PERFORMANCE OF HEALTH CARE SYSTEM: DOES STRUCTURE OF GOVERNMENT SPENDING MATTER?

by

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Abstract

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This paper considers impact of government spending structure on the performance of health care system. Data used in this research comes from publicly available sources and covers sample of 20 OECD countries during the period of 1991-2007. Pooled OLS methodology is applied to the health production function with avoidable mortality as a measure of health care system performance. Government expenditures on education, environment protection, health, along with private health expenditures, GDP, schooling, alcohol consumption, emissions and unemployment are considered to be major "inputs' of the health production process and are employed as regressors in the model. Findings indicate significant impact of government expenditures on environmental protection in the improvement of health care system performance. Expenditures on education reveal their effect through the number of years of schooling while public expenditures on health are found to be insignificant. Meanwhile private health expenditures substantially decrease avoidable mortality.

To Oleksandr

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Chapter 1

INTRODUCTION

Mutual dependence of economic growth and human capital has been widely investigated both theoretically (Becker, 1990; Romer, 1989) and empirically (Barro, 2001; Subramanian, 2002). Increase in the accumulation of human capital, traditionally measured by average number of years of schooling, substantially affects economic growth, e.g. on average output may be increased by roughly 6% with one additional year of education at the country level (Bassanini, 2001). At the same time health is considered to be one of the most relevant components of human capital (Grossman, 1972) and therefore it has an indisputable effect on the economic growth. David Bloom finds that "one-year improvement in a population's life expectancy contributes to an increase of 4% in output" (Bloom, 2004, p.11). Improvement in health status of the nation, therefore, is one of the feasible methods of enhancement both human capital and economic growth of the nation.

Improvements of the health status may be attained by means of either health behavior changes or medical services that are supplied by health care institutions. The latter can be perceived as "producers" of health (Phelps, 2003). Like traditional firms which use inputs to produce outputs with a certain technology, health care systems use inputs (Or, 2001) such as total expenditures on health, stock of physicians, nurses and beds in the hospitals, immunization, etc. to produce outputs measured by life expectancy of people, mortality rates, infant mortality, etc. Hence, any health care system can be considered as a technology that ensures production of output (medical services and therefore health) from the set of inputs.

Results of patients' medical treatment provided by national health care systems are reflecting in the health statuses of nations. Evidence of existent health inequality has been attracting more attention recently. Facts show that gaps in the health outcomes do not only persist, but increase over time. For example, the difference[1] in the total mortality rates in 1960 between New Zealand and Canada was 305 deaths per 100,000 of population, while in 2000 it has increased to 1,031. This shows a drastic increase in the inequality of the health outcomes across mentioned countries. Moreover, mortality rates are not the same within countries (Subramanian, 2001). There is an evidence of upward trend in mortality rates over time. For instance, in USA total mortality has increased from 4,149 deaths per 100,000 of population in 1960 to 4,252 in 2000[2].

Disproportion in the distribution of health outcomes both within and across countries can be partially explained by the health care systems' performance and by state policies (Pasqual, 2004). In addition, health inequality can arise due to the differences in people's living conditions, access to the state social protection, individual health related behavior such as smoking, alcohol consumption, etc. (Xavier, 2009). Health care system can serve as a tool to mitigate health inequalities among population groups or vice versa, can lead to further divergence in health outcomes.

Concern about equally good performance of the health care systems across countries brings up the question of government's intervening into the health care system's performance with regulation purposes. Although there is no consensus about the role of public spending in the performance of the health care system, evidence shows that increase of public spending on health care, in particular, ensures improvement of health outcomes (Cutler, 2004). For example, according

[1] Difference between total mortality rates in two countries in the same year

[2] Data is taken from the World Health Organization database

to findings of Cutler, medical spending on the cardiovascular disease in the amount of $30, 000 yields benefits of $120, 000, both measured per capita. On the other hand, there is a number of studies showing that health expenditures are wasteful and do not result in health improvements (Fisher, 2003). A particular example of inadequate public spending is USA. In 2004 the United States ranked 46th and 42nd places (Schroeder, 2007) in average life expectancy at birth and infant mortality respectively, while at the same time having the largest public spending on health in the world. Moreover, substantial amount of public health expenditures in the USA is not reflected in public access to the health care. About 16.1% of American citizens are unable to receive at least one medical service they need (Berk, 1995). Therefore, a need arises in the reform of national health care system in the USA, as well as in the other countries with similar situation.

Additionally, the role of public spending is particularly important in the period of crisis that a lot of economies are facing now. A lot of them are trying to mitigate the crisis effect on public health spending by changing their fiscal policy and looking for investments into this sphere (Schneider, 2009).

At the same time, not only health expenditures and health care reform require careful analysis. There is evidence of strong link between public health and clean environment (Corvalan, 1999; Vries, 2003). Air and water pollution, as well as noise are negatively correlated with improvement in health (Freeman, 1979) and have distributional effect (Lazarus, 1993). In particular, an increase in carbon dioxide emissions (as a ratio to GDP) into the atmosphere reduces under-five survival rate by 22% (Drabo, 2010). Besides clean environment, education is also one of the major determinants of health (Adler, 1994). Therefore, performance of the national health care system should be analyzed with consideration of government expenditures not only on health, but on environment protection, as well as on education simultaneously.

Performance of health care system measurement with the means of total mortality may be obscure since the latter includes both avoidable and non avoidable forms of mortality, and health care system has no impact on the non avoidable one. For that reason the goal of this paper is to investigate the role of the structure of government expenditures in the performance of health care system measured by avoidable mortality. The data used in the research comes from the publicly available databases. The sample covers 20 OECD countries during the period of 1991 – 2007. The main question to be answered in this research is: how does structure of government expenditures affect the performance of health care system?

The remainder of the paper is structured in the following way: Chapter 2 gives a comprehensive review of the literature about performance of health care system and studies of different determinants of the health status; Chapter 3 outlines theoretical and empirical framework of the research; Chapter 4 provides data description and finally estimation results are presented in the Chapter 5. Conclusions and inferences are given in the Chapter 6.

