The Russian mortality crisis of 1991-2005:

causes, outcomes and consequences

By Nina Dmitrieva

A Thesis

Submitted to

Central European University

Department of Business and Economics

In partial fulfillment of the requirements for the degree of Master of Arts

in Economic Policy in Global Markets

Supervisor: Professor Péter Mihályi

Budapest, Hungary

2019

ABSTRACT

In the period 1991-2005, the Russian economy experienced a major transformational recession with depressed output, increased unemployment rates and, most importantly, shooting mortality indicators. In just seven years (from 1987 to 1994) the death rates soared by more than 60%, with life expectancy going down from 70 to only 64 years (Gerry et al., 2010). The mortality crisis that lasted more than two decades represent an unprecedented case in the peaceful history of the country. While many of the underlying crisis causes remain unexplained, it is now agreed in the academic literature that there are two major stances on it: the stress-related and alcohol-related hypotheses, which were analyzed in-depths in this thesis. The root-cause analysis was backed up with quantitative research. A fixed effects model with region and year dummies was run on regional panel data. This analysis confirms that privatization, unemployment and oil prices are associated with increased male adult mortality in Russia (statistically significant coefficient with robust clustered standard errors were calculated). The implications of this research are far-reaching, with contribution to both social sciences academic literature and practical policy-making process. The potential limitations of the devised models and directions of future research are discussed in the last section of this thesis.

Keywords: mortality, crisis, Russia, privatization, unemployment

Table of contents

List of figures	iii
List of tables	iv
Introduction	1
Chapter 1	
1.1 Problem introduction	
1.2 Literature review	7
1.3 Main hypothesis	14
Chapter 2	
2.1 Assumptions	
2.2 Data description	
2.3 Methodology	
2.3 Results of empirical analysis	
2.4 Discussion of results	
2.5 Implications for policy-making	
Conclusion	
References	
Appendix	

List of figures

Figure 1: Mortality in selected countries (per 1000 male adults)
Figure 2: Sales of alcohol, liters of pure alcohol per capita (left scale); death rates per 100,000 from
alcohol poisoning, murders, and suicides (right scale)
Figure 3: GDP per capita (current USD) and mortality rates (per 1000 male adults) in Russia 16
Figure 4: Mortality rates (per 1000 male adults) and oil prices in Russia
Figure 5: Unemployment (as % of total labor force based on national estimate) and mortality rate (per
1000 male adults) in Russia
Figure 6: Trends in mortality among Russian men, by age group, 1989-1996
Figure 7: Russian mortality rate split by gender (per 1000 adults)
Figure 8: Heterogeneity across years of unemployment and GRP rates
Figure 9: Plots mortality VS co-variates
Figure 10: Unemployment in Russia by gender split
Figure 11: Natural gas prices and mortality in Russia
Figure 12: Co-plot of mortality change by region by year
Figure 13: Mortality heterogeneity across the Russian regions
Figure 14: Mortality heterogeneity across years

List of tables

able 1: Variables description2	25
able 2: Heteroscedasticity consistent coefficients (Model 1)	30
able 3: Heteroscedasticity consistent coefficients (Model 2, only co-variates without reporting	ng
ummies)	31
able 4: Heteroscedasticity consistent coefficients (Model 3, only co-variates without reporting	ng
ummies)	32
able 5: Summary statistics	18
able 6: Correlation coefficients	18
able 7: Regression models results	51

Introduction

Relevance of the study. A study on the causes of mortality hikes during the Russian demographic crisis in 1991-2005 is even more vital and important today than in any other time period. As can be seen in major forecasts, Russian population is expected to decrease in the upcoming years, hence it is crucial to understand the links and transmission mechanisms between mortality and its root causes. Notwithstanding with that, other countries (both socialist and market economies) are encountering similar puzzles in their decision-making processes. Thus, the applicability of this analysis could help manage their demographic changes with minimum costs in both millions of lives and dollars.

Theoretical background. There is now ongoing debate in the academic literature regarding the causes of the mortality crisis in Russia. Some academics blame excessive alcohol consumption, while others see mass privatization that took place in 1995 and stress stemming from it as major factors that explain the mortality puzzle. The most prominent research in support for stress-related argument was conducted by Cornia (1997), Stuckler, King and McKee (2009, 2012), Azarova et al. (2017). The opponents of this view point (Nemtsov, 2002; Leon, Shkolnikov, Shapiro et al., 1997, Shkolnikov, 1999) conducted quantitative analysis in favor of alcohol-related explanation. Still today there is no consensus on this issue among the academics, which opens up additional window for contribution of this particular research.

Current research objective. Current research seeks to unleash the underlying causes of Russian mortality crisis of 1991-2005, and contribute to the existing academic debate on the topic. I investigate the link between mortality and unemployment, privatization, incomes and oil prices in the empirical model setting.

Data. The data used for the empirical research was retrieved from GKS, CEIC and EBRD. I used the following variables: mortality change, unemployment, GRP change, large-scale privatization index

and the change in oil prices. All of the relevant transformations with the variables were done before running the regression model (taking logs, transforming observations with absolute indicators into growth rates). Serial correlation and heteroscedasticity were checked and taken care of by employing clustered standard errors in the model. The dataset contains some missing observations that are missing in the data at random.

Methodology. I run fixed effects regression model with region, year dummies and lags on regionallevel panel data with 1282 observations. With this model I seek to quantify the effect of unemployment, GRP, privatization and oil prices on mortality fluctuations. All of the statistical tests (for stationarity, correlation, serial correlation, etc.) were conducted before running the regression model itself.

Hypotheses to be tested. **Hypothesis 1:** Economic downturns are correlated with changes in mortality data. **Hypothesis 2:** Changes in prices of exportable natural resources are negatively associated with mortality fluctuations. **Hypothesis 3:** Increased unemployment is associated with higher mortality rates. **Hypothesis 4:** Bigger private sector share in GDP indicator is associated with higher mortality rates in the short run.

Outline of chapters. Firstly, I review the existing literature on the topic and conduct some critical analysis of it. Secondly, I propose four hypotheses that may explain increasing mortality rates in post-Soviet countries. Thirdly, in the Second chapter an empirical model is constructed that would help accept or reject the proposed explanations of mortality crisis in Russia. Finally, policy implications are discussed, and the research relevance and importance proved.

Chapter 1

1.1 Problem introduction

Looking back in history of the former Soviet Union (FSU) and some Eastern European countries (EE), one of their most turbulent periods is considered to be the transition to market economy during the last decade of the 20th century. During it, major shifts in terms of social, political and economic life happened which adversely affected mortality and life expectancy rates of the population in respective countries. This, in turn, resulted in depopulation in the regions. However, if we look at the mortality data of some FSU countries, (see Figure 1), most countries saw a very long increasing mortality trend from 1964 to 1985 – i.e. the problems started well *before* the political regime change. The culmination of the crisis happened after the year 1986, when all of the countries under consideration (Belarus, Russia, Estonia, Kazakhstan, Latvia, Ukraine) experienced a sharp increase in mortality rates for another 10 years. After its peak in 1995 the trend went in the downwards sloping direction, but still with its ups and downs in different years for different countries. The most dramatic rise in mortality occurred in Russia, where in the period from 1987 to 1994 it surged up by 60% (World Bank, retrieved on 01.03.2019). This constituted an unprecedented mortality level for the country ever since the beginning of the 20th century. If we look at the end of Stalin's rule in 1950s (which was characterized by violence and oppression), even back then the death rates were two times lower than in the 1990s (Popov, 2018). The picture is similar, if we use another indicator: life expectancy was down from the average of 70 years to only 64 (Gerry et al., 2010).



Figure 1: Mortality in selected countries (per 1000 male adults)

Source: World Bank, retrieved on 01.03.2019

A phenomenon of mortality spike - between approximately 1986 and 2006 - is rightfully referred to as exceptional: there are few similar cases over the entire human history. For example, in the period 7000-3000 B.C. during the transition from the Paleolithic to Neolithic age population's life expectancy decreased by several years. The major causes for this drop are considered to be: shifts in lifestyle (from "hunting and gathering" type to horticulture) and changes in nutrition habits (Popov, 2018). Another example on a par is the Industrial Revolution in Britain and later in other Western European countries during which there were major drops in life expectancy (by approximately 10 years) and spikes of mortality rates (Wringley et al., 1981). The underlying reasons of such devastating outcomes were again the changes in lifestyle (to accommodate to industrialization), huge gaps in income among the population and the overall impoverishment of the masses. Though if we look at the

two examples mentioned above, both of them took more than 200 years to come into effect. However, the mortality crisis in the post-communist states evolved in one and a half or two decades.

