HEALTH CARE EXPENDITURES AND PHYSICAL ACTIVITY LEVEL. CROSS-COUNTRY COMPARISON

by

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Abstract

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Comparison of aggregate Health Care Expenditures (HCE) using cross-section data for 118 countries was performed in the thesis. As in the previous findings, GDP proves to be a key determinant of variation in the amount of resources countries devote to health. Additionally, this study reveals a significant cost, which the share of insufficiently active population imposes on Health Care. Following the data recently provided by World Health Organization (WHO), we regard physical activity as multi-dimensional variable that captures transportation, job-related physical activity, housework, recreation, sports and leisure-time physical activity. Research shows that, Physical Inactivity explains part of the variation in HCE that was initially attributed to aggregate income.

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GLOSSARY

Health Care Expenditures (HCE) .Total expenditure on health expressed in PPP international dollar. Aggregate HCE are measured as the sum of spending of all financing agents managing funds to purchase health goods and services.

Insufficient level of Physical Activity (PI). Person is defined as insufficiently active if she doesn`t meet the following ccriteria: at least 30 minutes of moderate-intensity activity per day on at least 5 days per week, or at least 20 minutes of vigorous-intensity activity per day on at least 3 days per week, or an equivalent combination.

Chapter 1

INTRODUCTION

According to the World Health Organization data, more than 36 million people die each year from noncommunicable diseases (NCD) and 60% of this number are people under 60 years of age. 80% of all NCD deaths are attributed to cardiovascular diseases (17 million people annually), cancers (7.6 million), respiratory diseases (4.2 million), and diabetes (1.3 million). Four mentioned groups share same risk factors: tobacco smoking, physical inactivity, alcohol abuse and unhealthy diets (WHO 2008).

Sedentary lifestyle, or in other words, physical inactivity, causes high mortality rate, doubles the risk of cardiovascular diseases, diabetes, and obesity, and increases the risk of colon cancer, high blood pressure, osteoporosis, lipid disorders, depression and anxiety. According to WHO data, 60 to 85% of people in the world—from both developed and developing countries—lead sedentary lifestyles, thus making it one of the more serious yet insufficiently addressed public health problems of our time. It is estimated that nearly two-thirds of children are also insufficiently active, with serious implications for their future health.

Nations spend huge amounts of resources on medical care, to cure people from NCD. And over the last decades determinants of Health Care Expenditures (HCE) got a meticulous attention. What motivates these considerations is, beside all, long lasting up-sloping trend both in absolute and per capita health expenditures around the Globe. While African countries spend about 2-4% of GDP on Health Care, European countries spend nearly 7-11%, the USA spends 17% (WHO 2008). Even so spending are escalating, there is no evidence that nations become healthier

because of this. In addition, a great part of HCE is publicly financed, through taxes or compulsory insurance contributions; on average 20% for developing and up to 80% for OECD countries (World Bank 2008). High fraction of public finance creates a problem because most of countries are burdened by deficits in public sector and public debts. That is, HCE increase public debt and interest payments on the debt.

On the other hand, consequences of physical inactivity are bothersome per se for citizens. Physical inactivity is shown to be closely connected with obesity and metabolic syndrome, mental health and health related quality of life. Within the Organisation for Economic Co-operation and Development, physical inactivity is estimated to cause 12% of all mortality, 8% of all lost years as a result of premature death, 2% of lost years as a result of morbidity, and 5% of the disease burden (Hagberg 2007). Sedentary life style causes the reduced quality of life, which is together with the burden of disease increases social costs. Physical activity has also a strong socializing function and is shown to increase social and human capital of the society (Frey et al. 1991).

Generally speaking, the paradigm through which we look at Public Health and Health Care system refers to life-style as one of the key determinants of individuals` health and amount of Medical Services they consume (Lalonde 1974, Birch et al. 2000, Contoyannis and Jones 2011). The literature on economic consequences of physical inactivity investigates as well economic cost of inactivity.

For instance, P.T. Katzmarzyk, N. Gledhill, R.J. Shephard (Katzmarzyk et al. 2000) calculated additional expenditures carried by Canadian citizens due to insufficient physical activity. According to their study, nearly 2.5% of total HCE in 1999 were attributable to physical inactivity. Similar research was done in the USA

(Hagberg 2000). Recent papers (Anderson et al. 2005, Katzmarzyk et al. 2000) reveal also significant influence of physical inactivity on the major world non-communicable diseases (Lee et al. 2012). Thus, it sounds to be a valid assumption that physical inactivity creates an implicit impact through uplifting risks to health on country-level expenditures.

Notwithstanding the evidence observed in micro level studies, the connection between health (and consequently Health Care), and life-style factors is not well established in macro level research. Particularly, cross-country comparisons of HCE explain the variation in devoted recourses mostly by income and to less extent by socio-economic, socio-geographic differences (Gerdtham and Jonsson 2000).

