcohol-consumption level (8.9 liters per capita) as a quotient of regional alcohol sales (in terms of absolute alcohol levels) over regional population. However, in world practice, the alcohol-consumption level is usually estimated for the population that is not younger than 15 years old. Taking this into consideration and assuming that the part of Russia's population younger than 15 in 2008 was estimated as 14.6%[5], we concluded that alcohol consumption by the adult population approximately equals 10.2 liters per capita. This number exceeds the maximum WHO alcohol-consumption level by 27.5%.

- Data on alcohol sales per capita in Russia implies that registered alcohol sales for one adult equal 30 grams of "pure" alcohol per day. At the same time, on a micro-level, many

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[4] http://www.itar-tass.com/level2.html?NewsID=15331987
[5] http://www.gks.ru/free_doc/new_site/population/demo/demo14.xls

consider consuming more than 60 grams of absolute alcohol to be dangerous. Exceeding this limit suggests alcoholism, regardless as to how often the consumer has physical exercise[6].

- The estimated amount of alcohol consumed by the average adult in Russia (10.2 liters) might be underestimated due to a lack of data on unregistered alcohol sales.

Many working papers have warned about such a high alcohol consumption level in the country.

Despite the fact that it is very important to know the data on Russia as a whole in order to solve the country's traditional alcohol problems, the focus should be on understanding the features of particular regions.

At the same time, as is illustrated in Figure 2.1, there are substantial differences in regional alcohol consumption. The amount of absolute alcohol consumed per capita varies from 2 to 15 liters. There are also certain differences in alcohol quality.

Relatively little alcohol is consumed in the southern regions of the European part of Russia (less than 6 liters per capita), particularly in Rostov, Saratov, North Ossetia-Alania, Kabardino-Balkaria, Karachay-Cherkessia, Chechnya, Ingushetia, Kalmykia, and Adygea.

As considerably higher-than-average amount of "pure" alcohol (more than 11.5 liters per capita) is consumed in the Moscow, Leningrad, Vologda, Chelyabinsk, Sverdlovsk, Sakhalin, Komi, Khabarovsk, Kamchatka, and Chukotka regions, as well as in the cities of Moscow and St. Petersburg themselves.

Working papers, such as Andreev et al (1994) and Walberg et al (1998) support the conclusion that alcohol consumption in Russia increases from north to south and from west to east. The presence of two major cities – Moscow and St. Petersburg – in this list might be caused by the significant number of migrants, tourists, and people coming to these cities to earn money. Therefore, the level of alcohol consumption in these two cities is overestimated. However, such high alcohol-consumption levels for Sverdlovsk and Chelyabinsk were revealed for the first time.

It can be concluded from analyzing the structure of alcoholic-beverage consumption (Table 2.2) that regional differences in absolute alcohol consumption are determined mainly by the differences in consumption of two products: vodka and beer. The combined share of these two categories is about 80% and it is approximately the same both for the top 10% of alcohol-consuming regions and the bottom 10% of alcohol-consuming regions. This structure corresponds to the so-called "northern" style of alcohol consumption, according to which alcohol consumption occurs mainly in the form of spirits (vodka and liqueurs).

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[6] http://www.narcology-help.ru/4.php

Table 2.2

Amount of alcohol, consumed in regions with the maximum and minimum levels of alcohol consumption, liters per capita

|	Vodka and liqueurs	Champagne and sparkling wine	Cognacs, brandy and brandy spirits	Beer	Wines	Absolute alcohol
Min alcohol consumption, 10% regions	4.85	0.80	0.37	26.38	3.20	3.68
Min alcohol consumption, 25% regions	6.92	0.99	0.39	38.24	4.55	5.20
Max alcohol consumption, 25% regions	16.40	2.34	1.15	81.51	9.75	11.90
Max alcohol consumption, 10% regions	17.30	2.67	1.23	89.96	9.51	12.64
Share in absolute alcohol	50-60%	1-3%	3-5%	25-30%	10-12%	

Based on data from Russian Federal State Statistics Service: www.gks.ru

The population of countries with a northern alcohol-consumption style (Russia and, recently, Sweden) is subject to alcoholism, high rates of morbidity, and mortality from reasons connected to alcohol consumption. In countries with a "southern" alcohol-consumption style (Italy, France, Spain, etc.), where wine and beer are prevalent, alcoholism is not such an acute medical and social problem[7].

The distribution of regional vodka consumption per capita in 2008 is illustrated in Figure 2.1. The x-axis reflects the rank of a region and the y-axis is the amount of vodka per capita consumed in a particular region.

