Determinants of health status and the difference in efficiency of the utilization of health care inputs in countries of the former Soviet Union

By Anna Ryltseva

Submitted to
Central European University
Department of Economics

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

Supervisor: Professor Péter Mihályi

Budapest, Hungary
2010

ABSTRACT

In this thesis I examine whether a certain set of factors have an impact on the health status of the population in the former Soviet Union countries. I conduct my research based on the data using panel data approach. Life expectancy at birth and infant mortality were chosen as proxies for the health status. The results are not homogenous when different measures for health status are considered. Socio-economic and lifestyle factors were found to have a more significant effect on life expectancy and infant mortality than health care resources. I also show that countries differ in efficiency of using health care resources and that the efficiency can be increased for majority of the countries without changing the level of health care inputs.

ACKNOWLEDGEMENTS

First and foremost I would like to express my gratitude to my thesis supervisor, Professor Péter Mihályi for his support, advice and recommendations during the period of working on the thesis. I am really thankful to Professor Gábor Kézdi and Proffesor Gábor Kőrösi for their help with econometric part of my thesis, and Professor John Harbord for his advice on the structure of my study. I am also very grateful to Chantal Nicq who was eager to answer the questions regarding the research conducted for the OECD countries and provided the software for Data Envelopment Analysis, and Aitalina Azarova who kindly agreed to explain how to work with that statistical package. Finally, I owe my deepest gratitude to my family ad friends for their support, encouragement and belief in me.

Table of contents

Itroduction

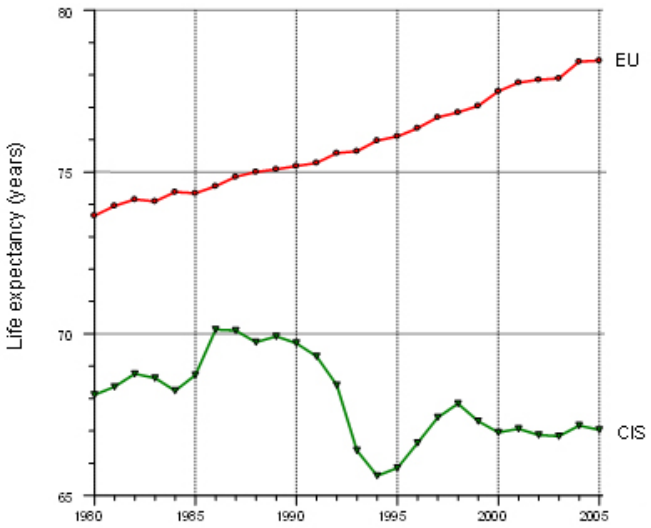
The demographic situation is one of the burning issues for the majority of countries in the world since demographic problems have a significant impact on the economic sphere and that impact is quite broad. Changes of life expectancy, birth and mortality rates are widely discussed in the existing literature together with comparisons of health statuses among various countries. The comparative analysis bears the idea of shedding light on the main parameters that determine health status.

According to the World Bank countries report (2007) ageing of the population and increase in proportion of retired people lead to strengthening of dependence on social support systems. Moreover, it causes decrease of productivity and lowering the speed of economic growth. Lack of work force makes employer face higher searching and replacing costs due to rise in employee turnover. Furthermore, in this situation less strict migration policies are needed in order to substitute for the lack of labour force. According to Zubarevich (2008), deterioration of demographic situation makes human resources more valuable and the competition for them is constantly growing.

However, even though life expectancy, birth and mortality rates are the key topics analyzed in the frame of the demographic policy, those parameters vary among countries showing that in some countries the demographic situation is improving while in others the issues of ageing and high mortality rates need urgent consideration. Heterogeneity among countries helps to analyze the determinants of population health status in order to establish a certain set of policy measures for improving the situation. For instance, huge difference in life expectancy is observed between the countries of the European Union (EU) and the Commonwealth of Independent States (CIS) (Figure 1). The most striking thing in this case is that even in the century when fast and efficient exchange of technologies and knowledge in all

spheres of life including health care is possible, the contrast among the countries can still be easily seen.

Figure 1. Life expectancy at birth in countries of the EU and CIS, 1980–2005



Source: World Bank

Going back to negative impact of demographic problems, it should be said that those problems can be the consequences of economic and health care development, which make the issues even more complicated and end up in a sort of "vicious circle". The question of identifying the direction of causality and determining other health related factors is widely discussed in the existing literature (Afonso and Aubyn 2006, Andreev et al. 2005, Cremieux et al. 1999, Cutler and Brainerd 2005, Joumard et al. 2008, Or 2000, Shkolnikov et al. 2000). However, econometric analysis of those factors has been conducted in a huge volume just for the EU and OECD countries, the United States, Canada. It can be explained by the availability of wide databases, more broad use of the econometric techniques in those countries and more qualified researchers familiar with all the modern techniques and software.

The former Soviet Union countries face a lack of econometric analysis of health status determinants. The majority of conclusions were made based on statistical figures (Nolte et al. 2005). Among those who examined the influence of various factors on health of the population using econometric tools are Andreev et al. (2005), Cutler and Brainerd (2005),

Shkolnikov et al. (1998, 2006). However, the authors have mainly conducted their research for Russia having given just short description of situation for the CIS of FSU countries. Therefore, the main aim of this thesis is to determine the factors influencing health status of the population of the Former Soviet Union countries. The study by Joumard et al. (2008) was chosen as the starting point of my own research. It contains a broad literature analysis and a detailed classification of health status indicators and determinants. Moreover, the study was published by the OECD which adds a lot to the reliability of the model and results. The main hypotheses about influencing factors are made based on the results of that research and then the panel data approach is applied for testing the model.

I also proceed with showing whether the efficiency of utilization of health care inputs varies across countries. This analysis is carried out based on a non-parametric method, Data Envelopment Analysis (DEA). The use of this method can be justified by the fact that the efficiency of utilization of health care inputs prevails over the quantity of those resources (Rudycheva 2009).

The rest of the thesis is organized in the following way. In the first chapter I describe proxies for health status and make hypotheses regarding its determinants based on the existing literature. In the second chapter the description of the model and empirical results are provided. I show whether the efficiency of using health care inputs is the same across countries in the third chapter and make conclusions in the last section.

Chapter 1: Identifying measures of population health status and its determinants

In this chapter I describe proxies of health status of population and the parameters that might affect it based on the available literature. Moreover, I make the hypothesis regarding the determinants of health status for the set of the FSU countries.

1.1 Measuring health status of a population

As well as the widely used measures such as life expectancy and a range of mortality rates, there are other proxies for health status of the population. According to Joumard et al. (2008), all those indicators can be divided into three groups:

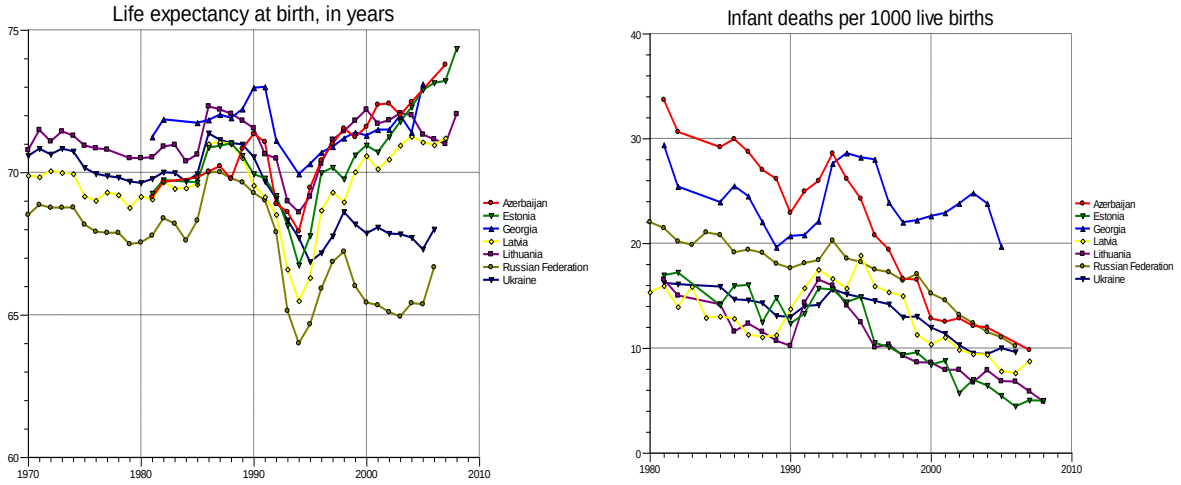
1. mortality/longevity indicators;
2. mortality indicators adjusted for the presence of diseases and/or disability and/or the quality of life;
3. other indicators connected to health.