The present study tries to establish the connection between two separate points of view on countries` HCE. Specifically, we look at HCE as the input in production of health (Grossman 1972, Contoyannis and Jones 2011) and integrate this framework into standard cross-country comparison framework. We expect that the influence of life-style factors on amount of Medical Services consumed should not disappear in the higher level of integration.

The one can suggest that our question is unexplored because data on life-style components like physically inactive population became available only recently. Global Physical Activity Questionnaire developed by the World Health Organization (WHO 2012) allowed to provide information for 120 countries on the WHO website in 2012.

To check the hypothesis, we build empirical model which explains aggregate HCE as a function of three groups of variables: factors of "available recourses" factors

of "need" and life-style factors. The first group covers characteristics of the economy that shape National Health Accounts, like GDP of the country. The second group encompasses measures usually used to evaluate overall health status: age structure of population, mortality and burden of disease, characteristics of the labor force. They are named as factors of "need" to point out that aging of population, high infant mortality rate etc. expand the need in Medical Care and, consequently, increase total Health Expenditures (Christiansen et al. 2006).

The third group is of particular interest, it captures information about prevailing level of physical activity, alcohol and tobacco consumption. Data for the prevailing level of insufficiently active population is taken, as it was mentioned, from WHO website, while controls are taken from World Development Indicators database by World Bank. The sample of countries consists of 118 observations. Independent variables are measured in the year 2008, while aggregate HCE are taken in 2011 to eliminate endogeneity problem.

Ordinary Least Squares method confirms hypothesis that countries with higher share of insufficiently active population spend more on Health Care controlling for aggregate income and socio-economic factors. 10% increase in PI level adds nearly 2% to expenditures on Health Care.

The paper is organized as follows. Section 2 reviews the literature on determinants of health care expenditures from different angles, as well as the literature on economic burden of physical inactivity. Section 3 overviews the methodology. We briefly discuss theoretical approaches which can, in principle, be used; and then explain the intuition behind empirical model of our choice. Section 4 describes the data. We also discuss the number of observations in our sample and provide comparison to the larger sample of 214 economies. Section 5 presents empirical

results. Section 6 concludes with the discussion of advantages of the study, as well as problems. The last section also describes the scope of implications.

Chapter 2

LITERATURE REVIEW

In this section we summarize the findings on determinants of HCE in two separate frameworks. First, we look at expenditures on medical services as an input in production of health. Starting with Grossman`s model of health production we will move to modern theories which incorporate heterogeneity of individuals and non-health-care influences on health status. These are individual level studies. In the second part of literature review HCE are seen as an input in production of Health Care. Econometric models applied for modeling HCE use macro level data. The subtle conceptual difference in regarding the output allows to study another set of questions. Particularly, the second group of studies strives to explain health expenditures variation between different countries and derive main causes of continuous growth in HCE all over the world.

Review aims to create two pictures describing two concepts where HCE seen as input and either health or Health Care seen as output. Connection which exists between the mentioned concepts, in our assumption, should be also revealed with econometric tools. The one will see from previous findings that while life-style plays important role if health is an output, this effect vanishes if Health Care is.

The most widely used model of health production belongs to Grossman (Grossman 1972). According to this model, good health is a durable commodity. Initial level is inherited at birth and can be increased through investment of time and investment of money on health enhancing activities and goods, services respectively. Return on investment depends on so-called "environmental conditions" which are usually taken as Human capital. Stock of health also depreciates. Remarkable feature Grossman`s theory is that individuals choose their

length of life; they die when the stock of health lessens to certain minimum level. In this framework, Health Care Expenditures are treated as monetary investment in good health. Consequently, demand for Medical Care is derived from demand for health.

Empirical reformulation of the model defines health as a function of health status in the previous period, wage rate, price for Medical Services, education, age, elasticity of Medical Care schedule and depreciation rate. Verification of Grossman`s theory (Grossman 1972, Wagstaff 1986, Wagstaff 1993, Erbsland et al. 1995) shows that longer years of education, higher wage and aging are associated with higher demand for health. Higher wage, lower prices, less of schooling increase demand for Medical Care. Later on parental characteristics and mental abilities were shown to positively affect health, and consequently demand for Health Care (Kenkel 2000).

With introduction of "health field" concept by Marc Lalonde (Lalonde 1981), more and more researchers started paying attention to non-health-care determinants of health. Lalonde stated that determinants of health include biomedical, environmental and life-style factors together with consumption of Medical Services. His report gave birth to series of articles in epidemiology and behavioral studies that explain health inequality partially by life-style (Contoyannis and Jones 2011).

A good instance of individual-level economic value is study which uses epidemiological methods to estimate the direct cost of physical inactivity within the membership of a health plan, Blue Cross Blue Shield of Minnesota (Garrett et al. 2004). According to results, 12% of depression and anxiety and 31% of colon cancer, heart disease, osteoporosis and stroke cases are triggered by physical

inactivity. Total health plan expenditures attributable to physical inactivity were $83.6 million or $56 per member in 2000.