Chapter 2

LITERATURE REVIEW

In the existing literature, a particular interest is devoted to both theory and empirics of hospital production functions. The first attempts to explain productivity of non-profit organizations go as far back as the second half of the twentieth century (Newhouse, 1970 and Long, 1964). The production function of such organizations is derived from the maximization problem of quantity and quality of services provided to the public subject to a budget constraint. Budget constraint of a non-profit hospital is measured by its budget deficit. A solution to this problem yields the optimal amount of services with their respective quality that the hospital should provide to patients. These optimal values were used as first productivity indices.

An improved theoretical model of the hospital production function appeared later (Hellinger, 1973). It has explicitly distinguished inputs and outputs of health care production process unlike previous works that use budget constraint as an implicit input measure. The basic assumption of the new model is that every service produced by the hospital requires specific inputs that are not needed for production of any other services in the hospital. As a result, the production function of hospital is broken down into a set of implicit production functions of all services that the hospital can provide.

First approaches to the description of hospital production function are concentrated at the micro level and possess similar characteristics. Hence, a natural extension in the research of this field results in the aggregation of micro level hospital production functions in order to define the production function of a health care system at the macro level (Baily, 1977). The set of inputs is

broadened and defined more accurately. They are divided into three groups: labor inputs, capital inputs, and supplies. As an output measure the model suggests to use mortality index and life expectancy depending on the particular disease (with respect to which productivity of the health care system is questioned). However, inferences about performance of health care systems from the macro level may suffer from bias due to omission of the country's specific characteristics (lifestyle, diet, health practices) that could have affected performance of health care system. Meanwhile, a general pattern is obvious. Increase in the quantities of inputs in the health care system lead to the movement along the production curve, while improvements in the technologies shift the production curve further (Lichtenberg, 2002). Inclusion of technology input into the production function largely improves the explanation of health care system's productivity. Macroeconomic health production model analyzes change in the health status of population as a consequence of using medical services controlling for life style, socioeconomic status etc. (Auster, 1972).

Existing empirical literature focuses on various measures of "output" and "determinants" of health care system. Some researchers measure health care systems' performance by expected years of life that a person has either at birth or at a particular age (usually at 65 th year of life). Other studies use mortality (either crude or infant) for that purpose.

A number of papers investigate a set of inputs which affect performance of a health care system and focus on the following inputs: income, health expenditures (total expenditures, as well as separation of them into public and private expenditures), type of health care system, material resources, environmental pollution, etc.

There are different approaches that try to explain the nature of health care system and measure its performance. Two measures that are most commonly used to gauge performance of health care system are life expectancy and mortality. An increase of life expectancy by almost 10% during 1960-1997 in the United States entailed an intensive research of this phenomenon (Lichtenberg, 2002). However, life expectancy is defined sometimes as a piecemeal index of health status because it does not reflect the quality of life although is good enough to reflect the health status of an individual or a nation (Joumard, 2010). Crude mortality (Or, 2001) is another indicator that encompasses general patterns of medical improvements, the length and quality of life. It is also a comparable indicator across countries and within time. At the same time infant mortality is also widely used to assess the outcomes of health care systems and measure of the country's development (Pritchett and Summers, 1993). There are arguments in favor of the infant mortality measure as this is the most related indicator to the performance of health care system unlike crude mortality that captures deaths due to aging of people that are impossible to eliminate even with well-performed health care system.

Since mid 1970's researchers have been discussing a new indicator of health care system performance which can reflect the contemporary level of medical progress. The concept of avoidable mortality was first introduced by Rutstein et al. in 1976. According to their work there is a certain list of diseases that was compiled through consultations with doctors and medical scientists. Deaths from those diseases can be avoided under the condition of the well-performed health care system. Mortality data on this list of diseases can be treated as a measure of health care system performance. This approach provides an opportunity to measure health care system performance in a more precise way.

The avoidable mortality reflects performance of health care system via the rate of deaths that could have been avoided if health care system worked efficiently[3]. First empirical analysis using avoidable mortality as a measure of quality of health care system was done in 1978 by Adler on the US data. This study is extended on the national and international levels (Charlton a, b, 1986). Nolte and McKee (2004) present the newly updated list of diseases that are treated as avoidable. They take into account the latest advances in medical science and technology and also relaxed some of the age restrictions to compute an updated avoidable mortality indicator.

Empirical research shows that avoidable mortality as a measure of health care system performance produce less obscure results compared to total mortality. For instance, life expectancy as a measure of health care system's performance of some European countries is subject to change after it is computed on the basis of avoidable mortality implying that total mortality is not a perfect tool for measuring performance of health care system since the latter has no impact on the non-avoidable component of the total mortality (Nolte and McKee, 2003). Similar results are found in Canada and the United States (Douglas G. Manuel and Yang Mao, 2002). Therefore, the evidence shows that there is no perfect correlation between traditional (life expectancy, mortality) and novel (avoidable) measures of output in the health care system's production. Moreover, the estimated coefficient of correlation in the sample that is used in this paper is 0.13.

Observed facts show that the major determinants of avoidable mortality are income of population and alcohol consumption that affect it in opposite directions (Arah, 2005). However, other relevant factors of avoidable mortality such as life style and environment are not robust to different specifications of the

[3] According to World Health Organization, efficient health care system is one that provides fairness of financing, responsiveness and high levels of health attainment.

model. Education has a disproportional impact on avoidable mortality. For instance, educational inequality in the diseases of infection origin is almost three times larger in Baltic region compared to other European countries (Stirbu, 2009). At the same time, evidence shows that avoidable mortality is higher in the groups with lower socioeconomic status (Korda, 2007). It should be noted that the same holds for total mortality as well (Mackenbach, 2008).

The most frequently used factors that affect performance of health care system are income, health expenditures (both public and private), type of the health care system, and life style of people (Cutler, 2006).

Further analysis shows that the effect of income as well as health expenditures fades in the developing countries where the access to education alongside with the access to improved sanitation and water resources are more relevant in explaining observed health outcomes (McCarthy, 2001).