Among the first group of indicators are those, such as life expectancy at birth, at the age of 65 and infant mortality. Life expectancy at birth is widely used because of the availability of data (Cremieux et al. 1999, Hollingsworth et al. 1999, Joumard et al. 2008 Nixon and Ullman 2006, Puig-Junoy 1998, Retzlaff-Roberts et al. 2003, Soares 2007, Spinks and Hollingsworth 2007). Moreover, it provides a general picture of to what extent the analyzed population is healthy.

Life expectancy at the age of 65, which is not used as often as the previous proxy, is a useful indicator as people in that age group are more vulnerable to different kinds of diseases and are the most intensive consumers of health care services (Joumard et al. 2008, Or et al. 2005). Infant mortality is also a popular indicator, especially, for the reason of less exposure to the factors that are not connected to the level of health care development (Joumard et al. 2008). The trends in mortality/longevity indicators for the CIS countries are provided in

Figure 2. However, the disadvantage of using mortality/longevity indicators is the fact that they are not adjusted to different kinds of diseases and external causes of death. That is why next group of indicators can provide more reliable measures.

Figure 2. Trends in measures of health outcomes: selected FSU countries



Source: World Health Organization (WHO)

The second group of indicators includes the health-adjusted life expectancy (HALE) and the disability free life expectancy (DFLE). The former makes adjustments for different diseases and illnesses and the latter counts the years that a person lives without any disability. The shortcoming of DFLE is placing equal weights to disabilities disregarding their severities (Joumard et al. 2008).

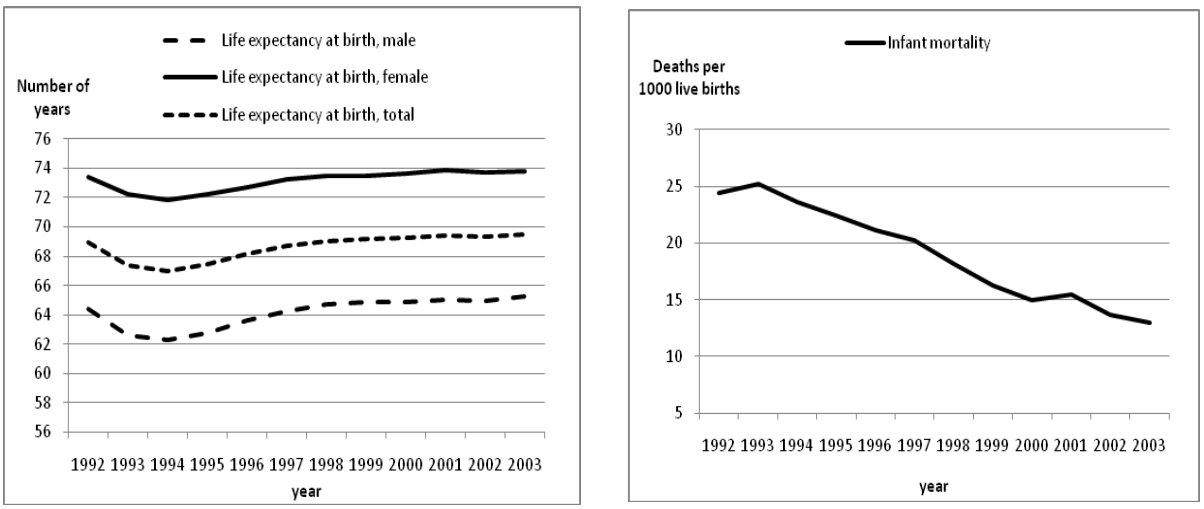
Among other factors related to health are sick leave and public satisfaction with the health care system. According to Joumard et al (2008) results of estimations using sick leave as the outcome variable can be ambiguous. On the one hand, larger amount of sick leave can be explained by poor development of health care in a country. However, on the other hand, leading to increase of life expectancy and helping sick people to continue working, well-developed health services can result in an increase of the sick leave. Campostrini and Bellini (2000) also argued that sick leave can be a measure of health status, but only for employed

people, which already makes this measure irrelevant for estimation of health care outcomes for the whole population.

Public satisfaction with health care services is not a reliable measure for assessing health care level. Joumard et al. (2008) and Bleich et al. (2009) argue that the satisfaction is affected by the expectations, which vary across people, and countries and the determinants of satisfaction are also not clear.

Since a lot of data is missing for the second and the third groups of indicators, I use the indicators from the first group as proxies for the health status of the population. In particular, I take life expectancy for female and male separately as well as the total indicator, and infant mortality in the former Soviet Union countries for my analysis. Life expectancies at birth are often provided separately for men and women since, as stated above (Shkolnikov et al. 1998), the same factors can have different impact on males and females.

Figure 3. Trends in measures of health outcomes: FSU average



Source: World Health Organization (WHO), the World Bank

It can be seen from Figure 3 that there was a huge decrease in life expectancy at birth between 1992 and 1995, which can be explained by the collapse of the Soviet Union and all the uncertainty and changes it has caused. After that period an increase in life expectancy up to the level of 1992 can be observed. At the same time, when infant mortality is considered as

a proxy for health status it can be seen that it continued to decrease even during the period of 1992-1995 and fell almost by 50% during 1992-2003. However, various indicators of health status are strongly correlated (Table 1). Therefore, it makes it possible to use the same set of parameters in order to explain the relationship between health status and the parameters and find out which of them contribute more or less when different proxies for health status are used.

Table 1 Correlation between health status indicators

	Life expectancy at birth, female	Life expectancy at birth, male	Life expectancy at birth, total	Infant mortality
Life expectancy at birth, female	1,00	0,52	0,81	-0,75
Life expectancy at birth, male	0,52	1,00	0,92	-0,15
Life expectancy at birth, total	0,81	0,92	1,00	-0,45
Infant mortality	-0,75	-0,15	-0,45	1,00

Source: Calculations are made in EViews based on the data provided by the World Health Organization (WHO) and the World Bank

1.2 Determinants of health status

In this section I describe the factors that I expect to have an impact on the health status of a population. As it was stated in the introduction a considerable amount of research investigating the trends in life expectancy and mortality rates in the CIS countries and specifying the factors that may determine the health status of the population has been done. Various factors were found to have an impact on health status of population. The summary of the main factors and the authors who used these factors is provided in Table 1 below.

However, according to Joumard et al. (2008), all those factors can be divided into three groups: health care resources, lifestyle factors and socio-economic factors. I take this classification as a base and include several factors that were used in other works and might also have an effect on health status.