Country-level approach can be represented by Medicine (Lee 2012). According to their results physical inactivity causes 6% of the burden of disease from coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer, and 10% of colon cancer. Inactivity causes 9% of premature mortality, or more than 5 million of the 57 million deaths that occurred worldwide in 2008. They use so-called PAF-method. "The population attributable fraction-is a measure used by epidemiologists to estimate the effect of a risk factor on disease incidence in a population. It estimates the proportion of new cases that would not occur, absent a particular risk factor."

The latest economic models (Birch et al. 2000, Contoyannis 2011) account for unobserved heterogeneity that explain inequalities in health trough difference in utility functions of different agents. Both time and monetary investment in health compete with goods and services, which are perceived as unhealthy, but bring more utility to individuals. Implication of this finding to public health is that making education and Health Care more affordable will not necessarily lead to better health.

Summarizing our short history of the first concept where demand for Health Care is derived from demand for health, individual HCE are determined by health status, prices for medical care, income of the individual, human capital and life-style.

In the second section we look at research related to HCE determinants, as well as main results known about the nature of HCE. Hereafter we look at heritage of HCE investigation. "What determines the quantity of resources a country devotes

to medical care? ". This question asked by Joseph P. Newhouse in 1977 (Newhouse 1977) begins the long history of searching for determinants of Health Care Expenditures. Newhouse based his research on 13 developed countries with data available and obtained that over 90 percent of the variance in per capita medical expenditure in these countries can be explained by variation in per capita GDP! He technically applies cross-section bivariate regression to estimate the effect of per capita GDP on medical care expenditure.

Years later Van der Gaag and Stimac refer to it as "The first law of health economics:
1. Based on cross-country comparisons, the income elasticity of medical care is 1.0 or larger.
2. Variation in per capita GDP alone accounts for about 90 per cent of the variation among countries in HEXP/cap." (Gaag et al. 2008)

Van der Gaag and Stimac in 2008 proceed further in this direction (Musgrove et al. 2002) and check with more data available whether The first theorem of health economics holds as well for developing countries. Beside all, it is underlined that Theorem is a global phenomenon. In their analysis (1999–2004 data) they show a negative correlation between official development assistance received and per capita income. The same holds for total debt forgiveness and net debt forgiveness.

Medical progress is an important driver of HCE (Newhouse 1992) which might as well be proxied by life expectancy, percentage of people aged 65 in overall population and infant mortality (Dreger et al. 2005). Beside all, Dreger and Reimers underline that usual consideration of health care expenditures is made from the "demand side". Whereas, the one can observe from

the data available that prices in health sector grow faster and with larger yearly increments than GDP prices. And this logical experiment, supported by econometric analysis, emphasizes the importance of inclusion of "supply-side" explanatory factors. And what is more crucial is that even available data for macro-level analysis is hardly comparable between countries (Christiansen 2006) as these are qualitative features of the systems which are per se different models.

Another frequently used set of explanatory variables is population age structure. Possible specifications are the share of young (e.g., under 15 years) and old people (e.g., above 65 or 75 years) in overall population. These variables are most often insignificant (Gerdtham and Jönsson 2000). However, Christiansen (Christiansen 2006) finds for the samples of EU11 and EU15 positive and significant relation between HCE and the share of 65-74 age group. Unexpected result of the mentioned study is that significance of age is lost when the one controls for institutional and technology characteristics. He as well detects the negative impact of unemployment on HCE and the reverse effect of female labor force participation rate. Alcohol consumption is statistically insignificant and tobacco consumption has a slight effect.

The following explanatory variables are usually statistically significant: (Hartwig 2008) "indicators of capacity (number of beds per 1000 inhabitants), indicators of high technology (number of patients undergoing dialysis and tomography scanners per million inhabitants) and public health care expenditure as a share of the total. Negative associations were found for payment of GPs by salary and capitation payment of GDPs (as opposed to fee-for-service payment), case-based payment of hospitals and number of physicians per 1000 inhabitants."

Useful insights we as well get from Hartwig and Sturm`s (Hartwig and Sturm 2012) paper. Generally, they are focused on the problem of growth of HCE, not the level of expenditures. Albeit, they discover 4 significant equation components for OECD countries: "the growth in acute beds per 1'000 inhabitants, the change in the rate of unemployment, the growth in the number of patients undergoing renal dialysis per 100'000 population and the growth in per capita real expenditure on health administration".

Whilst the data on developing countries is restricted, so does the research of HCE determinants of these countries. Comparatively large sample of 44 African countries in 2001 is used by Murthy and Okunade (Murthy and Okunade 2009). They literarily apply consequently OLS, TSLS and LAE to cross-section model to check the effect of per-capita real GDP, per-capita foreign aid, physicians per thousand of population, percent of population aged 65 years of age, and maternal mortality rate on HCE. First two show significant impact robust to estimation method. At this point we address the second issue, concluding that institutional differences still allows for using one model for developed and developing countries.