Figure 2.1.
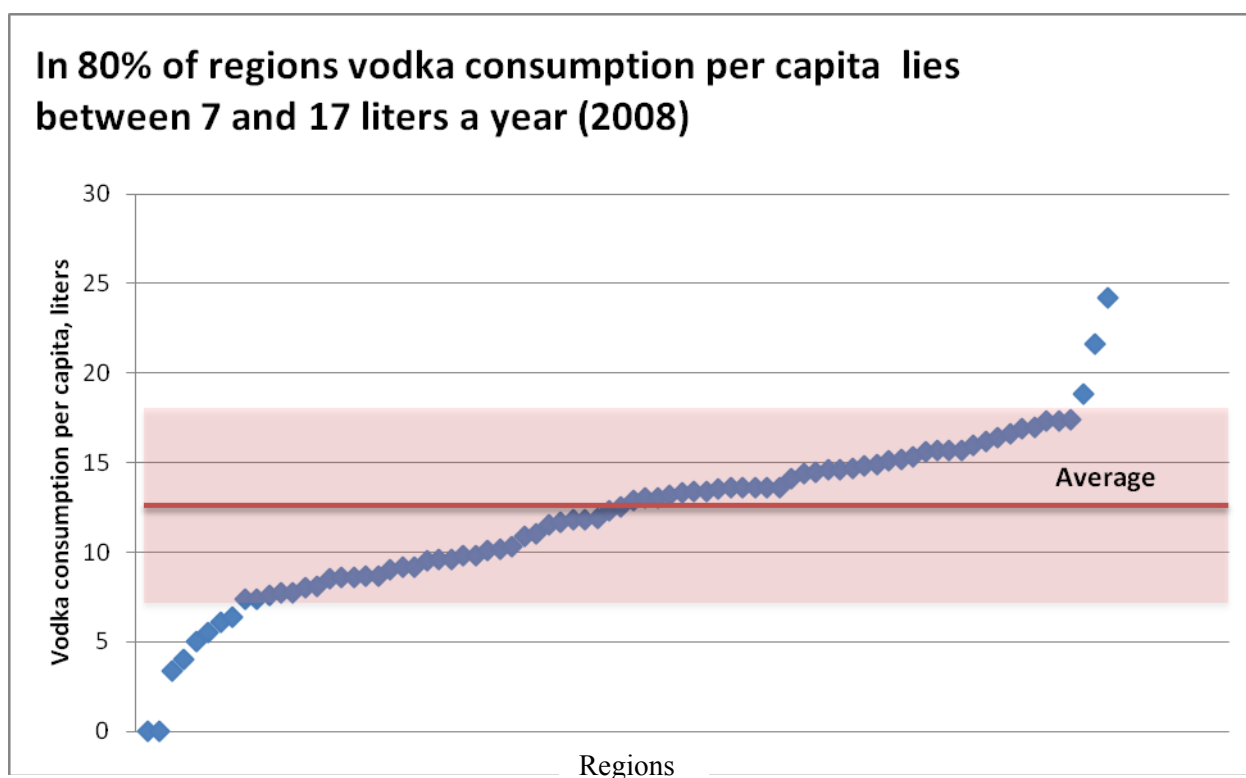
7 Journal "Алкогольная болезнь", N 6, Moscow, 2000

The average Russian consumes approximately 12 liters of vodka in physical terms during the year. Regions where vodka consumption is relatively low (less than 7 liters per capita during the year) are presented on the left side of the graph. They are prevalently the southern regions of Russia: Rostov, North Ossetia-Alania, Kabardino-Balkaria, Karachay-Cherkessia, Chechnya, Ingushetia, Kalmykia, and Adygea.

Relatively high levels of vodka consumption are observed in the far-eastern part of Russia (Khabarovsk, Kamchatka, Chukotka, Sakhalin, Magadan, and Khakasia), northern European regions (Murmansk, Arkhangelsk, Leningrad, Vologda, Komi, and Karelia), highly industrialized regions (Chelyabinsk, Sverdlovsk, and Kemerovo) as well as others (Moscow - city, Moscow – district, Tver and Chuvashia). These regions form the right side of the graph.

In 2008 the share of vodka in total "pure" alcohol consumption was 55%. Beer was second at 29%. The obtained parameters values imply a significant change in the alcohol consumption structure compared to the results of earlier studies, according to which the average contribution of vodka and beer in absolute alcohol consumption in the mid-1990s were 80% and 13%, respectively (Razvodovsky, 2010). It is further worth noting that in four Russian regions beer influences the consumption of absolute alcohol more than vodka. These regions are Volgograd, Omsk, Rostov, and St. Petersburg.