Income is considered to be one of the most important determinants of the people's access to health care and therefore affects their health status. There is no doubt that an increase in income opens greater possibilities for people to purchase better medical services and therefore improve their stock of health. In particular, an increase of income in an average developing country by one percent leads to the reduction of 33,000 infant deaths annually (Pritchett and Summers, 1993). At the same time, the relationship between income and health outcomes (e.g. life expectancy) is nonlinear which is clearly depicted on the Preston curve that plots life expectancy versus income (Preston, 1972).

Income has a direct impact on health expenditures (Fironi, 2006) that is another major determinant of health care system's performance. Health expenditures are positively related to the health status and therefore are of interest for policy

makers. Not only the quantity of health expenditures matter for the performance of health care system, but the source of funding is also crucial (Bhattacharya and Qiao, 2005). In general, public and private health care programs complement each other and produce positive synergy effect for the health status of people and therefore health care systems which use combination of different kinds of health programs perform better. Furthermore, elasticity of demand for health care services has substantial impact on the relative efficiency of the public and private health care programs (Parry, 2001).

Apart from income and health expenditures, there are other important factors of performance of the health care system. Education is found to have positive relation to health status (Conti, 2010). It is found, that additional year of schooling in the Unite States may increase life expectancy by 0.6 year (Cutler, 2006). Additionally, considering investments into education, it should be noted that health returns to education are positive for the first eight years of schooling, after which they diminish and finally disappear (Grignon, 2006).

Environmental pollution (Pautrel, 2007) and the so-called "industrial epidemics" (smoking, alcohol, noise, etc.) increase mortality of people and decrease life expectancy at the same time (Intignano and Ulmann, 1999; Freeman, 1979). Particularly, an increase in the carbon dioxide emissions (as a ratio to GDP) into the atmosphere may reduce under-five survival rate by 22% (Drabo, 2010).

Reviewing the above mentioned literature, it can be concluded that there is a number of studies that focus on performance of health care systems at both micro and macro level and that take into account a number of various determinants (Evans, 2001; Mathers, 2001). Government expenditures on health, education as well as environment protection are largely exploited in separate researches while measuring their effect on the performance of the health care

system. However, their simultaneous effect on the performance of the health care system was not captured so far. Therefore, this research will make a contribution to the existent body of literature regarding impact of government's spending structure on the performance of the health care system.

Chapter 3

METHODOLOGY

Theoretical framework:

Considering theoretical models of health production in the literature, a particular attention should be devoted to the Auster's model of health care production as he presents a basic model of health care system performance in the country (Auster, 1972). It defines medical services as an intermediate good in the process of the health production and measures output of the health production as a result of using health care services. Therefore Auster's health production model explains change in the health status of the population as a consequence of using medical services and subject to control characteristics. In general, it can be represented in the following formal form:

$$H = M^{\sigma_0} \cdot \prod_{i=1}^{9} X_i^{\sigma_i} \cdot e^{\varepsilon_1} \quad (1)$$

where M is per capita expenditures on medical services; σ_0 is elasticity of health with respect to medical services; ε_1 - random normally distributed error term. X_i is a set of control variables that are used in the health production process (race, income, education, location, job type, alcohol and cigarette consumption per capita, gender, and presence of medical schools dummy) and σ_i is elasticity of health with respect to corresponding factor (Auster, 1972).

Assumption that is applied in the model is that genetic factors do not have an impact on the health status, or that their impact remains relatively constant across various countries.

Auster's model is used as a background model in this research. It predicts that increase in the amount of per capita expenditures on medicine has positive effect on the improvement of health status in the population.

In the meantime, education also has positive impact on population's health (Conti, 2010). However, education and health are not the only objectives of government spending. Environment protection is connected to the health status as well (Drabo, 2010). That is why it would be natural to extend analysis with relevant streams of government expenditures in order to capture effect of structure of government spending on health status of the nation.

Considering impact of the structure of government spending on performance of health care system, keeping other relevant factors constant, one can anticipate positive effect of those spheres that are directly related to health (environmental protection, education).

Empirical framework:

Health production regression is taking the following form:

$$M_t = \alpha + \beta \cdot G_{t-1} + \gamma \cdot C_{t-1} + \varepsilon_t , \qquad (2)$$

where M is avoidable mortality indicator - AM (or non-avoidable mortality indicator[4] - NAM that is used with comparative purpose), G is a vector of a set of streams of government expenditures, C is a vector of control variables (to be specified shortly), and ε is a disturbance term. A time subscript of the explanatory variables implies using lagged values of the corresponding variables one period

[4] Non avoidable mortality indicator is calculated as a difference between total mortality and avoidable mortality

back. Regressors are lagged as expenditures on health, education, and environment protection, as well as a set of controls (private expenditures, GDP, schooling, alcohol consumption and carbon dioxide emissions) reveals its impact on the avoidable mortality not simultaneously but with time interval.

Avoidable mortality indicator (AM) is constructed from the total mortality rates. Deaths from diseases (see Table 1) if they are in the corresponding age interval are considered to be avoidable and therefore are kept, while rest are removed from the total mortality rate of deaths. The most recent version of list of diseases, deaths from which are considered to be avoidable until particular age is used for construction of this indicator (Nolte, 2004). In the case of the well-performed health care system in the country, values of avoidable mortality should be minimized.

Vector of government spending (G) includes a set of spheres that comprise health related shares in the structure of the government expenditures. This vector includes government expenditures on health care, education, as well as government expenditures on environment protection. Increase in the amount of public health expenditures should lead to an improvement in health status (Bhattacharya and Qiao, 2005) and therefore decrease avoidable mortality indicator as well as non-avoidable one. At the same time, education and health are also positively correlated (Grignon, 2006). Increase in the amount of public education expenditures most likely will lead to the improvement of the health status.

Vector of **controls** (C) that are used in the analysis includes private health expenditures, gross domestic product in per capita US dollars; average number of years of schooling for the population aged from 15 years and older;

unemployment rate; carbon dioxide emissions into the atmosphere; improved sanitation facilities; and alcohol consumption.

Empirical estimation is based on the Pooled Ordinary Least Squares methodology that is widely used in health economics (Or, 2000). In order to obtain consistent, pooled ordinary least square procedure requires several assumptions to hold. First assumption requires explanatory variables to be uncorrelated with the error term in the same time period. Second, no perfect linear dependency among explanatory variables is also required. Finally, in order to be eligible to apply usual OLS statistics from the pooled ordinary least squares regression across countries and time, homoscedasticity and no serial correlation assumptions should be considered as well (Wooldridge, 2002, p. 171).