Table 2. Summary of the main factors determining health status

Factors	Authors
Health care resources:	
Health care spending	*OECD countries:* Or (2000), Spinks and Hollingsworth (2007) *15 EU countries:* Nixon and Ullman (2006) *10 Canadian provinces:* Cremieux et al. (1999) *109 developing countries:* Filmer and Pritchett (1997) *191 developed countries:* Self and Grabowski (2003) *Russia:* Andreev et al. (2005)
Number of physicians	*OECD countries:* Afonso and St Aubyn (2006), Or (2000), Puig-Junoy (1998) *15 EU countries:* Nixon and Ullman (2006) *10 Canadian provinces:* Cremieux et al. (1999) *Russia:* Shkolnikov and Chervyakov (2000)
Number of hospital beds	*OECD countries:* Afonso and St Aubyn (2006), Puig-Junoy (1998) *15 EU countries:* Nixon and Ullman (2006) *Russia:* Shkolnikov and Chervyakov (2000)
Access to health care services	*CIS countries:* Danilovich (2010)
Lifestyle factors:	
Tobacco	*OECD countries:* Afonso and St Aubyn (2006), Or (2000), Puig-Junoy (1998) *15 EU countries:* Nixon and Ullman (2006) *10 Canadian provinces:* Cremieux et al. (1999) *US states:* Thornton (2002)
Alcohol consumption	*OECD countries:* Afonso and St Aubyn (2006), Or (2000), Puig-Junoy (1998) *15 EU countries:* Nixon and Ullman (2006) *US states:* Thornton (2002) *Russia and the former Soviet Union:* Cutler and Brainerd (2005)
Diet/obesity	*OECD countries:* Afonso and St Aubyn (2006) *15 EU countries:* Nixon and Ullman (2006) *10 Canadian provinces:* Cremieux et al. (1999) *191 developed countries:* Self and Grabowski (2003)
Degree of urbanization	*109 developing countries:* Filmer and Pritchett (1997) *191 developed countries:* Self and Grabowski (2003)
Socio-economic factors:	
Pollution	*OECD countries:* Or (2000) *15 EU countries:* Nixon and Ullman (2006)
Education	*OECD countries:* Afonso and St Aubyn (2006), Spinks and Hollingsworth (2007) *10 Canadian provinces:* Cremieux et al. (1999) *109 developing countries:* Filmer and Pritchett (1997) *191 developed countries:* Self and Grabowski (2003) *US states:* Thornton (2002) *CIS countries:* Shkolnikov et al. (1998), Plavinski et al. (2003), Shkolnikov et al. (2006)
Income	*OECD countries:* Afonso and Aubyn (2006), Or (2000), Spinks and Hollingsworth (2007) *10 Canadian provinces:* Cremieux et al. (1999) *109 developing countries:* Filmer and Pritchett (1997) *191 developed countries:* Self and Grabowski (2003) *US states:* Thornton (2002)
Unemployment	*OECD countries:* Spinks and Hollingsworth (2007) *15 EU countries:* Nixon and Ullman (2006)
Occupational status (share of white collars)	*OECD countries:* Or (2000)

1.2.1 Health care resources

Health care resources are usually measured either in monetary terms or in physical terms (Joumard et al. 2008). When measuring health care resources using the former method such parameters as total *health care spending* (Cremieux et al. 1999, Joumard et al. 2008), health spending as a share of GDP (Nixon and Ullman 2006) are usually taken into consideration. However, there is a problem in estimating the contribution of health spending on health status as the expenditure is closely related to countries' GDP and development level. Another disadvantage in using health spending is that health sector financing schemes may also vary across countries. In this case, it is better to separate the effects of private and public spending if the data for these sources of financing is available (Filmer and Pritchett 1997, Or 2000, Self and Grabowski 2003, Verhoeven et al. 2007).

Higher health care spending was mainly found to lead to increase in health status (Bonilla-Chacin et al. 2003, Joumard et al. 2008, Or 2000). However, small or even insignificant impact was also found by several authors (Andreev et al. 2005, Filmer and Pritchett 1997), which might be attributable to the inefficient use of health care spending.

As regards physical terms of measuring health status of a population, such parameters as *number of physicians and hospital beds* are usually considered. Number of physicians and hospital beds can provide more reliable results of the health sources impact on health status than health care spending, since they depend less on the other factors. Moreover, empirical evidence shows less ambigious results than monetary measures. Cremieux et al. (1999), Nixon and Ullman (2006), Or (2000), Puig-Junoy (1998) and Verhoeven et al. (2007) found that a larger number of physicians and hospital beds was associated with a rise in life expectancy and a decrease in mortality rates. However, the results are striking in case of Russia. Shkolnikov and Chervyakov (2000) claimed that the decrease in health status in Russia in 1992-1995 was not attributable to the number of physicians and hospital beds as

those health care resources did not change significantly during that period. At the same time this result was found just for Russia and was mainly based on the statistical figures.

Lack of econometric analysis and the goal of finding health status determinants for the whole set of post-soviet countries makes it tempting to find out whether the health care resources have a positive impact on the population health. It is expected that increase in both terms of measuring health care resources attribute in a positive way. Higher health spending is supposed to lead to more developed equipage, availability of modern and quality pharmaceuticals and to a higher development level of health industry in general. Larger number of physicians and hospital beds make those resources available to a greater number of people.

Among the above factors, in one of the latest works conducted by Danilovich (2010) *access to* reproductive *health care services* was found to have an increasing impact on maternal and infant mortality rates. The author stressed the fact that there is a lower access to reproductive health care in countries with higher payment for health care services, in particular, in Kazakhstan. In contrast, a higher use of health care services was found in Belarus because of its Soviet-style policy of universal access to those services. Danilovich (2010) claims that in this case income is the most important factor that determines the use of health care in Kazakhstan.

1.2.2 Lifestyle factors

The most common life-style factors that affect health status are tobacco and alcohol consumption and measures for diets (Joumard et al. 2008). *Alcohol* has lots of harmful health effects such as cardiovascular disease and violent deaths (Joumard et al. 2008). Moreover, in one of the works that have been done for the CIS countries using econometric tools Cutler and Brainerd (2005) argued that the decrease in male life expectancy at birth in Russia and the former Soviet Union can be partly attributable to alcohol consumption and stress caused by

the uncertain future and the negative perspectives about it. However, the authors pointed out that there is approximately half of the increase in the mortality left unexplained. According to Nolte et al. (2005), the pattern of alcohol consumption in the FSU countries is characterized by "binge drinking" which is more harmful than moderate alcohol consumption. *Tobacco*, in its turn, also leads to cardiovascular disease as well as lung cancer and smoking is one of the most important factors in determining of the population health status (Joumard et al. 2008, Nolte et al. 2005).

The existing literature provides different measures of *diet*. Self and Grabowski (2003) used calorie intake while Joumard et al. (2008) tested sugar and fat consumption and the consumption of fresh fruits and vegetables, Afonso and St Aubyn (2006) tested the impact of obesity. Among those measures consumption of fresh fruits and vegetables was chosen as a proxy for diet. In the opinion of Joumard et al. (2008), calories, sugar and fat consumption might have a non-linear effect meaning that they can have a positive impact just up to a certain level. Taking consumption of fruits and vegetables as a measure of diet and healthy nutrition is relevant for the FSU countries as it has increased significantly since the collapse of the Soviet Union. Brainerd and Cutler (2005) claim that during the Soviet period people did not consume a lot of fresh fruits and vegetables because of the introduction of different governmental nutrition and agriculture programs.

In case of developing countries, a *degree of urbanization* is also included in the group of lifestyle factors. Degree of urbanization was found to have a negative effect or insignificant effect (Filmer and Pritchett 1997, Self and Grabowski 2003). The negative impact can be explained by the presence of more harmful and dangerous factors on urbanized areas such as pollution, a larger number of traffic accidents, more criminal environment. However, urbanized areas are equipped with better health care resources, hence, the effect of degree of urbanization is ambiguous.

According to all the lifestyle factors discussed, I make the following hypothesis. Tobacco and alcohol consumption has a negative impact on a population health in the FSU countries while consumption of fresh fruits and vegetables has a positive influence. There is no hypothesis regarding degree of urbanization because of the ambiguity of its effect. Nevertheless, the impact of this factor will be tested in the next chapter.

1.2.3 Socio-economic factors

According to Joumard et al. (2008) pollution, education and income are the factors included in the socio-economic group. *Pollution* is not widely used in the estimation of health production function. However, it has been lately recognized as one of the significant factors that has a negative effect on health and was used in a certain number of papers (Joumard et al. 2008, Nixon and Ullman 2006, Or 2000). I expect pollution to have a negative effect on health in the FSU countries.