The differences in regional beer consumption in 2008 are illustrated in Figure 2.2.

Figure 2.2.
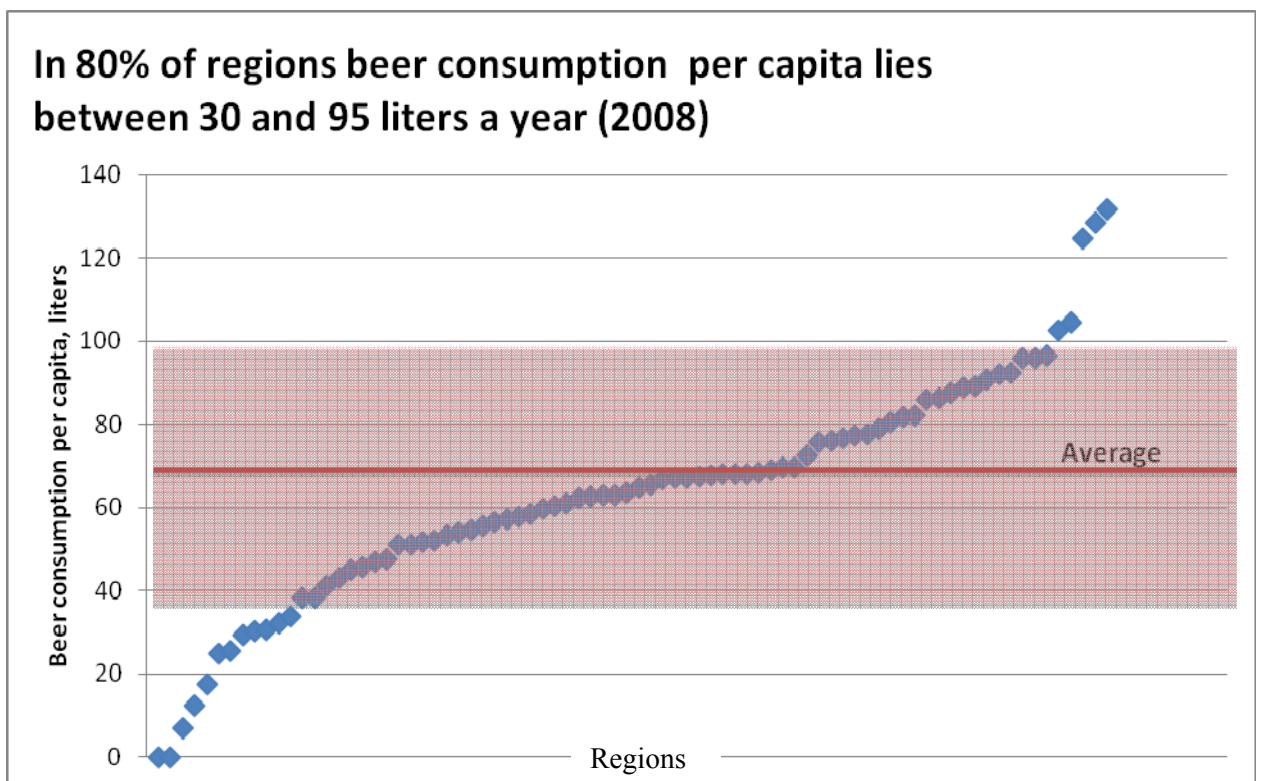
Our conclusion based on the data about beer sales in Russia (in physical terms) is that there are significant regional differences in the amount of beer consumption with an average of 63 liters per person per year. The relatively low consumption of beer (less than 35 liters per capita in 2008) was observed in North Ossetia-Alania, Adygeya, Dagestan, Ingushetia, Kalmykia, Mari El, Kabardino-Balkaria and Karachay-Cherkessia, Chechnya, Chukotka, Saratov, and Magadan. Moscow - city, St. Petersburg, Vologda, Volgograd, Ivanovo, Novosibirsk, Omsk, Sverdlovsk, Tyumen, Chelyabinsk, Perm, and Khabarovsk excelled with the highest consumption of beer (more than 90 liters per person per year). It is worth noting that most of the regions in the first group are characterized by low alcohol consumption in absolute terms. The exceptions are Chukotka and Magadan where the alcohol situation is the worst. In all regions in the second group, with the exception of Volgograd, the consumption of absolute alcohol is much higher than the national average, which suggests that beer consumption does not substitute, but rather complements absolute alcohol consumption. The role of other alcoholic beverages, such as grape and fruit wines, champagnes, and sparkling wines, as well as brandy and cognac, was relatively small in the formation of the volume of alcohol consumption, equaling about 16% in the total "pure" alcohol consumption in physical terms.

