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DETERMINANTS OF LIFE EXPECTANCY AND MORTALITY:

COMPARATIVE ANALYSIS OF DIFFERENT REGIONS IN KAZAKHSTAN

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This work proposes set of hypotheses of potentially important contributors to mortality and life expectancy variations in different countries including Russia. Experts agree that life expectancy fluctuations and their causes are similar in most NIS countries, particularly, in Russia and Kazakhstan. Nevertheless, reasons for life expectancy changes in Kazakhstan have not yet been studied in detail.

Therefore, this paper, first of all, aims to provide an analytical description of overall mortality and life expectancy trends in Kazakhstan and its regions from 1991. It further tries to adapt existing approaches to determinants of life expectancy in order to test hypotheses, which could explain the observed mortality and life expectancy fluctuations. Namely, the paper uses the Kazakh National Statistic Agency data to investigate the effect of socio-economic factors, such as income, employment and urbanization, effect of stress and social cohesion, the effects of medical services provision and the effect of pollution. Consideration of the combined influence of various characteristics on life expectancy and mortality gives the following results:

1. Death rate is influenced by the quality of medical services provision and by the level of stress and social cohesion. In spite of the fact that urbanization and unemployment describe socio-economic conditions in the country, it can be assumed that they are also included in components of stress. Higher urbanization results in higher mortality rate.
2. The levels of female and male life expectancy depend on similar parameters such as stress and social cohesion, quality of medical care and socio-economic factor such as unemployment. Moreover, the same factors influence the changes in life expectancy for both sexes.

The empirical results are estimated by the panel regression models. The socio-economic analysis in this study fills in the existing gap in knowledge of situation with mortality and life expectancy in Kazakhstan and can be used for normative and policy analysis.

Чукмаитова А.Д. Факторы определяющие продолжительность жизни и смертность: сравнительный анализ различных областей в Казахстане. / Препринт # BSP/2003/072 E. - М.: Российская Экономическая Школа, 2003. - 39с. (Англ.)

В работе представлен качественный анализ потенциально важных оснований для вариации продолжительности жизни и смертности в различных странах, включая и Россию. Существует мнение, что изменения в продолжительности жизни и детерминанты таких изменений являются очень схожими для большинства государств СНГ, в частности, для России и Казахстана. Тем не менее, детального анализа возможных факторов, определяющих продолжительность жизни, для Казахстана не проводилось.

Принимая это во внимание, основной целью работы является аналитическое описание динамики изменения продолжительности жизни и смертности в Казахстане с 1991 года. Учитывая существующие теории о предпосылках колебаний в продолжительности жизни, целью также является проверка предположений о возможных объясняющих причинах таких изменений. Данные Агентства по статистике Республики Казахстан используются для тестирования гипотез о влиянии социально-экономических факторов, таких как семейное положение, занятость, доходы, а также влиянии загрязнения окружающей среды, качества медицинского обеспечения, стресса и взаимоотношений в обществе на смертность и продолжительность жизни. В результате исследования получены следующие результаты:

1. Уровень смертности зависит от качества медицинского обслуживания, уровня стресса и развитости взаимоотношений в обществе – степени их сплоченности. Несмотря на то, что традиционно урбанизация и занятость определяют социально–экономическое развитие, можно предположить, что они также являются составляющими стресса. Более высокая урбанизация приводит к увеличению уровня смертности.
2. Женская и мужская продолжительность жизни также зависят от качества медицинского обслуживания, уровня стресса и развитости взаимоотношений в обществе. Аналогичный вывод можно сделать и относительно изменений в продолжительности жизни для обоих полов.

Данные результаты получены с помощью анализа панельных данных. Проведенное исследование может заполнить собой существующий пробел в изучении ситуации, связанной с продолжительностью жизни и смертностью в Казахстане.

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Plan.

1. Introduction.

Among the most important, most enduring questions in health economics are: What are the determinants of life expectancy? Which factors influence mortality? Extensive research over the last 35 years has produced a variety of answers to these questions, depending in large part on the specific context, such as economic, social and political situation, within which the questions are posed.

To begin with, it should be mentioned that Kazakhstan experienced considerable transformation of political and economic life. Such unexpected changes and new conditions of living, which for majority of people become rather conditions of survival, caused irreparable injury for health. This fact can be seen from life expectancy and mortality fluctuations during the last decade (Figure 1 and Figure 2). Certainly, mortality and life expectancy are only some of many possible measures of health, but there are several reasons to concentrate on them. Firstly, mortality is by far the most objective measure. Secondly, it is, for majority of people, the most important health outcome. Thirdly, it is probably significantly correlated with morbidity since most deaths are preceded by illness. Life expectancy is also a very good approximation of health and it is very closely related to mortality. To understand this statement definition of life expectancy should be referred to.

Life expectancy may be generally called the average number of years newborn babies can be expected to live based on current health conditions. To be more precise, life expectancy at a specific age is the average number of additional years a person of that age could expect to live if current mortality levels observed for ages above that age were to continue for the rest of that person's life. In particular, life expectancy at birth is the average number of years a newborn would live if current age-specific mortality rates were to continue (remain constant). It can be easily concluded from definition that life expectancy is inversely related to mortality rate. It is evident that higher mortality levels reflect lower life expectancy, and vice versa.

The question of Kazakh life expectancy and mortality determinants is very urgent. There are a lot of works that describe situation with health on the whole, but there is no detailed study on factors, which influence life expectancy and mortality in Kazakhstan. Consequently, the paper provides an analytical description of life expectancy trends in Kazakhstan. The paper proceeds to hypothesis, which could explain the observed mortality and life expectancy fluctuations and influence of different variables such as income, employment, life style, and environment conditions on mortality and life expectancy, are tested. Moreover, in order to make investigation deeper determinants of mortality from specific diseases such as the blood circulation system diseases, accidents, poisoning and traumas, malignant tumors, diseases of the respiration and digestion organs, infectious and parasitic diseases are revealed.

The work uses regional data. The focus on regions in Kazakhstan is motivated in part by the fact that they are very different in environmental and economic conditions. Moreover, the structure of population by nationalities and, hence, by ethnic culture, differs markedly in regions. One more reason for focusing on area differences is that the regional data helps to create econometric cross-sectional model in order to find common factors, which influence mortality and life expectancy in the whole Kazakhstan. Also, many health

policy analysts believe that the understanding of area differences may suggest opportunities to improve health.

So, the work describes comprehensive and rigorous analysis of the dynamics of life expectancy, mortality and reasons of such changes in whole Kazakhstan and its different regions (oblasts) and discusses comparative information in order to fill in the existing gap in knowledge of situation with mortality and life expectancy in Kazakhstan.

The paper is building blocks that can be used to:

- learn in detail about different approaches to the determinants of life expectancy.
- describe overall trends in life expectancy and mortality in Kazakhstan
- provide comparison in dynamics of life expectancy in different regions in Kazakhstan.
- highlight hypothesis of a potentially important contributor to the Kazakh mortality crisis.

There are many reasons of life expectancy deterioration. Among them there are sharp deterioration of living standards, unfavorable environmental situation, unhealthy mode of life, gender aspect, factor of urban versus rural residence, education level, employment, occupation, marital status, and ethnic origin.

On the agenda of the paper are some hypotheses that can explain mortality and life expectancy fluctuations in Kazakhstan, which can be divided into following main groups:

1. Socio-economic status (SES) or access to life opportunities.
2. Social cohesion (social capital), in particular, marital status and crime rate.
3. Level of development of health care services (provision of medical services).
4. Unhealthy behaviors such as less smoking, drinking.
5. Environment.

But these factors are only part in the totality of different determinants. The main reasons are the following. Firstly there are the big varieties of determinants. Secondly, some causes of life expectancy change are not easy to unravel. Improvements in health technology and availability are evidently relevant; education certainly plays an important part, sanitation, clean water supply and a host of other environmental variables have undoubted effects. But empirically, the effects of these different factors are difficult to identify. The variables tend to be collinear with each other, and with many other aspects of development, making their isolation difficult.

The first section of the paper discusses the main trends in life expectancy and mortality in Kazakhstan and its different regions. The second section provides an overview of the various economic approaches to the nature of dependence of mortality and life expectancy from socio-economic status and crisis. Also it examines the reasons for Russian mortality crisis and hypothesis explaining Kazakh mortality rate fluctuations. The third discusses data sources and empirical results by considering trends in national mortality rates, life expectancy and mortality by main cause. The last section concludes.

2. The main trends in life expectancy and mortality in Kazakhstan.

2.1. Life expectancy fluctuations in the 1990s.

Kazakhstan became an independent state in 1991. The breakup of the USSR brought positive and negative changes. The biggest disadvantages of collapse were distraction of economic tiers, followed by economic crises and social problems.

The Kazakhstan population decreased during the 1990s, mostly due to migration, birth rate decline and rise of mortality. The population of the Republic of Kazakhstan declined from 16902.7 thousand in 1992 to14831.4 in 2001.

Before 1991 life expectancy at birth in Kazakhstan was nearly as in some other Soviet Union republics (Figure 3) In particular, most of the republics exhibited similar changes to those seen at the time of Gorbachev's anti-alcohol campaign in the mid-1980s. Moreover, this tendency continued after the Soviet Union collapse. Nevertheless, comparison of the Central Asian and Russian life expectancy rate during 1985-1990 shows that this campaign had the most important impact on the life expectancy of Russian citizens. In 1985-1987 there was a sharp increase in Russia life expectancy, which reached the peak in 1986-1987. In Kazakhstan rise was not so rapid. However, life expectancy increased at the biggest extent: 1-1.5 years for both sexes due to prohibition of alcohol consumption. It seems that alcohol consumption plays significant role in the health of Kazakh population. Downward trend appeared from 1990s, owing partly to a return to former patterns of alcohol consumption and partly to the difficult socioeconomic conditions during the transitional period. Life expectancy in Kazakhstan was declining until 1995. At the same time, there has been significant gender differentiation in life expectancy (the so-called problem of male hyper-mortality) and also between urban and rural populations. Male life expectancy was approximately 10 years lower in 1990-1995 and 11 years lower then for women nowadays. One possible explanation for the gender differences in life expectancy is that the responses of the males and females to the worsening economic situation differed in accordance with their respective social roles.

The minimal life expectancy was 63.5 in 1995. But there are some divergences in data. Different sources (Health for All Database and Kazakh National Statistics Agency) give distinct data (According to National Statistics Agency database life expectancy is lower). The main trends in life expectancy can be seen from Figure 1. Since 1997 situation started to improve. While there is steady increase, life expectancy level does not run up to the rate before the crisis.

It seems to be very useful to analyze data on life expectancy in oblasts, since the data are very different among them. The country was divided into 19 administrative divisions, plus the capital city. A 1997 President Decree reduced the number of oblasts to14. Regional inequality of the 14 oblasts appears in the distribution of population and all the social, economical and health facilities. Eastern-Kazakhstan region, Northern –Kazakhstan, Karaganda and Kostanay regions are the most problematic areas. As can be seen from Figure 2, the highest mortality rate is in Eastern-Kazakhstan, Northern –Kazakhstan, Karaganda regions. The mortality rate in Aklmolinskaya oblast has been rising since 2000, on the other hand, in Astana mortality rate have been decreasing during the same period (Figure 2). This can be attributed to changes in statistical

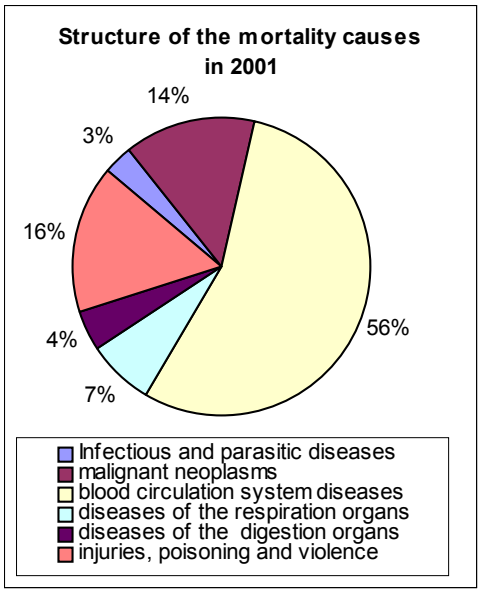
accounting. It is rather probable that officials started to register deaths not in Astana but in Akmola oblast. Otherwise, it is very difficult to explain such significant changes in mortality rate in these regions.