In this thesis the focus would mostly be channeled at mortality crisis in Russia rather than any other post-communist state. The motivation behind this choice consists in the magnitude of effect of the crisis itself, plus the space constraints. Russia experienced the sharpest mortality increase which has no analogues in other countries. If we compare Russia with other post-Soviet countries, we could see that all of the countries followed a somewhat different route out of transition recession, and in some cases those routes were less destructive for the population. For example, in Uzbekistan and Belarus the governments managed to implement more gradual reforms over the transition period, which, in turn, allowed them to preserve institution functioning and, hence, did not have such an adverse effect on output and mortality rates. In Central European countries the whole system change was smoother, again with less negative shocks on output and mortality. Comparing with Asian socialist countries (e.g Vietnam) transition period, there it happened without any reduction in output or transformational downturns, keeping upwards life expectancy trend over the whole period (however it was slow in China, it was still positive growth during the transition). Finally, there is the case of Cuba, which has experienced a similar to Russian output reduction by 40% over the transition period from 1989 to 1994 (Popov, 2010). However, in Cuba such a decrease did not translate into depopulation trend and increased mortality. Instead, life expectancy was up 3 years from late 1980s to 2006 (an increase from 75 years to 78) (Popov, 2010). These examples show that the transition by itself is not necessarily the cause of mortality crisis as there are numerous counter-examples to it. Different states have different social and economic environments (even though they might seem to have similar ones) and, thus, different scenarios out of crisis with potentially good or bad consequences are being equally plausible.

Russia has seen the longest route out of crisis with several other mortality spikes on the way, which makes it obvious that the crisis and major reasons behind it are not as straightforward and easy-to-tackle as it might seem from the first glance. Still today Russia has not found a solid way out of the mortality crisis. Prestigious international institutions predict the continuation of the increased mortality trend in the years to come with an official estimate of population reduction from 142 million to 139 million by the year 2031 (United Nations DESA, 2017). Even more pessimistic scenario was envisaged by the independent experts in the field, forecast population drop to be all the way down to 127 million, implying a more than 10% drop (Popov, 2010). These figures make the question of whether the crisis is over being still in place. All of these considerations make Russia an extraordinary and especially important case, worthy of further exploration and proper quantitative and qualitative analysis.

Before proceeding with the existing literature investigation, we shall briefly describe the economic and political landscape in Russia in the period under review. Right before the USSR dissolution in 1991 and immediately after it, there was a major economic recession in Russia. In the period between 1989 and 1998 national output (measured by the GDP per capita indicator) almost halved (45%); crime, suicide and murder rates were all up (Stuckler at al., 2012). Unemployment was shooting, labor turnover and migration were at high levels. The distinctive trait of the Russian transition period is the market privatization: a significant part of public property was transferred into private ownership. This process was oftentimes initiated through corruption and nepotism, which caused additional inequality, stress and dissatisfaction in the society.

These factors are not the only ones that had a say in mortality increase, which was mostly concentrated among the *male adults* and had *cardiovascular disease* as a main medical cause of death (Gentile, 2012). Due to lower disposable incomes, people were switching from meat and milk products

to cheaper grow-yourself types of foods, such as potatoes, grains and bread (Popov, 2010). Such changes in diet coupled with overall healthcare deterioration and smoking habits, were also some of the contributing factors that lead to a higher mortality trend for the entire country.

Additionally, it is worthy to mention that the mortality crisis was not homogeneous across the Russian regions. The biggest mortality spike took place in Northern and Eastern areas which are considered to be rich for natural resources (Azarova et al., 2017). In a way, this is surprising. This has probably happened because before the crisis those regions were way more output-generating and reliant on industrial production compared to the other Southern or Western regions. Hence, once the crisis hit, they suffered more and proved to be unable to find new possibilities on how to make up for the lost output, vanishing jobs and migrating people. As a result, the potentially richer and better-off areas with respect to the output change, turned out to be worse-off in terms of mortality increases and life expectancy shortenings due to stronger stress pressures. The different hypothesis on the reasons behind the mortality crisis would be further revisited in the following sections.

1.2 Literature review: stress and/or alcohol

The Russian mortality crisis today is one of the most discussed though still unresolved riddles in Russian academic circles. There are many theories explaining the underlying causes of it, but overall the experts in the field have two major stances on it. The first group of researchers claims that mortality crisis was stemming from the increased stress in the society. Alternative explanation attributes crisis to excessive alcohol consumption. Let us look at the most prominent pieces of research within these two broader categories.

Every transition period is characterized by drastic changes in people's lives. As identified in the research by Cornia and Paniccia (2000), the marketization of the Russian economy and the privatization trend affected very different facets of workers' lives: increased unemployment, uncertainty due to labor migration in search for work, widening income gap and more family divorces. As shown in the study by Cornia (1997), these factors when comprised into one "stress index" were a good predictor of premature deaths in the 1990s for male adults. Russian mortality crisis was a striking example of the role of stress in the society on mortality and life expectancy. Researchers today perceive it as a natural experiment that is rare and valuable to analyze. In a sense, it reveals how much stress can be sustained by the population before dying out and to what depopulation rates it could lead. The most radical and influential research in support for stress-related argument of the mortality crisis was conducted by Stuckler, King and McKee (2009, 2012) the results of which were first published in the internationally renown British medical journal, *The Lancet*.

In their research Stuckler et al. (2012) postulated that stress invoked by *rapid mass privatization* was the major cause for increased mortality rates. On the basis of country-specific comparison of death outcomes before and right after the mass privatization in Russia (covering years 1989-2002), the authors argued that specifically for the former USSR republics they found a strong association between the rapid privatization index and working-age male mortality. Once they compared it with more gradual transition periods of the Eastern European countries, the effect on mortality is much smaller, if at all at place. Hence, these authors concluded that countries that resorted to rapid mass privatization and marketization of the economy tended to have greater social and health costs for the population.

Nonetheless, their research was extensively criticized and debated among other scholars. The most radical opponents (Gerry et al., 2010; Gerry, 2012; Gentile, 2012; Earle et al., 2011) identified several flaws in the study by Stuckler (2009). Firstly, they claim that the research does not allow to make a sound conclusion regarding dependences between mortality and privatization. Gerry (2010) stated that if, for example, there exist some death cause in a country in one specific year, very likely

the very same cause would lead to deaths in the following year. The study by Stuckler et al. (2009) does not take into account this fact when applying a static modelling approach. Gerry proposed implementing a dynamic model with lags of both dependent and independent variables. Once such accommodation was applied – none of the conclusions derived by Stuckler were supported. Secondly, the timing of the transition period was questioned by Gentile (2012). The study bases its statistical research on the comparison of Central and Eastern European countries with the former-Soviet ones, however, as Gentile spotted, they have all gone through the transition period at different years. The EE countries entered the transition stage in the period 1989-1990, whereas the FSU countries abandoned socialism one or two years later – in 1991-1992. Stuckler proxies the transition to the 1992-1994 period, which, according to his opponents, is risky if one wants to see the effect of mass privatization and socialism's demise on mortality rates.

Among the research in support for stress-related causes of mortality crisis, there is one more prominent piece by Azarova et al. (2017) published in Lancet Public Health. The authors test the effect of rapid mass privatization on mortality rates in Russia. Differently from the research by Stuckler et al., Azarova and colleagues use data on the population of the mono-industrial towns in order to better isolate the effect of privatization on health outcome. However, similarly to Stuckler they arrived to the conclusion that fast privatization invoked more stress among the working age (20-69 years) males and was associated with higher mortality rates in the period between 1992 and 2006.

Another view on the transmission mechanism between stress in the society and the mortality rates was described in the paper by Sabirianova (2002). Her research explores the link between deaths and the occupational activities of the Russian people. In the empirical part of her paper, the author states that between 1991-1998 almost 48% of working age population changed their professional occupation. This in itself represents an extremely large number, much higher than in any other country

during the transition period. Sabirianova concludes that this generated a massive stress among the employees, and was one of the leading causes for higher mortality rates.

Alternative stance on causes of mortality crisis claims that elevated mortality rates occurred due to increased consumption of alcohol (Nemtsov, 2002; Leon, Shkolnikov, Shapiro et al., 1997; Pridemore, 2008; Vishnevsky, Shkolnikov, 1999). By looking at the graph (see Figure 2), it can be easily spotted that the two – mortality and alcohol consumption – have very similar trends over time. During the period from 1990 to 1994 deaths from alcohol poisoning per 100000 persons increased 4fold from 10 to almost 40, and were higher than the deaths from suicide or murder. According to Popov (2018), the mortality rates affected by the alcohol consumption are the ones belonging to the group of deaths from external causes, such as accidents, suicides and murders. The author further explores statistics, even though the death rates from external causes in Russia in 2002 were not the most rampant factor of death, it was the highest indicator in the world. These figures are especially impressive, once we take into account the fact that many of the causes of death were purposefully misclassified by the local and/or central authorities, hence the official numbers are probably lower than the true ones. Surely, there is a correlation between the overall death rates (i.e. from all causes) and vodka consumption, however this correlation was not proved to have any causation relationship, yet.

