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THE ROLE OF GOVERNANCE ON PROMOTING LONGER, HEALTHIER LIVES

Empirical Evidence for Developing and Developed Countries

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The role of Governance on promoting longer, healthier Lives – Empirical Evidence for Developing and Developed Countries

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Abstract

After reviewing the literature on efficiency of public health systems we focus on three questions: First, to what extent can the observed substantial progress in the provision of longer and healthier lives during the last 15 years be attributed to economic development? Second, what is the additional effect of total health expenditures and the share of public expenditures thereof on both outcomes of the health system? Third, how is gender-equality in healthiness related to its level? These questions are addressed using a series of cross-section analyses for 165 countries based on data from the Global Burden of Disease Study for 2000 and 2012. Evidence is revealed separately for low-, middle-, and high-income countries and informs policy-making concerning the priority-setting in health system design in order to support the achievement of the sustainable development goals.

Key Words: Health, Quality of life, Human Development, Income, Gender Inequality.
JEL Category: O15, I18, J16

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1. Introduction

Improvement of the health status of a countries' population is considered as one of the major sources of social well-being and economic development. Hence, improving public health is widely accepted as a general goal of public policy, and as a development goal in particular. Its importance is reflected by the fact that three out of eight Millennium Development Goals (MDGs) addressed improvement of health conditions in developing countries. Furthermore, the third goal of the currently discussed set of Sustainable Development Goals (SDGs) calls upon us to: "Ensure healthy lives and promote well-being for all at all ages"[1].

For policy-makers, the question arises on how to achieve these goals under given – scarce-resources. Furthermore, a health system might affect two dimensions of public health: (a) longer lives and (b) healthier lives. In order to provide a sound basis for informed decision-making in health and development policies it is worthwhile to study the possible trade-off between longer and healthier lives and review the currently available evidence on the determinants of public health with respect to the following research questions:

1.) What is the impact of economic development on public health?
2.) What is the additional impact of public and private health expenditures, as an input factor of the health system, on public health, as the main outcome of the health system under given environmental dispositions.
3.) What is the role of health system governance, e.g. gender inequality in the access to health services and education or the improvement of sanitation facilities, on the overall level of public health?

This study adds to the literature in at least three ways. First, we hypothesize that health systems produce life-expectancy and quality of life as joint outcomes and that under given restrictions

[1] see: Open Working Group Proposal for Sustainable Development Goals (OWG, 2013)

there might exist a trade-off in the production of these. Thus, we study the joint distribution of both outcomes for a set of 165 countries.

Second, we analyze the impact of material well-being, proxied by GDP per capita, and total health spending on both health outcomes, by allowing it to be of non-linear nature. Third, we hypothesize that greater equity in the access to and provision of healthcare services should improve both outcomes, ceteris paribus. Hence, we analyze the effect of gender-specific inequality in the health-status and the share of public on total health spending on both health outcomes.

For that purpose, we start reviewing the currently available literature on the topic in chapter 2. In chapter 3 we introduce our conceptual framework including the economic and econometric model and hypotheses derived from our set of research questions. Chapter 4 describes the data used in this study. Chapter 5 presents the main findings and interpretations on the background of the theory. Chapter 6 concludes the study and discusses the policy implications of the study.

2. Literature Review

Efficiency of Health systems

The efficiency of health systems, in terms of relating health expenditures as an input factor to the output and outcomes of the health system, is one of the focal topics of health economics. While a majority of studies from this field is of microeconomic nature, fewer studies offer insights from comparative analyses of different national health systems. Musgrove (1999) defines nine factor criteria to determine the impact of health spending on the overall efficiency of national health systems. Evans et al. (2001) determined the efficiency of health care systems for 191 countries using a stochastic frontier analysis and came to the conclusion that increased public health expenditure alone does not have a very strong impact on the general health of the

population. Rivers (2010) attributed the efficiency of health care systems to the investment being made by each country in preventive treatments.