The situation is less clear with *education* because of the uncertainty of causality direction (Joumard et al. 2008). On the one hand, it might be the case that healthier people can devote more time to studying and can achieve better results. On the other hand, more educated people are more aware of disease and the measures to prevent them and are able to use health care services more effectively. Afonso and St Aubyn (2006), Filmer and Pritchett (1997) claim that education has a significant and positive impact on health improvement both in OECD countries and in the developing countries from East and South Asia, Latin America, Africa.

Education also appeared to be one of the important factors that contribute to changes in mortality rates and life expectancy in the former Soviet Union countries. In their work Shkolnikov et al. (1998) have showed that differences in mortality rates in Russia can be explained by the differences in the length of education. They showed that the relationship between those two parameters declines with age and is stronger for men than women. In

support of Shkolnikov et al. (1998) findings, Plavinski et al. (2003) have concluded that men with the lowest level of education contributed most to the increase in mortality in the 1990-s, however, the mortality rates did not change for men who obtained a university degree. Several years later, Shkolnikov et al. (2006) comparing Russia and Estonia with the Czech Republic, showed the differences in life expectancy trends for the countries. The authors found that life expectancy increased for people with higher education and decreased for those with low and middle education in Russia and Estonia in comparison with the Czech Republic, where the health status indicator increased for all educational groups. Unfortunately, I had to omit education from the set of variables due to the lack of data for its proxies such as literacy rate and share of population with at least secondary education.

Cremieux et al. (1999), who unlike the majority of authors found a small effect of education on health in Canadian provinces, argued that income is the main determinant of health status. *Income*, usually measured as GDP per capita, was stated as an explanatory factor also both for developed (Self and Grabowski 2003) and developing countries (Filmer and Princhett 1997).

However, in the same respect as education, the income effect is also ambiguous. From one point of view, high-income people can afford better quality medicine, more healthy food and devote time and money to various sport activities. In general, they have more access to services and goods that have a positive impact on health. Looking at the situation from the other point of view, a reverse relationship can be established. As in the case of education, healthier individuals can work more, they have more energy and are more productive and, as a result, their income is higher (Joumard et al. 2008). Joumard et al. (2008) argue that the first case should be considered for a macro level research. Therefore, I assume that higher income per capita in the FSU countries leads to health improvement.

The factors that are not widely used in a group of socio-economic factors are the *occupational status and unemployment*. The positive effect of the share of white collar workers on the reduction of mortality rates was measured by Or (2000). In its turn, unemployment is mainly used as the input measure in the data envelopment analysis (DEA) of health care efficiency (Nixon and Ullman 2006, Spinks and Hollingsworth 2007), which will be described in the following chapter. Unemployment is supposed to contribute to health deterioration in a following way. It is more likely that unemployed people do not have financial resources to get access to services and goods that have a positive impact on health. Moreover, health insurance is usually paid by employees, thus, unemployed people are unable to get it. Therefore, I expect a negative impact of higher unemployment rates on health status.

Based on all the factors discussed, I expect the following factors to have an impact on the health status of the population in the FSU countries:

- three health care resources - number of physicians and hospital beds and health care spending;
- four lifestyle factors - tobacco and alcohol consumption, average number of fruits;
- three socio-economic factors - pollution, income and unemployment.

The empirical results are provided in the next chapter.

Chapter 2: Model and empirical results

In this chapter I describe the data used for estimation of health production function for the FSU countries, the chosen methodology and empirical results.

2.1 Data and methodology

In my study I use data for countries of the FSU for the period of 1992-2003. The data I use for the analysis were collected from the official websites of the World Health Organization, the World Bank and the United States Department of Agriculture. The fact that the latest period is 2003 is explained by a large number of missing data for the recent years. The description of the main variables and the sources is provided in Appendix A.

Since the data for GDP and health spending is available for two countries for the year of 1996, this year was excluded from the estimations. Moreover, the data for tobacco consumption was provided in a different measure for Azerbaijan. Therefore, the country was not considered in the analysis when tobacco consumption was included as a variable in the health production function.

I specify the health production function in the following way:

$$\boldsymbol{Y_{it} = \beta_0 + \beta_1 * HR_{it} + \beta_2 * lnSE_{it} + \beta_3 * lnLS_{it} + a_i + v_{it,}}$$

where Y_{it} is a measure of population status, i.e.

- life expectancy at birth, total, for males and females
- infant mortality.

HR_{it} is a vector of health care resources which are measured either in physical or in monetary terms. Health production function is estimated separately for the case when health care spending is used as a measure of health care resources and when the numbers of hospital

beds and physicians are used. SE_{it} is a vector of socio-economic factors and LS_{it} is a vector of lifestyle parameters.

The above equation is estimated using a panel data approach as it makes it possible to account both for changes over time and country differences (Joumard et al. 2008). I have chosen log-linear form for the regressions. In this case coefficients are interpreted as elasticities. I have also tested the specification with the dependent variable in level and the explanatory variables in logs, but those results did not differ a lot. The equations are estimated with account to country and year fixed effects. Countries can differ in health care systems, in climate and environment in general. All these parameters can influence the population health status and the estimators will be biased if country fixed effects are not taking into consideration. The same can apply to year fixed effects.

In my study I estimated the health production function both with the variable of tobacco consumption included and excluded. The reason for this is the need of omitting Azerbaijan from the set of countries. I have an unbalanced panel due to the missing data. In each of the estimations at least one or two countries (Tajikistan and Turkmenistan) are missing. Exclusion of one country reduces the sample even further and it is not favorable in this case.

In addition to the missing data problem, there is one more difficulty in estimating the health production function. In case of using health care spending as health care resources measure, collinearity problem arises. Despite the fact that omitting GDP per capita will result in a biased estimator for health care spending as it will also capture income effect, and that what was found by Joumard et al. (2008), in my case these two variables are highly correlated. Hence, I excluded income from the regression when health care spending is used.

2.2 Empirical results

In this section I describe the results of the estimations of the health production function. First, I estimated the impact of three groups of factors using number of hospital beds and physicians as a measure of health care resources, but without including tobacco consumption in a range of lifestyle factors. The results of this estimation are provided in Table 2.

Table 3. Health status determinants, with health care resources in physical terms

Independent Variable	Life expectancy at birth			Infant mortality
	Total	Male	Female	
Hospital beds	-0.006 [0.024]	-0.007 [0.038]	-0.001 [0.011]	-0.336* [0.188]
Physicians	-0.035 [0.022]	-0.033 [0.025]	-0.036*** [0.011]	0.547 [0.339]
Income	0.017** [0.007]	0.018*** [0.010]	0.013*** [0.004]	-0.231*** [0.056]
Unemployment	-0.015*** [0.004]	-0.020* [0.005]	-0.008*** [0.003]	0.051 [0.034]
Pollution	-0.023* [0.013]	-0.035 [0.023]	-0.008 [0.005]	0.131 [0.140]
Alcohol consumption	0.0002 [0.005]	0.001 [0.006]	-0.0005 [0.005]	-0.029 [0.025]
Diet	0.017** [0.008]	0.020 [0.0004]	0.012** [0.005]	-0.208** [0.099]
Urbanization	-0.089*** [0.052]	-0.102 [0.078]	-0.073** [0.030]	0.332 [0.300]
Constant	4.354*** [0.260]	3.498*** [0.029]	4.414*** [0.166]	6.001*** [1.387]
Country fixed effects	Yes	Yes	Yes	Yes
Observations	137	137	137	137
Countries	14	14	14	14
R-Squared	0.893	0.876	0.945	0.836

*Note: 1. ***, **, * - significance of coefficients at 1, 5, 10 % significance level respectively*
2. White standard errors are reported

As it can be seen from Table 2, number of hospital beds and physicians mainly has an insignificant impact on the health status. It goes in line with the findings of Shkolnikov and Chervyakov (2000) even though those results were obtained just for Russia. Nevertheless, the results are not homogenous when different proxies for the population health status are used. For instance, there is a striking result in case of the impact of physicians on life expectancy of females at birth. This result is somewhat counterintuitive. However, it might be explained by the level of physicians and the fact that women usually use health care services more often than men. Moreover, we can interpret the negative sign of the coefficient as evidence that women go to physicians when they already have some serious diseases. At the same time, a significant and negative impact of the number of hospital beds on infant mortality can be observed. It can be explained by the fact that children at the early days of their life are more vulnerable to different kinds of diseases or are already born with some of them. Furthermore, they usually stay in hospitals with their mothers for whom hospital beds have to be provided.