To summarize the second section, HCE are usually considered to be driven by GDP which explains approximately 90% of variation in cross-section analysis. Other factors can be divided into "supply" and "demand-side" ones. Demand side factors like economic and socio-geographical explain that richer countries spend more. Supply-side framework encompasses medical progress, features of health care system per se, and has been only applied to developed OECD countries.

Physical inactivity can be put together with tobacco and alcohol consumption in the demand-side framework of HCE. The last result provides direct economic logic of how can physical inactivity drive the demand-side Health Care expenditures.

Chapter 3

METHODOLOGY

Ulf-G. Gerdtham and Bengt Jonsson in their comprehensive meta-study of international comparisons of health expenditures (Gerdtham and Jonsson 2000) underline "the weakness of theoretical base" for the determinants of HCE. The only attempts were made by James Buchanan in 1965 and Robert Leu in 1986. Yet, both were criticized and didn`t get popularity. The latest studies that focus on HCE growth (Hall and Jones 2007) apply dynamic models with heterogeneous agents to US data. Unfortunately, the PI variable is available for the single year which restricts us to using cross-sectional data.

Therefore, empirical model for International comparison is set up in the fashion of Gerdtham (Gerdtham et al. 1992), which is a basic approach for cross-section multivariate regression. Set of variables varies depending on specific issues, which the authors address, however, the common tendency is to include economic and socio-geographical factors, institutional variables. Gerdtham, in particular, covers the following determinants: 1) relative prices, 2) number of doctors, 3) the ratio of in-patient to total spending, 4) the ratio of government to total HE, 5) the ratio between population 65 years of age and over and population aged 15 to 64, 6) the fraction of population living in towns with over 500,000 inhabitants, 7) dummy variable for the fee-for-service payment of doctors and 8) a dummy variable for global budgeting caps.

Empirical model used to check our hypothesis of interest is described below. The set of explanatory variables is very similar to the one of Gardthem, but divided into groups for convenience.

Expenditures of the country on Health Care are viewed as a function of three groups of factors – the factors of "available recourses" $\{R_i\}$, factors of "need" $\{N_i\}$ and life-style factors$\{\widetilde{N}_i\}$.

$$HCE = \alpha_0 + \sum_i \alpha_i R_i + \sum_i \beta_i N_i + \sum_i \gamma_i \widetilde{N}_i + \varepsilon \qquad (1)$$

The first group covers characteristics of the economy that shape National Health Accounts: GDP of the country and the overall framework for Health Care System including institutional arrangements. $R_1 =$ GDP per capita, PPP (constant 2005 international $); $R_2 =$ Health expenditure, public (% of total health; $R_3 =$ External resources for health (% of total expenditure on health); $R_4 =$ Hospital beds (per 1,000 people); $R_5 =$ Nurses and midwives (per 1,000 people); $R_6 =$ Physicians (per 1,000 people).

The second group encompasses measures usually used to evaluate overall health status: age structure of population, mortality and burden of disease, characteristics of the labor force. They are named as factors of "need" to point out that aging of population, high infant mortality rate etc. expand the need in Medical Care and, consequently, increase total Health Expenditures (Christiansen et al. 2006). $N_1 =$ Mortality rate, infant (per 1,000 live births); $N_2 =$ Population ages 65 and above (% of total); $N_3 =$ Unemployment, total (% of total labor force); $N_4 =$ Employment to population ratio, 15+, female (%); $N_5 =$ Urbanization.
This mentioned variables are customary in modeling HE for cross-country comparison (Gerdtham et al. 1998, Christiansen 2006).

Of particular interest is the third group of variables. They also affect expenditures through increase in "need". But they differ from the first group in the sense that $\{\widetilde{N}_i\}$ decrease the stock of health of population but don`t demand instantaneous expenditures from the budget. However, variables from the set $\{N_i\}$ require immediate expenditures from the country. To illustrate, the one doesn`t pay physician right after smoking cigarette; while the birth of premature infant has an explicit immediate cost. Both cases, certainly, would have future outcomes, but we emphasize the difference for current year. $\widetilde{N}_1 =$ Insufficiently active (age-standardized estimate); $\widetilde{N}_2 =$ Total (recorded and unrecorded) per capita consumption of alcohol, 15+ years; $\widetilde{N}_3 =$ Current smoking of cigarettes (age-standardized estimate).

By division onto factor groups we implicitly assume that they have different effects on the level of expenditures. We can ask ourselves - should we separate factors of need, or should we consider them as an outcome of countries' prosperity, or GDP levels? The answer is yes, we should separate and not to mix correlation and causation. Of course, wealth and prosperity of the nation imply health and fitness of inhabitants; however, there is no perfect economic indicator to reflect well-being of the population. Furthermore, it is easy to find the contradiction to the statement that GDP predestinates the level of "need". USA is the 9th by per capita GDP, the first by per capita HCE, however Japan has the highest life expectancy with 25th place by HCE and 32nd by per capita GDP.