Aggregate Income and Health Expenditures

Studies from the field of Development Economics provide possible explanations for the yawning health gaps between developed and developing countries by focusing on aspects like inequality of health-care provision (cf. Wagstaff (2002), Jeong and Gunji (1994)), public vs. private health-care provision (cf. Mills (2002)), the lack of medical research (Trouiller et al. (2002)) and the impact of foreign aid and structural adjustment programs in developing countries (cf. Liang and Mirelman (2014), Gottret and Schieber (2006), Kentikelenis et al. (2015)).

Jeong and Gunji (1994) showed that the total health care expenditures are positively associated with a countries GDP per capita. Once this effect is controlled for, they could show in a study of 24 OECD-countries that greater accessibility and equity in the healthcare system also enhances the macroeconomic efficiency of the system. Similar findings were also reported by Potrafke (2010) who estimates that in most developed countries a 1 percent increase in GDP per capita leads to an increase of 0.4 percent in health expenditures. An earlier study by Gerdtham et al. (1998) reported income elasticities of health expenditures that exceed one, for 19 OECD countries between 1974 and 1987.

Besides income, there also exist demographic determinants of health expenditures as Thomas et al. (2009) present evidence that the age of the population directly impacts the health expenditure both in the public and the private sector. In a World Bank study of 42 countries, Adam Wagstaff (2002) showed that as the GDP per capita increases throughout the development process, the inequalities in health also show an upward trend. This trend is not limited to developing countries.

Public Health Systems

Inherent to the discussion of the efficiency of health systems is the debate about public vs. private health care provision (see, e.g. Leu (1986) and Culyer and Jönsson (1986) as cited in Jeong and Gunji (1994), and Gerdtham et. al (1992)).In contrast to the general notion that public health systems seem to be more inefficient than privately managed, Mills et al. (2002) indicate that the quality of private health care provision has always been poor in developing countries, especially in the informal sector. Nonetheless, it is still widely popular because it sometimes can provide services at lower cost than the parallel public system, especially for diseases like tuberculosis and malaria. Developing countries observe considerable amount of overlapping activities between the public and private health sector. The employees of public hospitals also run private clinics; some public hospitals have private wards or visiting staff that charge fee to both the government and the patient. Moreover, the government makes use of private contractors to reach far off areas to provide vaccines and drugs to patients (Mills et al., 2002).

Trouiller et al. (2002) pointed out that the core problem of developing countries lies with the lack of effective medication for infectious diseases, as the pharmaceutical companies only invest in drugs that reap higher returns, leading to deficient market and a public health policy failure especially in the developing countries.

Liang and Mirelman (2014) expressed their conerns about over-dependence of developing countries on external financing for funding their health and welfare projects. Furthermore, developing countries tend to reallocate their resources domestically after receiving financial assistance and so a decrease in public health spending is observed for most countries that are receiving external funds (Gottret and Schieber (2006)). Additionally, some developing countries might be forced to readjust their public health spending patterns because of the conditionality attached to the funds that they are borrowing externally (Kentikelenis, et al., 2015)

Governance

A last group of studies identifies governance, education, gender inequality, sanitation facilities, socio-economic and political factors as determinants in the effectiveness of healthcare provision (cf. Potrafke (2010), Mou (2013), Liang and Mirelman (2014), Cutler and Muney (2006)).

Potrafke (2010) presents evidence from a sample of 18 OECD countries between 1971 and 2004 that most of the governments tend to increase their budget on public health and education expenditure right before the elections. Mou (2013) showed that the ideology of the elected government also has an effect on the total public expenditure on health. The more left leaning the ideological values of the government, the higher is the share of public health expenditure in the total budget. Furthermore, it was shown that larger income inequalities and larger shares of aging population, coincide with smaller shares of public health expenditures on total health expenditures (Mou, 2013).

Based on a survey of the literature and empirical evidence, Cutler and Lleras-Muney (2006) identified the common finding that an increase in education causes the life expectancy to improve, especially in poorer countries. Increased education has greater impact on women in reducing sicknesses like depression and obesity while with respect to reduction of drinking and smoking it has a higher impact on men. While discussing the penalties of gender inequality on health, Osmani and Sen (2003) indicated that deprivation of proper healthcare facilities for women rebounds on the entire society in the form of unhealthy off-springs; this leads to additional economic costs of overlapping health problems in the young generations.