Figure 2: 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: Popov, 2018

But a new question arises. Why did people start consuming more alcoholic beverages? As identified by Norstrom (2011), there are several factors that influenced such a behavior. There were major political and economic shifts with respect to alcohol sale and consumption regulation. Firstly, Gorbachev's strict anti-alcohol campaign which started in 1985 was abolished by the end of 1988 (Nemtsov, 2002). Even though the program was successful in terms of reduction of alcohol consumption, it met great resistance from the society at all levels. Moreover, it caused severe stops in the accustomed circulation of cash in the economy, because in the absence of alcohol, people simply didn't spend their incomes. The excess money stayed in the drawers. Hence, it had to be ceased, and people gained back the right to consume vodka freely. Secondly, in the 1990s Russia entered the transition period with weakened economic control over the beverage industry. In 1992 the

marketization trend abolished state monopoly on alcohol sale and production which boosted private sector players and pushed considerably prices for spirits down. The supply of alcohol beverages (mostly vodka) came, to a large extent, from illegal sources. The shadow market for vodka was not only the result of increased competition among market players, but also the reluctance to adjust excise taxes to hyperinflation which was an integral part of the new economic system for quite a long period of time. Treisman (2010) estimated that the real vodka price level was down by 80% in 1994 compared to 1990. After this dramatic changes in vodka consumption, in 2000s the government again adopted laws with stricter regulation and even regional bans on alcohol advertising.

The academic world is also divided with respect to the *gender split* of alcohol consumption effect on mortality rates. Horvat et al. (2018) conducted a survey among the relatives of the adults living during the transition period in Russia, Belarus and Hungary, and found that the increased drinking pattern was associated with higher mortality levels in all three countries. What is more important, the researchers claimed that the effect was *not* less important and strong for women as for men (though given that overall there are less female drinkers, the population impact in women would be slightly lower than in men). Another study of the relationship between alcohol and mortality in Russia by Sidorenkov (2012), also revealed equal effect of drinking habits among women and men on mortality risks. However, the majority of research still only concentrates on male representatives disregarding the effect on female drinkers (Azarova et al., 2017).

Another important issue brought about by the academics, is variables selection and model specification. Once the official Russian statistics on alcohol consumption during the investigation period is factored in, Bobak and Marmot (2010) state that the explanatory power of just this variable is too low: increase in alcohol consumption alone does not really explain the mortality rise. Norstrom (2010) decided to approach this question differently by changing the alcohol consumption variable

itself. The Swedish researcher stated that the official statistics underestimate the actual increase in vodka consumption, hence he changed the estimation design and calculated per capita alcohol consumption on the basis of three different sources: sales of alcohol statistics, the illicit alcohol inflows in form of home-produced vodka (*samogon* in Russian) calculated through a proxy of sugar sales (which is the main component) and the proportion of alcohol-related deaths. Having conducted such an analysis through the semi-log ARIMA regression model, Norstrom obtained results similar to those of other prominent researchers (Zaridze et al., 2009): excessive alcohol consumption is the leading cause (potentially the only major one) of changes in mortality rates in Russia since 1980.

However, some academics (Popov, 2010) have identified potential flows in alcohol-related explanation of the crisis. Firstly, they have spotted periods when per capita consumption of spirits and the death rate from external reasons (which include alcohol poisoning, murders and suicides) were moving in the opposite directions. For example, from 2002 to 2009 death rates were going down whereas the alcohol consumption was on the increase. More than that, already by 2007 death rates stemming from the alcohol poisoning were lower than those of the late Soviet era while the mortality rates by that time were still much higher. Then as well, inconsistencies were found between 1960 and 1970, where per capita alcohol intake increased significantly from 4.6 to 8.5 liters, however the life expectancy indicator was more or less stable (69 years in 1960, 70 - 1965 and again 69 years in 1970).

Additionally, opponents of the alcohol explanation of mortality crisis claim that according to both official and alternative estimates, per capita alcohol consumption in the 1990s wes lower than that before the Gorbachev anti-alcohol campaign of early 1985-1987, however the death rates were increased by half. Hence, the opponents conclude that if people drink less but die more in 1990s compared to the previous periods, probably there were reasons other than excessive alcohol consumption that had major effect on the increased mortality rates. Finally, many non-Russian scholars (Childs, O'Connor and de Wit, 2011; Dawson, Grant and Ruan, 2005) argue that there is a problem with respect to both viewpoints on the causes of Russian mortality crisis. Particularly, stress and alcoholism are difficult to separate one from the other one. Stress stemming from the transition to market economy, indeed, could be the reason for engaging into excessive alcohol consumption, hence leading to increased mortality rates. But also, stress factors might lead to higher mortality rates among the population without necessarily increased alcohol consumption. Similarly, increased consumption of vodka could have happened without causing high stress levels in the society, but leading to higher mortality rates. However, the two (stress and alcohol) could have also been interrelated (the endogeneity issue), or the two could have been caused by another third factor that affected the two variables. In the academia we still do not have a certain answer to the question of whether the increased mortality is linked to stress, or alcohol, or the two, or a third factor influencing both.

While there might be consensus among the scholars on the various causes of mortality crisis in Russia, the relative importance attributed to each and every factor is different from one piece of research to another one. Due to the fact that currently there is no one common stance on the issue, this academic problem is now in the deadlock. With this research I will be able to contribute to the field, and try to identify the most relevant and important factors in my setting of the problem.

1.3 Main hypothesis

Having analyzed the existing literature on the topic, we have come up with the potential factors that could have a say in Russian mortality crisis in an empirical study. Here are the hypotheses that would be further proved or disproved during the data analysis section of Chapter 2.

Hypothesis 1: Economic downturns are correlated with changes in mortality data.

Hypothesis 2: Changes in prices of exportable natural resources are negatively associated with mortality fluctuations.

Hypothesis 3: Increased unemployment is associated with higher mortality rates.

Hypothesis 4: Bigger private sector share in GDP indicator is associated with higher mortality rates in the short run.

Let us now look at the rationale behind each hypothesis to be tested:

a) Economic recession and mortality.

It would be obvious to assume that the higher are the disposable incomes of the population and the overall GDP of the whole country, the better should be the health status of the population. Hence, with respect to the Russian case it can be implied that the higher is GDP per capita the lower should be the mortality rates among the population (i.e. inverse relationship). Every new economic crisis should deteriorate health conditions of people. The logic is as follows: the less money people have at their disposal, the worse and less quality nutrition habits they follow, spend less on healthcare and experience more emotional stress – all of these factors together lead to premature deaths and higher mortality rates in the country.

However, if we look back in history, it can be seen that the relationship has not always been like that in other parts of the world. One of the most striking counter-examples is the USA. During the Great Depression, alongside the falls in output, the life expectancy indicator rose significantly (from roughly 57 to more than 63 years during the three most depressive years of the crisis 1929-1932) and overall mortality rates were down, for all causes except for the suicides (Granadoux, 2009). Similarly, the decreasing GDP indicator was going hand in hand with declining mortality rates for many countries during the Asian crisis of 1998. But still the transition crisis in certain post-Soviet states leads to decreased outputs accompanied by increased mortality rates.

Hence, what needs to be figured out is whether in case of Russian mortality crisis the association between mortality rates and incomes is positive, negative or non-existent. From the graph below (see Figure 3) it can be seen that there are periods in support for pro-cyclicality of the relationship, and there are years when it is counter-cyclical. In the following quantitative analysis section, I will try to separate the overall effect between the two variables and establish the relationship more precisely.



Figure 3: GDP per capita (current USD) and mortality rates (per 1000 male adults) in Russia

Source: World Bank, retrieved on 01.03.2019

b) Oil prices and mortality.

Another proxy for the economic well-being could be the prices of natural resources. This is a case-specific proxy of income, suitable to a rare number of countries which are extensively reliant on the exports of natural resources like oil, gas, coal, etc. Russia has always been known to be

economically dependent on its rich natural resources, especially oil and gas. If we look at its budget, the big portion of money inflows comes from the exporting activity of the very these items, the price of which depends on the external parties –such as the OPEC countries. Hence, I can assume that if the prices are on the increase, country earns more money and more of those are channeled directly and indirectly (through institutes and infrastructure improvements) to the final population, which should result in better health outcomes; if prices are down the opposite is true. By looking at the graph (see Figure 4), we can see that there is some kind of correlation between the two variables, which has to be further quantified and explored.