Among other factors which have an impact on infant mortality are those such as income and consumption of fruits and vegetables. These factors have the expected sign and are highly significant. Contributions of significant explanatory variables for infant mortality are presented in Table 3.

Table 4. Contributions of explanatory variables to changes in infant mortality

	Decline in infant mortality rate
Explained by:	*Deaths/1000 live births*
Hospital beds	4,19
Income	-1,97
Diet	-1,25

It was stated in chapter 1 that infant mortality has declined approximately by 50% during the period of 1992-2003, i.e. by 12 deaths/1000 live births. From Table 3 it can be seen that income and consumption of fruits and vegetables contributed just to the forth part of that

decline. Hospital beds were estimated to have a negative impact. However, their number has decreased during that period, which has been reflected in the positive contribution of their change to infant mortality. Hence, we can see that the larger part of the decline in infant mortality was left unexplained. It can be assumed that all unexplained changes are results of differences in efficiencies of utilization of health care resources, but this will be analyzed in the next chapter. Also, the omission of education proxy, which was found to have a significant impact, might lead to biased results.

Going back to the results of the estimations when life expectancy was used as a proxy for health status, the factors, such as income, unemployment, urbanization, diet and pollution were found to have an impact. The majority of the coefficients have expected signs. The effect of level of urbanization on life expectancy for the FSU countries, for which there was no hypothesis made, was found to be negative.

Alcohol consumption appeared to have no significant impact on life expectancy. This result seems also counterfactual. At the same time, the main findings regarding the impact of alcohol on health status were made for Russia. Moreover, alcohol consumption can have a lagged effect. In my model I use contemporaneous measure that might not fully describe the impact of alcohol consumption.

Then, I also estimated the impact of three groups of factors using number of hospital beds and physicians as a measure of health care resources including tobacco consumption in a range of lifestyle factors. The results of this estimation are provided in Appendix B. As the results did not alter a lot and the effect of tobacco consumption was found to be insignificant, the preference was given to the estimates in Table 3. The insignificant impact of smoking can also have the analogous interpretation as the alcohol consumption. Smoking does not lead to all the harmful diseases immediately, nevertheless, in the regressions I used the contemporaneous measure of tobacco consumption.

Having estimated the health production function using health care resources in physical terms, I continued the estimations with health care spending instead of the number of physicians and hospital beds. The results of the estimations are provided in Table 5.

Table 5. Health status determinants, with health care resources in monetary terms

Independent Variable	Life expectancy at birth			Infant mortality
	Total	Male	Female	
Health care spending	0.009** [0.003]	0.011** [0.005]	0.005*** [0.002]	-0.048 [0.042]
Unemployment	-0.010*** [0.004]	-0.014*** [0.005]	-0.005** [0.002]	0.021 [0.029]
Pollution	-0.025* [0.013]	-0.030* [0.016]	-0.015* [0.008]	-0.052 [0.117]
Alcohol consumption	0.013** [0.006]	0.014* [0.008]	0.010*** [0.004]	-0.065 [0.046]
Tobacco	0.010** [0.005]	0.012** [0.005]	0.008 [0.005]	-0.067 [0.074]
Diet	0.029** [0.011]	0.036** [0.014]	0.020*** [0.007]	-0.208* [0.106]
Urbanization	-0.129** [0.060]	-0.176** [0.086]	-0.074** [0.029]	0.036 [0.326]
Constant	4.659*** [0.228]	4.752*** [0.336]	4.537*** [0.107]	3.551** [1.408]
Country fixed effects	Yes	Yes	Yes	Yes
Observations	97	97	97	97
Countries	12	12	12	12
R-Squared	0.934	0.918	0.973	0.969

*Note: 1. ***, **, * - significance of coefficients at 1, 5, 10 % significance level respectively*
2. White standard errors are reported

The results for the model including tobacco consumption are not significantly different from the results when this variable is omitted (Appendix C), hence, the first model was paid attention to. As it was stated in chapter 2.1, income is not included in the health production function when health care spending is used due to the collinearity of the variables.

It can be seen from Table 5 that only consumption of fresh fruits and vegetables has a negative and statistically significant impact on infant mortality. In contrast, all the hypothesized factors contribute to the change of life expectancy. Almost all the coefficients have expected signs; urbanization again has a negative effect as in the case of health care resources measured by hospital beds and physicians. However, the results are counterfactual for tobacco and alcohol consumption, which appeared to have positive impacts on life expectancy. It might be the case that the increase of health care spending in the FSU countries happened for the reason of need to use health care resources more often, which in its turn, can be a result of having various diseases caused by alcohol and tobacco consumption. According to this scenario, the increase of health care spending can be considered as a response to harmful lifestyle. When alcohol and tobacco consumption are excluded from the model, the coefficient on health care spending increases and becomes more significant. Moreover, alcohol and tobacco consumption should usually have a more significant effect in the future. Therefore, the contemporaneous measures can capture the effect of more efficient treatment of the disease caused by previous consumption, and show the positive effect.

However, having an impact on health care status, health care spending contribution to the increase in life expectancy is not bigger than contribution of other factors. This result goes in line with the findings of Andreev et al. (2005) for the case of Russia, when the author claimed that the increase in health care spending will not lead to the improvement of health status to the same extent. We can see from Table 6 that consumption of fruits and vegetables, level of urbanization and especially unemployment have a larger effect on life expectancy. Decrease in the level of urbanization and increase in consumption of fruits and vegetables have led to the increase in life expectancy. At the same time, a huge rise in unemployment during the period of 1992-2003 decreased life expectancy for more than one year. The negative effect of unemployment can be explained by the really low unemployment at the

time of the Soviet Union and the sudden restructuring of the economy after its collapse. Unemployed people do not just have a health care insurance provided by their employer but also are in a more stressful situation due to the uncertainty during a process of looking for a job.

Table 6. Contributions of explanatory variables to changes in life expectancy at birth

	Gains in life expectancy at birth		
	Total	**Male**	**Female**
Explained by:	*Years*		
Health care spending	0,28	0,33	0,18
Unemployment	-1,45	-1,83	-0,80
Pollution	0,63	0,72	0,41
Alcohol consumption	0,05	0,06	0,05
Tobacco	0,19	0,22	0,15
Diet	0,50	0,58	0,36
Urbanization	0,42	0,53	0,25

To summarize all the results, I should draw attention to the fact that different set of factors contribute to life expectancy at birth and to infant mortality. The factors not connected to health care resources such as unemployment, pollution, diet and level of urbanization were found to be the main factors influencing health status of the population in the former FSU countries. Health care resources measured in physical terms have a significant impact just for female life expectancy at birth and infant mortality though the results are not homogenous in this case. The increase in the number of physicians was found to have a negative effect while the result for number of hospital beds is opposite. Health care resources measured in monetary terms showed more consistent results. At the same time, the results for alcohol and tobacco consumption are counterfactual.

I suppose that counterfactual an inconsistent results can be a result of the model drawbacks. First, I do not exclude the possibility of omitted variables and endogeneity problem. There is no proxy for education, though, in existing studies education was found as

one of the significant factors contributing to the health status improvement. Second, the sample size is small and the panel used is unbalanced. Moreover, taking the contemporaneous variables, for w instance, alcohol and tobacco consumption, might not show the robust results as the majority of the factors are unlikely to have an immediate impact on health status but will have it in the future.