With respect to other health mitigating factors, Bouabid and Louis (2015) pointed out that more than 40 percent of the world's population lacks access to proper sanitation facilites and adequate water supplies. Cronka et al. (2015) found that lack of proper sanitation facilities and unhygenic living conditions in schools, work places and health care insititutions have a large impact on the education, health and productivity of the people especially in low and middle income countries. Unfortunately, the indicators for measuring saniation and hygiene related factors

have been poorly defined by international authories and are usually non comparable among countries. If proper monitoring and data collection systems are implemented in this field, the cost effectivness and efficiency of health care systems could be significantly improved (Cronka, Slaymaker, & Bartram, 2015).

Summary

With respect to our research questions, we can summarize that the literature finds a positive correlation of the GDP level and the overall health status of a countries' population. Partly, this might be due to increased relative and absolute Health Expenditures of the more developped countries. Inequality in income distribution seems to be translated into inequality in health outcomes, and lower inequality seems to support the macroeconomic efficiency of the health system. With respect to the efficiency of public vs. private health systems the literature is inconclusive. While most of the empirical evidence is derived from developped countries, evidence for developping countries is scarce, but there are indications that the effectiveness of the health system correlates with the development stage of the country. With respect to health mitigating factors we see clear evidence for the positive influence of education and improvement of sanitation facilities on health outcomes and adverse effects of gender inequality.

3. Conceptual Framework

For the analysis of our research questions, we are focusing on the macro-economic aspects of health. We assume that the Health Status (HS) of the population can be described by mortality (quantitative dimension) and morbidity (qualitative dimension). Furthermore, we assume that this health status is affected by the material well-being of the country (e.g. proxied by GDP per capita), the provision of health care (HC) services (e.g. proxied by health expenditures and governance), education and sanitation, just to focus on the most important amongst others. The

relationship between the health status and its determinants can described by a joint-health production function:

$$HS = \begin{pmatrix} Morbidity \\ Mortality \end{pmatrix} = \text{f}(\text{GDPp.c.}, \text{HC} - \text{inputs}, \text{education}, \text{sanitation})$$

Measuring health status

For the purpose of statistical analysis, mortality is customarily proxied and measured by crude death rates, mortality rates of specific population groups (e.g. under 5-years old, or elderly), or life expectancy at birth. Here data is widely available, due to ease of measurement and mandatory registers in most countries. The second health dimension, morbidity, describes the extent of disability a person suffers as a consequence of an injury or disease. In contrast, it is harder to measure, since it involves many aspects, like the severity, duration and the clear attribution of consequences to a disease or injury. When it comes to severity, a normative judgement is usually needed, since it is near to impossible to quantify and directly compare the sufferings of two persons under two diseases.

Health Science has developed several summary measures in order to describe mortality and morbidity simultaneously. Most of these measures seek to find a correction or adjustment to the observable or estimated number of (remaining) life-years. Such Health-adjusted-life-year measures (HALYs) enable comparisons across families of diseases, treatments, or health systems and countries. For the purpose of cost-effectiveness studies in Health Economics the quality adjusted life years (QALYs) concept has been developed in the late 1960s. In the early 1990s joint efforts of World Bank and World Health Organization led to the development of Disability-adjusted life years (DALYs) that quantify the burden of nonfatal health outcomes and diseases and thus facilitate such considerations in international debates on public health. (For a systematic overview, comparison, and discussion of these measures, see Gold et. al (2002))

These DALYs have been estimated within several Global Burden of Disease Studies, compiled by WHO (2013) and are publicly available on WHOs website.