Graphs on male and female life expectancy show that Karaganda and Akmola oblasts, Eastern-Kazakhstan and Northern –Kazakhstan are among regions with the lowest male life expectancy (Figure 5, 6). Situation with female life expectancy is substantially better. In most regions it has been increasing since 1998. The lowest female life expectancy is in Atirau, Akmola, Mangistau oblasts and the highest level is in Almaty and Almaty oblast.

In order to develop main reasons of such life expectancy deterioration, it is necessary to analyze structure of mortality causes. As was mentioned above life expectancy is inversely related to mortality rate. It is evident that the higher mortality level is, the lower life expectancy is, and vice versa. It is clearly that decline in life expectancy in Kazakhstan is called into being by increase in mortality rate. The question on the factors, which can entail mortality rise, demands explanation.

2.2. Structure of the general mortality by main causes.

Mortality from the blood circulation system diseases remains to be the leading cause in the structure of the general mortality during many years; then there is mortality from accidents, poisoning and traumas, malignant tumors, diseases of the respiration and digestion organs, infectious and parasitic diseases. See also Figure 7.



Death from blood circulation system diseases is the largest contributor to the crude mortality. Since the early 1990s, rate increased steeply. But among men rise was especially dramatic. Mortality from blood circulation system diseases increased by almost 50%. Reasons include traditional factors, such as smoking, the diet high in fat and, probably, poor detection and treatment of hypertension, as well as the diet that extremely low in antioxidants.

The second leading contributor to mortality is injuries, poisoning and violence. Mortality from these causes has increased steadily. As with cardiovascular disease, alcohol consumption is often an important proximate cause. As from 1997, some stabilization is seen.

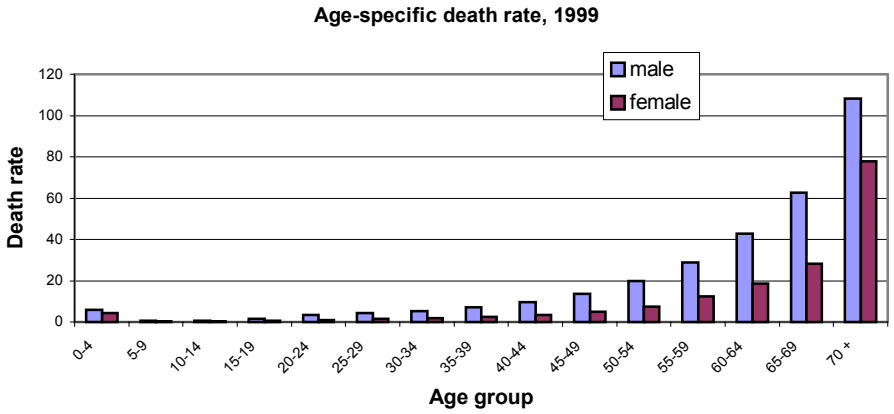
Cancer is also a major contributor to mortality. This may be due to both late diagnostics and hospitalization. Among various cancers (malignant neoplasm) such as trachea, lung (bronchial) cancer, cancer of the cervix, leather-bottle stomach, breast cancer, major cause of mortality from malignant neoplasm is lung cancer with death rates among men being twice than seen in Western Europe. The main reasons of this kind of cancer are smoking and air pollution. However, the mortality rate is not uniform throughout the various regions of the country. There are the potential risks of cancer arising from Soviet era nuclear testing

at Semipalatinsk (Eastern Kazakhstan). A study of childhood cancers found about 70% more cases of childhood leukemia among those living within 200 km of test sites, compared with those living over 400 km away. The highest mortality rate from cancers is in Eastern Kazakhstan, Karaganda oblast and Almaty. The next big contributor is respiratory disease. This can be due to smoking and environmental problems.

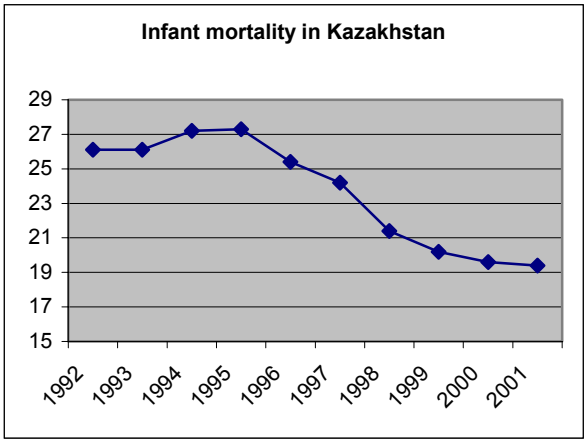
It can be conclude that differences bolster the argument that there exists very substantial means for reducing the death rate. In many socio-demographic groups, excessive death rates could be largely due to psychological and behavioral factors rather than to inefficient health care system. Nevertheless, medical service provision could play partial role in deterioration of health. Also, economic conditions should not be excluded from consideration.

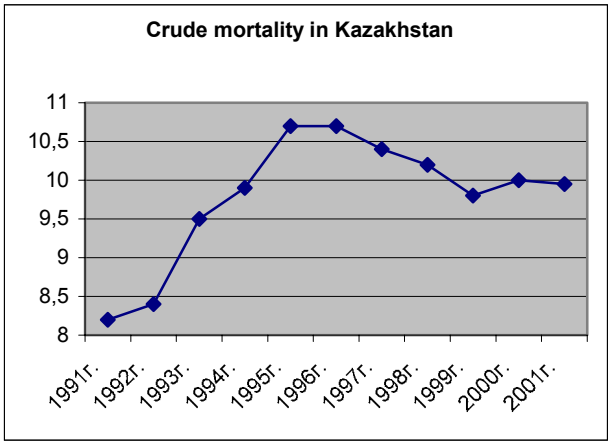
2.3. Age-specific mortality.

It is also quite reasonable to consider the share of different age groups in the whole mortality rate. Age specific mortality fluctuation is a very important question in understanding determinants of mortality. The most discussable part of age specific mortality is infant mortality. As can be seen from the graph the most significant contributors in total mortality rate are mortality between 0 and 4 and also adult mortality. Mortality in 0-4 ages is so high mostly due to high infant mortality. The question of infant mortality is not the center of interest of the present paper, but infant mortality needs to be mentioned in the context of the current work since infant mortality is a part of total mortality.



There are some problems with infant mortality in Kazakhstan. First of all, Kazakhstan does not use international methods of measuring infant mortality. This creates difficulties in international comparison. Secondly, some authors suggest that cases of infant deaths in rural areas are not even properly accounted. It means than infant mortality is much higher in reality. As there is no any substantial evidence to prove or reject such suggestions, the research will concentrate on data, which are available.





As can be seen from the graphs the trends in crude and infant mortality are very similar. In contrast to the Russian situation, where infant mortality remained constant during the last decade, Kazakh infant mortality changed significantly. So, it would be wrong to exclude infant mortality from total mortality in order to find the right determinants of mortality, as the same factors can also explain infant mortality deterioration. As well, it is better to use life expectancy at birth, but not life expectancy at age 1 in order to find common factors of mortality and life expectancy fluctuations for all age groups.

3. Hypotheses explaining life expectancy and mortality fluctuations.

There are many research articles, commentaries and debates that have contributed to the field of income inequality, education, diet, cultural factors, medical services and their effects on public health and life expectancy in development countries. Certainly, there are fewer works that deal with the same field in transition countries. Nevertheless, health in Eastern Europe, Russia and Russian mortality crisis are the subjects of wide speculations. But the situation concerned with papers and research works in Central Asia is different. The questions related to health economics and life expectancy in Central Asia have not been studied properly.

Life expectancy is one of the key indicators of population health and economic development. Why is life expectancy so different among countries? Several arguments developed to account for these differences - from dietary influences such as consumption of olive oil or fish to cultural factors such as national perceptions of self-esteem - but many of them are peculiar to one country or a small group of countries. Nevertheless, it is difficult to find a monocausal explanation of international variation in life expectancy.

3.1. Economic related hypotheses.

In recent years it has been suggested that the key determinant of variations in life expectancy at birth among less developed countries is absolute level of income and among developed societies are inequalities in the distribution of income within countries.

3.1.1. Socio-economic status.

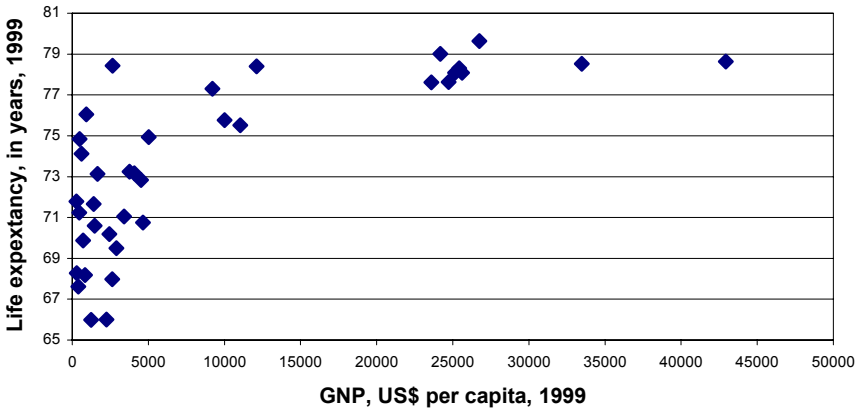
A positive relationship between SES and life expectancy has been observed over many populations and many time periods. SES can be assessed as occupation, assets, social class, education, income or wealth. The quantitative importance of different SES determinants of life expectancy is likely to vary across

populations. In less developed populations giving people additional economic resources is likely to improve their life expectancy via improved nutrition and access to health care services, whereas such effects are probably very small or even zero in developed economies. Within a population, giving economic resources to those who are economically deprived may similarly improve their life expectancy but it would not do so for those who are better off.

Social scientists have long suspected that the widening income inequalities result in a heavy social cost in terms of social exclusion, rising incidence of crime, and the erosion of civil society such as latent social conflicts, declining support for public institutions. The growing body of research suggests that economic inequality has real costs in the form of worth population health. In fact, the evidence shows that absolute and relative standards of living matter for the health and well being of the members of society.

The relationship to poor health outcomes is established, both internationally (World Bank, 1993) and within individual countries (Black, 1988). Among poor countries in the world, strong relationship between absolute level of income, which measured by per capita gross national product (GDP), and life expectancy exists: the lower GDP, the lower average life expectancy (World Bank, 1993).

However, once country have attained some threshold level of income, the relationship between the absolute standard of living and life expectancy disappears, so that further increases in GDP per capita are no longer associated with life expectancy gains (Wilkinson, 1996). Figure below proves this statement and shows relations between GNP and life expectancy for 36 countries. It seems that in more affluent countries the extent of relative deprivation, which measured by the size of the income gap between the rich and the poor, strongly predicts life expectancy (Wilkinson, 1992,1996).



Rodgers (1979) is the first who reports the association between mortality and income distribution using data from around 1965 from 56 developed and less developed countries. Since then has been found by many others. Flegg (1982) finds that income distribution is related to national infant mortality among a group of 59 developing countries. Flegg reports statistically significant relations between income distribution and measures of mortality. The associations are found to be independent of fertility, maternal literacy, and education in developing countries.

There are some interesting research papers presenting analysis of health outcomes in communist countries. Wilkinson (1996) examines the relationship between health, civic society and distribution of income in Eastern Europe before 1989. It appears that communism is good for health. The same result is founded by Amartya Sen (1981), who looks at improvements in life expectancy among 100 developed and less developed countries between 1960 and 1977. He finds that nine out of the ten communists countries in his list of 100 nations come within the top quartile in terms of the percentage reduction in the life expectancy shortfall they achieved.

The communist countries success was in reducing the extremes of poverty. The distribution of income had an important influence on national mortality rates. Given that living standards in communist countries were substantially lower, what was perhaps most surprising about life expectancy in Eastern European countries that it had been ever comparable with life expectancy in Western Europe. But position of communist countries compared to Western European countries had deteriorated since the early 1970s.

Wilkinson tries to answer the question why did communism, which had apparently been so good for health, start from the early 19970 to loose some of its advantages? He concludes that the main reasons are: disappearance in 1970s any health advantages associated with an egalitarian ethic and public spiritedness, which remained in the 1960s, and the increase alcohol and drug consumption.