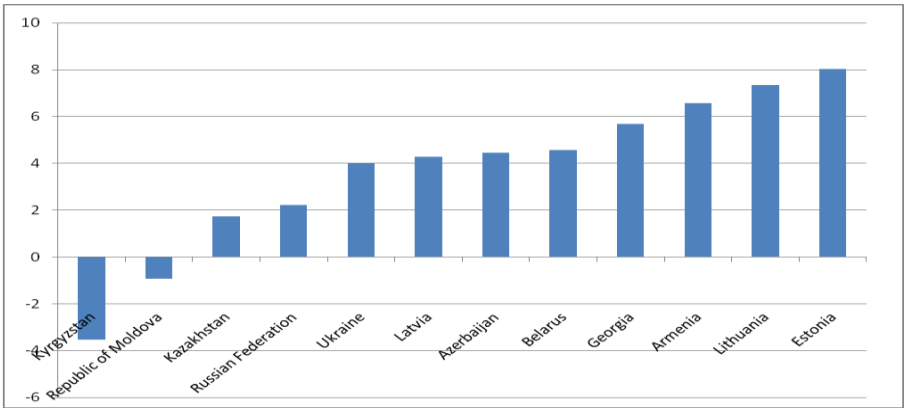
Chapter 3: Efficiency of health care inputs

In this chapter I describe Data Envelopment Analysis (DEA) approach to analyze the efficiencies of health care resources utilization among the FSU countries. Also, I determine the factors that influence the efficiencies by mean of a regression model.

3.1 Data envelopment analysis

The results of panel data regressions give us the average picture. It was found in the previous chapter that health care resources measured in physical terms do not have a significant impact on life expectancy. At the same time, the effect of health care resources on health status may vary among the countries. We can assume that country fixed effects and residuals of the panel model are the results of differences in efficiency of health care resources utilization (Joumard et al. 2008). From Figure 3 we can see the differences between the actual levels of life expectancy and the levels predicted by the model.

Figure 4. Years of life not explained by the main model with health care resources in physical terms for 2003



DEA can be used to find the efficient units; it is used to build the efficiency frontier, which is assumed to be convex, based on the values of inputs and outputs by means of linear programming. The advantage of the method is the possibility to use multiple inputs and outputs. DEA is a non-parametric deterministic method and it shows us the maximum result that can be achieved. As a non-parametric method it does not require to specify a functional form of the frontier and as a deterministic method it assumes that the distance to the frontier is

explained totally by inefficiency. DEA was previously largely used in microeconomics in order to evaluate the performance of the firms. However, nowadays it is more used for evaluating relative performance of countries' health care or education systems (Afonso and Aubun 2005, Hollingsworth et al. 1998, Joumard et al. 2008, Puig-Junoy 1998, Retzlaff-Roberts et al. 2003, Spinks and Hollingsworth 2005, Zhang et al. 2007).

DEA provides the measures of technical efficiency which also depends on the specification of DEA orientation. According to input-oriented DEA, efficient units are those that cannot reduce inputs without decreasing output. In output-oriented DEA, on the contrary, efficient units are those that cannot improve output without changing the input quantities (Afonso and Aubun 2005, Joumard et al. 2008,). In my research I focus on output-oriented approach as the goal is to see whether health status can be improved holding inputs fixed. The efficient units, those which are situated on the frontier, receive scores equal to 1. In output-oriented DEA inefficient units, that are situated inside the frontier, get the scores which are bigger than 1.

In different studies various factors were chosen as inputs. Retzlaff-Roberts et al. (2003) conducted ouput- and input-oriented DEA based on the health and social environment inputs; Joumard et al. (2008) have chosen three groups of factors such as health care resources, socio-economic environment and lifestyle. However, more often the efficiency of health care systems among different countries or country regions is built based on the direct inputs such as number of doctors, hospital beds, health care spending and health employment (Afonso and Aubun 2006, Zhang et al. 2007).

At the same time, the authors who use just direct inputs to find the efficient units do not reject the fact that socio-economic and lifestyle factors, non-discretionary factors in general, may play an important role in explaining differences among the countries (Afonso and Aubun 2006, Puig-Junoy 1998, Zhang et al. 2007). Therefore, they introduce two-stage

models. In the first stage the efficiency frontier built and scores are determined for each of the units. In the second stage the efficiency scores are regressed on non-discretionary factors using censored (Tobit) method. In my research I follow the second approach. First, I find the efficiency frontier and efficiency scores for the countries using number of hospital beds and physicians as direct inputs in health production function. Then I continue with regressing the efficiency scores on socio-economic and lifestyle factors defined in chapter 1. I would like to see what countries lie on the efficiency frontier and to compare the results of Tobit regression with the panel data approach described in chapter 2.

Various programs are used for DEA. In my study I use the program Frontier efficiency analysis in R (FEAR) which can be run under the statistical package R. FEAR was kindly provided by Chantal Nicq[1]. The description of results is provided below.

3.2 DEA efficiency scores and analysis of inefficiency

For efficiency analysis I use the data for the year of 2003 for 12 FSU countries. As the data for non-discretionary factors is missing for Tajikistan, Turkmenistan and Uzbekistan these countries were excluded from the analysis. The reason for this is the fact that efficiency frontier depends on the number of countries included. For instance, if a more efficient country is added to a sample, the efficiency frontier would move causing the efficiency scores for other countries to fall (Retzlaff-Roberts et al. 2003). I chose life expectancy at birth as a measure of output as we want to maximize the output. In case of using infant mortality the situation is less clear as lower values are better (Retzlaff-Roberts et al. 2003). The results for output-oriented DEA are provided in Table 7.

[1] Chantal Nicq is a co-author of the study "Health Status Determinants: Lifestyle, Environment, Health Care Resources and Efficiency", OECD Economics Department Working Papers, No. 627, OECD Publishing, which was chosen as the starting point of the present research.

As it can be seen from Table 7 five countries are situated on the efficiency frontier. Those countries are Armenia, Estonia, Georgia, Kyrgyzstan and Latvia. Despite having a poor health outcome, Kyrgyzstan is situated on the efficiency frontier. This might be that case that health care consumption is low in this country, therefore, it is shown as an efficient one. According to the results the most inefficient countries are Russia and Belarus where health care outcomes can be improved by 64.5% and 72.3% respectively without increasing inputs. On average, life expectancy in 12 FSU countries can be increased by 20.1%

Table 7. DEA results

	DEA scores	***Life expectancy at birth, years***
Armenia	1,000	73,08
Azerbaijan	1,111	72,01
Belarus	1,723	68,53
Estonia	1,000	71,78
Georgia	1,000	72
Kazakhstan	1,431	65,89
Kyrgyzstan	1,000	67,91
Latvia	1,000	70,95
Lithuania	1,212	72,08
Republic of Moldova	1,120	68,07
Russian Federation	1,645	64,94
Ukraine	1,170	67,83
Mean value	*1,201*	*69,589*

Having determined efficiency scores for countries, I continue with a second stage – regression of the scores on socio-economic and lifestyle factors in order to analyze the efficiency determinants. The results of Tobit regressions are presented in Table 8.

The coefficients of Tobit regression do not provide direct information by how much the efficiency scores change with respect to various factors but they show the direction of changes. The results presented in Table 8 coincide with the ones from panel data approach for such factors as alcohol consumption, diet and urbanization level. The coefficient on alcohol consumption is not statistically significant and the coefficients on diet and urbanization have negative and positive signs respectively. The increase in consumption of fruits and vegetables

lead to the decrease in efficiency score making countries move closer to the efficiency frontier. However, the results for income, pollution and unemployment differ from the panel data approach. The first two factors appeared to be insignificant and the sign for unemployment is counterintuitive.

Table 8. Censored Tobit results

Influencing factor	***Coefficient (p-value)***
Income	0.113 (0.593)
Unemployment	-0.405 (0.003)
Pollution	0.127 (0.208)
Alcohol consumption	-0.050 (0.583)
Diet	-2.399 (0.003)
Urbanization	0.913 (0.084)
Constant	24.499 (0.006)

The negative effect of unemployment on efficiency score can be explained by the fact that technical efficiency increases when demand for health care services decreases. Since unemployed people have low demand for the services, the increase in efficiency is observed. Moreover, according to Spinks and Hollingsworth (2005) one should be cautious with the results of DEA approach as the method suffers from certain drawbacks.