Figure 4: Mortality rates (per 1000 male adults) and oil prices in Russia

Source: World Bank, retrieved on 01.03.2019

c) Unemployment and mortality.

The unemployment indicator is supposed to have positive relationship with mortality rates. Having a job (at least a part-time or seasonal one) means a sense of security and a control for what is and will happen in person's life. The relationship between the employment and mortality is proven for at least one cause of death – suicides. Moreover, there seems to be a cumulative effect, the longer is the jobless period, the higher is the probability of premature death. With respect to the overall mortality rate, the existing cases differ for different countries. The literature on Russian mortality crisis did not come to one definitive conclusion with solid statistical support. Hence, this study could contribute by uncovering the relationship between unemployment and death rates in my model setting. If we look at the graph below (see Figure 5), it can be inferred from the first glance that the two variables are positively correlated and follow more or less similar cycle.

Figure 5: Unemployment (as % of total labor force based on national estimate) and mortality rate (per 1000 male adults) in Russia



Source: World Bank, retrieved on 01.03.2019

d) Privatization and mortality rate.

Finally, I seek to unleash the relationship between the privatization and the mortality rates. Privatization (measured by the share of private sector in GDP) would serve a proxy for potential increased stress in the society in the short-run time period. The most common transmission channel of the privatization trend works as follows: people fear that due to economy re-structuring they will lose their previous jobs-related benefits (e.g. housing, extra money perks, catering, holiday recreation, healthcare and other social services), earn smaller incomes and will be have to dislocate which brings more uncertainty and anxiety. Increased level of stress, in turn, would cause a deterioration of health status among the population leading to more deaths (also through risky behaviors, such as excessive alcohol consumption). People were not able to immediately re-gain the lost social perks that they used to have while being employed by a public corporation since the municipal and administrative divisions of government (which normally provide such services) had huge budget deficits and, hence, were unable to cover social care of adequate quality and scale.

All of these hypotheses would be quantified and tested on the basis of regression models in the following chapter. Based on the results obtained from the data analysis, I will be able to draw conclusions regarding the underlying causes of the Russian mortality crisis, and further support or disprove the arguments posed in the existing literature on the topic.

Chapter 2

In the second chapter of this Master thesis I will explore the quantitative link between mortality crisis and its contributing factors. Before describing the data used, methodology and the results of the regression model, I would like to state some of the assumptions that had influenced the variables selection and the model choice.

2.1 Assumptions

The two important data inferences and essential assumptions for the empirical model are:

a) The working-age category was affected the most during the mortality crisis in Russia.

As can be inferred from the graph published by Stuckler et al. (2012) (see Figure 6 below), the most radical changes in death rates happened for the working-age groups: the biggest spike for the 25-39 age group, second highest rates for the 40-59, followed by the 15-24. The mortality crisis almost did not affect age groups: infant and child, children 5-14 and the elderly (60 years and more). This fact allows to state that if the working-age people is the category that was touched the most by the crisis, the underlying factors of the mortality trap might be linked to the labor market. Thus, it is relevant to include labor market indicators in the regression model to quantify their effect on mortality rates.





 b) The regression model contains only annual male mortality rates, excluding the indicator for women.

As can be seen in the graph (see Figure 10 in the Appendix), women were suffering from unemployment on par with men. However, if we look at the gender split by the mortality indicator (see Figure 7 below) women were much less affected (almost three-times smaller indicators during the observed period, with no radical spikes). Hence, it can be concluded that females better coped with the crisis during the transition period in terms of the mortality rates, despite the fact that their labor market conditions were similar. Why was the difference so striking? The major explanation of this puzzle consists in the notion of "safety nets". Although women had more burdens than men – the work had to be combined with family care – this extra social function allowed them to have more meaning in their lives and go less with risky activities (such as vodka drinking) and stress. Hence, it seems logical to only analyze the male mortality rates (rather than the ones for both genders) as they saw the most drastic ups and downs over the period.



Figure 7: Russian mortality rate split by gender (per 1000 adults)

Source: World Bank, retrieved on 01.03.2019

2.2 Data description

In the following section let me briefly describe the data used for each variable in the model. In Table 1 below there is a summary of all variables used in the model and their notations in the analysis. Additionally, the full summary statistics for each variable is presented in the Appendix (see Table 5). All of the missing observations in the variables that have them are missing at random. The missing observations in the model were not omitted or substituted so as not to lose important links between the data. The model used in the analysis allows for such an accommodation.

a) Mortality variable

The mortality variable is represented by the annual male mortality rate, which states the number of deaths in males over the year. The data was taken from the GKS website (the Russian Federation Statistics Service) – public governmental statistical database. The mortality data are regional level data and contains death rates for each of the 79 regions in Russia (Moscow and Saint-Petersburg were taken separately, out of their respective regions, and added on a par with them). Due

to the fact that all regions differ a lot in terms of their population size, the absolute death numbers were very heterogeneous (ranging from 81151 to almost 0). Very large death rates for Moscow and Saint-Petersburg skewed the data to the right. Hence, the data was transformed to percentage points, representing the mortality growth rates in a certain year compared to the previous year. The mortality rates (in percentage) are varying from the decrease of -30% to a maximum increase of almost +36%. Additionally, it is worthy to mention that there are data gaps for the mortality indicator. For example, the Chechnya region lacks the data from 1993 to 2000 due to the fact that this was the war period in the area. Similarly, the data from 1990 to 1994 is missing for Ingushetia region where there was also a war in the period.

b) Unemployment variable

The unemployment variable is represented by the regional data observations for each region and year. There are two sources of data: the CEIC database for the period from 1990 to 1999 and the GKS for the period 2000 onwards¹. The observations are calculated as the percentage of unemployed people in the age of 15-72 among the labor population (both employed and unemployed). For the period before 1992, the unemployment rates for all regions are 0%. This was the case due to the fact that before the USSR dissolution in 1991, unemployment, as it exists today, did not exist in the country. In the USSR from 1930 (the time when the last job fair ceased to exist and unemployment was liquidated) there was a slogan "who does not work – does not eat" (Demoscope, 2010). Hence, everyone was employed (predominately by the public sector), and the unemployment rate was 0%. In our data, the maximum unemployment indicator attains the level of 67.7% (for Chechnya, 2006).

¹ The data on unemployment indicator by region before 2000 was not available on the *GKS* website (official public data source for metrics on Russia), hence private data source *CEIC* was used to obtain the rates from 1990 to 1999 (the methodology is the same in both sources).

c) Gross Regional Product (GRP) variable

The per capita income in the model is measured through the per capita gross regional product, measured in rubles. The data was retrieved from the GKS website. However, again due to regional disparities the absolute indicator was skewing the data, as it was ranging from about 2000 in Ingushetia during the peak crisis year to almost 8000000 in Moscow in the after crisis times. In order to get more homogeneous indicators, the GRP was transformed in percentage points – showing the annual percentage increase/decrease of GRP in a certain region in a certain year. The maximum and minimum annual GRP changes were registered in Vologodskaya region (+202% and -30% respectively). For the GRP indicator there are some missing observations in the period from 1991 to 1994, which is mostly due to the fact that GKS did not report the data for that period because this was a period right after the dissolution when there were major changes in the country and some of the statistics were not recorded at all.

d) Privatization variable

The privatization indicator is represented by the "EBRD large scale privatization index". The index is constructed by the EBRD as part of their transition indicators (1989-2014) database. The indicator ranges from 1 to 4+, with 1 associated with rigid centrally planned economy and 4 with industrialized market economy. As defined by the EBRD:

- 1 is very little private ownership;
- \circ 2 is a prepared scheme for ownership transfer, not yet implemented;
- 3 is reached when more than 25% of large-scale enterprise assets are being in private hands or in the process of being privatized;
- \circ 4 is once the target is at 50%;

 4+ is 75% of enterprise assets or more are in private ownership with effective corporate governance.

This is a country-level variable. No figures are available in regional breakdown.

e) Oil price variable

As a proxy for the oil price changes, I used the Brent crude oil historical annual data, measured in dollars/barrel. The observations were taken from the *Macrotrends* financial research platform. In order to have a more homogeneous pattern across the observations, the prices were transformed into growth rates, measured in percentage. The biggest international oil price increase of 60% was registered in the year 2000, and the most pronounceable drop of -46% in 2015, after the mortality crisis period.