3.1.2. Influence of crisis on life expectancy.

The impact of economic and financial crisis on health is important since economic crisis have been frequent and severe over the three past decades, particularly in developing countries. Effects of crisis on health in developing and transition countries may be large because large segments of the population are vulnerable – for example, the very young, the old, or poor.

Cutler D., et al.(2000) investigate consequences of economic downturns for the well being of population. Particularly, they study the impact of economic crisis on health in Mexico. Authors find that mortality rates are higher in the crisis years compared to the years just prior to the crisis. Their empirical analysis points to a strong conclusion: mortality rates have increased with economic crisis, particularly among the elderly and possibly among the very young.

Under consideration are four theories for why the crisis in Mexico affected mortality. First, the crisis reduced income, which, in turn, reduced resources for goods, such as out-of-pocket medical spending or vital nutrition that improve or maintain health. Second, the crisis reduced public sector funds for health systems, which affected groups particularly dependent on those systems. Third, the crisis caused more people to work, which resulted in health reductions for affected workers. Forth, the crisis affected the informal care that families can provide for children and the aged. There was found strongest evidence for the first two of these theories and little evidence for the latter two.

One of the conclusions of this work is that the influence of crisis on reduction in family income with a resulting impact on nutrition and health status is closely correlated with hypothesis about socio-economic status, especially with income hypothesis. It is seems that Kazakhstan as many other transition countries

experienced both effects of income on health (absolute and relative income inequality) and shocks in income fluctuations (economic crisis).

3.2. Soviet mortality trends.

Some researchers (Anderson B., Silver B., 1989) take great interest in mortality trends of the population of the Soviet Union and the decline in life expectancy at birth among males in the late 1960s.

The most common interpretation of the trends in Soviet mortality is that they reflect some combination of worsening overall health habits – poor diet, abuse of alcohol, and smoking – and a deterioration of the quality of public health programs in the 1960s and 1970s. On the other words, those changes can be described as worsening contemporary health conditions or period-effects explanations of mortality trends.

An alternative to a period-effects explanation is one that focuses on cohorts.

Cohort replacement.

Cohort replacement approach suspects the presence of significant effects of earlier population calamities on the long- term mortality of people who were most seriously affected by different events. Moreover, cohort replacement approach attributes the rise in mortality to historical rather than contemporary factors. Word War II permanently affected the health and subsequent death rate both of male combatants and of females who were born or were very young during the war. The War of 1941-1945 took more than 20 million lives of Soviet citizens. After the war there remained millions of invalids, tens of millions of people with weakened health, undermined by wounds, famine, deprivation, and backbreaking labor. The war had many short- and long-term effects on the Soviet population. So, it is reasonable to expect that such events as wars, agricultural Collectivization, and the 1932-1933 famine had some effect on the age distribution, on flow of birth and on mortality in the Soviet Union.

Anderson B., Silver B. (1989) find a number of cohort effects on mortality that are sensible in light of Soviet history. Firstly, both males and females born during World War II experienced elevated cohort mortality. Secondly, males who were in early adolescents during World War II also experienced elevated cohort mortality. Females who were adolescent or young adults during the war experienced somewhat elevated cohort mortality. There was no evidence of elevated cohort mortality among males of combatant age during the war. Thirdly, females who were born in the Central Asian republics from the mid-1920 through 1944 elevated cohort mortality. This may have been an indirect consequence of efforts by Soviet authorities to integrate Central Asia into the Soviet Union.

It is possible that the hardships associated with the period of forced-draft industrialization, agricultural Collectivization, the Great Terror, World War II, and postwar reconstruction affected the subsequent health of broad age spectrum. Many of the hardships were likely to fall more heavily on males. If so, a substantial part of the rise in mortality among Kazakh males in the 1990s should be attributed to historical experience rather than to contemporary health conditions. On the basis of currently available information, however, we are reluctant to press the case for such an interpretation of the mortality increase.

But it is probable that cohort effects account for at least part of the rise in the mortality of Kazakh population in the 1990s.

3.3. Russian mortality crisis.

There is a large literature in public health, stretching back more than 5 years, that documents the main reasons of Russian mortality crisis. These papers present relationship between mortality and stress-related factors, factors of "asocial behavior", factors of unhealthy life style. Alternative hypothesis is that the recent Russian mortality increase is basically a return to the medium-turn trend in life expectancy, which has been deteriorating since 1965. Other point is that mortality crisis represents a "catching up" following the largest saving of years of the life during the late 1980.

Shkolnikov V., et. al (1996) describe dissimilarities in mortality rates in Russia as a result of gender gaps, urban vs. rural populations, differences by education and occupation, differences by marital status, birth cohort, ethnic differences, and by impact of behavioral risk factors. For example, the paper concludes that married people, higher educated groups or people involved in high mental work were relatively protected from the risk of death. This work analyzes standard data of official state statistical committee and individual data of special researches. This analysis has helped in limning some major reasons for variations in the death rates across various social and ethic groups of the Russian population.

Gavrilova N., et.al (2001) analyses mortality fluctuations in context of economic crisis. Authors demonstrate strong dependence of mortality dynamisms on political and economic decisions made by government: "anti-alcohol campaign" and "shock therapy", which caused changes in life style and living standards.

Stress.

Shapiro, J. (1997) emphasizes on trends in health of the Russian population. The key aspects of the work are the Russian mortality crisis, the Soviet legacy and public policy discussion on what should be done. Author suggests that poor environmental legacy cannot explain mortality crisis in Russia. Arguments behind this assumption are the following. First, some environmental conditions have improved, because industrial production is down. Second, environmental destruction may be an important background factor, but it is difficult to connect it with the paten of death rates that were observed in the 1990s. Also Shapiro stresses that health care expenditures or health care system are not the important determinants of mortality crisis. Shortage of medicine is commonly cited. It is frequently the case that when the poor condition of health service system is cited as a cause for the rising death, insufficient attention is paid to whether the situation is new. While there are substantial numbers of hospitals without hot or even running water, or sewers, these hospitals were not disconnected from civil engineering systems at the time of the rise in mortality, but have never be connected. Moreover, the years the worst for death rates, were years of improvement for health care expenditure.

So, the author concludes that the main cause of mortality deterioration is biological mechanisms such as chronic stress. It is more probable that the main factor, which lies behind the increased death rate, is stress. Stress is very accumulative parameter and it can absorb different sides of humane life. The stress can

result in increase of drinking for some; the stress itself can be a mortality risk factor for others. As Shapiro points the most difficult part of this theory is that the lack of independent measure of stress. On the one hand, Russia has always been a stressful place. On the other hand, Soviet Russian life might have been miserable, but it was less stressful, because it required citizens to be rather fatalist.

Shapiro supposes that poverty and inequality are likely less important than the stress and behavior factors.

Influence of social cohesion (social capital) on life expectancy.

Kennedy B., Kawachi I. and Brainerd E. (1998) suggest that the degree of social cohesion is an important determinant of population health status. Citizens living in societies with a high degree of social cohesion – characterized by strong social networks and high level of interpersonal trust – seem to be healthier than those living in socially disorganized societies. Kennedy, Kawachi, Brainerd examine the role of social capital in the Russian mortality crisis. Social capital has been defined as those features of social organization - such as density of civic associations, levels of interpersonal trust, and norms of reciprocity - that act as resources for individuals, and facilitate collective actions. Authors find associations between indicators of social capital (mistrust in government, crime, quality of work relations, civic engagement in politics) and life expectancy, as well as mortality rates.

In the absence of civil society, it is more probable that people rely on informal sources of support (friends, family) to deal with their day-to-day problems. Those lacking such sources of support may have been especially vulnerable to the hardships following the transformation to a market economy.

In this context it appears that the influence of family status hypothesis is very interesting to analyze and check. One of questions, which would be answered in this paper, is how can family status such as divorced, married or single influence on mortality and life expectancy.

In the conclusion of this part of the work it should be mentioned that papers on mortality crisis in Russia are distinguishing by method and theories used, but most of them propose multiple explanations for the observed mortality increase: deterioration of the health system, malnutrition, poor lifestyle (alcoholism, smoking), environmental catastrophe, and economic impoverishment.

4. Reasons for death rate and life expectancy deterioration in Kazakhstan. Testing of hypothesis.

It may be generally assumed that all hypotheses, which explain Russian mortality crisis, can also be used to explain Kazakh mortality fluctuation. As can be seen from Figure 3 Kazakh and Russian life expectancy trends are very similar. This is shown by increases and drops in life expectancy during 1985-2000 years. The main reason of such similarity is long period of Kazakhstan and Russia being a part of Soviet Union. Relations between countries in earlier centuries caused tighter cultural and economic links. Kazakhstan is not ethnically homogeneous. Although Kazakhstan is the titular area of ethnic Kazakhs, a traditionally Muslim group, and is one of the Central Asian republics, the large part of the population of the

republic is comprised of ethnic Ukrainians and Russians. The patterns for Kazakhstan shown in Figure 4 are quite different from patterns for the Central Asian republics. Kazakhstan looks most like the Russian Federation.

Five types of explanation of the rise in Kazakh mortality in the 1990s are offered: socio-economic conditions, medical services provision, stress and social cohesion, life style, and pollution. These factors deal with different realms of human being and according to opinions of most Russian authors are the main determinants of mortality and life expectancy.

4.1. Some methodological aspects of the work.

Before proceeding with the next part of the work - data analysis of mortality and life expectancy, it seems be necessary to discuss some methodological concepts of the paper.

The central part of the study is five main factors, which could explain the level of present crude mortality rate, mortality by main causes and life expectancy. Influence of alcohol and tobacco consumption is not tested econometrically due to absence of relevant data.

The work considers not only the level of mortality and life expectancy but also the changes in these parameters. So, on the agenda are the questions about factors, which determine **levels** and **changes** in mortality and life expectancy. Annual data on different factors (absolute values of variables) can explain current level of mortality and life expectancy. In order to answer the second question first differences method is used.

Moreover, it should be mentioned that objects of investigation are not individuals, but regions in Kazakhstan. So, the data that were collected for this study describe situation in particular region in Kazakhstan.

It seems that fixed effect panel regression is the best specification of the level of mortality and life expectancy in econometric analysis. There are some reasons for that. First of all, regions in our model are big enough. Secondly the number of regions and regions themselves do not change over time and they are not random. However, these two reasons are mostly based on intuition. Thus, in order to prove the assumption that fixed effect regressions are correctly used, Hausman test is conducted.

First differences method explains changes in mortality and life expectancy. Since first differences method helps to eliminate individual effects, it is used along with random effect. On the other hand it should be pointed out that random effects model degenerates into simple OLS regression, so Stata software is not able to conduct Hausman test in order to reveal which effect should be used. Attempts to use both random and fixed effect show that the values of coefficients are very similar.

Hypothesis testing is divided into 5 steps.

The analysis starts from the socio-economic factors, such as unemployment rate, relative income of regions and urbanization. These factors were chosen not deliberately. They can explain the main aspects of socio-economic state of population in regions. Unemployment is measured as the rate of unemployment in each region and in each year. Relative income is the ratio of the income of each region to total income of the republic. Clearly, data on government expenditure on health or income in PPP would be better

approximation of income inequality among regions. Unfortunately, such data are not available and cannot be used in this work. The last but not the least socio-economic factor is urbanization. Urbanization is commonly calculated as the share of population living in town relative to the total population of region.

The second step is examination of effect of medical services provision on health. First of all, medical care provision is divided into two groups. The first group describes quantitative characteristics of medical services; the second group describes qualitative characteristics. The numbers of beds, doctors and hospitals are used as proxies of quantitative characteristics. The number of deaths after operations is used as characteristic of quality.

The third step discusses hypotheses about influence of social cohesion and stress on life expectancy. There are indicators of social capital such as mistrust in government, crime, quality of work relations and civil engagement in politics. In the absence of civil society people rely on informal sources of support such as family and friends. If people do not have such sources then it is very probable that they would be very vulnerable to the economic hardships. Similar arguments are used by Kennedy, Kawachi, Brainerd (1998). It is very difficult to find data on mistrust in government, quality of work relations and civil engagement in politics for Kazakh regions. There is no research on these questions in Kazakh scientific literature. It should be pointed that the main reason lies in the political system of Kazakhstan, in the authoritarian regime. Nevertheless, data on crime are available. So, hypothesis on influence of social cohesion could be partly tested.