Outlining expected signs of variables in empirical model, factors of "available recourses" should presumably show positive effect on dependent variable. If we look behind the numbers we will see that $\{R_i\}$ contribute to financing inflows in

the Health System. According to WHO Financing Sources are made up of Public and Private Funds and External recourses. Thereby $R_1 - R_3$ alter financing.

Production of Health Care bares the following Resource Costs: Current Outlays (compensation to human resources, supplies and services, consumption of fixed capital, interest, other current expenditures) and Capital (buildings and movable equipment). So $R_4 - R_6$ modify HCE through costs of Current Outlays.
Effects of $\{N_i\}$ are most likely to be also positive because they widen the domain of recipients of Medical Care. The hypothesis is that $\{\widetilde{N}_i\}$ also increase expenditures.

The next section presents results of OLS estimates of empirical model and discussion of the findings.

Chapter 4

DATA DESCRIPTION

In this research we use data from World Health Organization (2008) for Physical Inactivity and from World Development Indicators (2008) for the rest of the variables for 118 countries. How do we measure Physical Activity and Physical Inactivity?

By WHO person is defined as insufficiently active if she doesn`t meet the following ccriteria: at least 30 minutes of moderate-intensity activity per day on at least 5 days per week, or at least 20 minutes of vigorous-intensity activity per day on at least 3 days per week, or an equivalent combination.

WHO uses surveys that present sex- and age-specific prevalence with minimum sample size of 50 observations. All the included surveys capture activity across all domains of life including work/household, transport and leisure time. In order to report comparable data for a standard year (2008) and standard age groups, adjustments were made for over-reporting of the International Physical Activity Questionnaire (IPAQ) (1-3) coverage (urban and rural), and age coverage of the survey. Crude adjusted prevalence values were produced for 5-year age groups, and then combined for ages 15+ years, using country population estimates. To further enable comparison among countries, age-standardized comparable estimates were produced. This was done by adjusting the crude estimates to an artificial population structure, the WHO Standard Population that closely reflects the age and sex structure of most low and middle income countries. This corrects for the differences in age/sex structure between countries.

Dealing with missing data we use median value of the variable for the particular income group. Income Level classification is made by World Bank. Economies are divided according to 2008 GNI per capita, calculated using the World Bank Atlas method. Groups are low income, $1 025 or less; middle income, $1 026–12 475; high income, $12 476 and more. Countries without data about Physical Inactivity level are excluded from the research. Therefore, sample contains 21 low-income countries 63 middle-income and 34 high-income countries. Table 1 presents summary statistics.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
HCE per capita* (PPP,constant 2005 $)	1239	1604	17	8608
Insufficiently active (% of total population)	34,91	16,63	4,7	71,90
GDP per capita (PPP,constant 2005 $)	13014	13995	489,80	72176
Population ages 65 and above (% of total)	8,1	5,61	0,5	21,50
Employment to population ratio,female,%	49,53	15,63	9,90	81,40
Current smoking of cigarettes	20,83	11,26	4,00	57,00
Total per capita alcohol consumption	6,81	4,87	0,05	17,47
Urban population (% of total)	55,31	22,89	12,46	98,22
Mortality rate, infant (per 1,000 live births)	28,84	27,34	2,50	126,10
Physicians (per 1,000 people)	1,50	1,44	0,02	6,04
Passenger cars (per 1,000 people)	173,26	206,02	1	673,00

**Note: 2011 data. Other variables are taken in the year 2008*

***Note:Number of observations is 118*

Simple graphical visualization (Figures 1-2) shows connection between countries GDP and HCE (both measured in per capita terms). On the contrary, Physical Inactivity of population doesn`t display evident link to HCE. But we can notice that the poorest countries are the most active.