Pooled Ordinary Least Squares estimates will be compared to Fixed Effects estimates. The latter is applied in the case if the omitted variable is constant over time and therefore fixed effects estimator of the time demeaned data enables eliminating this kind of omitted variable bias. However, the application of fixed effects requires additional assumptions. In particular, fixed effects estimator is consistent in the case of strict exogeneity of the explanatory variables, as well as explanatory variables should not correlate with omitted fixed effects to ensure efficiency of the estimator (Woolridge, 2002, pp. 265-270). However, fixed effects estimation technique eliminates possibility to measure effect of the fixed variables and moreover, if explanatory variables do not vary over time, this precludes obtaining meaningful results.

Fixed effects estimator is referred as within-group estimator as it is based on the within group variation. Similarly, Pooled OLS is considered as between group estimator. Therefore if correlation is present then fixed effects estimator would

be consistent. While if this correlation is absent, between estimator would produce consistent results (Davidson, 1993).

Chapter 4

DATA DESCRIPTION

Data used in this research comes from the following sources: the Organization for Economic Co-operation and Development (OECD) health database, World Health Organization (WHO) mortality database, and World Development Indicators (WDI). All three datasets are publicly available. OECD health dataset particularly contains information on major aspects of the countries' health care systems. It provides information on total expenditures on health, government expenditures on health, and alcohol consumption in OECD countries (31 members and 3 accession countries: Estonia, Slovenia, and Israel). Moreover, OECD government expenditures dataset includes information on government spending according to major government functions. Specifically, it provides data of government expenditure on education as well as environment protection.

Information on average years of total schooling of the population older than 15 years old, as well as information regarding carbon dioxide emissions into the atmosphere, unemployment rate comes from the WDI.

The data used for the construction of the avoidable mortality indicator comes from the WHO mortality database. This database comprises deaths registered in national systems, with underlying cause of death that is coded according to the 10th International Classification of Diseases. The database contains the number of deaths by country, year, sex, age group and cause of deaths.

Avoidable mortality indicator is not explicitly present in the mortality dataset of the World Health Organization. This indicator is constructed relying on the list of avoidable diseases and a corresponding age at which mortality from those

diseases are considered to be avoidable. The most recent list suggested in the literature and the one that is used in this research is Nolte and McKee (2004) list. This list of diseases and age groups mortality from which is considered to be avoidable is presented in Table 1.

Sample covers 20 OECD countries during the period of 1991 – 2007. Detailed list of countries and years available are presented in the Table 2. Sample contains 239 observations.

The summary statistics of the avoidable versus non-avoidable mortality by gender is presented in the Table 3. Avoidable mortality indicator is smaller compared to non-avoidable mortality indicator, but its magnitude is consistent with the literature (Nolte, 2004). For example, according to Table 14 in Nolte (2004) avoidable mortality in Italy in 1990 for males and females was 89.12 and 84.01 respectively while in the sample those values are 81.07 and 76.61 respectively. It should be noted that Portugal is excluded from the sample since it has special ICD10 list and diseases are grouped in such a way that it impedes distinguishing deaths from particular diseases.

The structure of government spending is presented in the Table 4. It provides a description of government spending in OECD countries from 1991 till 2007. The share of government health expenditures in GDP varies from 0.78% in Slovakia to 71.85% in Spain. The share of government education expenditures as well as the share of expenditures on environment protection in GDP is less volatile compared to health expenditures.

In order to give more intuition about interrelation between government spending on e.g. health care and avoidable mortality rates, let's consider ranking of OECD

countries according to government health expenditures (Figure 1) and ranking of OECD countries according to the avoidable mortality (Figure 2).

As expected, Estonia, having the smallest fraction in GDP devoted to health, ranks last in the list of countries according to the avoidable mortality. And vice verse, countries that tend to spend more on the health care system (Iceland, Canada, Japan) tend to have smaller rates of avoidable mortality implying better performance of their health care systems.

Similarly, this conclusion would be applicable to the expenditures on education as well as environment protection (Figures 3-4 respectively). Countries with lower avoidable mortality appear in the group of countries with larger shares of education expenditures and expenditures on environment protection. It should be noted, that the list of countries in the figures does not include those that have missing observations at least in one of the variables in 2003 (avoidable mortality, health, education and environment protection expenditures) for comparison purposes.

Control variables that are employed in the analysis are private health expenditures, gross domestic product, and alcohol consumption, carbon dioxide emissions into the atmosphere, unemployment rate, and schooling measured by the average number of years of total schooling for both genders. Table 5 shows that per capita GDP in OECD countries is varying from 1094.25 international millions dollars in Spain to 170,606 in Luxembourg. At the same time, unemployment rate in the sample is also in the wide range and changes from 1.8% in Luxembourg to 24% in Spain.

Chapter 5

EMPIRICAL RESULTS

While analyzing the structure of government expenditures' impact on the performance of health care system, a basic specification is being estimated using Pooled Ordinary Least Squares method with robust standard errors to control for heteroscedasticity. The former includes only variables of interest among its regressors, e.g. government expenditures on health, education, and environment protection. Avoidable mortality is the major dependent variable, and non-avoidable mortality is used as a second regressant for comparison purposes. Estimation results are presented in the Table 6.

Estimates of the model basic specification indicate significance of expenditures on education, as well as expenditures on environmental protection in explaining variation of avoidable mortality. Coefficients near regressors are of the expected signs according to theory predictions. At the same time, government expenditures on health care have significant effect on the performance of health care system as well. Avoidable mortality reduces with increase in government expenditures on health, education as well as environment protection. This is common for both males and females, though the magnitude of the coefficients for females is relatively smaller. In general, government expenditures on health care, education, and environment protection explain around 22.0% and 21.4% of the variation in avoidable mortality for males and females respectively. This numbers are even smaller for non-avoidable mortality (around 6%).