The DALYs measure the aggregate life-quality lost and number of life-years lost due to an incident. The quality-adjustment is performed by disability weights which are normalized on a scale from zero to one, where one is an indication of death while zero means perfect health. The DALY-value is the sum of years of life lost due to premature mortality (YLL) and years of life lost due to disability (YLD).

$$DALY = YLL + YLD$$

The formula for both these terms is:

$$YLL = N \times L$$

(with: *N = number of deaths due to cause c at a given age a and sex s in time t, L= standard loss function specifying years of life loss for a death at age a for sex s)*

$$YLD = I \times DW \times L$$

(with: *I= number of incidents; DW = disability weight of cause, L= average duration of the cause until death)*

DALY maps the two Health dimensions into a single number and thus reduces complexity but it might also be interesting to analyze YLL and YLD separately. DALYs are separately available for an incidence (disease, injury), country, gender, and age-groups. In order to make the DALY measure comparable it must be divided by the size of the relevant population and is typically expressed in “life-years lost per 1.000 citizens”.

The DALY index was criticized on the grounds that it gave different weights based on gender and age and it discounted the future years of life lost. WHO responded to this critique by a major revision of the DALY estimates for the year 2012. (For a detailed discussion see WHO (2013)). As an unwanted by-product of this major change in the estimation methods between

2000 and 2012, the DALYs for these two years are not comparable and thus have to be analyzed separately.

Empirical Strategy

Based on our considerations above, we apply a cross-country analysis of DALY-data for the reported years 2000 and 2012 for up to 165 countries. We use a series of OLS regressions in order to identify correlations between several health measures and its explanatory covariates. We formulate the following econometric model, for country *i* (1…165) in year *j* (2000, 2012):

$$\begin{bmatrix} DALY \\ YLL \\ YLD \\ \Delta\big(standard(YLL - YLD)\big) \\ LifeExp \end{bmatrix} =$$

$$= \alpha + [\beta_1, \beta_2] \begin{bmatrix} GDPpc \\ GDPpc^2 \end{bmatrix} + [\beta_3 \dots \beta_7] \begin{bmatrix} HExp \\ HExp^2 \\ PubHExp \\ PubHExp^2 \\ GGap(DALY) \end{bmatrix}$$

$$+ [\beta_8, \beta_9] \begin{bmatrix} SE1 \\ GGap(SE1) \end{bmatrix} + \beta_{10} Sanit + \varepsilon$$

with:
DALY = disability adjusted life years lost
YLL = life-years lost due to pre-mature death
YLD = life-years lost due to disability
$\Delta standard(YLL - YLD) = \frac{YLL - \mu_{YLL}}{\sigma_{YLL}} - \frac{YLD - \mu_{YLD}}{\sigma_{YLD}}$
LifeExp = life expectancy
GDPpc = GDP per capita, PPP, in 2011 international US-Dollar; and squared
HExp = Total Health Expenditures per capita, PPP, in 2011 international US-Dollar; and its square
PubHExp = share of public health expenditures on total health expenditures
GGap(DALY) = gender gap in DALYs, i.e. DALY(females) – DALY (males)
SE1 = primary school enrollment rate
GGap(SE1) = SE1(boys) – SE1(girls)
Sanit = Improved sanitation facilities in %
$\alpha = constant, \beta_1 \dots \beta_{10} = regression\ coefficients, \varepsilon = error\ term$

The regressions are performed separately for each of the 5 dependent variables. We hypothesize that there are structural differences between developed and developing countries. Thus, we divide our sample into 3 income groups: LIC (low income countries), MIC (lower- and upper-middle income countries) and HIC (high income countries). The income categorization bases upon the World Bank definition of the year 2000, and is kept constant for 2012 in order to prevent changes in sample sizes due to self-selection in other income groups and to ease comparisons. Subsequent to a year-specific pooled regression, we test the effects of the determinants of life-length and quality of life for each income group separately and compare its results.

In order to evaluate the robustness of possible effects and correlations, we start estimating a sparse model with the logged GDP per capita, logged Health Expenditures, and the share of Public on total health expenditures, only (model 1). Then we stepwise augment the model by the other covariates until we estimate the presented full model above (model 7).

We allow for non-linear effects of GDP per capita, total Health Expenditures per capita, and the share of Public health expenditures on the dimensions of the health status, by estimating a polynomial of second order. Based on the estimated regression coefficients, we calculate the Extrema (minimum or maximum) of the effect.