2.3   Macroeconomic determinants of alcohol abuse in the Russian regions analysis

In order to identify the factors that have the most significant effect on the level of alcohol consumption, we conducted research using the methods of data analysis. Indicators of alcohol consumption (in terms of "pure" alcohol and broken down by type of alcoholic beverage) were taken as dependent variables. As independent variables we have chosen such indicators as average income (a proxy for quality of life in a region), degree of urbanization (urban population, population density), and level of psychological tension (unemployment rate, Gini coefficient). These indicators are traditionally used for modeling macroeconomic determinants of unhealthy lifestyles (McAvinchey, 1994; Ruhm, 2000, 2003, 2005b; Macela et al, 2001; Neumayer, 2004; Johansson et al, 2006; Li and Zhu, 2006; Periman and Bobak, 2009). However, as we noted in the introduction, conclusions about the direction of their impact on the dependent variable do not always coincide. The objective of this study is to identify economic reasons explaining the differences in regional alcoholism levels in Russia based on inter-regional comparisons. When these reasons are revealed, subsequent measures for the development of alcohol policy can be elaborated. The database we used in this research is dated to 2008. The reason for panel data renunciation is a lack of data for some regions of Russia in previous

periods. The exception of 2009 is motivated by a desire to avoid the distortion caused by the economic crisis.

As a result, linear regression models with a normally distributed random error were estimated with the method of least squares on the basis of the regional data for 2008. We also tested these models on model adequacy, significance of variables, and random component normality. We introduced dummy variables in order to test our hypotheses about regional data homogeneity for some regions.

To test the robustness of the results we estimated models with the same variables but in different functional forms. All the models show similar results in terms of the direction of independent variables influence. We also tested the robustness of our results by restricting the sample size. Estimates for the coefficient of variables in the model with fewer observations were almost unchanged. We chose a log-linear form to describe the dependence on absolute alcohol consumption and consumption of different types of alcoholic beverages. Examples of the estimation results of absolute alcohol consumption in linear and log-linear forms and for a different number of observations can be seen in Annex 1.

All the models show high values of coefficients for determination that are close to 1, which suggests a high level of model accuracy (high values of F-statistics and small p-values also confirm this). All independent variables are statistically significant at the 1% level.

The model describing the relationship between regional differences in (absolute) alcohol consumption and macroeconomic factors is presented in Table 2.3.

Table 2.3.

Result of regression analysis on absolute alcohol consumption (Russian regions)

Dependent variable: LOG(absolute alcohol consumption consumption), N=81

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Population density	-0.002244	0.000994	-2.256367	0.0269
Unemployment rate	-26.97466	1117.821	-24.13146	0.0000
Income per capita	3.65E-05	6.74E-06	5.407778	0.0000
Ingushetia Republic (dummy variable)	-5.186157	0.325475	-15.93412	0.0000
Const	2.060106	0.093380	22.06164	0.0000
Coefficient of determination R-squared	0.944809			
F-statistic	325.2572			
Prob(F-statistic)	0.000000			

The coefficient of determination indicates a high level of fit for the model. All variables are significant. The coefficient signs of the variables verify our hypotheses about the positive link between alcohol consumption and income and about the negative correlation of alcohol

consumption and population density. The negative sign of the estimate for unemployment rate does not coincide with the results of studies based on micro data (Brenner, 1975; Treisman, 2010). At the same time, this result is logical and reflects the fact that, when competition on the labor market increases, employed people reduce their alcohol consumption. A dummy variable was introduced for an atypical observation (Republic of Ingushetia, which has an extremely low volume of alcoholic beverages sales).

In order to identify factors determining cross-regional differences in the structure of alcoholic beverages consumption, we used the models presented in tables 2.4 – 2.7.

Table 2.4.

Result of regression analysis on vodka consumption (Russian regions)

Dependent variable: LOG(Vodka consumption), N=80

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Population density	-0.003786	0.001223	-3.095801	0.0028
Unemployment rate	-26.00874	1370.271	-18.98072	0.0000
Income per capita	4.51E-05	8.17E-06	5.516195	0.0000
Male population, %	4.904015	0.245300	19.99187	0.0000
Ingushetia Republic (dummy variable)	-4.458856	0.399196	-11.16960	0.0000
Coefficient of determination R-squared	0.912324			

Vodka consumption is the main factor influencing the consumption of pure alcohol in a majority of the regions. Given that, we included factors into the model that contribute the most to regional differences in pure alcohol consumption. However, we added one more variable for the proportion of male population because the main consumers of alcoholic beverages are men. Therefore, the proportion of male population demonstrates a positive relationship with the consumption of vodka. But we do not have an opportunity to analyze the regression model for alcohol consumption by male population separately because data from official sources shows only joint consumption.