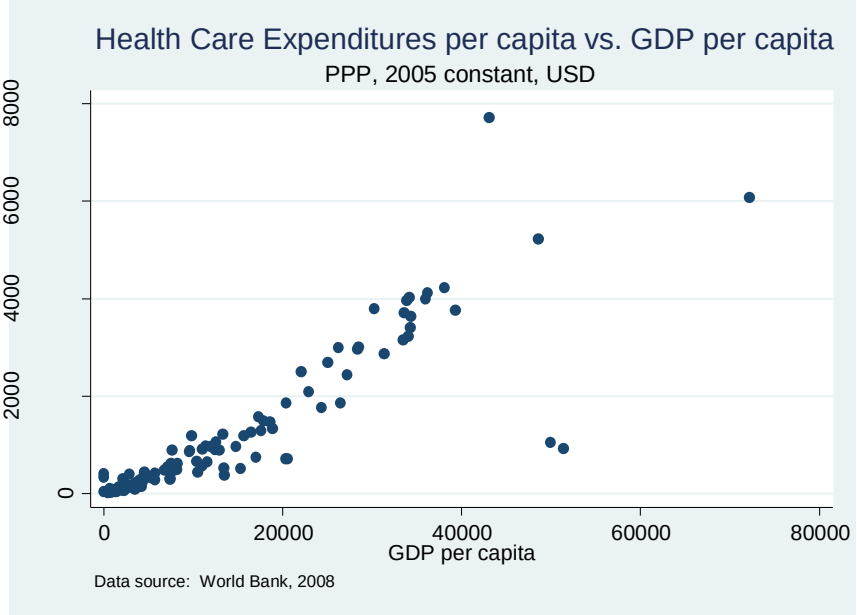

Figure 1. Health Care Expenditures per capita vs GDP per capita

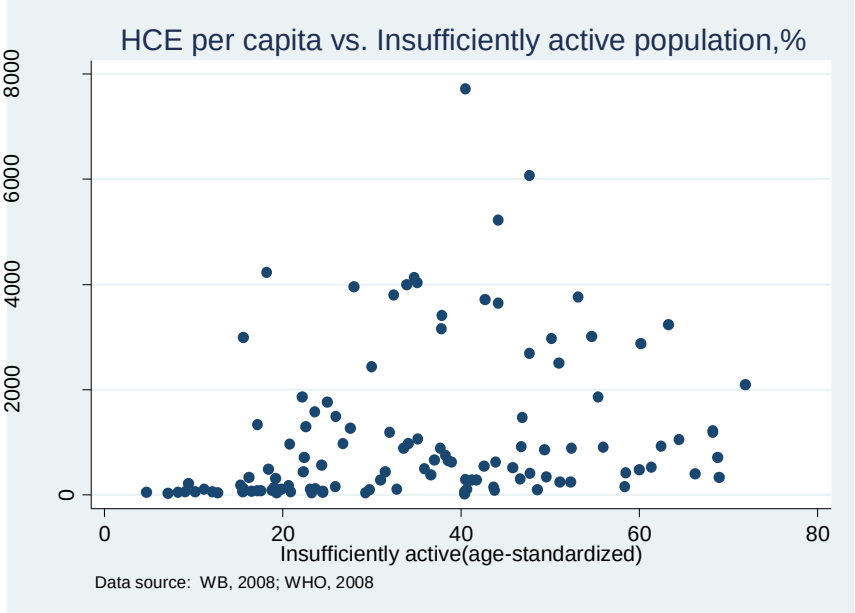

Figure 2. HCE per capita vs Share of Insufficiently Active population.

PI has such dimensions as job-related physical activity, transportation physical activity, housework, recreation, sports and leisure-time physical activity. Clearly, there are more physical workers in the poorest countries, underdeveloped infrastructure makes people walk more and housework is more frequent.

Sample consists of 118 variables. GDP explains most of variation in HCE. It can be seen from simple comparison of descriptive statistics (See Table 2) that we lack information mostly for poor countries.

Table 2.Comparison of samples with 118 and 214 observations 1

Variable	Mean, 118 observations	Mean, 214 observations
HCE per capita* (PPP,constant 2005 $)	1239	1125
GDP per capita (PPP,constant 2005 $)	13014,00	11987,00
Population ages 65 and above (% of total)	8,1	7,1
Employment to population ratio, female (%)	49,53	43,20
Life expectancy at birth, years	68,7	66,06
Income elasticity of HCE	1,10	1,04

Mean values are higher in the sample of 118 countries. We take sample of 214 economies for comparison because it is the maximum number of observations available for 2011 HCE in WDI. However, our particular model still makes sense. First, level of Physical Inactivity is not predetermined by income level; correlation between PI and HCE per capita is 0.25, correlation between PI and GDP per capita is 0.35. There is no evident reason to assume that missing economies have exceptional features of PI level just because they are poor. Second, it is more important for our particular question to have sample of countries which can be compared to the whole set of economies (World Bank defines 214 economies with population over 30 000) in terms of health characteristics. Summary statistics for

Life Expectancy at birth from WDI is provided in Table 3. Numbers are almost identical for both samples. Third, it is important for our empirical model to have comparable income elasticitites of per capita HCE. Table 2 shows comparable estimates if we consider per capita HCE as a function of per capita GDP and per capita GDP squared.

Table 3. Comparison of samples with 118 and 214 observations 2.
Life Expectancy at birth, 2008

				Quantiles			
Sample	Mean	Std. Dev.	Min	25th	50th	75th	Max
118 observations	68,7	10,1	46,4	62,8	72,4	75,9	82,6
214 observations	68,6	9,7	45,9	61,9	71,9	75,3	82,8

It is interesting to look on Share of Insufficiently active population in different countries (See Table 4). Bangladesh has the most active nation in the world! It is a small developing country known, beside all, for high population density. 80% of people live in rural areas with 54% of them being employed in agriculture.