Variable	Description	Notation in the model
Region name	The names of 79 Russian	region
	regions	
Year	Years from 1991 to 2017	year
Mortality rate	Annual male mortality growth	mortality_change
	rates in a given region in a	
	given year (%)	
Unemployment	The percentage of unemployed	unemployment
	people in a given region in a	
	given year (%)	
Gross Regional Product (GRP)	The growth rate of GRP in a	GRP_change
	given region in a given year	
	(%)	
Privatization	Index varying from 1 to 4,	privatization_index
	measured annually	
Oil price	The percentage	oil_price_change
	increase/decrease of oil price in	
	a given year compared to the	
	previous (%)	

Table 1: V	ariables (description
------------	------------	-------------

The whole data collection process was probably the biggest challenge to the empirical part of my research on Russian mortality crisis. The problem of missing data in the early 90s due to wars (in some regions) and USSR dissolution across the whole country, as well as the overall unreliability of the open-source statistics for that period posed many hardships for the analysis. Still, I believe that this model was able to capture major trends and relationships between the data points over time. I was not able to find good data on alcohol consumption.

2.3 Methodology

Before moving on to the regression model itself, I explored the statistical links between the variables, and their overall compatibility of being included into one single model. Firstly, the correlation coefficients were checked (see Appendix Table 6). There are no highly significant correlation coefficients (the maximum correlation of 0.37 is between privatization index and the unemployment rate). Hence, we can safely put the variables into one regression model. Secondly, I checked the co-plot of mortality rates across the regions and years (see Appendix Figure 12). As can be inferred from the graph, all of the regions experienced a mortality shock in the 1990es, though of a different magnitude. To further zoom into heterogeneity issue across regions and years, we can look at the graph of mortality rate means with confidence intervals (see Figure 13 and Figure 14). The statistics again confirm that even when we take the regional data the two spikes in mortality rates are at place as a major common trend.

CEU eTD Collection

Let us now have a look at other covariates in the model. The unemployment indicator also has some spikes (see Figure 8 below), with the biggest one happening around the year 1998. The data on unemployment looks slightly skewed to the right. Hence, once running a regression I will use the log of the unemployment variable so as to have it look closer to the normal distribution. Figure 8: Heterogeneity across years of unemployment and GRP rates



After reviewing each variable individually, I built the plots to unleash the relationship of covariates with the dependent variable – mortality rate (see Figure 9). We can infer that the dependency is not that pronounced, but with an explicit trend for each covariate.



Figure 9: Plots mortality VS co-variates

Before running the regression model, the stationarity of data was checked (essential step for the time series analysis). The Augmented Dickey-Fuller Test was run to test the null hypothesis of non-stationary data. The reported p-value is 0.01 (which is less than 0,05), hence we can reject the null in favor of the alternative hypothesis: the data is stationary. In the model I do not have to worry about the heteroscedasticity problem and serial correlation, since clustered standard errors are used which automatically take care of these issues (by adapting the variables coefficients accordingly).

For this panel data and the purpose of the research the most suitable method is the regression model. In order to quantify the effect of explanatory variables on mortality indicator, I used three different models types:

1) The standard OLS model.

2) The fixed effects model using least squares dummy variable on regions.

3) The fixed effects model for panel data with dummy variables on regions and years and time lags.

The three models allow us to see the contribution of each covariate to the changes in mortality and quantify the effect. The second model (unlike the first one) additionally controls for individual fixed effects of each region (i.e. accounting for all region-specific differences). The third model comprises both the individual and time-invariant fixed effects, thus taking into account not only region specifics but also differences across time. Along with it, the third model has got a one-year lag of the unemployment variable. I included the one-year lag since it is possible that the effect of unemployment (i.e. stress, loss of income, loss of social and medical company benefits, etc.) is delayed, and only directly affects the mortality rates in one-year time. Even more plausible is a more prolonged effect – of three to five years lags – however, I did not incorporate it due to a small number of observations in the initial data (once the lags are introduced the number of observations decreases as the first-row components are used for lags calculation and do not appear in the model in its initial form).

In the final results section, I would mostly refer to the last model, as it allows to filter out all time-invariant things that are specific for each region, hence making the comparison more impartial and allowing for more causal links, compared to the usual OLS models (more generalization of the results is possible). For each model clustered standard errors (and corresponding coefficients) were computed which allows to account for potential serial correlation and heteroscedasticity problems.

General model specification: mortality_change = *f* (unemployment, GRP_change, privatization_index, oil_price_change)

Model specification in econometric format (for the third model): mortality_change = $\beta 0$ ln(unemployment) + $\beta 1$ lag(ln(unemployment)) + $\beta 2$ (GRP_change) + $\beta 3$ (privatization_index) + $\beta 4$ (oil_price_change) + Region Dummies + Year Dummies + ϵ

Let us now proceed with the results of the above described regression models.

2.3 Results of empirical analysis

A regression model was conducted in the R programming language. I run the regression models for unbalanced panel data with 2133 observations. The full R-output of the regression models results (with relevant statistics, p-values, etc.) are available in the Appendix (see Table 7).

1) Model one (see Table 2):

Table 2: Heteroscedasticity consistent coefficients (Model 1)

t test of coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	-53.6854497	2.6595643	-20.1858	< 2.2e-16	***
log(unemployment)	0.7394539	0.3087511	2.3950	0.01676	*
GRP_change	0.0103158	0.0069919	1.4754	0.14036	
oil_price_change	0.0207594	0.0052908	3.9236	9.186e-05	***
privatization_index	16.3877531	0.8979039	18.2511	< 2.2e-16	***
Signif. codes: 0 '	***' 0.001 '**	'' 0.01 '*'	0.05 '.'	0.1 ' ' 1	

- We can infer that the unemployment, oil price and privatization variables are statistically significant, whereas the GRP variable is not.
- The adjusted R-squared indicator is 30%: cross-regional variation in independent variables together explain 30% of the cross-regional variation in mortality changes.
- For a 10% increase in the unemployment level of regions with same GRP change, oil price change and privatization index, mortality indicator, on average, will increase by 0,07%.
- For a 100% increase in the GRP growth rate of regions with same unemployment rate, oil price change and privatization index, mortality indicator, on average, will increase by 0,01%. However, this estimate is not statistically significant.
- For regions with same GRP change, unemployment rate and privatization index and a twice increased oil price level, mortality indicator, on average, will increase by 0,02%.
- For a 1-level higher EBRD privatization indicator, mortality indicator, on average, increases by 16%.

2) Model 2 (see Table 3):

Table 3: Heteroscedasticity consistent coefficients (Model 2, only co-variates without reporting dummies)

```
t test of coefficients:
```

log(unemployment) GRP_change oil_price_change privatization_index	Estimate 2.2414318 0.0060733 0.0190834 15.0490293	Std. Error 0.5722469 0.0069128 0.0052063 1.0321137	t value Pr(> t) 3.9169 9.475e-05 0.8785 0.3798232 3.6655 0.0002577 14.5808 < 2.2e-16	*** ***
Signif. codes: 0 '***' 0.001 '**	' 0.01'*' 0	.05'.'0.1	''1	

- We can infer that the unemployment, oil price and privatization variables are statistically significant, whereas the GRP variable is not (similarly to the previous model). However, here the unemployment variable is statistically significant at higher level.
- The adjusted R-squared indicator is slightly lower at 28%: the independent variables in the model together explain 28% of the variation in mortality changes in the given time period.
- The effects of the variables on mortality are smaller in magnitude (lower coefficients) than in the previous model.

3) Model 3:

Table 4: Heteroscedasticity consistent coefficients (Model 3, only co-variates without reporting dummies)

```
t test of coefficients:
```

```
Std. Error t value Pr(>|t|)
0.5822170 -2.2062 0.0275625
                                  Estimate
log(unemployment)
                                -1.2844799
lag(log(unemployment), 1:1)
                                             0.8180755
                                1.2435895
                                                          1.5201 0.1287430
GRP_change
                                             0.0089593
                                                          1.0030 0.3160573
                                0.0089864
oil_price_change
                                             0.0952480 -3.4592 0.0005611
                                                                            ***
                                -0.3294809
privatization_index
                               32.4409371
                                            11.4801900 2.8258 0.0047953 **
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

- We can infer that once we introduce a fixed effects model with region and year dummies, there are some similarities as well as differences across the three models. We see that the GRP and privatization variables did not change the signs, only the magnitude, whereas the oil price indicator did change a sign to negative. Additionally, the unemployment variable now allows for more inference. The association between the unemployment and mortality change is negative, however if we introduce one lag it is positive again.
- The adjusted R-squared indicator is now 60%: the independent variables in the model together explain 60% of the variation in mortality changes taking into account time-invariant region controls. Such a high R-squared coefficient could be the result of introducing many more dummy variables (we now have 79 more variables on regions plus 15 variables on years) and lags. Notwithstanding with that, the explanatory power of this model is still higher as the model is able to capture more links between the data points.

- Compare two regions that have the same GRP growth, privatization index and oil price growth rates and also are the same in everything that does not change in time, but are different in the unemployment indicator. The region in which the unemployment rate is 10% higher, the mortality rate tends to be 0,128% lower (significant at 5% level). But <u>one year after</u> the unemployment increases by 10%, the mortality rate tends to be 0,124% higher (however, this coefficient is not statistically significant).
- Compare two regions that have the same unemployment rate, privatization index and oil price growth rates and also are the same in everything that does not change in time, but are different in the GRP growth indicator. The region in which the GRP change rate is 100% higher, the mortality rate tends to be 0,009% higher (not significant in the model).
- Compare two regions that have the same GRP growth, privatization index and unemployment rates and also are the same in everything that does not change in time, but are different in the oil price growth indicator. The region in which the oil price growth is 100% higher, the mortality rate tends to be 0,32% lower (significant coefficient).
- Compare two regions that have the same GRP growth, unemployment rate and oil price growth rates and also are the same in everything that does not change in time, but are different in the EBRD privatization indicator. The region in which the privatization level is higher by 1, the mortality rate tends to be by 32% higher (significant at 1% level).

2.4 Discussion of results

Having analyzed the results of the regression models, I got some interesting insights from the data and the links between the observations.

Firstly, it is worthwhile to try to explain the difference between the coefficients on unemployment variable with and without a lag in the third fixed effects model. We can infer that the <u>immediate effect</u> of unemployment on mortality is negative, which is logical: without the job, a person has got more free time, hence he/she is able to take more care of oneself, relax and experience less stress without a boss, unwanted job duties and physical and emotional stress. This also has some kind of prove in real life. However, if we look at the lagged variable (in our model) we could infer that the <u>deferred effect</u> of unemployment is actually positive. If people do not have job for quite a long period of life (more than a year), they not only lose income but also job perks, social functions, healthcare provision bonus, and, in case of men specifically, the role of the family feeder and head. Hence, the job loss not only reduces income, but, more importantly, increases stress factors in the society, leading to premature deaths. This could be one of the explanations why the same variable might have coefficients of different directions in one model – it could capture the immediate and deferred effects.

Another important insight from all three models is why the GRP variable is not statistically significant in either model. I suppose this could be the case because there is a big time lag in real life between the change in GDP indicator and the mortality rate. More precisely, the effect of low material well-being at birth or in the middle of life only translates into health status deterioration after some years. Hence, the model without big deferred time lag was not able to capture it. Additionally, it is worthy to mention that the direction of effect of GRP on mortality is the same across all three models. The higher the GRP change, the bigger the mortality increase. This outcome allows us to classify the

Russian mortality crisis into the bucket of countries for which the mortality and output go hand-inhand together – as the case of the Great Depression in the USA and the Asian crisis.

Thirdly, it is important to understand why does the oil price coefficient change its sign in the last regression model making the model less robust with respect to it. The association between oil prices and the mortality rates is positive in the first two models, whereas in the last model (once we control for all regional time-invariant features) it becomes negative. I suppose that this switch in the direction of effect shows that, overall, oil price indicator is not a good proxy for real per capita incomes in the regions. Probably, in case of Russia oil prices represent a windfall of extra profits which does not qualitatively change people's lives in any direct way. On putting this differently: when the international oil princes changed, various government-induced redistributive policy measures largely neutralized the direct positive or negative impacts.

Hence, oil price increase/decrease does not really have one pronounced effect on individual mortality rates. If with this extra profits from higher prices structural reforms were introduced, it could be the case that the effect was more pronounced and had a solid negative relationship with mortality in all three models.

Finally, if we look at the association between the privatization index and the mortality rates, it appears to be the most robust one and of the biggest magnitude across all three models (always positive and statistically significant). This shows us that privatization, indeed, was a major stress factor for the Russian citizens that lead to higher mortality rates. People did perceive privatization and economy restructuring as a major uncertainty that could have reduced their incomes, changed their homes and social status. Hence, with respect to this variable my piece of research goes in line with the group of economists who claim that privatization was one of the most important factors in mortality crisis in Russia.

After discussing the results of the regression models, we could state that:

Hypothesis 1 is accepted: Economic downturns are correlated with changes in mortality data (positively correlated, though statistically insignificant in all three models).

Hypothesis 2 is partially accepted: Changes in prices of exportable natural resources are negatively associated with mortality fluctuations (only for model 3).

Hypothesis 3 is partially accepted: Increased unemployment is associated with higher mortality rates (for models 1, 2 and only lagged variable in model 3).

Hypothesis 4 accepted: Bigger private sector share in GDP indicator is associated with higher mortality rates in the short run (for all three models).

We could see that all of the initial hypothesis are accepted, at least partially. It is also important to mention some potential limitations to the models used in this thesis:

- The three regression models appeared to be not enough robust, as some variables change the direction of their coefficients when I implement a different method (i.e. the oil price variable). This could be the case due to the fact that there are too few observations for the regression model and too big a time span. Too big time span blurs the short-run effect of each variable, and, coupled with overall low number of observations and big amount of missing data points, the robustness suffers.
- For some variables the effect on the mortality change was marginal (i.e. just a few decimals of the percentage). Low magnitude of effect could also be linked to the overall too wide time span introduced in the models. Probably if we have restricted to a narrower timeframe from 1995 to 2005, the links between the data during the mortality crisis itself would have been better captured. However, this again was not viable

enough due to bad data quality in the early 1990es and big number of missing observations in the corresponding period.

• Once the year dummies are introduced, not all of the years are at statistically significant level, though all of the regions are. This could have been connected to the fact that in the model the unbalanced data is used, and, hence, less observations are used in each separate year, less robust it is. Surely, there could have been other reasons than that too.