Table 2.6.

Result of regression analysis on beer consumption (Russian regions)

Dependent variable: LOG(Beer consumption), N=81

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Const	3.484466	0.305214	11.41648	0.0000
Unemployment rate	-14.34912	1686.119	-8.510143	0.0000
Income per capita	2.11E-05	8.72E-06	2.419607	0.0180
LOG(vodka consumption)	0.226296	0.128792	1.757064	0.0831
Dagestan dummy variable	-2.387553	0.379040	-6.298955	0.0000
Ingushetia Republic dummy variable	-1.970673	0.305450	-6.451701	0.0000

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Chukotka dummy variable	-1.658234	0.337350	-4.915465	0.0000
North Ossetia-Alania dummy variable	-1.220179	0.326775	-3.734004	0.0004

Coefficient of determination R-squared	0.868002		
F-statistic	68.57672		
Prob(F-statistic)	0.000000		

The inclusion of four dummy variables in the model (Table 2.6) is needed to eliminate the distorting effects of regions with extremely low volumes of beer sales (less than 12 liters per person per year). These regions are the Republics of Ingushetia, Dagestan, North Ossetia-Alania, and Chukotka. Also, the factors determining the differences in regional beer consumption are income per capita (positive relationship) and unemployment rate (negative relationship). In addition to these factors, there is a positive logarithmic relationship between beer and vodka consumption. Thus, the regions basically leading in consumption of soft drinks are also leaders in the consumption of spirits. This fact empirically confirms the conclusion that beer and spirits are complementary (not substitute) products for most of the population.

Table 2.7.

Result of regression analysis on wine consumption (Russian regions)

Dependent Variable: LOG(wine consumption), N=81

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Const	1.955401	0.103691	18.85804	0.0000
Unemployment rate	-8.464998	1237.180	-6.842173	0.0000
Income per capita	1.65E-05	7.29E-06	2.259389	0.0267
Ingushetia Republic dummy variable	-1.329476	0.338238	-3.930593	0.0002
North Ossetia-Alania dummy variable	-0.932685	0.323116	-2.886532	0.0051

Coefficient of determination R-squared	0.569563			
F-statistic	25.14117			
Prob(F-statistic)	0.000000			

The coefficient of determination (Table 2.7) in the model above suggests a lower quality of model fit (in comparison with vodka, beer, and absolute alcohol models), which is nevertheless still acceptable. Here we left only two dummy variables (Ingushetia and North Ossetia) of the four originally used in the beer-consumption model because data on the wine consumption in the regions of Dagestan and North Ossetia-Alania fit into the overall picture.

Based on the results of the regression analysis, we concluded that the main macroeconomic determinant explaining inter-regional differences in alcohol consumption is income per capita (positive correlation) and the unemployment rate, which had a negative sign in all of the models.

All the 12 regions with a significantly higher level of absolute alcohol consumption also had higher-than-average income per capita (11,600 rubles a month in 2008). Eight regions out of

these 12 are also among Russia's top 12 regions according to highest incomes (where income per capita was higher than 17,000 rubles a month in 2008). At the same time, out of the 9 regions with the least absolute alcohol consumption, only Rostov and the Chechen Republic have an income per capita that is higher than the average, while 6 regions out of these 9 are also included among Russia's bottom 12 regions according to lowest income per capita (less than 9,000 rubles per month in 2008).

It is also worth noting that the Gini coefficient (indicating inequality) was not significant and, therefore, was not included in any of the models. The urbanization rate also turned out to be insignificant, while the population density was included in regression models of vodka and absolute alcohol consumption. The variable for the male population (%) was a significant factor only in the model of vodka consumption.

The hypothesis that vodka and liqueurs are the main products forming the consumption of absolute alcohol was verified while analyzing the structure of consumption of alcoholic beverages. At the same time, there are substantial regional differences on this indicator, with values ranging from 37% to 85%. The lowest proportion of vodka in the structure of consumption of alcoholic beverages can be observed not only in those regions where less alcohol was consumed (Volgograd, Rostov, Krasnodar, and Stavropol), but also in Omsk and St. Petersburg, which ranks 3rd for the consumption of pure alcohol. It should be noted that, as the leader in beer consumption (132 liters per person per year), St. Petersburg had an equal contribution of vodka and beer in its structure of absolute alcohol consumption.