Other indicators of the level of social capital are the number of marriages and divorces. Family is very important structure of the society, especially in the non-democratic states. It should be mentioned that relations in dictatorial state are built in a one-direction horizontal way: authorities can impose decisions but citizens do not have enough civic rights and protection mechanisms from government tyranny, and, consequently, cannot undertake actions against political regime. Under such conditions people cannot trust the state and can only rely on family and close friends' support. This situation was observed during the Soviet period. Family, therefore, plays more important role in post-soviet countries by virtue of historical events. Moreover, the role of family deepens in hard time, e.g. in transition period. Relations in family indicate not only the level of social cohesion but also the level of stress. Quarrels inside family make people feel nervous. Divorced people have felt severities of divorce suit on their own back. These and other sociological effects of instability in marriage can cause stress, which in turn has negative effect on health.

In the fourth step influence of environment deterioration on mortality is investigated.

The fifth step is life stile description.

The last section presents multi casual explanation of mortality and life expectancy deterioration. Furthermore, the influence of the same factors on mortality by different causes is tested.

4.2. Data description.

A number of methodological problems have arisen during the research. In Kazakhstan there is relatively little information available on some issues such as alcohol and tobacco consumption. Moreover, it is of a special concern that statistical data on health indicators in Kazakhstan are not always correct. Also,

as a result of changes in administrative division there are some problems with data analysis. Nevertheless, the most reliable data are used.

Estimation of the cross-sectional model on determinants of life expectancy and mortality requires data on income level, unemployment, urbanization, health services provision, marital status, crime, pollution, etc. as well as on life expectancy and mortality. Annual Kazakh data on each of these variables for the period 1992-2001 has been used.

Quantitative data on life expectancy are based on a number of different sources, in particular, on the WHO Regional Office for Europe Health for All database, Kazakh National Statistical Agency health and Ministry of health of Republic of Kazakhstan data (www.medinfo.kz). The WHO Regional Office for Europe Health for All database helped to make international comparison of life expectancy trends in Kazakhstan with situation in other Central Asian Republics and Russia.

Official data on mortality are provided by Kazakh Statistical Agency including death by cause. In this study, attention is focused on mortality from the blood circulation system diseases, mortality from accidents, poisoning and traumas, malignant tumors, diseases of the respiration and digestion organs, infectious and parasitic diseases. Data on such deaths are available since 1991.

Paper presented here deals with data for different regions in Kazakhstan. Before 1997 there were 19 oblasts in Kazakhstan. President Decree reduced 19 oblasts to 14 oblasts and Astana become new capital.

The number of marriages and divorces that is used in this paper is the result of calculations, based on official statistics for 19 regions from 1992-1997 and for 14 regions from 1997. Data on urbanization are also calculated as a share of people living in towns. Data on pollution were collected from statistical press-bulletin#3, 2002. (Almaty 2002).

To obtain more correct result all data are calculated per capita. All regional time series are merged into a single panel data set in order to get statistically significant results of econometric analysis.

4.3. Socio-economic conditions.

In Kazakhstan it is very probable that significant influence on life expectancy has socio-economic status. In the past 10 years there was dramatic growth of the social and economic inequality in Kazakh society.

Kazakhstan economy had been in severe recession during 1991-1994. The worst recorded drop of GDP was in1994. (Figure 8) These economic and social disruptions of the 90s had led to low incomes, with consequent implications for health and for capacity to pay for health services and goods. Poverty rates and income differences across the regions have increased significantly. Now situation has been improving slowly. There are some data on income distribution among different oblasts available (Figure 9). At Figure 9 income is presented as the share of regional income in the total income of the country. The lowest income is in Almatinskaya oblast, the highest income is in Almaty.

The income hypothesis is closely related to urbanization. Legacy of Soviet period lies in fact that income is higher in towns, which were founded near raw material production. The main source of income in

rural areas is agricultural production. Agricultural production deterioration caused decrease in income of rural population.

During last decade adult literacy, educational attainment worsened. On a positive note, even now central Asian republics have high adult literacy and education rate and Kazakhstan has higher rates than most of its neighbors. This is one reason why it is very probable that education does not play an important role as a determinant of life expectancy in Kazakhstan. On the other hand, it is possible that the level of education can increase the gap in life expectancy between the top and bottom education groups. There is no possibility to test such hypotheses about influence of education on mortality and life expectancy because data on such question are not available.

Also, it would be very interesting to analyze the hypothesis about influence of unemployment on changes occurred in life expectancy variation in regions. The data on unemployment show that it was rather high in period between 1996 and 1999 (Figure 10). It is very probable that such data are more reliable in reality due to hidden unemployment, which consists of people who have not registered as unemployed. Unemployed person experiences hardships, which make him vulnerable to diseases.

So, the following hypotheses are put in the forefront:

1. The higher income is, the lower mortality should be. The mechanisms of income influence on mortality are very different. One of them is the following: an increase in income can give person bigger variety of opportunities and larger chances to have better medical provisions, better nutrition and to prevent some diseases, which in turn can decrease probability of death.

2. The high unemployment can result in higher mortality rate. Under situation of transition economies job loss could affect person negatively. Firstly, majority of Kazakh citizens do not have other sources of income. Moreover, the government securities on unemployment (doles) are so low that no one can live or even exist. Another reason of undesirable affect of unemployment is that unemployed person feels disoriented in such situation. The males are more vulnerable in this case. To understand the point the role of men in Kazakh society should be mentioned. The traditional way of thinking is that men have to earn family's living, this is their main function and the responsibility for relative's wealth lies on men. Without work and permanent income females fill disappointed and stressed. So, it can be guessed that stress from being unemployed influence crude mortality through mortality from cardiovascular diseases.

3. Urbanization can decrease mortality rate. Under existing conditions in Kazakhstan urbanization can bring about higher opportunities for population. It is not a secret that people who live in towns have higher income, access to better medical facilities and education. If share of population living in town is bigger in a region then mortality should be lower. This hypothesis is very similar to hypothesis about income.

On the other hand, high income and urbanization could also involve high pressure on person behavior through constant stress and fear to loss job, money and position in society. So, our econometric model

might answer the question of which effect –stress or ability to have large variety of opportunities – are stronger.

As was mentioned above the two main problems are of particular interest. Firstly, the question of determinants of current high **level** of crude mortality and mortality by main causes is considered. Secondly, the factors influencing the **changes** of mortality and life expectancy are examined.

At first, regression of influence of income, unemployment and urbanization on the level of crude mortality is run.

Fixed-effects (within) regression:

$$death_{i,t} = -5.43\ cons + 7.87\ income_{i,t} + 24.95\ town_{i,t} + \\ + 0.049\ unemp_{i,t} + u_i + v_{i,t}$$

	Coef.	*Std. Err.*	*t*	*P>t*
income	*7.87*	*6.28*	*1.25*	*0.213*
town	*24.95*	*6.86*	*3.64*	*0.000*
unemp	*.049*	*.02*	*2.32*	*0.023*
_cons	*-5.43*	*4.05*	*-1.34*	*0.184*

R-sq: 0.1485

The results of our econometric model show that income coefficient is not significant. Does it really mean that income does not influence mortality? It is very probable that income, unemployment and urbanization are correlated. Actually, as it could be seen from the correlation matrix (Table?) income and town are highly correlated (corr = 0,89 is very close to 1). It is a very expectable result. As was mentioned previously, Kazakhstan has raw material oriented economy. Towns were created near production factories and incomes usually concentrate in these town. Rural areas have comparatively low income. Therefore, if the share of population living in town higher in this region it is more probable that production concentrates there and share of income in total income of republic is higher. It is likely that income and town variables show the sides of the same effect.

It should be better to exclude one coefficient-income from regression to avoid multicollinearity.

Fixed-effects (within) regression:

$$death_{i,t} = -4.52\ cons + 23.9\ town_{i,t} + 0.039\ unemp_{i,t} + u_i + v_{i,t}$$

	Coef.	*Std. Err.*	*t*	*P>t*
town	*23.9*	*7.34*	*3.26*	*0.001*
unemp	*.039*	*.02*	*1.78*	*0.077*
_cons	*-4.52*	*4.35*	*-1.04*	*0.301*

R-sq: 0.1115

Two factors such as urbanization and unemployment can describe 11% of the current mortality level. At the first glance, it seems that the higher urbanization can imply higher mortality is outstanding result. Nevertheless, the explanation of this result is founded from the point of view of stress.

The next step is consideration of influence of socio-economic factors on changes in mortality rate. For this analysis the method of the first differences is be used.

Random-effects GLS regression:

$$chdeath_{i,t} = -0.01\, cons + 0.077\, chunemp_{i,t} + u_{i,t} + v_{i,t}$$

	Coef.	*Std. Err.*	*t*	*P>t*
chunemp	*.077*	*.02*	*3.31*	*0.001*
_cons	*-.01*	*.05*	*-0.22*	*0.823*

R-sq: within = 0.1005

between = 0.0168

overall = 0.0897

In this case only coefficient of unemployment changes is significant. Among three main economic factors only unemployment describes changes in mortality rate and can explain 10% of total mortality fluctuation.

4.4. Stress and social cohesion (Marital status and crimes).

As was mentioned above stress and social cohesion is a question of wide speculation. Nevertheless, the hypotheses on influence of stress and social cohesion on mortality and life expectancy should be tested.

It is likely that stress contribution in mortality increase is significant. On the one hand stress is the aggregate measure of mortality. A variety of reasons, events and situations such as social inequality, absence of job, economical and political changes can cause stress. Stress, in turn, implies unhealthy behaviors – drinking and smoking, also, the loss of life objectives, apathy and indifference. Under condition of economic and political difficulties and uncertainty in transition period the probability to suffer from stressed is very high. Stress can be an underlying factor of antisocial behavior and have unpleasant consequences such as suicide. So, stress can explain a large part of mortality and life expectancy deterioration. On the other hand, the effect of stress cannot be easily revealed. In estimating the share of variation in mortality and life expectancy caused by stress the main problem is selection of proper variable. In the research stress is approximated by family status. Numbers of divorces and marriages are also good approximations of social cohesion. As can be seen from the Figure 11, the quantity of divorces decreased during the 1990s. The number of marriages fell dramatically. Only in 1999 situation started to improve – difference between number of marriages and divorces decreased.

Social cohesion is the determinant of relations inside society. Social cohesion is described by density of civil associations, levels of interpersonal trust, and norms of reciprocity and indicated by mistrust in government, crime, quality of work relations, civic engagement in politics. Under conditions of distrust to the government, absence of civil society, failures of laws and all branches of power, it is more probable that family and friends become the main source of support.

Kennedy B.P., etl (1998) make conclusion based on Russian data that crime rate defines the level of social cohesion and influences life expectancy. Does such result fit for Kazakh reality? The Figure 12 shows that in spite of the economic crisis crime rate declined practically in all regions.

So, in order to test influence of stress and social cohesion on mortality, the three types of data: the number of crimes, the number of divorces and marriages are used.

The following models disclose that number of crimes cannot explain the high level of mortality, what can hardly be said about marriages and divorces.

Fixed-effects (within) regression:

$$death_{i,t} = 12.26\, cons + 0.42\, div_{i,t} - 0.44\, mar_{i,t} - 0.002\, crime_{i,t} + u_i + v_{i,t}$$

	Coef.	Std. Err.	t	P>t
div	.42	.22	1.92	0.058
mar	-.44	.086	-5.16	0.000
crime	-.002	.005	-0.49	0.625
cons	12.26	.46	26.49	0.000

R-sq: = 0.2509

$$death_{i,t} = 12.12\, cons + 0.39\, div_{i,t} - 0.45\, mar_{i,t} + u_i + v_{i,t}$$

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
div	.39	.21	1.86	0.065	-.025	.80
mar	-.45	.086	-5.26	0.000	-.62	-.28
cons	12.12	.36	33.75	0.000	11.4	12.8

R-sq: = 0.2496

Random-effects GLS regression:

$$chdeath_{i,t} = 0.23\, cons + 0.35\, chdiv_{i,t} + u_{i,t} + v_{i,t}$$

	Coef.	Std. Err.	t	P>t
chdiv	.36	.15	2.51	0.012
chcrime	.006	.004	1.51	0.131
cons	.23	.06	4.05	0.000

R-sq: within = 0.0532

between = 0.5681

overall = 0.0680

4.5. Provision of medical services.

The next group of factors is provision of medical services. Many demographers and health economist do not pay proper attention to the fact of influence of medical services provision on sharp increase in death

rate in Russia. There is very popular opinion in Russia that the most important factors, which influence mortality and life expectancy deterioration at the beginning of the 1990s, are life stile- alcohol and tobacco abuse and economic situation. Nevertheless, no one can prove that these factors are the main contributors to the mortality rise. This suggests that the medical services provision can explain partially life expectancy and mortality fluctuation and can be more significant than expected.