An extended model specification includes a set of control variables in addition to the variables of interest. Unemployment, alcohol consumption, private health expenditures, carbon dioxide emissions, average years of total schooling, and

quadratic equivalent of the latter are added to the specification as control variables. Similarly, avoidable and non-avoidable mortality indicators are used as dependent variables for both males and females. This model specification is being estimated with Pooled Ordinary Least Squares as well as Fixed Effects methods.

Estimation results obtained using Pooled OLS and Fixed Effects are given in the Table 7 and Table 8 respectively. Consider Pooled OLS estimation results first. Coefficients are consistent with theory and are only reduced in magnitude compared to basic specification. A number of controls appear to be important in the specification and signs of coefficients near corresponding control variables do not deviate from the theory predictions. Only carbon dioxide emissions and unemployment are statistically not different from zero for males and females.

Effect of health expenditures. Government expenditures on health appear to have no significant effect on the performance of health care system once controlling for private health expenditures and other relevant characteristics. This might indicate about inefficiency of public spending on health and waste of resources that could have been transmitted to education, environment protection to improve health of the population. At the same time this may signal about relative efficiency of "private" versus "public" health care systems where resources spent on the improvement of health care system performance are not wasted and result in the decrease of avoidable mortality. Furthermore, it should be noted that neither public nor private expenditures on health have significant effect on non-avoidable mortality. This finding validates employment of avoidable mortality as a measure of health care system performance since any rate of both public and private health expenditures, at the given level of technologies available in the health sphere, is ineligible in avoiding deaths from e.g. aging, majority kinds of cancer, AIDS, and therefore improvement of the health care system performance. Apart, it should be noted that there is no robust effect of

government health expenditures on the performance of health care system in the literature. A number of researches find insignificant effect of government health expenditures (Filmer, 1999) or even negative (Berger, 2002) impact on the performance of the health care system.

Effect of education expenditures. Government education expenditures reduce avoidable mortality of males but have no significant impact for females. However, average years of schooling do have a substantial impact on the performance of health care system. Though, expenditures on education are not found to have direct significant effect for improvement of health care system performance, but they are one of major determinants of schooling (Pritchett, 1997) and therefore affect performance of health care system indirectly. Although being unable to control for private education expenditures, an increase in the public spending on education results in improved level of enlightenment. Therefore being more educated produces favorable conditions to have healthy life style, increase knowledge about different diseases and their first symptoms, therefore improves chances of detecting diseases at early stages and therefore reduces mortality rates. And finally similarly to the health expenditures on health, increase in the schooling years has no significant effect on non-avoidable mortality. This indicates that current level of technology available in the health sphere is unable to reduce non-avoidable portion of mortality.

Effect of expenditures on environmental protection. Increase of government expenditures on environmental protection reduces avoidable mortality. This implies that clean environment is crucial for health of population. As environmental pollution is one of the sources of certain diseases, by eliminating it, or at least reducing its impact, an improved population's health may be attained. Therefore government should make investments into the sphere of

environment protection in order to improve performance of the health care system.

Fixed Effects estimation results are not significant in any specification for any gender. This can be explained by the lack of within variation of explanatory variables that results in meaningless estimates that is constructed on the time demeaned data (deviation of the variable from its mean). Detailed descriptive statistics of explanatory variables is presented in the Appendix A which shows close to zero within variation. At the same time fixed effects estimator appears to be inefficient if unobserved fixed effects are uncorrelated with observed explanatory variables. Relevant fixed effects that are unobserved in the model specification might be characteristics of lifestyle and preferences for healthy versus unhealthy behavior, e.g. going in for sports, active recreation versus harmful habits, substantial fast food consumption versus healthy food, etc. In that case, explanatory variables are not correlated with unobserved fixed effects of countries in the sample, and this ultimately results in an inefficiency of the fixed effects estimator.

Therefore, estimation results obtained with the Pooled Ordinary Least Squares are consistent with the theory. Testing of the underlying assumptions (no serial correlation and heteroscedasticity) of the Pooled OLS methodology confirmed consistency of applied methodology.

Chapter 6

CONCLUSIONS

Structure of government expenditures has significant effect on the performance of the health care system. In general, government expenditures on environment protection appear to be significant in all specifications and important in explaining performance of health care system as they are directed on the provision of clean environment and therefore improvement of health. At the same time, even though government expenditures on health appear to be insignificant in all specifications, private health expenditures are crucial for reduction of avoidable mortality. This might appear as a result of observing different types of health care systems, particularly those that have dominant private expenditures as a funding source. On contrary, this might also serve as a signal of inefficiency (waste of public resources that could have been reallocated and used efficiently) of government expenditures in improving performance of health care system and hence necessity of reforming latter. Moreover, education is important for reduction of avoidable mortality. However, this effect is captured not through the direct impact of government education expenditures, but through average years of schooling of the population (that are largely affected by public investments into education).

Performance of the health care system is affected by the structure of government expenditures. Hence, public policy, aimed at the improvement of health care system performance, should be oriented at least at three dimensions as direct expenditures on health care do not reduce avoidable mortality completely. More educated people are associated with lower rates of avoidable mortality as well as people living in clean environment die less. So, these three components should be considered simultaneously.

At the same time, the type of health care system is crucial. Results indicate that private health expenditures appear to have larger impact on health care system performance. As a result, this might be a sign of more efficient "private" versus "public" health care systems.

Findings indicate that policy in the sphere of health care system administration should be changed and reoriented to the reduction of government expenditures on health (that turned out to be inefficient); increase in the expenditures on education as well as environment protection, that are although indirect components of health care, but crucial in the improvement of health care system performance. And finally, policy changes might be implemented to reorganize health care system, making it less dependent on government, since private expenditures on health proved to be important in improving health care system and therefore health of the nation.