The consumption of spirits and soft drinks demonstrates a strong correlation. For the most part, leaders in the consumption of soft drinks also lead in the consumption of spirits. In addition, vodka and beer can be seen as complementary rather than mutually exclusive products, as it was shown in Table 2.6.

As a result of our analysis, we concluded that an increase in beer consumption is incrementally becoming a significant factor of alcoholism in the Russian population. However, this does not imply that spirits are being replaced by soft drinks.

We also consider the overconsumption of alcohol in Russia as a cause of severe adverse health effects and Russian population's shorter life duration.

2.4   The impact of alcohol on population health analysis

In 2008, the average life expectancy in Russia was 67 years on average 67, which is below 1990s level of 69 years. At the same time among Russian regions there are significant differences on this index, ranging from 59.7 in Chukotka to 80.1 in the Republic of Ingushetia. In order to test the hypotheses regarding the negative impact of alcohol consumption on life

expectancy, we conducted research on macroeconomic determinants of life expectancy and on the level and structure of alcohol consumption.

GDP per capita (in US dollars) or energy consumption per capita are usually used to assess standards of living (Brenner, 1975, 1979; Kossova, 1991; McAvinchey, 1994; Macela et al, 2001; Johansson et al, 2006). However, for cross-regional analysis, we recognized a need to find indicators reflecting more subtle differences in the level of welfare. This problem is particularly acute in Russia, where uneven regional development has become one of the most important migration factors. The most active part of the population (especially youth) migrates to more developed regions and regularly supports their relatives financially. This trend is not reflected in the population income data. In such circumstances, cost figures are more informative.

One of the products indicating wealth is sugar. Sugar consumption has a positive correlation with standards of living. Analysis of data on the cost structure of the Russian population has shown that the category of indicative goods in Russia in additional to sugar may include computers and gold, as well as meat. Variation on these measures in the Russian regions allows us to evaluate the differences in wealth, so the per capita spending on these indicative goods could be used as a factor in our model. Since these products are not classified as essential, regions with higher spending on their purchase are considered well off in terms of disposable income.

In addition to wealth indicators, we used common macroeconomic determinants, such as unemployment rate, urbanization rate, population density, proportion of the male population, and Gini index as independent variables in the models discussed below.

Table 2.8.

Result of regression analysis on life expectancy (Russian regions)

Dependent variable: Life expectancy, N=81

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Const	71.55501	0.702217	101.8988	0.0000
Sugar spending	8.66E-07	1.15E-07	7.558250	0.0000
Computers spending per capita	1.159962	0.425444	2.726476	0.0080
Gold spending per capita	0.640320	0.286236	2.237034	0.0284
Meat spending per capita	-0.753829	0.156784	-4.808070	0.0000
Unemployment rate	-18.94996	10.17685	-1.862065	0.0667
LOG(absolute alcohol consumption)	-1.929813	0.264655	-7.291795	0.0000
Tiva Republic dummy variable	-5.843734	1.604619	-3.641821	0.0005
Coefficient of determination R-squared	0.751823			
F-statistic	31.15933			
Prob(F-statistic)	0.000000			

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The coefficients of the model verify our hypothesis that there is a positive connection between a population's life expectancy and its level of prosperity. Differences in wealth were assessed on the basis of spending on indicative goods. The negative impact of unemployment on life expectancy also came as no surprise. A dummy variable was introduced to eliminate the distorting influence of the Tuva Republic, where average life expectancy is significantly lower.

An important implication of this model is the constant negative impact of the consumption of pure alcohol on average life expectancy in the regions.

We noted that alcohol abuse not only reduces life expectancy, but also has a significant impact on mortality from external causes. This indicator has a strong negative correlation with life expectancy, with a coefficient of -0.84. Regions with the least mortality from external causes are usually included in the list of regions with the highest life expectancy, and vice versa. At the same time, variations in mortality from external causes are significantly higher.

In order to test the hypothesis that the level of alcohol consumption has a negative impact on health in both the male and female populations, we have built regression models where the dependent variables were indicators of life expectancy for men and women separately.

Table 2.9.