The funding and management of health services are undergoing major changes. Government expenditure as a percentage of GDP declined from 31% to 19% of GDP between 1990-1996. This represents a public sector crisis since GDP has also dropped. The health budget has returned since 1995 to its 1991 level, but it is still substantially below the level needed to maintain health care services. At the same time out-of-pocket payments by patients increased. As the government health budget shrank, people increasingly had to pay for health services and drugs, which disadvantaged those on subsistence incomes.

Kazakhstan had an over-supply of hospitals, especially small ones, compared to many countries before 1990. At the same time situation was similar to Russian, as Judith Shapiro points out, there were a sporadic medical supply lines; bad organized health care delivery and poorly equipped hospitals. European Observatory on Health Care Systems marks that a major problem for standard setting was that about two thirds of equipment in health facilities was out-of-date or in need to repair.

Since 1990 the number of doctors, hospitals, hospital beds and other medical facilities had decreased in all regions. Nevertheless, reduction is not bad in itself, when it brings changes from quantities of facilities to quality of services. This results in shift of resources to more cost-effective health care and optimizes health care facilities. Transition to market economy brought incentives for health care providers to offer more efficient and effective health care. On the other hand, rural health care has suffered disproportionately from severe budget cut and hospital closures. The closure of small rural hospitals has left many rural people with little access to health services. One problem with access is the lack of public and private transport between dispersed villages and the central town of the district.

To test hypothesis of influence the level of medical care development on death rate the quality and quantity characteristics are used. Quantity characteristics are measured by number of hospitals, doctors and beds. It can be assumed that the number of deaths after operations is the best approximation of medical services quality among existing variables. The following model shows that the number of hospitals and the number of deaths after operations coefficients are significant. These two variables explain about 40 % of the total mortality level.

Fixed-effects (within) regression:

$$death_{i,t} = 9.6 cons - 14.75 hos_{i,t} + 1.9 op\_de_{i,t} + u_i + v_{i,t}$$

	Coef.	*Std. Err.*	*t*	*P>t*
hos	*-14.75*	*2.43*	*-6.06*	*0.000*
op_de	*1.9*	*.33*	*.76*	*0.000*
_cons	*9.56*	*.37*	*26.05*	*0.000*

R-sq: within = 0.3962

It can be concluded that health care provision is one of the most important determinant of mortality level. Both qualitative and quantitative characteristics play significant role.

In order to find the influence of the same factors on mortality rate changes the following regression was run.

Random-effects GLS regression:

$$chdeath_{i,t} = 0.26\,cons - 0.31\,chdoc - 10.27\,chhos_{i,t} + 0.23\,chbed + \\ + 0.45\,chop\_de_{i,t} + u_{i,t} + v_{i,t}$$

	Coef.	*Std. Err.*	*t*	*P>t*
chhos	*-11.04*	*6.10*	*-1.81*	*0.071*
chbed	*.17*	*.06*	*2.81*	*0.005*
chop_de	*.63*	*.29*	*2.26*	*0.026*
_cons	*.26*	*.059*	*4.13*	*0.000*

R-sq: within = 0.0823

between = 0.5329

overall = 0.0893

The results show 12% level significance of all variables. Changes in the number of bed results in increase in mortality rate. Such relation between mortality and the number of beds is not obvious. There can be two-way direction of causality. High mortality and increase in diseases can increase the number of beds. Situation with number of hospitals is different. The main reason is that the number of hospitals cannot increase fast due to necessity of large financial support of government or investments. So, it is more probable that there is only one-way direction of influence. As can be seen from regression fall in hospital number results in mortality increase. It is likely that dominating opinion that there are too many doctors and hospitals allowed government to decrease number of such medical facilities and current number of hospitals does not fit demand of population in medical services provision.

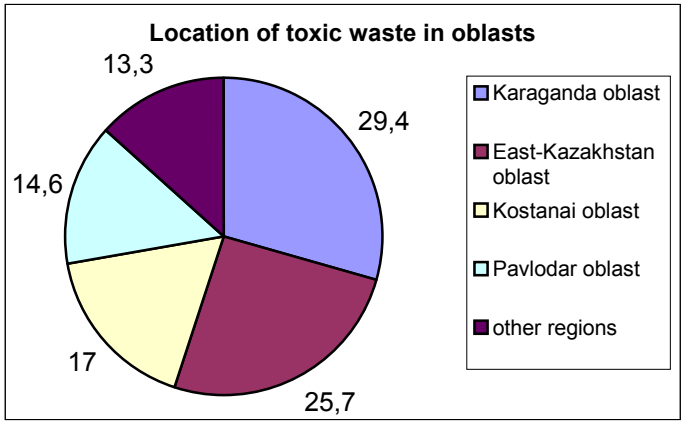
4.6. Influence of environment on life expectancy.

Poor environmental legacy.

The possible effects upon population health of severe environmental degradation are considerable concern in Kazakhstan. There are various forms of contamination:

1. Industrial and toxic waste.

Twenty billion tons of industrial wastes have been accumulated up to the present on the territory of Kazakhstan under the annual accumulation in amount of 1 billion tons. Ninety five percent of the total amounts of the mined ore go to waste, quite often being



extremely toxic and left in places, inadequate for storage. Large amounts of waste are accumulated at the enterprises themselves. The major amounts of toxic industrial waste have been accumulated: in Karaganda oblast – 29.4%, East-Kazakhstan – 25.7%, Kostanai – 17.0%, Pavlodar – 14.6% oblasts.

2. Radiation contamination.

Under diversity of factors, forming radio ecological situation on the territory of the Republic, the main factors remain to be: activity of the former Semipalatinsk Nuclear Testing Site; nuclear explosions for purpose of the national economy, made in 1949-1961; activity of enterprises of nuclear industry complex; mining and processing of minerals with elevated content of radioactive elements; natural radioactive anomalies in residential areas and underground waters, used for drinking water supply.

Active development of oil production industry in Mangistay and Atyrau regions has led to technical radio active pollution of areas of oil production and surrounding territories, there have been registered zones of crisis situations. Twelve cities and populated areas of these oblasts with population of approximately 100 thousand people are exposed to radioactive hazard.

3. Air pollution.

The air pollution level of cities and industrial centers, despite the reduction of production, remains rather high. A recession of industrial production has brought about a monotonous reduction of harmful substance emissions into the air from stationary sources. Despite the reduction, there has been no considerable improvement of the air in the cities and industrial centers of Kazakhstan. The qualitative composition of emissions practically does not change. Most of the emissions are characteristic for the areas of Pavlodar, Karaganda regions. In the recent years the role of automobile transport in the air pollution has increased. The automobile transport emitting dozens of pollutants together with exhausted gas, with the total volume up to one million tons, has a negative impact on the environment. In most of the large cities the contribution of automobile transport to the air basin pollution has reached in the recent years more than 60%, and in the city of Almaty - 90% of the total emissions. Among most polluted cities are Taraz, Ust-Kamenogorsk, Shymkent, Ekibastuz, Pavlodar, Zhezkazgan and Leninogorsc. A chronically unfavorable impact with regard to small concentrations of the air polluters on the human health results in damaging separate organs and systems, and reduction of the total resistance. It is possible that under the conditions of the air polluter impact there is high morbidity and mortality from cardio-vascular diseases.

The enterprises of the oil and gas complex in Atyrau, Mangystau, Kyzyl-Orda, and Aktyubinsk regions play a negative role in contamination of the air.

Effect of pollution on life expectancy and mortality rate is ambiguous. It seems that pollution is not the biggest contributor to the life expectancy. Clearly, pollution has an influence on appearance and exacerbation of different diseases. On the other hand, statistical data shows that in developed countries, where industrial production is on advanced level and, consequently, pollution is heavier, rate of life expectancy higher than in less developed countries. One reason is that effective and modern medical care; good nutrition and proper life style can compensate negative consequences of environmental deterioration. Nevertheless, developed countries try to establish high-level environment protection standards and

transnational corporations allocate more polluting industries in poor countries, where legislation is not so strong. Testing hypothesis on influence of pollution on life expectancy shows that pollution.

Fixed-effects (within) regression:

	Coef.	*Std. Err.*	*t*	*P>t*
pol_pop	*-1.17*	*1.00*	*-1.17*	*0.246*
cons	*10.33*	*.17*	*59.23*	*0.000*

R-sq: = 0.0146

The same insignificant result was got for first difference regression on influence of changes in pollution on changes in mortality rate.

4.7. Mode of life - influence of unhealthy behavior such as fewer smoking and drinking on life expectancy.

Rates of various non-communicable diseases have risen and may be associated with unhealthy behaviors such as a high fat diet, smoking and alcohol abuse. Due to Health for All Database consumption of cigarettes per person was the highest in 1995, at the same time life expectancy was the lowest. According to Figure 15, since 1995 cigarette consumption has been fluctuating: decreasing in 1996-1997, increasing in1998 and again decreasing in 1999.

There are some data available on share of cigarette consumption expenditure in total expenditure in 1998-2001 years (Figure 14). In 2001 expenditure on cigarettes increased in all oblasts with only one exception - Southern Kazakhstan. It is interesting fact that trends in the different regions are very similar (Figure 14). During 1999-2000 expenditure on cigarette consumption was rather constant or decreased in some regions. At the same period life expectancy level rose and began to fall in 2000. Influence of cigarette consumption is not so obvious. Since drop in life expectancy can be due to large cigarette consumption previously – one, two, ten years ago. Another possibility is that the increase in number cigarettes per day can exacerbate diseases. The probable consequence of this is higher mortality rate at the same year. Unfortunately, it is difficult to make any certain conclusions since number of available data not enough.

Alcohol consumption plays significant role. Figure 13 shows fluctuations in alcohol related expenditures during 1998-2000. Figure 3 presents life expectancy changes in the 80s and in the 90s. Remarkable, that the anti-alcohol campaign was accompanied by improvement in life expectancy. It can be conclude that life style has large impact on life expectancy. Data on alcohol consumption in regions for necessary period are not available. Therefore it is impossible to test hypotheses on influence of such factors on mortality and life expectancy.

4.8. Multicasual explanation.

According to dominating opinion in Russian health economics literature, multicasual approach is likely to be used as the best method to explain mortality deterioration that appeared in the last decade. In order to verify the hypothesis, regressions on simultaneous influence of factors such as socio-economic situation, medical services provision, stress, social cohesion and pollution are run.

The main result of influence of different factors on crude death rate is the following:

Fixed-effects (within) regression:

$$death_{i,t} = -5.94\,cons + 0.06\,unemp_{i,t} + 24.51\,town_{i,t} +$$
$$+ 0.56\,op\_de_{i,t} + 0.31\,div_{i,t} + u_i + v_{i,t}$$

Fe, death	*Coef.*	*Std. Err.*	*t*	*P>t*
unemp	*.06*	*.02*	*2.87*	*0.005*
town	*24.51*	*6.63*	*3.70*	*0.000*
op_de	*.56*	*.29*	*1.93*	*0.057**
div	*.31*	*.12*	*2.55*	*0.012*
_cons	*-5.94*	*3.88*	*-1.53*	*0.129*

R-sq: = 0.2532;

* – 6% significance

Next, the same factors are used to analyze determinants of male and female life expectancy. The results of regression on influence of all factors on male life expectancy reveal that stress, bad quality of medical services and unemployment define level of male life expectancy.

Fixed-effects (within) regression:

$$male_{i,t} = 62.76\,cons - 0.08\,unemp_{i,t} - 0.9\,op\_de_{i,t} + 0.76\,div_{i,t} + u_i + v_{i,t}$$

Fe, male	*Coef.*	*Std. Err.*	*t*	*P>t*
unemp	*-.08*	*.04*	*-2.28*	*0.025*
op_de	*-.90*	*.49*	*-1.82*	*0.072*
div	*-.76*	*.21*	*-3.62*	*0.000*
_cons	*62.76*	*.79*	*79.75*	*0.000*

R-sq: = 0.21

As can be observed from the next regression, the same variables influence female mortality. It is an interesting fact that unemployment affects female life expectancy weaker than male life expectancy. Divorce rate is important for the level of life expectancy for both sexes. Nevertheless, women take hardships of divorce easier.