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TABLE 1

Causes of death considered amenable to health care (Nolte, 2004)

Name of the group	Age	ICD10
1. Intestinal infections	0-14	A00-A09
2. Tuberculosis	0-74	A15-A19, B90
3. Other infectious (Diphtheria, Tetanus, Poliomyelitis)	0-74	A36, A35, A80
4. Whooping cough	0-14	A37
5. Septicaemia	0-74	A40-A41
6. Measles	1-14	B05
7. Malignant neoplasm of colon and rectum	0-74	C18-C21
8. Malignant neoplasm of skin	0-74	C44
9. Malignant neoplasm of breast	0-74	C50
10. Malignant neoplasm of cervix uteri	0-74	C53
11. Malignant neoplasm of cervix uteri and body of the uterus	0-44	C54, C55
12. Malignant neoplasm of testis	0-74	C62
13. Hodgkin's disease	0-74	C81
14. Leukaemia	0-44	C91-C95
15. Diseases of the thyroid	0-74	E00-E07
16. Diabetes mellitus	0-49	E10-E14
17. Epilepsy	0-74	G40-G41
18. Chronic rheumatic heart disease	0-74	I05-I09
19. Hypertensive disease	0-74	I10-I13, I15
20. Ischaemic heart diseas	0-74	I20-I25
21. Cerebrovascular disease	0-74	I60-I69
22. All respiratory diseases (excl. pneumonia/influenza)	1-14	J00-J09
23. Influenza	0-74	J20-J99
24. Pneumonia	0-74	J10-J11
25. Peptic ulcer	0-74	J12-J18
26. Appendicitis	0-74	K25-K27
27. Abdominal hernia	0-74	K35-K38
28. Cholelithiasis & cholecystitis	0-74	K40-K46
29. Nephritis and nephrosis	0-74	K80-K81
30. Benign prostatic hyperplasia	0-74	N00-N07, N17-N19, N25-N27
31. Maternal deaths	All	N40
32. Congenital cardiovascular anomalies	0-74	O00-O99
33. Perinatal deaths, all causes	All	Q20-Q28
34. Misadventures to patients during surgical and medical care	All	P00-P96, A33 A34

TABLE 2

Sample Description

Country	Year																
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria						+	+	+	+	+	+	+	+	+	+	+	+
Belgium						+	+							+			
Canada	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Czech Republic						+	+	+	+	+	+	+	+	+	+	+	+
Denmark	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Estonia																+	+
Finland	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Germany			+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Hungary						+	+	+	+	+	+	+	+	+	+	+	+
Iceland									+	+	+	+	+	+	+	+	+
Ireland	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Italy	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
Japan	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Luxem-bourg						+	+	+	+	+	+	+	+	+			
Nether-lands						+	+	+	+	+	+	+	+				
Norway	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+
Slovakia								+	+	+	+	+	+	+	+		
Spain						+	+	+	+	+	+	+	+	+			
Sweden						+	+	+	+	+	+	+	+	+	+	+	+
UK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

TABLE 3

Summary statistics of avoidable/non-avoidable mortality across genders, during 1991 – 2007

Mortality	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
		Males			
Avoidable Mortality per 100,000 of population	*239*	*137.805*	*65.674*	*48.469*	*353.496*
Non Avoidable Mortality per 100,000 of population	*239*	*1907.396*	*316.448*	*1155.083*	*2909.026*
		Females			
Avoidable Mortality per 100,000 of population	*239*	*134.035*	*62.330*	*50.482*	*331.628*
Non Avoidable Mortality per 100,000 of population	*239*	*1916.103*	*321.9853*	*1139.388*	*2995.998*

TABLE 4

Descriptive statistics of government spending structure, 1991 - 2007

Function	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Health	*239*	*8.998*	*17.632*	*.781*	*71.852*
Education	*239*	*5.582*	*1.412*	*.384*	*9.550*
Environment protection	*239*	*.757*	*.374*	*.051*	*1.994*

Note: Government spending is presented as a percent of GDP.

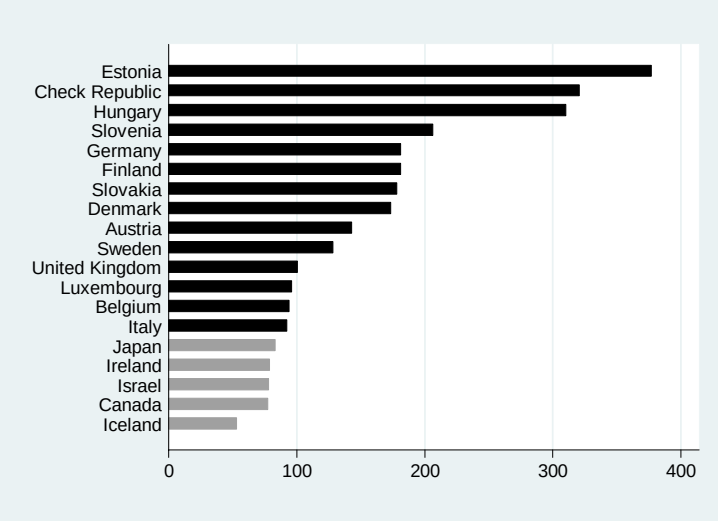

Figure 1. Ranking of OECD countries according to avoidable mortality per 100,000 population, males in 2003

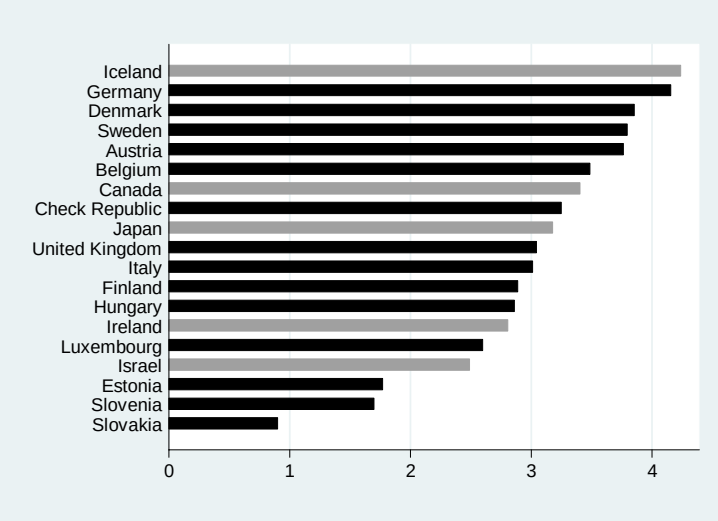

Figure 2. Ranking of OECD countries according to government expenditures on health in 2003, % of GDP