Result of regression analysis on (male) life expectancy (Russian regions)

Dependent variable: Life expectancy (male), N=80

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Const	72.15743	1.005047	71.79509	0.0000
Computers spending per capita	0.784776	0.375159	2.091851	0.0400
Meat spending per capita	-0.462243	0.138474	-3.338123	0.0013
Sugar spending	5.06E-07	1.13E-07	4.462103	0.0000
Unemployment rate	17.96891	6.266397	2.867503	0.0054
Mortality rate from external reasons	-0.036893	0.003813	-9.675733	0.0000
Vodka consumption	-0.147239	0.055514	-2.652285	0.0099
Beer to vodka consumption ratio	-0.170841	0.080180	-2.130706	0.0366
Wine to vodka consumption ratio	-2.725992	0.781676	-3.487367	0.0008
Coefficient of determination R-squared	0.858288			
F-statistic	53.75181			
Prob(F-statistic)	0.000000			

Mortality from external causes, which allows us to separate the contribution of short-term alcohol effects on health and living standards from long-term (cumulative) effects, was introduced into this model as the independent variable. In this model, we also used data on consumption of alcoholic beverages by type to reflect the impact of the structure of alcohol consumption on average life expectancy. Converting these to ratios helped to avoid problems arising from multicollinearity in data on the consumption of different alcoholic beverages types.

This raises the question as to whether it is possible to consider mortality from external causes that are uncorrelated with random error. And, if there is a correlation, as to how significant the offset of estimates for the model coefficient will be. To answer this question, we made an alternative model of life expectancy with instrumental variables for mortality from external causes (tables are given in Appendix 1). The estimates for the coefficients of the variables practically did not change, leading to the conclusion that this factor may be used as an independent variable.

Analysis of model coefficients suggests that differences in regional male life expectancy are caused by both macroeconomic (e.g., average income) and individual factors, including consumption of alcoholic beverages. The signs of coefficients for the variables that characterize the structure of alcohol consumption are negative. This implies a negative impact of the overuse of alcoholic beverages on the health of the male population.

Table 2.10.

Result of regression analysis on (female) life expectancy (Russian regions)

Dependent variable: Life expectancy (female), N=79

Variable	Coefficient	Standard Deviation	t-statistic	Prob.
Const	73.15010	3.931300	18.60710	0.0000
Computers spending per capita	0.542822	0.258822	2.097283	0.0397
Meat spending per capita	-0.298934	0.096937	-3.083792	0.0030
Sugar spending	2.59E-07	7.87E-08	3.294401	0.0016
Unemployment rate	27.52600	6.183182	4.451753	0.0000
Mortality from external reasons	-0.032299	0.002696	-11.98057	0.0000
Vodka consumption	-0.108203	0.040653	-2.661592	0.0097
Wine consumption	0.085280	0.050871	1.676393	0.0983
Champagne to vodka consumption ratio	-8.300006	1.595994	-5.200525	0.0000
Male population, %	17.05770	8.366594	2.038787	0.0454
Chukotka dummy variable	-1.840863	1.051182	-1.751232	0.0845
Evreyskaya autonomic oblast	-2.189304	0.953841	-2.295251	0.0249

Coefficient of determination R-squared	0.891235	Mean dependent var		73.62532
F-statistic	49.90968	Durbin-Watson stat		1.972219
Prob(F-statistic)	0.000000			

This model was built to determine factors influencing the life expectancy of the female population. The macroeconomic determinants in both "life expectancy" regressions (for the male and female population) are almost the same. However, variables describing the consumption of alcoholic beverages in the "female" model have changed.

- the value of the coefficient for the variable representing vodka consumption has become almost 1.5 times lower, while constants in both models are almost the same. This suggests that the average volume of vodka consumption has a greater impact on the health of the male population. The variable representing the male share of the population is significant in the

"female" model and has a positive coefficient. This provides an additional adjustment to the calculated female life expectancy level, given that the main consumers of vodka are male (this variable was included in the vodka consumption model);

- the negative sign of the coefficient for the variable representing the champagne-to-vodka consumption ratio, in combination with a positive coefficient for the wine-consumption variable, suggests a negative impact of excessive consumption on alcoholic beverages on the life expectancy of females.

All in all, the above analysis proves the hypothesis that the level of alcohol consumption in Russia has a significant negative impact on the population's life expectancy.

3.   Implications

The analysis has confirmed the findings of other authors about the continuous troubled state of alcohol consumption in Russia and about the prevalence of vodka and spirits in the structure of alcohol consumed, as well as about the negative impact of excessive alcohol consumption on the population's average life expectancy.