Fixed-effects (within) regression:

$$female_{i,t} = 73.15 cons - 0.05 unemp_{i,t} - 0.84 op\_de_{i,t} + 0.66 div_{i,t} + u_i + v_{i,t}$$

Fe, female	*Coef.*	*Std. Err.*	*t*	*P>t*
unemp	*-.05*	*.03*	*-1.77*	*0.081*
op_de	*-.84*	*.39*	*-2.12*	*0.036*
div	*-.66*	*.17*	*-3.96*	*0.000*
_cons	*73.15*	*.63*	*116.63*	*0.000*

R-sq: = 0.24

In the structure of the general mortality causes mortality from the blood circulation system diseases stays in the first place during many years; it is followed by mortality from accidents, poisoning and traumas, malignant tumors, infectious and parasitic diseases.

The next step is analysis of influence of such factors as pollution, medical services provision, stress and social cohesion and economic factors on mortality from main causes.

Below are the most significant results. Firstly, regression on dependence of death from infectious and parasitic diseases on different factors shows that the number of deaths increase with drop in the number of hospitals and rise in unemployment rate, urbanization and divorce rate. Relations between mortality from infectious and parasitic diseases and the number of beds may be explained by two ways causalities. Higher mortality rate results in higher number of beds.

Fixed-effects (within) regression:

$$\inf_{i,t} = -1.54\, cons + 0.02\, unemp_{i,t} + 2.6\, town_{i,t} +$$
$$+ 0.02\, bed_{i,t} - 1.99\, hos_{i,t} + 0.13\, div_{i,t} + u_i + v_{i,t}$$

Fe, inf	*Coef.*	*Std. Err.*	*t*	*P>t*
unemp	*-1.54*	*.75*	*-2.05*	*0.044*
town	*2. 6*	*1.27*	*2.05*	*0.044*
bed	*.02*	*.006*	*2.82*	*0.006*
hos	*-1.99*	*.77*	*-2.57*	*0.012*
div	*.13*	*.02*	*5.45*	*0.000*
_cons	*.02*	*.005*	*2.96*	*0.004*

R-sq: = 0.4885

Death from malignant tumors (neoplasm) is affected by urbanization, divorces and pollution. A region, where the share of people living in town is high, experiences high mortality from malignant neoplasm. But the most attractive result is significance of pollution. As was mentioned in the preceding part pollution variables do not influence crude mortality and mortality from other diseases. Nevertheless, pollution is an important factor in explaining mortality from malignant neoplasm. Activity of the former Semipalatinsk Nuclear Testing Area which included nuclear explosions for purpose of the national economy, made in 1949-1961, accumulation of twenty billion tons of industrial wastes with large amount in Karaganda oblast East-Kazakhstan, Kostanai , Pavlodar and development of oil production industry in Mangistay and Atyrau regions, which leads to technical radio active pollution of areas, can be the causes mortality from malignant neoplasm.

Fixed-effects (within) regression:

$$neop_{i,t} = -0.92\, cons + 3.19\, town_{i,t} + 0.16\, div_{i,t} + 0.4\, pol\_pop_{i,t} + u_i + v_{i,t}$$

Fe, neop	*Coef.*	*Std. Err.*	*t*	*P>t*
town	*3.19*	*1.79*	*1.78*	*0.078*
div	*.16*	*.03*	*6.38*	*0.000*
pol_pop	*.40*	*.22*	*1.82*	*0.073*
_cons	*-.92*	*1.06*	*-0.87*	*0.387*

R-sq: = 0.3439

Mortality from accidents, poisoning, traumas and suicides is influenced by stress and social cohesion, which are approximated by crime and divorce rate. Other variables from available data set are not significant. Such result helps to draw a conclusion that only factors related to social life of individual affect mortality from accidents, poisoning, traumas and suicides are significant.

Fixed-effects (within) regression:

$$inj_{i,t} = -0.96\, cons + 0.003\, crime_{i,t} + 0.13\, div_{i,t} + u_i + v_{i,t}$$

Fe, inj	*Coef.*	*Std. Err.*	*t*	*P>t*
crime	*.003*	*.0009*	*3.30*	*0.000*
div	*.13*	*.03*	*4.52*	*0.000*
_cons	*.81*	*.09*	*8.63*	*0.000*

R-sq: = 0.35

Mortality from the blood circulation system diseases depends on the quality of medical service provision and economic factor such as unemployment.

Fixed-effects (within) regression:

$$circ_{i,t} = -4.69\, cons + 0.41\, unemp_{i,t} + 0.26\, bed_{i,t} + 1.74\, op\_de_{i,t} + u_i + v_{i,t}$$

Fe, circ	*Coef.*	*Std. Err*	*t*	*P>t*
unemp	*.41*	*.07*	*5.97*	*0.000*
bed	*.26*	*.05*	*4.85*	*0.000*
op_de	*1.74*	*.69*	*2.53*	*0.013*
_cons	*-4.69*	*1.15*	*-4.08*	*0.000*

R-sq: = 0.4116

In order to define factors, which determine changes in mortality and life expectancy, the following regressions are run.

Random–effects regression on influence of changes in different parameters on changes in mortality rate shows significance of the following variables: divorce rate, the number of bed and unemployment.

Random-effects regression:

$$chdeath_{i,t} = 0.10\, cons_{i,t} - 0.31\, chdoc - 10.27\, chhos_{i,t} + 0.23\, chbed +$$
$$+ 0.45\, chop\_de_{i,t} + u_{i,t} + v_{i,t}$$

Re, chdeath	*Coef.*	*Std. Err.*	*t*	*P>t*
chdiv	*.49*	*.12*	*3.98*	*0.000*
chbed	*.10*	*.04*	*2.68*	*0.007*
chunemp	*.09*	*.02*	*4.47*	*0.000*
_cons	*.10*	*.06*	*1.51*	*0.13*

R-sq: within = 0.2740

between = 0.2956

overall = 0.2307

The results of fixed effects regression are similar to random effects model, which mean that specification of the model does not influence the quality of final results and interpretation of these results.

Fixed-effects (within) regression:

$$chdeath_{i,t} = 0.26\,cons_{i,t} - 0.31\,chdoc - 10.27\,chhos_{i,t} + 0.23\,chbed + \\ + 0.45\,chop\_de_{i,t} + u_i + v_{i,t}$$

Fe, chdeath	*Coef.*	*Std. Err.*	*t*	*P>t*
Chdiv	*.48*	*.13*	*3.86*	*0.000*
chbed	*.11*	*.04*	*3.02*	*0.003*
chunemp	*.09*	*.02*	*4.38*	*0.000*
_cons	*.11*	*.05*	*2.14*	*0.035*

R-sq: within = 0.2753

It can be concluded that increase in divorce rate and unemployment, which approximate socio-economic condition deterioration and stress, results in mortality rate worsening.

The next regression shows that the changes in male life expectancy depend on the changes in divorce rate and unemployment. Both fixed effects and random effects models give the same results. Changes in male life expectancy depend mostly on divorce rate and ability to work.

Random-effects GLS regression:

$$chmale_{i,t} = -0.1cons - 1.24\,div_{i,t} - 0.13\,unemp_{i,t} + u_{i,t} + v_{i,t}$$

chmale	*Coef.*	*Std. Err.*	*t*	*P>t*
Chdiv	*-1.24*	*.27*	*-4.65*	*0.000*
chunemp	*-.13*	*.06*	*-2.30*	*0.022*
_cons	*-.10*	*.12*	*-0.88*	*0.380*

R-sq: within = 0.2642

between = 0.3929

overall = 0.2476

Fixed-effects (within) regression:

$$chmale_{i,t} = -0.11\,cons - 1.34\,div_{i,t} - 0.13\,unemp_{i,t} + u_i + v_{i,t}$$

chmale	Coef.	Std. Err .	t	P>t
Chdiv	-1.34	.30	-4.48	0.000
chunemp	-.13	.06	-2.17	0.033
_cons	-.11	.12	-0.93	0.357

R-sq: within = 0.2644

between = 0.3920

overall = 0.2474

Determinants of changes in female life expectancy are different from those in male life expectancy.

Random-effects GLS regression:

$$chfemale_{i,t} = 0.28\, cons - 0.18\, unemp_{i,t} - 0.67\, op\_de_{i,t} + u_i + v_{i,t}$$

chfemale	Coef.	Std. Err.	t	P>t
chunemp	-.18	.04	-4.42	0.000
chop_de	-.67	.38	-1.74	0.082
_cons	.28	.08	3.53	0.000

R-sq: within = 0.1969

between = 0.5928

overall = 0.2060

Fixed-effects (within) regression:

$$chfemale_{i,t} = 0.28\, cons - 0.18\, unemp_{i,t} - 0.66\, op\_de_{i,t} + u_{i,t} + v_{i,t}$$

Fe, chfemale	Coef.	Std. Err.	t	P>t
chunemp	-.18	.04	-3.99	0.000
chop_de	-.66	.44	-1.48	0.143
_cons	.28	.09	3.26	0.002

R-sq: = 0.1969

5. Conclusion.

Mortality is one of the most important indices of health on a par with life expectancy. Life expectancy at birth, being a component of the human development index, represents a generalized parameter characterizing the health of the country's population. The focus of this paper is to find the determinants of life expectancy and mortality. The paper represents an attempt to sum up the information known about variations in life expectancy and mortality rate in Kazakhstan. Description of the latest trends in life expectancy and mortality rates provides a background for the econometric analysis of factors, which influence mortality and life expectancy. There are many factors such as environment deterioration, factor of urban versus rural residence, education level, employment, marital status, and life stile. It should be stressed that influence of all these determinants is very disputable. Some of them have considerable impact on the overall life expectancy rate, but some do not have.

This study uses Kazakh National Statistic Agency data to investigate the effect of socio-economic factors, such as income, employment and urbanization, effects of stress and social cohesion; the effect of medical services provision and of pollution on mortality. Some of these effects are reasonable in the light of last decade's events. Consideration of the combined influence of various characteristics on life expectancy and mortality gives the following results:

1. Death rate is influenced by quality of medical services provision and by level of stress and social cohesion. In spite of the fact that urbanization and unemployment describe socio-economic conditions in the country, it can be assumed that they are also included in components of stress. Higher urbanization results in higher mortality rate.
2. The levels of female and male life expectancy depend on similar parameters such as stress and social cohesion, quality of medical care and socio-economic factor such as unemployment. Moreover, the same factors influence changes in life expectancy for both sexes.

Socio-economic effects explain only part of the increase in mortality between 1990-1996. It appears that decrease in the number of doctors, hospitals and beds is not a major source of reported changes in Kazakh mortality and explains only some of the increase in mortality over time. Moreover, such factor as pollution does not influence crude mortality, but influences mortality from malignant neoplasm. We can conclude that stress and level of social cohesion are very important factors of mortality and life expectancy deterioration.

The work presents analysis of determinants of mortality and life expectancy. Although, the results of hypotheses testing are significant, the source of the increase in mortality between 1991-1996 and after 1999 and the explanation for the decline in mortality after 1996 in Kazakhstan are yet to be found.

6. References

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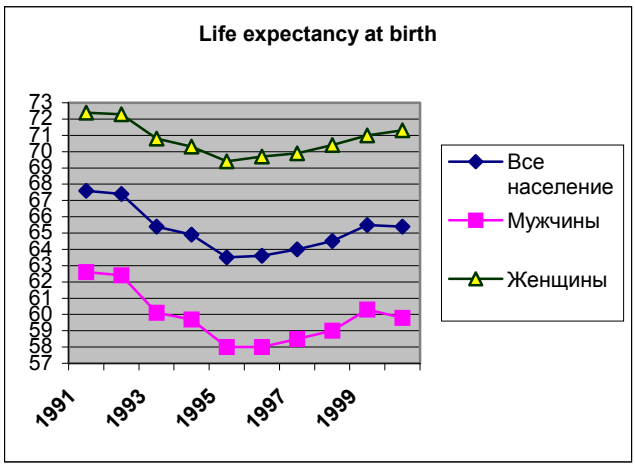
Appendix 1.