First, DEA depends on the number of countries and the sample I used in the study is quite small for showing robust results. Second, the results entirely depend on the values of inputs and the number of chosen inputs (Retzlaff-Roberts et al. 2003). For instance, health care spending may also be used as a direct input. But due to data limitations for this factor it was omitted. Moreover, DEA was conducted taking into consideration health inputs and outputs just for one year – 2003. In reality, efficiency changes over time and it is better to use panel data and DEA based on Malmquist index, which accounts both for changes in technical efficiency and technology.

Conclusion

The main goal of my thesis was to identify the determinants of health status of the population in the countries of the former Soviet Union. Life expectancy at birth and infant mortality were chosen as proxies for health status. A certain set of hypothesized influencing factors were selected for the model and tested using panel data approach with country and year fixed effects for the period of 1992-2003. A large number of missing data for later periods has determined the time frames for the analyzed period. I examined whether a certain set of factors have an impact.

The results of the estimations did not show homogenous results when different proxies are used for the health status. Almost all of the factors have expected signs in case of life expectancy chosen as a proxy. Socio-economic and lifestyle factors appeared to have a significant effect on health status. Health care resources measured in physical terms showed a significant impact just on infant mortality together with the other factors such as income and diet.

However, health care resources measure as health care spending showed a significant impact on increase of life expectancy while not having affected infant mortality. Moreover, alcohol and tobacco consumption provided counterfactual results. Both lifestyle factors showed a positive and significant impact on life expectancy. This can be explained by the limitations of the data and the model. Tobacco consumption was not provided for all the countries, hence, the sample was decreased. Also, I have included contemporaneous measure for alcohol and tobacco consumption, though they are more likely to have effect in the future, therefore to include lagged variables would be more reasonable (Joumard et al. 2008). Furthermore, no education proxy was included in the model due to the lack of data for it. The omission of this variable, which was found to be highly significant in the previous studies, may lead to biased results.

As the results of panel data estimation give an average picture, I proceeded with output-oriented DEA to find out whether health care resources measured in physical terms are equally used across different countries in terms of efficiency. The analysis showed that Armenia, Estonia, Georgia, Kyrgyzstan and Latvia are the countries situated on the efficiency frontier. Furthermore, it was found that life expectancy can be increased on average by 20.1% in the FSU countries without increasing health care inputs. This result supports the idea of Rudycheva (2009) who stated that it is efficiency of health care resources use influences the health status of the population and not the quantity of those resources.

Since DEA suffers from the dependence on the set of chosen inputs, it was reasonable to determine whether indirect inputs such as socio-economic and lifestyle factors affects the assigned efficiency scores. The obtained results coincide with the panel data estimation ones for some factors, though they are not significant or even contradicting for the others. This also can be explained by limitations of DEA. First, the results are data-driven and depend on the number of units, i.e. countries. Second, the data was taken just for one period while it is more reasonable to use panel data as efficiency is changing over time. Finally, the choice of inputs is not uniquely determined and I do not reject the fact that more factors had to be included.

To summarize all the results, I should state that despite all the limitations of the data and the methods used it is still possible to determine the main determinants of health status of the population in the FSU countries. It is unlikely that the increase in health care resources without improvement of socio-economic sphere and promotion of healthy lifestyle will show a significant impact on health status. Increase of GDP and decrease of unemployment will not affect just the health care sphere. Moreover, one should not forget that a development level of a country and the health of its population are interrelated, therefore, they should be considered in a system. Finally, the considered countries have a potential for improvement of the population health status that can even be achieved without rise of health care inputs.

Appendices

Appendix A

Description of variables and sources

Variable	***Description***	***Source***
Life expectancy at birth	Life expectancy at birth in years	World Health Organization, World Bank
Infant mortality	Infant deaths per 1000 live births	World Health Organization, World Bank
Hospital beds	Number of hospital beds per 1000 of population	World Health Organization, World bank
Physicians	Number of physicians per 1000 of population	World Health Organization, World Bank
Health care spending	Total health care expenditure, PPP$ per capita	World Health Organization
Income	Real gross domestic product, PPP$ per capita	World Health Organization
Unemployment	Unemployment rate, %	World Health Organization
Pollution	CO2 emissions (metric tons per capita)	World Bank
Alcohol consumption	Pure alcohol consumption, litres per capita	World Health Organization
Tobacco	Tobacco consumption, number of cigarettes per capita	United States Department of Agriculture
Diet	Average amount of fruits and vegetables available per person, per year (in kg)	World Health Organization
Urbanization	% of urban population	World Health Organization

Appendix B

Health status determinants, with health care resources in physical terms

Independent Variable	Life expectancy at birth			Infant mortality
	Total	Male	Female	
Hospital beds	-0.027 [0.018]	-0.039 [0.026]	-0.011 [0.011]	-0.227 [0.197]
Physicians	-0.015 [0.013]	-0.013 [0.025]	-0.026** [0.011]	0.418 [0.315]
Income	0.016** [0.007]	0.018* [0.010]	0.012*** [0.005]	-0.231*** [0.052]
Unemployment	-0.014*** [0.004]	-0.018*** [0.005]	-0.008*** [0.002]	0.032 [0.031]
Pollution	-0.022 [0.016]	-0.031 [0.025]	-0.009 [0.006]	0.102 [0.145]
Alcohol consumption	0.005 [0.008]	0.004 [0.010]	0.005 [0.005]	-0.045 [0.049]
Tobacco	0.0008 [0.007]	0.001 [0.009]	0.001 [0.005]	-0.050 [0.062]
Diet	0.014* [0.008]	0.017 [0.011]	0.010** [0.005]	-0.204** [0.089]
Urbanization	-0.069 [0.049]	-0.075 [0.073]	-0.063** [0.031]	0.380 [0.272]
Constant	4.271*** [0.254]	4.448*** [0.386]	4.414*** [0.196]	6.615*** [1.770]
Country fixed effects	Yes	Yes	Yes	Yes
Observations	126	126	126	126
Countries	13	13	13	13
R-Squared	0.899	0.884	0.950	0.963

*Note: 1. ***, **, * - significance of coefficients at 1, 5, 10 % significance level respectively*
2. White standard errors are reported

Appendix C

Health status determinants, with health care resources in monetary terms

Independent Variable	Life expectancy at birth			Infant mortality
	Total	Male	Female	
Health care spending	0.009*** [0.003]	0.011** [0.004]	0.005*** [0.002]	-0.047 [0.037]
Unemployment	-0.011*** [0.004]	-0.015*** [0.006]	-0.006** [0.002]	0.025 [0.028]
Pollution	-0.019 [0.012]	-0.025* [0.014]	-0.011 [0.009]	-0.095 [0.141]
Alcohol consumption	0.011** [0.005]	0.013* [0.007]	0.009*** [0.003]	-0.067* [0.039]
Diet	0.028** [0.011]	0.035** [0.014]	0.019** [0.007]	-0.193* [0.108]
Urbanization	-0.126** [0.061]	-0.173** [0.086]	-0.072** [0.029]	-0.016 [0.318]
Constant	4.584*** [0.226]	4.662*** [0.326]	4.481*** [0.107]	4.192*** [1.254]
Country fixed effects	Yes	Yes	Yes	Yes
Observations	102	102	102	102
Countries	13	13	13	13
R-Squared	0.939	0.936	0.971	0.967

*Note: 1. ***, **, * - significance of coefficients at 1, 5, 10 % significance level respectively*
2. White standard errors are reported

Reference list

Andreev, E., A. Vyshnevskii, and A. Treivish, 2005, Perspectivy razvitiya Rossii: rol' demographicheskogo factora. – M.: Institut economiki perekhodnogo perioda, 2005. -141 str. [Andreev, E., A. Vyshnevskii, and A. Treivish, 2005, "Perspectives of development in Russia: role of demographic factor", Institute for the Economy in Transition, p. 141, Moscow].