Surprisingly, the least physically active population lives in Malta which is also one of the most densely populated countries. Malta is a so-called "advanced economy", it`s economy highly dependent on foreign trade and tourism. Car-ownership is fourth-highest in European Union.

Ukraine is among physically active countries with only 17% being insufficiently active. Russian Federation has 21%. USA has nearly 40% of physically inactive population. The country has the highest rate of obesity and spends more than others on Health Care. In 2008 34% of adults and 17% of children where obese, according to Centers of Disease Control and Prevention data.

Table 4. Share of insufficiently active population. Selected Sample.

Country	PI level
Bangladesh	4,7
Mozambique	7,1
Comoros	8,3
Greece	15,6
India	15,6
Estonia	17,2
Ghana	17,6
Netherlands	18,2
Ukraine	18,4
Russian Federation	20,8
Mali	20,9
Slovakia	22,2
Georgia	22,3
Czech Republic	25
Sri Lanka	25,9
China	31
Canada	33,9
Austria	34,8
Iran (Islamic Republic of)	37
Mexico	37,7
Finland	37,8
Australia	37,9
United States of America	40,5
Luxembourg	47,7
New Zealand	47,7
Japan	60,2
Malaysia	61,4
United Arab Emirates	62,5
United Kingdom	63,3
Saudi Arabia	68,8
Swaziland	69
Malta	71,9

Japan which is known, inter alia, for remarkable longevity and Japanese Fighting Arts, has nearly 60% of population being insufficiently active. Modern Japan is a leading nation in scientific research, the most technologically advanced producer of motor vehicles and electronics. We also know the term *karoshi* which refers to death by overworking in workplace; it is caused by stress from working 60 hours or more per week.

Chapter 5

EMPIRICAL RESULTS

The paragraph provides OLS estimates of our model (1) starting with the case of inclusion of all the mentioned variables and pursuing to the case where only significant variables are incorporated. By varying the set of variables we check the robustness of factor of interest to changes in the model.
General note is that countries with larger share of insufficiently active population spend more on Health Care, controlling for other factors.

The estimated equation (See Table 5) is

$$HCE_{pc} = 7.014 - 1.096 * GDP_{pc} + 0.109 * {GDP_{pc}}^2 - 0.425 * femp + \\ +0.203 * PI + 0.168 * pop_{65} + 0.187 * cig + \\ +0.249 * alcohol \quad (2)$$

All the mentioned variables explain 95% of sample variation. Particularly, 10% increase in per capita GDP leads to 8.2% higher HCE (See Table 5).That is, income elasticity of HCE is 0.82. If we compare this result to previous findings (Getzen 2006), national level studies show income elasticity of per capita Health Care Expenditures varying from 1.2 to 1.6. However, these are samples of 13 -33 developed countries. For instance, Gergtham (Gerdtham 1992) finds elasticity of 1.2 for 19 countries. Newhouse (Newhouse 1977) finds 1.3.

This can be easily explained by the difference in income effects for countries depending on their income level. In simple words, for poor countries health is rather "luxury" than "neccesity" (Getzen 2006). Christiansen (Christiansen et al. 2006) also finds elasticity lower than one, 0.93. Estimates have expected signs;

income elasticity of HCE is slightly less than 1 also arise for developing countries (Gaag et al. 2008).

10% larger share of population over 65 years is associated with 1.7% higher HCE. This is similar to what Christiansen has found for EU15 sample, 1990 year.

Share of females in employment shows negative significant impact of 4.3% decrease in HCE for 10% increase. This is an interesting result. Effect of this variable is different at different quintiles.

10% more cigarettes per day lead to 1.8% higher HCE. Consumption of 10% more alcohol per capita is associated with 2% higher HCE.

Effect of the variable of interest, logarithm of Physical Inactivity level, is statistically significant; 10% increase in PI level adds 2.5% to expenditures on Health Care.

As we can see, life-style factors all together have unquestionably significant effect on HCE.

In the second specification we apply robust regression analysis (See Table 5, 2). In this case, the effect of PI variable falls, however, the number of observation stays the same. We don`t treat any variable as outlier.