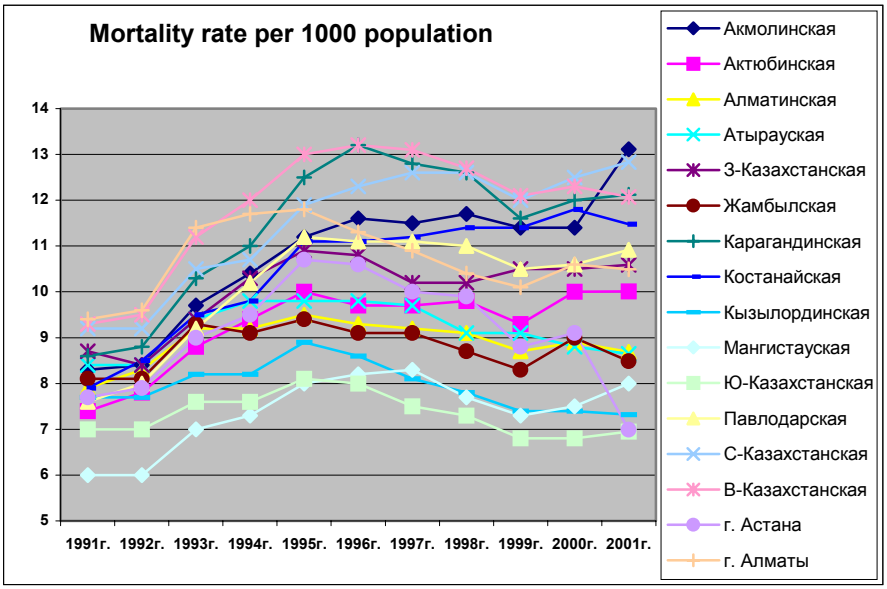
Figure1. Life expectancy at birth, 1991-2000



Годы	Все население	Мужчины	Женщины
1991	67,6	62,6	72,4
1992	67,4	62,4	72,3
1993	65,4	60,1	70,8
1994	64,9	59,7	70,3
1995	63,5	58,0	69,4
1996	63,6	58,0	69,7
1997	64,0	58,5	69,9
1998	64,5	59,0	70,4
1999	65,5	60,3	71,0
2000	65,4	59,8	71,3

Source: National Statistic Agency

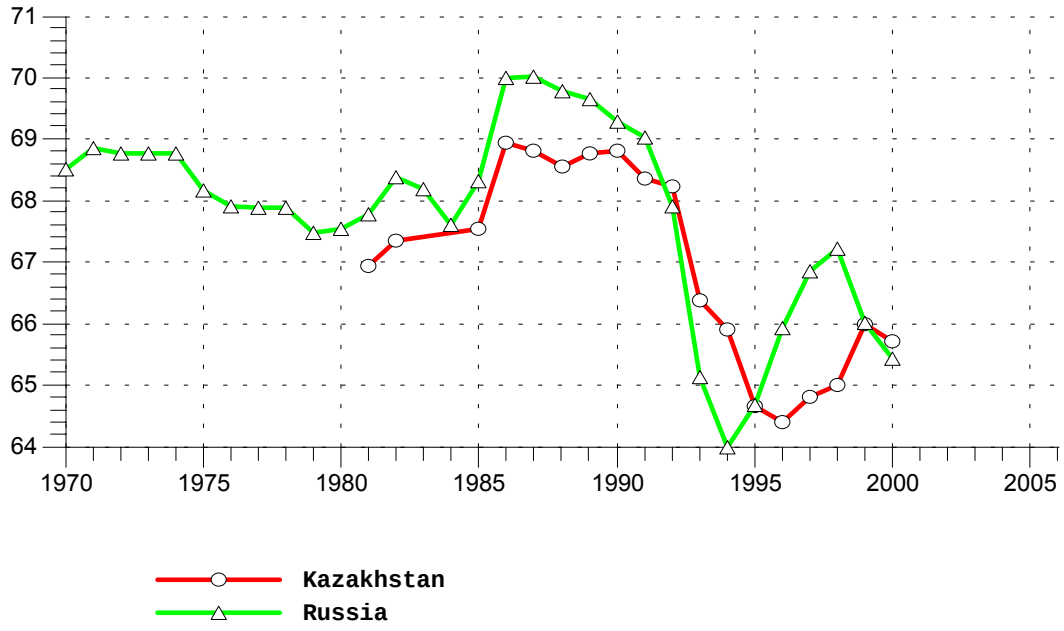
Figure 2. Mortality rate per 1000 population.



Source: National Statistic Agency

Figure 3.

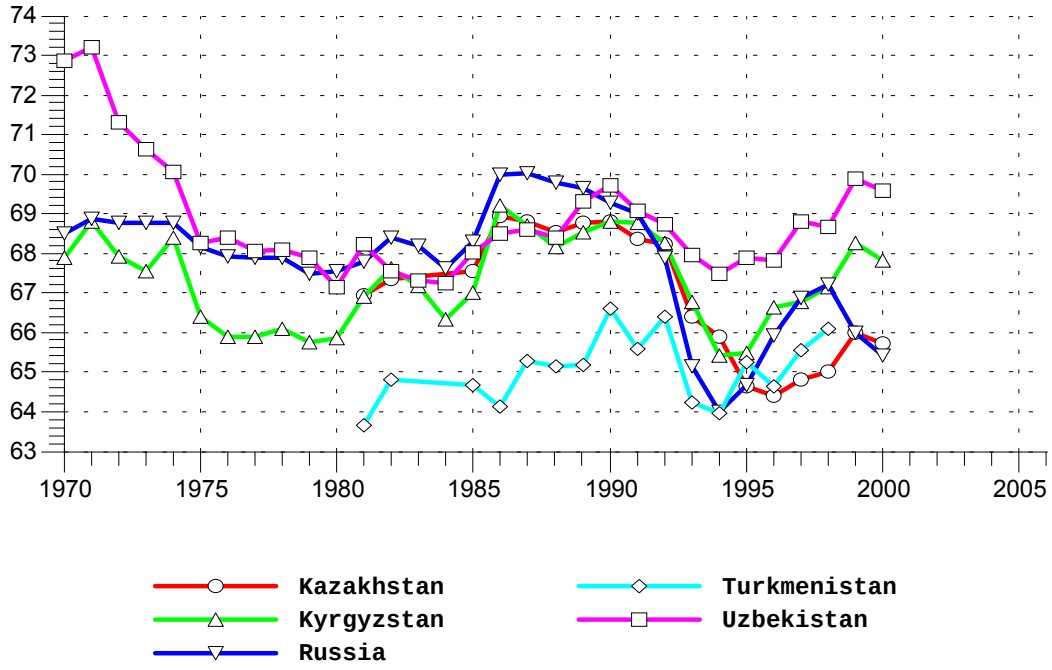
060101 +Life expectancy at birth, in years



Source: Health for All database

Figure 4.

060101 +Life expectancy at birth, in years



Source: Health for All database

Figure 5.

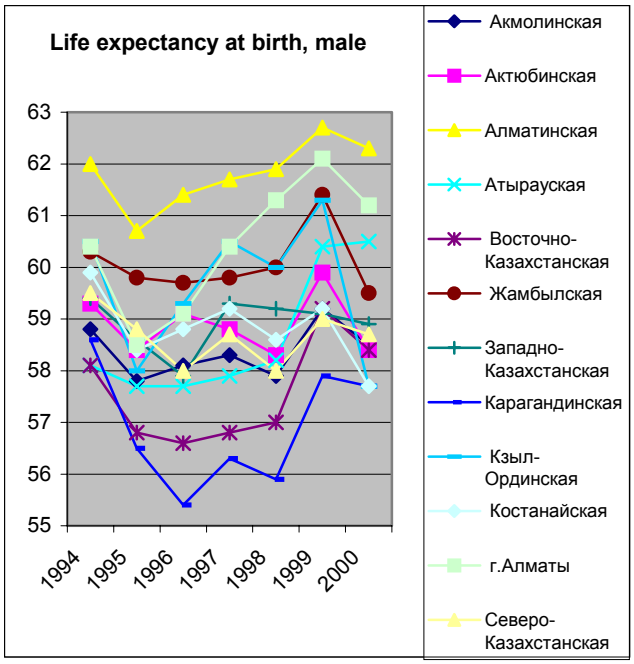
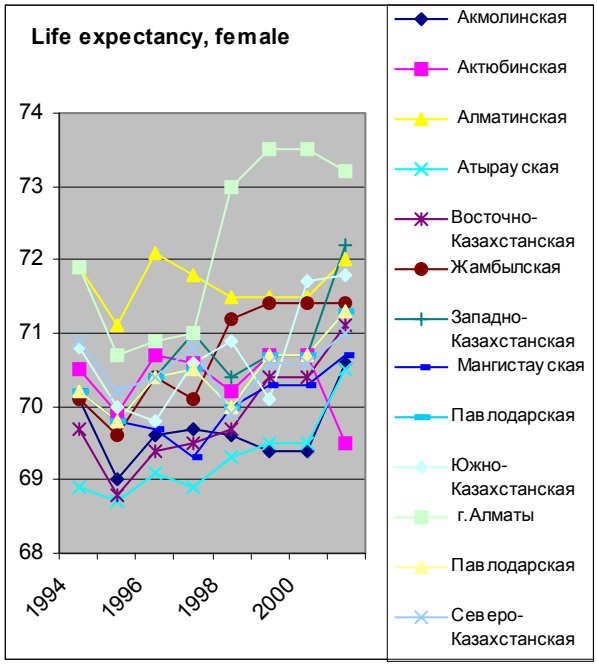
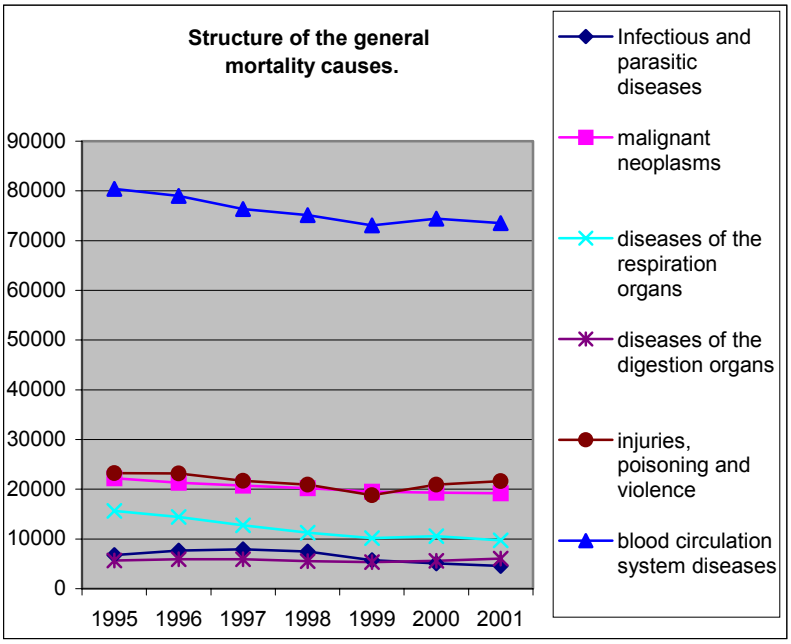


Figure 6.



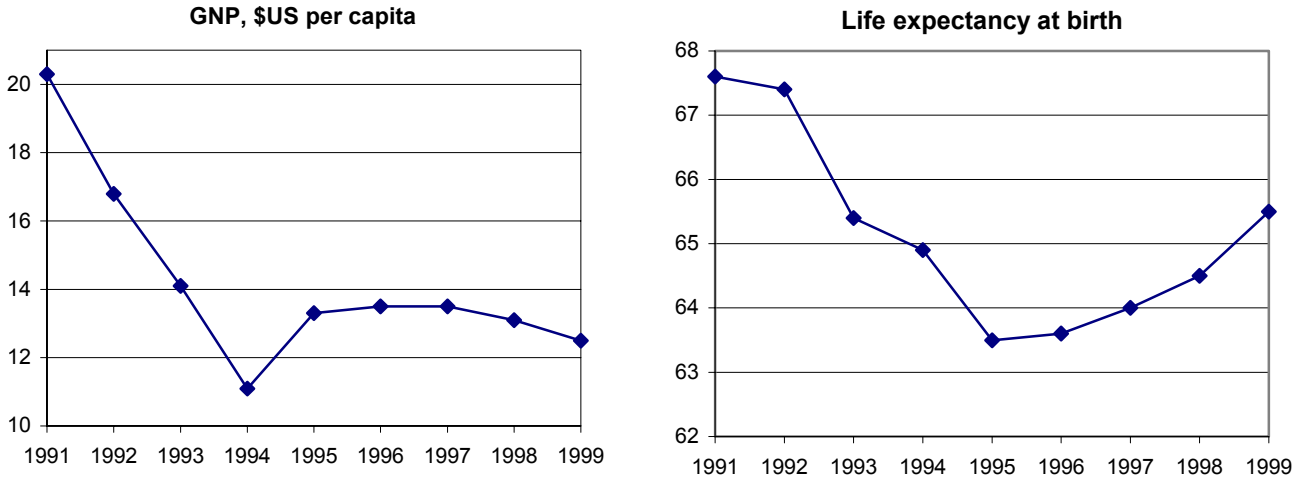
Source: Ministry of Health (www.medinfo.kz)

Figure 7.