Hypothesis Tests

Besides the standard regression diagnostics, we provide F-Tests on joint significance for the coefficients of the quadratic specification.

Since we assume that the heterogeneity in the data might be dependent with the state of development of a country, i.e. dependent on income, we perform a Breusch-Pagan test on heteroskedasticty after each regression. The null-hypothesis of this test is that the error term is homoskedastic. (Breusch and Pagan (1979))

Since, as expected, many test results support our assumption of Heteroskedasticity, we correct the estimated variance-covariance as proposed by White (1980) and report robust standard errors throughout the regression results tables in chapter 5.

4. Data

The data for DALY, YLL and YLD were retrieved from the World Health Organization's study on "*Global Burden of Disease Estimates 2000 – 2012*" (WHO 2013). In order to allow for cross-country comparisons, we divided the country-wise values by population size and multiplied by 1000 in order to get the variables total disability adjusted life years lost (DALY), life years lost due to premature death (YLL) and life years lost due to disabilitiy (YLD) per 1.000 citizens respectively. The values of DALY index were published in May 2014 and were calculated based on the population estimates of 2012 of the UN World Population Prospects and the estimates of Global burden of diseases 2010.

The grouping of the countries based on their income levels was done using the World Bank's defintion for the year 2000 of low income (LIC), lower middle income (LMC), upper middle income (UMC) and high income (HIC) countries (see Appendix, table A2).

The data for GDP per capita, health expenditure per capita, public health expenditure as a percentage of total health expantiure, life expectancy and improved sanitation facilities were retrieved from the World Development Indicators of the World Bank (2014). Data for school enrollment rates and gender specific enrollment rates were collected from UNESCO database (UNESCO 2015). There was large number of missing values for school enrollment rates and gender specific enrollment rates, therefore average of 1999 to 2006 was taken as standard values for the year 2000 and average of 2007 to 2013 was taken as standard values for the year 2012 for both variables; this method increased the total number of observations by approximately 17% for the year 2000 (from 111 observations to 140 observations) and by 20% for the year 2012 (from 111 observations to 146 observations). See table A2 in the appendix for missings

per variable. The gender gaps in primary school enrollment and DALY were calculated as differences of respective gender-specific variables.

The data shows that substantial progress has been achieved in terms of improving life expectancy and disability adjusted life-years between 2000 and 2012. The strongest progress in both domains can be seen for low income and lower middle income countries. This goes along with increases in total health expenditures and the share of public health expenditures and a reduction of gender-specific inequalities in the DALYs. The primary school enrollment rates and the gender inequality in education have seen substantial improvement between 2000 and 2012 as well especially for low income countries, while sanitation conditions could need further improvement in these countries (see table 1).

(- Insert table 1 around here -)

Figures 1 and 2 show the deviation of countries from the average years of life lost due to pre-mature mortality (YLL) and years of life lost due to disability (YLD) per 1.000 citizens for the years 2000 (figure 1) and 2012 (figure 2). Both indicate that people living in LICs face greater chances of pre-mature death compared to the UMCs and HICs. Surprisingly, UMCs and HICs do not differ substantially in deviating from the average YLL; countries of both income groups are by majority scattered between -200 to -300 YLLs below average. With regards to YLDs, the majority of both countries is located between +/-20 YLDs compared to average. There is no substantial change in this pattern in 2012, besides the observation that LICs have significantly reduced YLLs.

(- Insert figures 1 and 2 around here -)

This observation is also supported by figure 3 which presents the difference for YLLs and YLDs for each country between 2000 and 2012. Nearly all countries have reduced their YLLs, with highest reductions of LICs and LMCs. The results concerning the change in YLDs should be interpreted with caution, since WHO has removed disability weights from the calculation and thus a good share of the increasing trend in YLDs might be due to this methodological change.