At the same time, previously formulated hypotheses have been confirmed. This leads us to conclusions not reflected in other studies on this issue:

1) The amount of absolute alcohol consumption per capita varies substantially (from 2 to 15 liters of pure alcohol sold per capita per year) in Russia's regions. The regions with the highest alcohol consumption are the northern regions of European Russia, the Far Eastern regions (excepting for the Primorsky Krai), as well as for the cities of Moscow and St. Petersburg. The Southern regions of European Russia are characterized to have the lowest level of alcohol consumption. This conclusion, in general, confirms the results of previous studies. However, the fact that growth in beer consumption has radically changed the structure of alcohol consumed (by shrinking vodka's share to 55% and increasing beer's share to 29%) has never before been revealed. Moreover, the fact that beer has become the main product that forms absolute alcohol consumption in some regions of the country, namely Volgograd, Omsk, Rostov, and St. Petersburg, was revealed in this study for the first time.

2) Regional differences in the consumption of vodka and liqueur-vodka products can be explained by several macroeconomic factors, such as income per capita and the size of the male population as a proportion of the total population (positive influence), or population density and unemployment rate (negative influence). Differences in beer consumption can

be explained by the same factors that describe the differences in vodka consumption, which allows one to consider these products (beer and vodka) as complements rather than substitutes.

3) The results of the regression analysis suggest that differences in regional life expectancy in Russia are caused by objective (macroeconomic) factors, as well as by the volume and structure of the alcohol consumption. A brand new finding is that a negative correlation between alcohol consumption and life expectancy has been revealed for strong alcoholic beverages as well as soft drinks, both for the male and female populations. The negative impact of excessive consumption of low-grade alcoholic beverages on life expectancy has been proved in this study. In previous studies, the negative impact on mortality and life expectancy was caused by the consumption of spirits. So the harmful role of excessive consumption of low-grade alcoholic beverages remains undervalued (Nemtsov, 2002; Leon et al, 2007; Denisova, 2010; Razvodovsky, 2010; Denisova et al, 2010). This is apparently due to the fact that, in micro-database studies, particularly in Denisova (2010), respondents who consume different types of alcoholic beverages (both soft and strong) were not considered as consumers of low-grade alcoholic drinks consumers. However, the results of this study show that in Russia the increased consumption of low-grade alcoholic drinks, especially beer, is correlated with the strong alcohol consumption, which leads to an increase in aggregate alcohol consumption, as well as to reduced life expectancy. In conclusion, on the basis of this study, public policies should be aimed at reducing alcohol consumption because this will likely lead to remarkable macroeconomic effects in terms of the increase of life expectancy.

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Annex 1.

Table A.1.

Absolute alcohol consumption model for different number of observations

Dependent Variable: LOG(ABS_ALK)

Variable	Sample: 1 81 (N=81)	Sample: 15 65 (N=41)
const	2.1060**	1.7601**
DENS	-0.0026*	-0.0025*
UNEMP/(POP)	-26.9555**	-8.0003
INCOME	3.51E-05**	4.25E-05**
@TREND=49	-5.172347**	-6.489950**
@TREND=56	-1.272636**	-1.274824**
R-squared	0.958561	0.962688

** -- variables are statistically significant at the 1% level

* -- variables are statistically significant at the 5% level

Table A.2.

Absolute alcohol consumption model - linear form

Dependent Variable: ABS_ALK

Variable	Sample: 1 81 (N=81)
const	5.6815**
DENS	-0.0061
UNEMP/(POP)	-36.1192**
INCOME	0.0003**
@TREND=49	-3.4557*
@TREND=56	-5.9804**
R-squared	0.621645

** -- variables are statistically significant at the 1% level

* -- variables are statistically significant at the 5% level

Table A.3

Instrumental variables for mortality from external causes

Dependent Variable: MORT_ALKO

Variable	Sample: 1 80 (N=80)
const	139.2061**
POP	-1.09E-05**
VODKA	9.307756**
COGNAC	44.240334**
@TREND=58	127.4957**
1000*BUTTER/(POP*INCOME)	-47.7326
1000*UNEMP/POP	-5.9804**
R-squared	0.6807

** -- variables are statistically significant at the 1% level

* -- variables are statistically significant at the 5% level

Life expectancy (male) regression with instrumental variable

MORT_ALKO_INSTR = 139.2060 - 1.0939e-05*POP + 9.3077*VODKA - 44.240334*COGNAC + 127.4956975*(@TREND=58) – 47.7325*(1000*BUTTER/(POP*INCOME)) - 429.2370263*(1000*UNEMP/POP)

Variable	Sample: 1 80 (N=80)
const	72.7912**
COMP/(INCOME)	0.0061**
MEET/(INCOME)	-0.0037**
SHUGER	1.11E-06**
1000*UNEMP/POP	14.2408**
MORT_ALKO_INSTR	-0.0315**
VODKA	-0.2991**
BEER/VODKA	-0.2052**
WINE/VODKA	-3.0561**
R-squared	**0.736412**

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