Nonetheless, these limitations do not prevent the analysis to be insightful and be a contribution to the literature on the topic of Russian mortality crisis. The empirical analysis and the existing model could be further stretched in order to capture even more links between the variables and further explore the underlying causes of mortality trap. The following recommendations could be introduced in the future research so as to improve the explanatory power of the model and deeper understanding of the issue:

1) Include other covariates (alcohol (was not tested in the model), stress, healthcare quality in the country, etc.) to see the potential confounders and account for them.

2) Provide for data of higher quality (potentially not from the public access), so as to have less missing observations and, thus, a more balanced panel. This would allow to use more profound econometrics techniques and better capture the associations between the data points.

3) Introduce comparative analysis of Russian mortality crisis with other countries who experienced similar trends. This would allow to see what was really different for Russia, and which covariates are indeed region specific.

4) Do more data segregation – by cause, by age, by gender, etc. to better capture the disparities, and, hence, better see the underlying reasons of mortality trap in Russia.

2.5 Implications for policy-making

Finally, I would like to state the implications of this research. This thesis could be of high importance for both the academia and the practical side of policy-making in Russia and beyond. Let me briefly outline major insights from it.

Firstly, there are some far-reaching implications for the future policy decisions in Russia. As was stated in Chapter 1, many analysts predict that the Russian population will only be decreasing in the upcoming years, hence it would be of paramount importance to understand the underlying causes and transmission mechanisms that link increased mortality with other potential explanatory variables. Many of these explanatory variables are to big extent (if not fully) shaped by the economic and social policy decisions. Hence, the results of this empirical research could be an important contribution for general governments, international organizations, ministry departments and other interested parties alike.

Secondly, this research could compliment policy-making process in other countries that are currently or in the future will be facing the introduction of radical economic or social policy decisions. Unlike the case of the Russian privatization process, other countries could now learn that any reform does not only influence material and emotional well-being of citizens but sometimes, more crucially, the lives of people themselves. In the twenty-first century there are examples of countries that are currently undergoing the transition process to the market-type economy. The Russian case could be a lesson for them, and this particular empirical research could help them quantify the potential effect of transformational policies on mortality rates.

The mortality crisis today is not only a threat for the planned economies. Some of the developed countries are also facing this problem (more often not the whole population but only some clusters of it). For example, recently the mortality rates among white non-Hispanic working age adults (30 to 55 age cohort) in the US were on the uptrend (Popov, 2018). The researchers identified the stress as a pre-dominant cause for such a mortality pattern. This is a very rare case for such a developed high-income country, however it is still in place, and likely US is not the last one to encounter it. Hence, the relevance of the research on the topic of mortality causes is of primary focus. This analysis could be further adopted not only to meet the demands of transitional economies, but customized to also help quantify the effect on mortality for developed economies.

Finally, this piece of research has got extensive implications for social sciences and the academia which is becoming increasingly multidisciplinary. The debate on the root-causes of Russian mortality crisis of 1991-2005 which took millions of lives of Russian people still awaits resolution. The academics still have not arrived to one conclusions on the major factors that had a say in this puzzle. This thesis contributes to the debate by creating a model that quantifies and proves the stance on stress-related explanation of the mortality trap.

To conclude, I do believe that the topic of the underlying factors of mortality crisis today is as vital and important as never before, and this thesis helped the scientific society and policy-makers to create more profound and comprehensive research in the domain as well as more informative decisions that help shape people's lives.

Conclusion

Starting from the 1960s, the republics of the Soviet Union saw a deep demographic crisis. The dissolution of the SU in 1991 was a breaking point for Russia, which saw its mortality rate going up by more than 60% - unprecedented level in the world history of peaceful times. The crisis lasted for more than two decades after the dissolution across all Russian regions. Numerous studies were conducted in a bid to uncover the underlying reasons and links of this mortality puzzle. However, still today there is no consensus on it.

After having analyzed the potential explanations of mortality crisis by prominent economists, I conducted my own empirical research in order to confirm or reject the hypotheses on causal links between mortality and potential explanatory variables of it. I ran a panel data fixed effects regression model with regional and year dummies, which allowed me to net out all of the observed and unobserved time-invariant effects in order to best capture the real determinants of mortality fluctuations. I arrived to the following results:

- Privatization was strongly positively associated with increased mortality;
- Growth of GRP and mortality had positive relationship (but statistically insignificant)
- Oil price indicator was negatively associated with mortality (model 3)
- Unemployment was in positive relationship with mortality

Hence, all four initial hypotheses were accepted (at least partially).

From my theoretical and empirical research results, I arrived to the overall conclusion on the topic that it is not just one stress cause of the mortality crisis but rather things adding up. Increased stress level stemming from privatization, unemployment, excessive alcohol consumption and other factors - were all puzzles of the whole.

This research represents a valuable methodological and empirical contribution to both the domain of social sciences as well as policy decision makers. Its implications are far-reaching still today after almost 10 years after the Russian mortality crisis had finished, because such conclusions matter as they help "to understand the downstream effects of upstream social and economic choices" (Gerry et al., 2010).

References

- Azarova, A., Irdam, D., Gugushvili, A., Fazekas, M., Scheiring, G., Horvat, P., Stefler, D., Kolesnikova, I., Popov, V., Szelenyi, I., Stuckler, D., Marmot, M., Murphey, M., McKee, M., Bobak, M., King, L. (2017). The effect of rapid privatization on mortality in mono-industrial towns in post-Soviet Russia: a retrospective cohort study. *Lancet Public Health*, 2, 231-238.
- Bobak, M., Marmot, M. (1999). Alcohol and mortality in Russia: is it different than elsewhere? *Ann Epidemiol*, 9, 335-338.
- Bohk, C., Rau, R. (2015). Impact of economic conditions and crises on mortality and its predictability. *NCBI*, 67, 271-294. Available at: <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4577549/</u> (Last accessed: 14.05.2019)
- Brent Crude Oil Prices. *Macrotrends database*. Available at: <u>https://www.macrotrends.net/2480/brent-crude-oil-prices-10-year-daily-chart</u> (Last accessed: 14.05.2019)
- Childs, E., O'Connor, S., de Wit, H. (2011). Bidirectional interactions between acute psychosocial stress and acute intravenous alcohol in healthy men. *Alcoholism: clinical and experimental research*, 35, 1794-1803.
- Cornia, G. (1997). Labor market shocks, psychological stress and the transition's mortality crisis. *Research in progress*, 4.
- Cornia, G., Paniccia, R. (2000). The mortality crisis of transitional economies. *Oxford University Press.*
- Dawson, D., Grant, B., Ryan, W. (2005). The association between stress and drinking: modifying effects of gender and vulnerability. *Alcohol and alcoholism*, 40, 453-460.

- Demographic indicators for Russia. *GKS database*. Available at: <u>http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/population/demography/</u> # (Last accessed: 14.05.2019)
- Earle, J., Gehlbach, S. (2011). Did post-communist privatization increase mortality? *Comparative economic studies*, 53, 239-260.
- Gentile, M. (2012). Mass privatization, unemployment and mortality. *Europe-Asia studies*, 64, 785-787.
- Gerry, C. (2012). Revisiting the mass privatization mortality debate: a response to Stuckler, King and McKee. *Social science and medicine*, 75, 32-35.
- Gerry, C. (2012). The journals are full of great studies but can we believe the statistics? Revisiting the mass privatization mortality debate. *Social science and medicine*, 75, 14-22.
- Gerry, C., Mickiewicz, T., Nikoloski, Z. (2010). Did mass privatization really increase postcommunist mortality? *The Lancet*, 375.
- Granados, J., Roux, A. (2009). Life and death during the Great Depression. *National Academy of Sciences of the Unites States of America*, 106, 17290-17295.
- Horvat, P., Stefler, D., Murphey, M., King, L., McKee, M., Bobak, M. (2018). Alcohol, pattern of drinking and all-cause mortality in Russia, Belarus and Hungary: a retrospective indirect cohort study based on mortality of relatives. *Society for the study of addiction*, 113, 1252-1263.