Afonso, A., and M.St. Aubun, 2005, "Cross-country Efficiency of Secondary Education Provision: a Semi-parametric Analysis with Nondiscretionary Inputs", European Cetral Bank, Working Paper Series, No 494, June 2005, http://www.ecb.int/pub/pdf/scpwps/ecbwp494.pdfWORKING

Afonso, A., and M. St. Aubyn, 2006, "Relative Efficiency of Health Provision: a DEA Approach with Non-discretionary Inputs", ISEG-UTL Economics Working Paper, No. 33/2006/DE/UECE, http://www.iseg.utl.pt/departamentos/economia/wp/wp332006deuece.pdf.

Bleich, S.N., E. Özaltin, and C. JL Murray, 2009, "How does satisfaction with the health-care system relate to patient experience?" Bulletin of the World Health Organization, Vol. 87, No 4, April 2009, pp. 245-324, http://www.who.int/bulletin/volumes/87/4/07-050401/en/print.html.

Bonilla-Chacin, M., E. Murrugarra, and M. Temourov, 2003, "Health care during transition and health systems reform: evidence from the poorest CIS countries", Paper presented at the Lucerne Conference of the CIS-7 Initiative, 20–22 January, 2003, http://www.untj.org/files/reports/Health%20care%20system.pdf.

Campostrini, S., and P. Bellini, 2000, "Sick-Leave and Other Job-Related Health. Issues from Labour Force Surveys Data", International Statistical Review / Revue Internationale de Statistique, Vol. 68, No 2. August 2000, pp. 189-198.

Crémieux, P.-Y., P. Ouellette, and C. Pilon, 1999, "Health Care Spending as Determinants of Health Outcomes", Health Economics, Vol. 8, pp. 627-639.

Cutler, D.M., and E. Brainerd, 2005, "Autopsy on an Empire: Understanding Mortality in Russia and the Former Soviet Union", IZA Discussion Paper No. 1472, January 2005, ftp://repec.iza.org/RePEc/Discussionpaper/dp1472.pdf.

Danilovich, N., (2010), "Growing inequalities and reproductive health in transitional countries: Kazakhstan and Belarus", Journal of Public Health Policy, Vol. 31, 2010, pp.30-50.

Filmer, D., and L. Pritchett, 1997, "Child Mortality and Public Spending on Health: How Much Does Money Matter?", The World Bank, http://www.worldbank.org/html/dec/Publications/Workpapers/WPS1800series/wps1864/wps1864.pdf.

Hollingsworth, B., P.J. Dawson, and N. Maniadakis, 1999, "Efficiency measurement of health care: a review of non-parametric methods and applications", Health Care Management Science, Vol. 2, No 3, 1999, pp. 161–172.

Joumard, I., C. André, C. Nicq, and O. Chatal et al. 2008, "Health Status Determinants: Lifestyle, Environment, Health Care Resources and Efficiency", OECD Economics Department Working Papers, No. 627, OECD Publishing. doi: 10.1787/240858500130, http://www.olis.oecd.org/olis/2008doc.nsf/LinkTo/NT0000363E/$FILE/JT03249407.PDF.

Nixon, J., and P. Ullmann, 2006, "The Relationship between Health Care Expenditure and Health Outcomes – Evidence and Caveats for a Causal Link", European Journal of Health Economics, Vol. 7, No. 1, pp. 7-19.

Nolte, E., M.McKee, and A. Gilmore, 2005, "Mortality and Morbidity in the Transition Countries of Europe" In "The New Demographic Regime Population Challenges and Policy Responses", ed. Macura, M., A. L. MacDonald, and W. Haug, 153-72. Geneva: United Nations Publication.

Or, Z., 2000, "Exploring the Effects of Health Care on Mortality Across OECD Countries", OECD Labour Market and Social Policy, Occasional Paper No. 46.

Or, Z., J. Wang, and D. Jamison, 2005, "International Differences in the Impact of Doctors on Health: A Multilevel Analysis of OECD Countries", Journal of Health Economics, Vol. 24, pp. 531-560.

Plavinski, S. L., Plavinskaya, S. I., and A. N. Klimov, "Social factors and increase in mortality in
Russia in the 1990s: prospective cohort study," British Medical Journal 326, June 2003, pp. 1240 - 1242.

Puig-Junoy, J., 1998, "Measuring Health Production Performance in the OECD", Applied Economic Letters, Vol. 5, No. 4, pp. 255-259, http://www.informaworld.com/smpp/content?content=10.1080/135048598354933.

Retzlaff-Roberts, D., C. Chang, and R. Rubin, 2004, "Technical Efficiency in the Use of Health Care Resources: A Comparison of OECD Countries", Health Policy, Vol. 69, pp. 55-72.

Rudycheva, N., 2009, "The Situation in Russian Health Care System Leaves Much to Be Desired", December 2009, http://digestweb.ru/133-sostoyanie-rossijskogo-zdravooxraneniya-plachevno.html. (accessed June 4, 2010).

Self, S., and R. Grabowski, 2003, "How Effective is Public Health Expenditure in Improving Overall Health? A Cross-country Analysis", Applied Economics, Vol. 35, pp. 835-845.

Shkolnikov, V., D.A. Leon, S. Adamets, E. Andreev, and A. Deev, 1998, "Educational level and adult mortality in Russia: An analysis of routine data 1979 to 1994", Social Science & Medicine, Vol. 47, Issue 3, 1 August 1998, pp. 357-369.

Shkolnikov, V., E. Andreev, D. Jasilionis, M. Leinsalu, O. Antonova, M. McKee, 2006, "The changing relation between education and life expectancy in central and eastern Europe in the 1990s", J Epidemiol Community Health 2006;Vol. 60:875-88, doi:10.1136/jech.2005.044719, http://jech.bmj.com/content/60/10/825.full.pdf.

Shkolnikov, V., V. Chervyakov, 2000, S. Zakharov, and D. Bogoyavlenskii, 2000. Politika po kontrolyu krizisnoi smertnosti v Rossii v perekhodnyi period. Pod red. V.M. Shkolnikova I V.V. Chervyakova. M.: PROON, 2000. – 192 str. [Shkolnikov, V., V. Chervyakov, 2000, S. Zakharov, and D. Bogoyavlenskii, 2000, "Policy for Controlling Mortality in Russia in the Transition Period", ed. Shkolnikov, V. and V. Chervyakov, p. 192, Moscow: PROON].

Soares, R.R., 2007, "Health and the Evolution of Welfare across Brazilian Municipalities", Journal of Development Economics, Vol. 84, pp. 590-608.

Spinks, J., and B. Hollingsworth, 2007, "Cross-country Comparisons of Technical Efficiency of Health Production: A Demonstration of Pitfalls", Applied Economics, November.

United States Department of Agriculture, Foreign Agricultural Service, Downloadable Data Sets, http://www.fas.usda.gov/psdonline/psdDownload.aspx. (accessed May 5, 2010).

Verhoeven, M., V. Gunnarsson and S. Carcillo (2007), "Education and Health in G7 Countries: Achieving Better Outcomes with Less Spending", IMF Working Paper, No. 07/263, http://www.imf.org/external/pubs/cat/longres.cfm?sk=21444.0.

World Bank. Countries and regions. Report. http://go.worldbank.org/LLFC0ZQOH0. (accessed May 06, 2010).

World Bank, World Bank Database, http://data.worldbank.org/. (accessed May 1. 2010).

World Health Organization, European Health for All Database (HFA-DB), http://www.euro.who.int/en/what-we-do/data-and-evidence/databases/european-health-for-all-database-hfa-db. (accessed April 26, 2010).

Zhang, N., A. Hu, and J. Zheng, 2007, "Using Data Envelopment Analysis approach to estimate the health production efficiencies in China", Economic Research Journal), Vol. 7, 2006, pp. 92-105.

Zubarevich, N., 2008, "Who is winning the competition for human resources?" Russian Expert Review, No 1 (24), http://www.rusrev.org/eng/content/review/print.asp?ids=164&ida=2211.