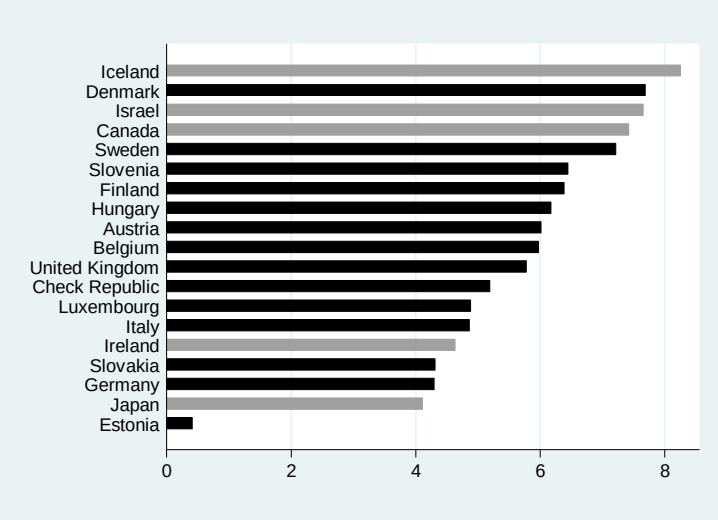

Figure 3. Ranking of OECD countries according to government expenditures on education in 2003, % of GDP

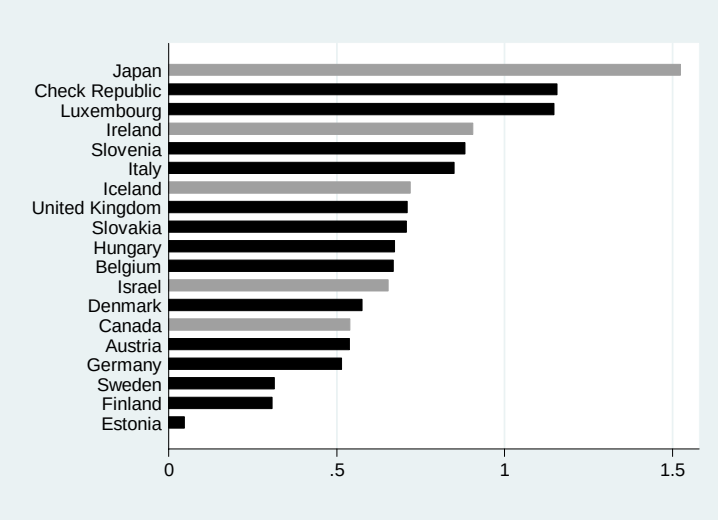

Figure 4. Ranking of OECD countries according to government expenditures on environment protection in 2003, % of GDP

TABLE 5

Descriptive Statistics of control variables, 1991 - 2007

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Private health expenditures, % of GDP	*239*	*2.480*	*5.348*	*.081*	*30.066*
log GDP per capita, PPP million international $	*239*	*10.556*	*.937*	*7.259*	*11.786*
GDP per capita, PPP million international $	*239*	*49029.53*	*22780.19*	*1421.07*	*131460.8*
Unemployment, total (% of total labor force)	*239*	*7.419*	*3.967*	*1.805*	*21.969*
Alcohol Consumption, liters per capita	*239*	*10.098*	*2.568*	*4.600*	*15.700*
CO2 emissions, kg per PPP $ of GDP	*239*	*.434*	*.163*	*.139*	*.943*
Average years of total schooling, age 15+ total population	*239*	*9.927*	*1.295*	*5.637*	*12.753*

TABLE 6

Estimation results of basic specification, Pooled OLS

	(1) Males AM	(2) Females AM	(3) Males NAM	(4) Females NAM
L.Government health expenditures, % of GDP	*-3.008****	*-3.291****	*-6.591***	*-4.872*
	(0.709)	*(0.643)*	*(3.028)*	*(3.103)*
L.Government education expenditures, % of GDP	*-13.95****	*-9.280****	*31.55**	*28.02*
	(2.291)	*(2.509)*	*(19.05)*	*(24.37)*
L.Government expenditurs on environment protection, % pf GDP	*-47.63****	*-32.96****	*-92.75***	*-135.5***
	(8.861)	*(8.195)*	*(49.02)*	*(61.68)*
L.lnGDP, per capita millions of international PPP $	*-59.35****	*-65.41****	*-118.2***	*-103.0**
	(12.63)	*(11.53)*	*(55.13)*	*(59.94)*
Constant	*902.3****	*925.8****	*3,101****	*2,986****
	(140.6)	*(127.2)*	*(603.2)*	*(662.0)*
Observations	*239*	*239*	*239*	*239*
R-squared	*0.220*	*0.214*	*0.062*	*0.068*
Number of country				

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Note: AM and NAM are Avoidable and Non-Avoidable Mortality per 100,000 of population

TABLE 7

Estimation results of extended specification, Pooled OLS

	(1) Males AM	(2) Females AM	(3) Males NAM	(4) Females NAM
L.Government health expenditures, % of GDP	*-0.0000199*	*-0.539*	*-11.11***	*-5.307*
	(0.896)	*(0.831)*	*(4.356)*	*(4.097)*
L.Government expenditurs on environmental protection, % pf GDP	*-45.16****	*-30.91****	*-87.03*	*-172.6***
	(11.96)	*(9.074)*	*(60.35)*	*(75.41)*
L.Government education expenditures, % of GDP	*-7.820**	*-3.373*	*47.04***	*37.73*
	(3.971)	*(2.904)*	*(21.76)*	*(27.10)*
L.Private health expenditures, % of GDP	*-8.503****	*-7.488****	*-4.418*	*-22.36**
	(1.960)	*(1.888)*	*(16.67)*	*(12.54)*
L.log of GDP per capita, PPP international million $	*-52.18****	*-57.19****	*-228.9****	*-241.6****
	(15.79)	*(13.37)*	*(61.65)*	*(60.38)*
L.Alcohol consumption, liters per capita (15+)	*8.145****	*7.929****	*25.79***	*29.12****
	(2.028)	*(1.772)*	*(11.26)*	*(11.16)*
L.CO2 Emissions, kg per PPP $ of GDP	*34.08*	*28.62*	*-451.2****	*-446.0***
	(30.98)	*(28.05)*	*(170.6)*	*(175.2)*
L.Unemployment, % of total labor force	*1.938*	*2.016*	*-1.219*	*-5.158*
	(1.673)	*(1.587)*	*(7.012)*	*(6.866)*
L.Average years of total schooling, age 15+, total population	*-137.1***	*-114.1***	*-36.51*	*56.31*
	(56.47)	*(48.21)*	*(252.7)*	*(272.0)*
L.Squaed average years of total schooling, age 15+, total population	*7.608****	*6.477****	*1.877*	*-1.276*
	(2.827)	*(2.385)*	*(12.35)*	*(13.44)*
Constant	*1,272****	*1,175****	*4,354****	*3,982****
	(348.0)	*(312.7)*	*(1,544)*	*(1,514)*
Observations	*239*	*239*	*239*	*239*
R-squared	*0.417*	*0.410*	*0.118*	*0.151*