- King, L., Stuckler, D., Hamm, P. (2009). Rapid large-scale privatization and death rates in excommunist countries. An analysis of stress-related and health system mechanisms. *International journal of health services*, 39, 461-489.
- Leon, D., Chenet, L., Shkolnikov, V., Zakharov, S., Shapiro, J., Rakhmanova, G., Vassin, S., McKee,
 M. (1997). Huge variation in Russian mortality rates 1984-94: artefact, alcohol, or what? *The Lancet*, 350. 383-388.
- Nemtsov, A. (2002). Alcohol-related harm losses in Russia in the 1980ies and 1990ies. *Society for the study of addiction*, 97, 1413-1425.
- Norstrom, T. (2011). The role of alcohol in the Russian mortality crisis. *Society for the study of addiction*, 106, 1957-1965.
- Popov, V. (2010). Mortality crisis in Russia revisited: evidence from cross-regional comparison. MPRA, 21311.
- Popov, V. (2010). Russia's mortality crisis: will we ever learn? *PONARS Eurasia policy memo*, 127. Available at: <u>http://www.ponarseurasia.org/sites/default/files/policy-memos-</u>pdf/pepm_127.pdf (Last accessed: 08.05.2019)
- Popov, V. (2018). Mortality and life expectancy in post-communist countries: what are the lessons for other countries? *Dialogue of civilizations research institute*.

Pridemore, W. (2008). The role of alcohol in Russia's violent mortality. Russian analytical digest, 35.

Russia Unemployment Rate: by Region: Annual. *CEIC database*. Available at: https://www.ceicdata.com/en/russia/unemployment-rate-by-region-annual (Last accessed: 14.05.2019)

- Sabirianova, K. (2002). The great human capital reallocation: an empirical analysis of occupational mobility in transition Russia. *Journal of Comparative Economics*, 30, 191-217.
- Sidorenko, O., Nilssen, O., Grjibovski, A. (2012). Determinants of cardiovascular and all-cause mortality in Northwest Russia: a 10-year follow-up study. *Ann Epidemiol*, 22, 57-65.
- Stuckler, D., King, L., McKee, M. (2012). The disappearing health effects of rapid privatization: A case of statistical obscurantism? *Social science and medicine*, 75, 23-21.
- Transition indicators (1989-2014). *EBRD*. Available at: <u>https://www.ebrd.com/what-we-do/economic-research-and-data/data/forecasts-macro-data-transition-indicators.html</u> (Last accessed: 14.05.2019)
- Treisman, D. (2010). Death and prices: the political economy of Russia's alcohol crisis. *Econ transit*, 18, 281-331.
- Unemployment rates for Russia. *GKS database*. Available at: <u>http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/wages/labour_force/</u> (Last accessed: 14.05.2019)
- United Nations DESA (2017). World population Prospects. Available at: https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/ (Last accessed: 08.05.2019)
- Vakhrusheva, D., Staroverova, E., Goncharova, E. (2010). Труд в России больше, чем работа.Demoskopweekly,417-418.Availableat:http://www.demoscope.ru/weekly/2010/0417/gazeta020.php(Last accessed: 14.05.2019)

- Vishnevsky, A., Shkolnikov, V. (1999). Russian mortality: past negative trends and recent improvements. Population under stress: the geodemography of post-Soviet Russia. *Westview press*.
- Vlassov, V., Vishnevsky, A. (2017). Privatization and mortality in Russia. Lancet public Health.
- World Bank (2017). World Population Prospects: 2017 Revision. *The Human Mortality Database*. Available at: <u>https://data.worldbank.org/indicator/SP.DYN.AMRT.MA?locations=RU-UA-BY-KZ-MD-</u> LV-EE-HU (Last accessed: 14.05.2019)
- Wringley, E., Schofield, R. (1981). The population history of England, 1541-1871. A Reconstruction.
- Zaridze, D., Brennan, P., Boreham, J., Boroda, A., Karpov, R., Lazarev, A. (2009). Alcohol and causespecific mortality in Russia: a retrospective case-cohort study of 48 557 deaths. *Lancet*, 373, 2201-2214.

Appendix



Figure 10: Unemployment in Russia by gender split

Source: World Bank, retrieved on 13.05.2019

Figure 11: Natural gas prices and mortality in Russia



Source: World Bank, retrieved on 13.05.2019

Table 5: Summary statistics

Statistic	Ν	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
unemployment	2,029	8.963	6.452	0.000	5.600	10.500	67.700
privatization_index	1,896	2.985	0.495	1.000	3.000	3.330	3.330
mortality_change	2,133	0.560	7.384	-30.335	-3.825	3.482	35.891
GRP_change	1,518	21.986	22.102	-27.644	9.332	27.255	202.024
oil_price_change	2,133	6.445	25.725	-46.418	-11.957	28.944	60.112

Table 6: Correlation coefficients

	mortality	unemployment	GRP_change	privatization	oil price
mortality	1				
unemployment	-0,05	1			
GRP_change	0,27	0,22	1		
privatization	-0,13	0,37	0,32	1	
oil price	-0,047	0,11	0,35	0,24	1



Figure 12: Co-plot of mortality change by region by year

year

Figure 13: Mortality heterogeneity across the Russian regions



Heterogeineity across regions

CEU eTD Collection

Figure 14: Mortality heterogeneity across years



Heterogeineity across years

year

Table 7: Regression models results

	Dependent variable:			
	mortality_change			
	0	LS	panel	
			linear	
	(1)	(2)	(3)	
log(unemployment)	0.739***	2.241***	-1.284**	
	(0.254)	(0.523)	(0.571)	
lag(log(unemployment), 1:1)			1.244**	
			(0.544)	
GRP_change	0.010*	0.006	0.009	
	(0.006)	(0.007)	(0.007)	
oil_price_change	0.021***	0.019***	-0.329***	
	(0.005)	(0.006)	(0.078)	
privatization_index	16.388***	15.049***	32.441***	
	(0.872)	(0.992)	(9.183)	
factor(region)Adygeya		-53.045***		
		(2.860)		
factor(region)Altay		-52.591***		
		(2.897)		
factor(region)Amurskaya		-52.437***		
		(2.925)		
factor(region)Arkhangelsk		-53.376***		
		(2.903)		

factor(region)Astrakhanskaya	-52.629 ^{***} (2.915)
factor(region)Bashkotorstan	-51.089 ^{***} (2.930)
factor(region)Belgorod	-50.870 ^{***} (2.962)
factor(region)Bryansk	-53.042 ^{***} (2.929)
factor(region)Buryatiya	-53.185 ^{***} (2.898)
factor(region)Chechnya	-52.367 ^{***} (2.987)
factor(region)Chelyabinskaya	-51.324 ^{***} (2.951)
factor(region)Chukotskiy	-51.482 ^{***} (2.982)
factor(region)Chuvashskaya	-51.404 ^{***} (2.920)
factor(region)Dagestan	-53.455 ^{***} (2.849)
factor(region)Evreiskaya	-52.010 ^{***} (2.910)
factor(region)Habarovskiy	-52.534 ^{***} (2.933)

factor(region)Ingushetiya	-57.571***
	(2.901)
factor(region)Irkutskaya	-52.989***
	(2.912)
factor(region)Ivanovo	-53.075***
	(2.948)
factor(region)Kabardino-Balkariya	-53.976***
	(2.858)
factor(region)Kaliningradskava	-52.589***
	(2.899)
factor(region)Kalmykiya	-54 114***
	(2.852)
factor(region)Kaluga	-51 706***
	(2.955)
factor(region)Kamchatskiv	-53 119***
	(2.889)
factor/region)Karachaovo	
Cherkesskaya	-53.402***
	(2.889)
factor(region)Kareliya	-53.051***
	(2.883)
factor(region)Kemerovskaya	-52.755***
	(2.923)
factor(region)Khakassia	-53.024***
	(2.921)

factor(region)Kirovskaya	-52.412***
	(2.935)
factor(region)Komi	-53.415***
	(2.880)
factor(region)Kostroma	-52.384***
	(2.966)
factor(region)Krasnodarskiy	-52.145***
	(2.926)
factor(region)Krasnovarskiv	-52.992***
	(2.927)
factor(region)Kurganskava	-53.081***
	(2.907)
factor(region)Kursk	-52.607***
	(2.940)
factor(region) eningradskava	-51 919***
	(2.921)
factor(region) linetsk	-51 233***
	(2.974)
factor(region)Magadanskava	-52 576***
Tactor (Tegion) iviagauanska ya	(2.920)
factor(region)) Arriv al	F1 0F1***
	(2.914)
<i></i>	****
tactor(region)Mordoviya	-51.594
	(2.958)

factor(region)Moskovskaya	-50.548***
	(3.012)
factor(region)Moskva	-49.322***
	(3.139)
factor(region)Murmanskava	-52.767***
	(2.890)
factor(rogion)Nizhogorodskava	ED 112***
Tactor(region)Nizhegorodskaya	(2.950)
factor(region)Novgorodskaya	-52.413***
	(2.331)
factor(region)Novosibirskaya	-51.852***
	(2.919)
factor(region)Omskaya	-51.896***
	(2.917)
factor(region)Orenburgskava	-52.011***
	(2.924)
factor(region)Orlovskava	-52.172***
	(2.943)
factor(rogion)Ocotiva	E2 777***
Tactor (region) Osetiya	(2.897)
factor(region)Penzenskaya	-52.286***
	(2.936)
factor(region)Permskiy	-52.386***
	(2.928)

factor(region)Primorskiy	-52.480***
	(2.921)
factor(region)Pskovskaya	-53.963***
	(2.898)
factor(region)Rostavskaya	-52.718***
	(2.916)
factor(region)Ryazan	-52.857***
	(2.945)
factor(region)Sakhalinskava	-52.939***
	(2.910)
factor(region)Samarskava	-50.770***
	(2.977)
factor(region)Sankt-Peterburg	-50.896***
	(3.028)
factor(region)Saratovskava	-52 228***
	(2.930)
factor(region)Smolensk	-53 464***
	(2.925)
factor(region)Stavronol	-52 526***
	(2.926)
	F-0 -0 4 -0***
factor(region)Sverdlovskaya	-52.212 (2.934)
	()
factor(region)Tambov	-53.129***
	(2.923)

factor(region)Tatarstan	-51.125***
	(2.955)
factor(region)Tomskaya	-52.462***
	(2.912)
factor(region)Tula	-52.592***
	(2.977)
factor(region)Tumenskaya	-51.378***
	(2.904)
factor(region)Tver	-52.740***
	(2.957)
factor(region)Tyva	-55.327***
	(2.857)
factor(region)Udmurtskava	-51.361***
	(2.929)
factor(region)Ulvanovskava	-51.565***
	(2.941)
factor(region)Vladimir	-52,591***
	(2.931)
factor(region)Volgogradskava	-52 668***
	(2.923)
factor(region))/ologodskava	-51 779***
	(2.915)
factor(region))/oronezh	-52 002***
	(2.935)

factor(region)Yakutiya	-52.858***	
	(2.895)	
factor(region)Yaroslavl	-51.858***	
	(2.977)	
factor(region)Zabaykalskiy	-53.385***	
	(2.901)	
factor(year)1998		-20.920***
		(5.724)
factor(year)1999		14.122***
		(0.704)
factor(year)2000		17 081***
		(2.097)
f		40.000***
factor(year)2001		-10.930 (3.781)
factor(year)2002		-3.377 (2.431)
		(2.101)
factor(year)2003		-1.408
		(1.435)
factor(year)2005		17.433***
		(3.841)
factor(year)2006		0.635
		(2.046)
factor(year)2007		0.825
		(1.447)

factor(year)2008			13.556***
			(3.177)
factor(year)2009			-11.681***
			(2.355)
factor(year)2010			11.758***
			(2.806)
factor(year)2011			10.239***
			(3.638)
factor(year)2012			-0.069
			(0.783)
factor(year)2013			-1.142 [*]
			(0.643)
Constant	-53.685***		
	(2.596)		
Observations	1,283	1,283	1,282
R ²	0.306	0.331	0.634
Adjusted R ²	0.304	0.285	0.604
Residual Std. Error	4.528 (df = 1278)	4.600 (df = 1200)	
F Statistic	141.025 ^{***} (df = 4; 1278)	7.158 ^{***} (df = 83; 1200)	102.676 ^{***} (df = 20; 1183)
			* ** ***

Note:

*p**p***p<0.01