To detect specification errors Specification link test (Pregibon 1980) and Ramsey RESET tests are used; this methods check whether it is possible to find additional independent variables that are significant accept by chance. According to both tests, the model is misspecified, unless logarithm of squared GDP per capita is added. In this case both tests fail to reject the assumption that model is correctly specified. Squared GDP is not usually added into the empirical model

Table 5. OLS estimates.
Dependent variable: Health Care Expenditures per capita, total, 2011

	1	2	3	4
GDP per capita	-1.096*	-0.998*	0.853***	-1.028*
GDP per capita squared	0.109***	0.104***		0.100**
Income elasticity of HCE	0.824	0.844	0.853	0.740
Physical Inactivity level	0.203**	0.159*	0.165*	0.185*
% population above 65 years	0.168*	0.185**	0.168*	0.142
Cigarette consumption	0.187**	0.153*	0.135	0.201*
Alcohol consumption	0.249***	0.200***	0.208***	0.244***
% females employed	-0.425***	-0.291**	-0.244*	-0.402**
Infant mortality rate				-0.097
Physicians (per 1,000)				-0.036
Urban population,%				0.238
Passenger cars (per 1,000)				-0.010
Constant	7.014**	6.288**	-1.902**	9.457*
R-sqr	0.946	0.952	0.935	0.948
dfres	110	110	111	106
BIC	118.6	.	132.2	131.4

* p<0.05, ** p<0.01, *** p<0.001

1 OLS,main specification
2 Robust regression
3 OLS, linear in GDP per capita
4 OLS,the whole set of variables

****Note: All the variables are log transformed*

for Health Care Expenditures. However we consider World data as opposed to the set of OECD countries in other research. Figure 1 also demonstrates quadratic relationship between two variables. Nevertheless, coefficient near logarithm of PI remains close to our final specification (2) (See Table 5, 3).

In the fourth specification (See Table 5, 4) we include additional variables from (1). Coefficient of interest proves to be robust to inclusion additional variables. However, infant mortality rate, number of physicians per 1000 of population have unexpected signs. The reason is that estimates are biased because of high correlation between GDP added variables.

Analysis of residuals is done with the means of univariate kernel density estimation and comparance of quantiles of residuals to quantiles of normal distribution. Verification allows to conclude normal distribution of residuals.

Heteroscedasticity in residuals is not detected neither by graphical tools, nor by common tests. Particularly, White`s and Breush-Pagan tests fail to reject the hypothesis that variance of residuals is homogenous.

Multicollinearity clearly arises. This fact doesn`t spoil model specification as non-perfect collinearity doesn`t contradict to any of OLS assumptions. But this problem motivates as, beside all, to choose model (2) against the model with larger set of explanatory variables.

Chapter 6

CONCLUSION

In this work we perform cross-country comparison of aggregate Health Care Expenditures using data for 118 countries. At the beginning of the thesis we state a hypothesis, that countries that are on average less physically active, would have higher expenditures on health of population than their active neighbors, controlling for income, aging of population, female participation on labor force, prevalence of smoking and alcohol consumption.

Hypothesis is confirmed and the impact of insufficient Physical Activity is robust to inclusion different socio-economic variables like urbanization, infant mortality rate, number of physicians per 1000 of population and infrastructure features (number of passenger cars per 1000 of population). 10% increase in PI level adds nearly 2% to expenditures on Health Care.

Some drawbacks should be mentioned. First, the size of the sample of 118 observations doesn`t allow to perform more sophisticated techniques to insure that result is invariant to changes in year taken. This is explained by the lack of data on Physical Activity, but we believe that this particular feature of life-style is comparatively stable.

In our opinion, explanatory power of the empirical model could be higher, if we could better address the endogeneity problem. Having larger number of observations, the one may compare effects for countries with different level of development and different features of Health Care System. This might give better explanation of our result.

What are the implications of our findings? Physical Activity in our study is a multi-dimensional variable that captures transportation, job-related physical activity, housework, recreation, sports and leisure-time physical activity. Promoting this activities may be a cost-saving and efficient way to healthier nations and equal opportunities.

This study has several advantages compared to previous articles on determinants of HCE. First, we still have larger sample of observations and are able to incorporate not only OECD countries, but developed and developing economies. It should also be mentioned that data is "more comparable" then it was in 80th and 90th. Only in 2000 OECD countries developed the System of Health Accounts and only in 2002-2009 National Health Accounts have been produced in developing countries. That is, we use data obtained through the same process of monitoring flow of money in health sector; this was not possible in most of previous studies of cross-country comparisons.

Second advantage is the capability to incorporate Physical Inactivity level which, in principle, can be seen as "life-style" of the country. Connection between Health Care Expenditures and Physical Inactivity on the macro-level extends the set of tools which can lead countries to the future with healthier population.

We know from the Human Capital theory that more educated people with better access to Medical Services are, on average, healthier. But we also know from the recent studies that difference between more educated wealthier people and people with less years of schooling, lower incomes lies in their "heterogeneity", underlying dissimilarities in their "utility functions". Practically, we can`t guarantee that if person gets additional income or free education, she will necessarily spent money on healthy activities. The result obtained in our empirical study shows additional tools for policy makers in improving life-style of population.

But what does it mean to increase the level of Physical Activity in the country? It means increasing transportation-related PA. Individuals who live in smaller towns, work not far from the place of living will walk more. Cycling infrastructure will also increase PA. It also means that housework, gardening and improving working conditions for physical workers lead to lower demand for medical services. In general, our result confirms the importance of non-medical investments in human health on the macro-level.

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