(- Insert figure 3 around here -)

5. Results

Health and Development

Our first research question addresses the impact of economic development on a populations' health status. Hence, we proxy economic development with the aggregate income of a country, i.e. GDP per capita with adjusted purchasing power parity and expressed in 2011 international US-Dollar. In model specification no. 1, we include the log GDP per capita as a regressor of the health status, changing the functional form into a linear-log model, which allows us to interpret the regression coefficient as the absolute change in the dependent variable at a 1% change of GDPp.c. at the sample mean. Table 2a) presents the regression results for all 7 model specifications, for a pooled regression of all 163 countries in the sample, for the year 2000 and table 2b) for 2012 respectively.

(- Insert table 2a around here -)

In both years, we can see that GDPp.c. is associated with a significant decrease in the DALY per 1.000 for a 1% change of GDPp.c., i.e. 145 USD at a mean of 14,497 USD. In 2000, such income increase would reduce the DALYs by 210 years per 1.000. In other words, an increase of 1% in per capita GDP would increase the disability weighted life-years of every individual by 0.21 years, or 0.098 years in 2012 respectively. On average, increasing the life of the citizens by one disability-adjusted life year would have been associated with 1/0.21*145 = 690 US-Dollar in GDPp.c. in 2000 and 1.765 USD in 2012. Both results are significant at the 1%-level of significance.

Next, we hypothesize that aggregate income might have a non-linear effect on Health, in such a way that increasing income increases health up to a maximum and after the inflection, increasing income would lead to decreasing health status due to increasing health deficiencies. Such observations are frequently reported in epidemiological studies of high-income countries, where this effect is attributed to lifestyle diseases like obesity, depressions, etc.

In order to test this hypothesis, we included the absolute GDPp.c. and its square as regressors in model specifications 2-7. We tested for joint significance using an F-Test and calculated the extrema (minimum or maximum) to evaluate the inflection. The regression results for model specifications 2-5 support our hypothesis: we find maximum positive impact of GDPp.c. on the health status (i.e. a minimum on DALYs) for GDP-levels of approx. 62,000-67,000 USD per capita in 2000 (see table 2a) and approx. 69,000-77,600 USD per capita in 2012 (see table 2b). The coefficients of this polynomial of 2nd order are jointly significant at significance levels of less than 5%. The results change, as soon as the model controls for education (see specifications 6 and 7): in 2000 the income effect becomes insignificant and in the 2012 regression the maximum reduces to approx. 57,400 – 58,300 USD.

(- Insert table 2b around here -)

Table 3 presents the regression results of the full model no. 7 separately for the three income groups LICs, MICs and HICs for 2000 and 2012. Here the income effect is mostly insignificant, only for middle-income countries in 2000 it finds a maximum at a reasonable level of 24,407 USD being significant at the 5%-level.

(- Insert table 3 around here -)

As discussed before, the DALYs are an additively combined summary measure of two underlying health dimensions YLL (life-years lost due to premature death) and YLD (life years with disabilities). Since we assumed a joint-health-production function that might affect both dimensions jointly, we regress our set of independent variables also on measures for both dimensions separately in order to allow for an asymmetric impact on the dimensions that would not be observable in the added values. To identify the impact of possible health determinant on life-length, we first regress our model on life expectancy at birth. Tables 4a) and 4b) summarize the signs and significance of the regressions coefficients for the models 1-7 for all countries in 2000 and 2012 respectively, and compare these with those from the DALY-regressions before. Since life-expectancy is defined opposite to DALYs (i.e. as a gain in life-years, while DALYs display loss of life-years) we would expect negative significant coefficients in the one regression (e.g. '- - -' for negative coefficients significant at 1% level) coincide with positive significant coefficients (e.g. '+ + +') in the other and vice-versa. With respect to the linear-log effect of GDP in model 1 we do not see any significant effects on life-expectancy. For the quadratic income specification of models 2-5 we see the expected opposite significant coefficients in both years 2000 and 2012. Again, this changes when it comes to the specifications 6 and 7, where we do not see any significant impact of GDPp.c. on LE in model 7. The (non-reported) GDPp.c.-levels that maximize life expectancy vary between with vary between approx. 55' and 66' USD.