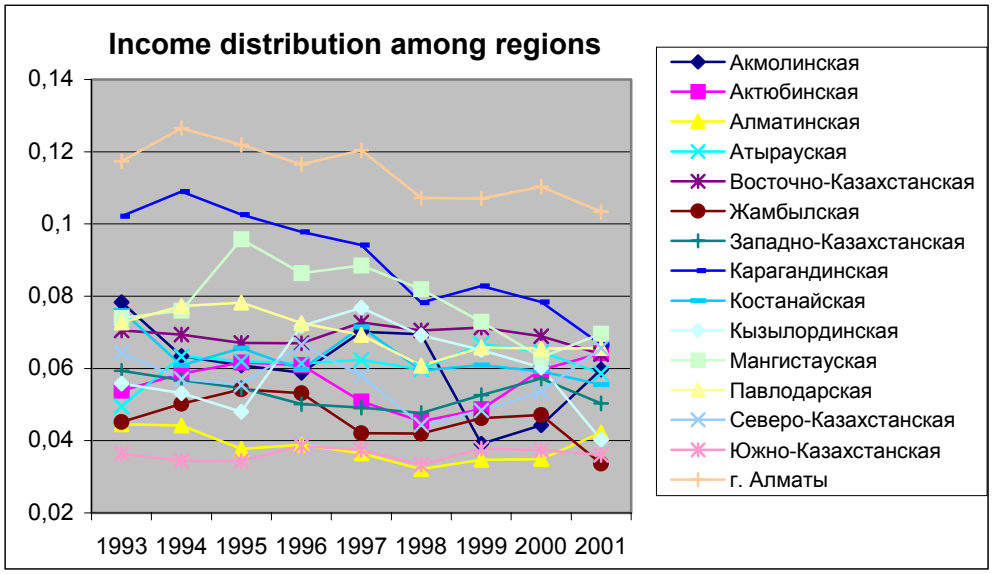
Source: National Statistic Agency

Figure 8.



Source: National Statistic Agency

Figure 9.

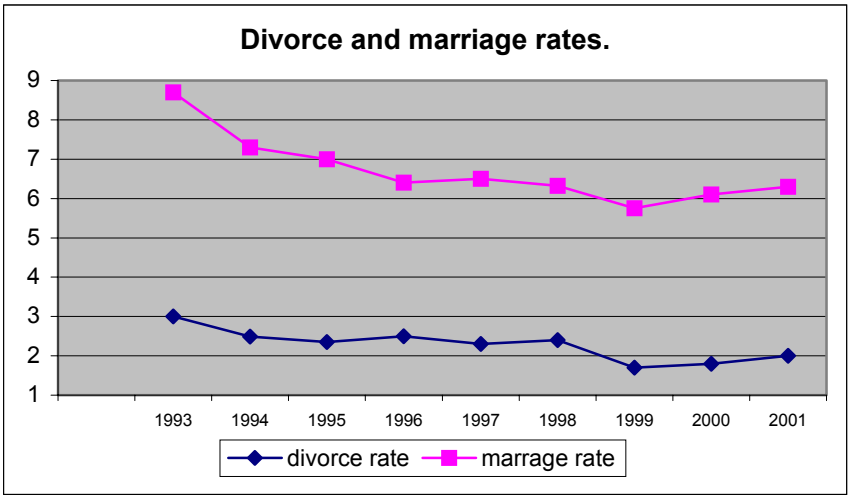


Source: National Statistic Agency

Figure 10.

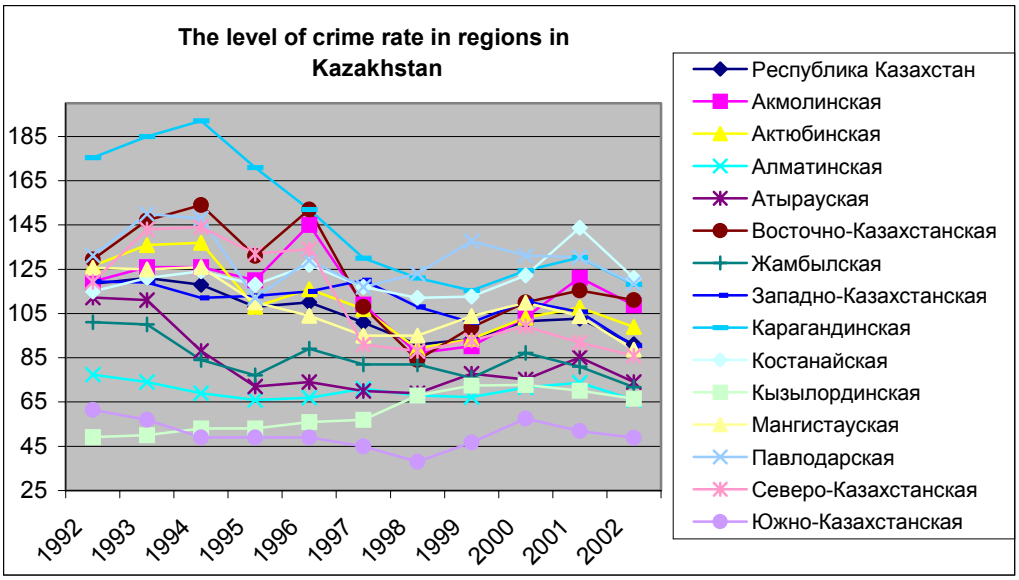
Source: National Statistic Agency

Figure 11.



Source: National Statistic Agency

Figure 12.



Source: National Statistic Agency

Figure 13.

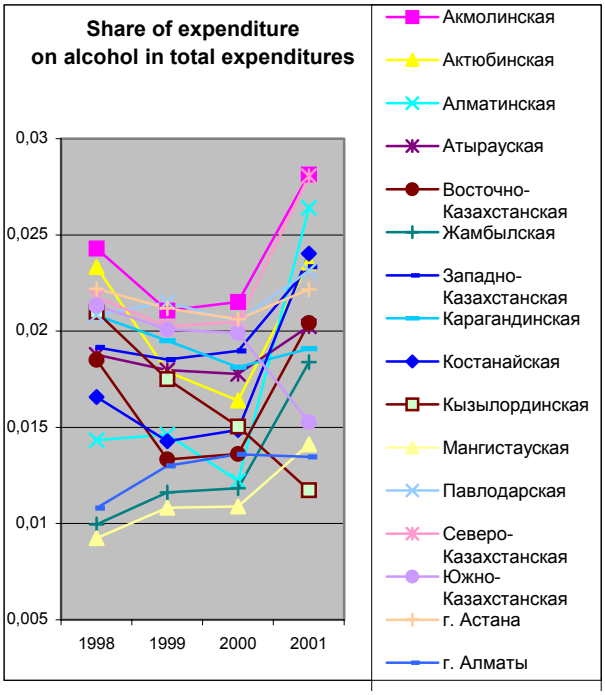
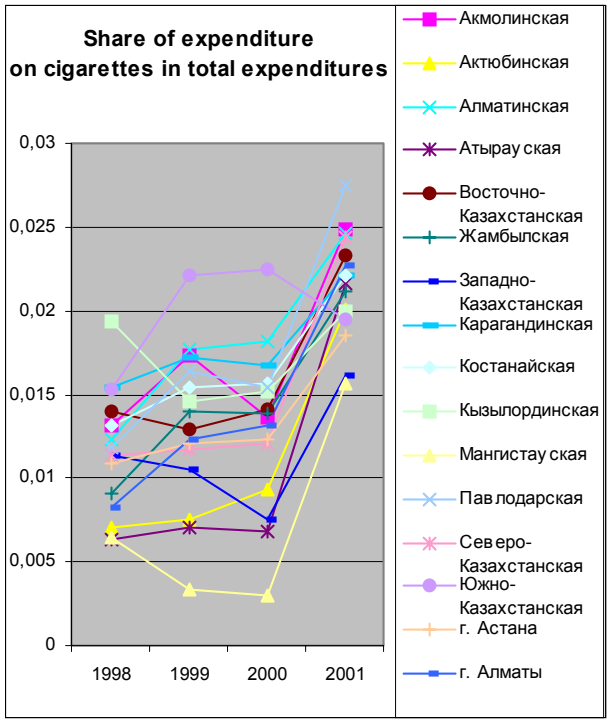
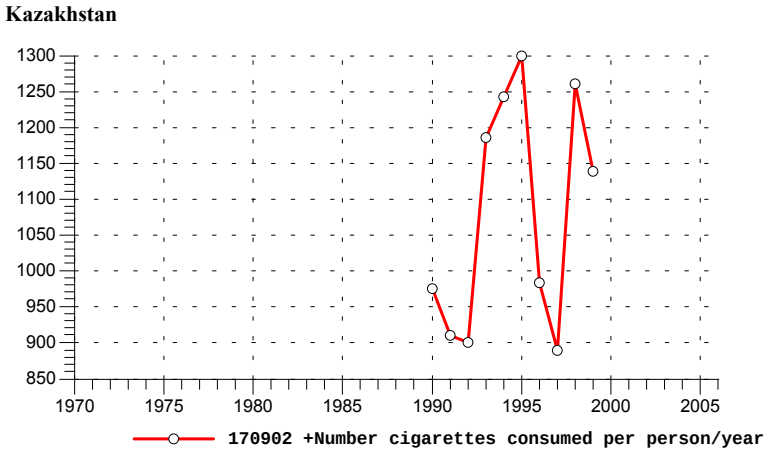


Figure 14.



Source: National Statistic Agency

Figure 15.



Source: Health for All database

Table 16.

	death	town	income	dev	mar	bed	hos	doc	op_de	pol_pop	crime	unemp
death	1.00											
town	-0.02	1.00										
income	0.18	0.90	1.00									
dev	0.45	0.57	0.67	1.00								
mar	-0.16	0.15	0.18	0.34	1.00							
bed	0.18	0.36	0.48	0.55	0.65	1.00						
hos	-0.11	-0.18	-0.15	-0.04	0.62	0.56	1.00					
doc	0.13	0.81	0.82	0.62	0.21	0.44	-0.18	1.00				
op_de	0.58	0.38	0.46	0.66	-0.10	0.18	-0.35	0.53	1.00			
pol_pop	0.27	0.34	0.29	0.33	0.11	0.19	0.14	0.04	0.24	1.00		
crime	0.60	0.61	0.69	0.79	0.03	0.38	-0.23	0.70	0.70	0.28	1.00	
unemp	-0.33	-0.01	-0.14	-0.22	0.03	-0.16	-0.14	-0.12	-0.23	-0.07	-0.29	1.00

Appendix 2.

- **death -** death rate - the number of death per 1000 people
- **unemp –** the number of unemployed people per capita
- **town** – the share of people living in towns in each region
- **income -** fraction of regional income in the total income of the country
- **div –** divorce rate- the number of divorces per capita
- **mar** –marriage rate- the number of marriages per capita
- **bed** – the number of hospital beds per capita
- **hos-** the number of medical institutions per capita
- **doc-** the number of doctors without dentists per capita
- **inf** -the number of death from infectious and parasitic diseases per capita
- **neop -** the number of death from malignant tumors (neoplasm) per capita
- **circ -** the number of death from blood circulation system diseases per capita
- **inj -** the number of death from injuries, accidents, poisoning, traumas and violence per capita
- **op.de -** death after operation rate per 100 operations
- **male -** male life expectancy
- **female –** female life expectancy
- **pol_pop** – air pollution from stationary sources (thousand tons) per capit