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Note: AM and NAM are Avoidable and Non-Avoidable Mortality per 100,000 of population

TABLE 8

Estimation results of extended specification, Fixed Effects

	(1) Males AM	(2) Females AM	(3) Males NAM	(4) Females NAM
L.Government health expenditures, % of GDP	*-0.553*	*0.919*	*-26.23*	*2.524*
	(1.807)	*(1.476)*	*(16.73)*	*(17.71)*
L.Government expenditurs on environment protection, % pf GDP	*-5.814*	*7.093*	*-112.7*	*-22.05*
	(14.36)	*(11.92)*	*(133.0)*	*(143.0)*
L.Government education expenditures, % of GDP	*5.345*	*4.934*	*93.80***	*13.41*
	(4.873)	*(4.057)*	*(45.12)*	*(48.66)*
L.Private health expenditures, % of GDP	*0.358*	*-4.622*	*72.27*	*-38.29*
	(5.836)	*(4.747)*	*(54.05)*	*(56.94)*
L.log of GDP per capita, PPP international million $	*-2.960*	*10.71*	*296.0*	*177.2*
	(26.84)	*(22.23)*	*(248.6)*	*(266.6)*
L.Alcohol consumption, liters per capita (15+)	*-3.336*	*-8.234***	*47.82*	*56.29*
	(3.963)	*(3.297)*	*(36.70)*	*(39.55)*
L.CO2 Emissions, kg per PPP $ of GDP	*19.43*	*20.33*	*608.1*	*209.8*
	(50.93)	*(42.40)*	*(471.6)*	*(508.6)*
L.Unemployment, % of total labor force	*-0.621*	*-0.754*	*6.141*	*5.229*
	(1.163)	*(0.965)*	*(10.77)*	*(11.57)*
L.Average years of total schooling, age 15+, total population	*-99.54****	*17.77*	*80.88*	*452.8*
	(37.60)	*(31.27)*	*(348.2)*	*(375.1)*
L.Squaed average years of total schooling, age 15+, total population	*4.966****	*-1.101*	*-4.728*	*-20.41*
	(1.872)	*(1.557)*	*(17.33)*	*(18.67)*
Constant	*669.9**	*5.597*	*-2,720*	*-3,093*
	(353.7)	*(292.6)*	*(3,275)*	*(3,510)*
Observations	*239*	*239*	*239*	*239*
R-squared	*0.046*	*0.063*	*0.046*	*0.033*
Number of country	*20*	*20*	*20*	*20*

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Note: AM and NAM are Avoidable and Non-Avoidable Mortality per 100,000 of population

APPENDIX A

Detailed descriptive statistics of explanatory variables

Variable		Mean	Std. Dev.	Min	Max	Observations
Government health expenditures, % of GDP	Overall	*8.998*	*17.632*	*.781*	*71.852*	*N = 239*
	Between		*17.873*	*.879*	*64.661*	*n = 20*
	Within		*2.075*	*-1.289*	*18.932*	*T-bar = 11.85*
Government education expenditures, % of GDP	Overall	*5.582*	*1.412*	*.384*	*9.549*	*N = 239*
	Between		*1.724*	*.385*	*8.131*	*n = 20*
	Within		*.403*	*4.432*	*6.999*	*T-bar = 11.95*
Government expenditurs on environment protection, % pf GDP	Overall	*.7571231*	*.374*	*.051*	*1.994*	*N = 239*
	Between		*.351*	*.053*	*1.731*	*n = 20*
	Within		*.140*	*.265*	*1.465*	*T-bar = 11.95*
Private health expenditures, % of GDP	Overall	*2.480*	*5.348*	*.081*	*30.066*	*N = 239*
	Between		*5.919*	*.159*	*25.714*	*n = 20*
	Within		*.6445*	*-.107*	*6.832*	*T-bar = 11.85*
log of GDP per capita, PPP international million $	Overall	*10.556*	*.937*	*7.259*	*11.786*	*N = 239*
	Between		*.964*	*7.468*	*11.544*	*n = 20*
	Within		*.206*	*9.946*	*11.149*	*T-bar = 11.95*
Alcohol consumption, liters per capita (15+)	Overall	*10.098*	*2.568*	*4.600*	*15.700*	*N = 239*
	Between		*2.640*	*5.527*	*15.088*	*n = 20*
	Within		*.610*	*8.422*	*11.722*	*T-bar = 11.7*
Unemployment, % of total labor force	Overall	*7.419*	*3.967*	*1.805*	*21.969*	*N = 239*
	Between		*3.800*	*2.679*	*17.191*	*n = 20*
	Within		*2.099*	*2.706*	*14.765*	*T-bar = 11.95*
CO2 Emissions, kg per PPP $ of GDP	Overall	*.434*	*.163*	*.139*	*.943*	*N = 239*
	Between		*.148*	*.209*	*.729*	*n = 20*
	Within		*.093*	*.197*	*.700*	*T-bar = 11.95*
Average years of total schooling, age 15+, total population	Overall	*9.927*	*1.295*	*5.637*	*12.753*	*N = 239*
	Between		*.994*	*8.099*	*11.491*	*n = 20*
	Within		*.888*	*6.088*	*11.758*	*T-bar = 11.95*