(- Insert tables 4a and 4b around here -)

For a second approach to evaluate possible asymmetric effects of the determinants of health, we standardized YLL and YLD and calculated the difference between both variables (YLLD.diff = standardized(YLL) - standardized(YLD)). Whenever YLLD.diff is positive, then YLD is relatively higher than YLL, compared to its respective average. Table 5 presents the regression results of the full model no. 7 separately for income groups and years 2000 and 2012. Again, we do not see any significant effects of GDP per capita and its square, implying a similar effect of GDP on both measures, YLL and YLD. For model 1, we find a significant positive effect of log-GDPp.c. in the HIC sub-sample (not reported in the tables), implying that aggregate income impacts YLD to a higher extent positively than YLL, or YLL to a higher extent negatively than YLD. The latter result corroborates our earlier finding that with increasing income the DALYs reduce, while there is no significant effect on life expectancy.

(- Insert table 5 around here -)

Health Expenditures

Our second research question addresses the additional effect of health expenditures (per capita in 2011 international US-Dollars), on the health status. For that reason, we include logged total health expenditures in model 1 but find no significant effect, neither in 2000 nor in 2012 (see tables 2a and 2b). Similar to aggregate income, we hypothesize that health expenditures might have a non-linear effect on health. Thus we include a quadratic specification in models 3-7. Nonetheless, we nearly find no jointly significant impact of total health expenditures on the DALYs. Only in 2012 we find a joint effect, significant at 10%-level, when controlling for

education in specification 7. Unfortunately, it is of inverse shape, increasing DALYs with increasing expenditures up to maximum of 6.985 USD per capita.

With respect to life expectancy, we find the expected result throughout all model specifications and years for all countries (see table 4 a and b): an inverse U-shaped effect of health expenditures on life expectancy, increasing the life expectancy with increasing expenditures up to a maximum at approx. 2.300-3.000 USD per capita in 2000 and 4.600 – 5.600 USD per capita in 2012 (not reported in tables). Table 4c) reveals that this finding is mostly driven by high income countries in 2000 and 2012, since the effect is insignificant for LICs and MICs. From table 5 we can see that health expenditures also do not impose any asymmetric effect on any of the two health dimensions. Only with respect to HICs in 2012 we can see a small positively significant effect of health expenditures on health, implying a little stronger negative effect on YLLs than on YLDs, which again is in line with the abovementioned findings concerning DALY and life expectancy.

Furthermore, we hypothesize that the type of the health system (public or private) might have an influence on the health status of the citizens. Thus, we proxy the health system type by the share of public health expenditures on total health expenditures and include it as a linear regressor in models 1 and 2 and in its quadratic form in models 3-7. However, we do not find any significant effects on DALYs and on life expectancy only when controlling for education in specifications 6 and 7 in both years. Here the effect is such that an increasing share of public health expenditures reduces life expectancy until it reaches minimum life expectancy at a share of 0.75 (model 6) or 0.9 (model 7) in 2000, or 0.78 and 0.65 in 2012 respectively. Public shares of health expenditures exceeding these minima, are associated with increasing life expectancies. It seems that peoples' health give a preference to either mostly private or mostly public health systems, while mixed forms seem to be disadvantageous.

Governance

Our third research question addresses the role of governance in the health and education system and health related public infrastructure. Thus we include an indicator for gender inequality in the DALYs (as difference between female – male specific DALYs) in model specifications 4-7. Additionally, we hypothesize that private health system might enhance the effects of gender inequality. Hence, we include an interaction term of share of private health expenditures * gender gap in DALYs. We only find small evidence that gender inequality has a negative impact on the overall health status. However, we can see a significant negative effect of the private-inequality-interaction on public health (i.e. positive on DALYs and negative on LE).

As a proxy for education, we include the primary school enrollment rates (as %-share of total children of the relevant age) and the gender gap in school enrollment, as the difference of the percentage of enrolled boys minus girls (i.e. positive values denote a boys surplus) in model specifications 6 and 7. Here, we find the expected strong effects of school enrollment (negative on DALYs and positive on LE) and on the schooling-inequality (positive on DALYs and negative on LE). (See tables 2, 3, and 4). We do not find strong evidence that these variables affect the two health dimensions asymmetrically. (See table 5)

Lastly, we include the share of improved sanitation facilities (%) as an explanatory variable in model 7. In line with findings from earlier studies, we see a significant positive effect on health (i.e. negative on DALYs, positive on LE) in both years. Additionally, we can identify a slightly asymmetric effect on both health dimensions, with the tendency to reduce the YLDs (years lived with disabilities) stronger than reducing the years lost due to pre-mature death (YLL).

6. Conclusion

The common finding that the health status of the population is highly dependent on the development stage or aggregate income of the country is supported throughout the various analyses of this study. However, the effect seems to get weaker, as soon as it is controlled for

other tangible and intangible assets that impact on the capability of the people, like education and sanitation facilities. Health systems that are well equipped with financial resources tend to increase life expectancy but don´t seem to increase the quality of life dimension. Both effects of aggregate income and total health expenditures are of non-linear type. Furthermore, Gender inequality in health access might be slightly enhanced by private health systems and then be associated with lower overall health. The strongest positive effects on public health could be reported for school enrollment and share of improved sanitation facilities. With respect to education, the presented results need to be treated with caution, since education and health might be endogenous, as it is quite often reported in the literature. Corresponding empirical modelling and analysis is subject to further investigation.

We conclude from these results that policy makers should not aim only at the increase of healthcare spending but need to consider the institutional development of the healthcare system and progress in other areas as well. Furthermore, the outcomes of the health system cannot be maximized by increasing the inputs since there exist maxima in the marginal productivity of health spending and areas with decreasing returns. In a similar vein, a greater share of public health provision does not improve quality of life and life length itself. It is more important to reduce inequalities in the access to and provision of health and educational services as well as investing in the public infrastructure in order to support longer and healthier lives of the citizens.

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Table 1 Outcomes of the health system and its (possible) input factors (averages), separately for LICs, LMCs, UMCs, and HICs in 2000 and 2012.

Arithmetic mean for:		All, 2000	All, 2012	LIC 2000	LIC 2012	LMC 2000	LMC 2012	UMC 2000	UMC 2012	HIC 2000	HIC 2012
Outcomes	Life Expectancy (years)	66.1	69.8	56.3	61.0	68.6	71.6	71.3	74.1	77.6	80.5
	DALYs, all causes per 1.000 citizens	550.8	426.5	877.0	609.8	405.8	356.7	355.2	317.5	270.7	250.8
	DALYs, all causes per 1.000 women	512	394.5	831.0	575.6	362.9	316.9	320.24	284.4	249.3	235.9
	DALYs, all causes per 1.000 men	590.9	459.6	924.1	644.7	450.5	398.2	391.6	352.1	292.6	266.4
	Difference in DALYs btw. men and women	78.8	65.0	94.1	69.1	87.5	81.2	71.3	67.7	43.3	30.4
	YLLs per 1.000 citizens	443.3	316.3	768.3	501.9	300.2	246.1	248.4	204.6	162.5	138.8
	YLDs per 1.000 citizens	107.5	110.3	108.8	108.0	105.7	110.7	106.9	113.0	108.2	112.0
Input factors	GDP per capita, PPP (constant 2011 US $)	14,497	17,297	2,114	3,365	7,614	11,810	18,586	23,559	44,288	47,089
	Total health expenditures per capita, PPP (constant 2011 US $)	654	1220	78	183	308	747	737	1,425	2,183	3,766
	Share of health expenditures on GDP (%)	4.5	7.0	3.7	5.4	4.0	6.3	3.9	6.0	4.9	7.9
	Share of public health expenditures on total health expenditures (%)	54.0	57.4	40.0	45.3	57.2	60.9	59.6	61.5	70.7	72.1
	School Enrollment rates, total	84.5	88.6	68.9	80.5	89.7	90.4	92.2	93.8	96.7	96.9
	Difference in School enrollment rates btw. boys and girls (boys surplus)	3.1	1.6	7.6	3.7	1.7	0.6	0.04	0.2	-0.2	-0.05
	Improved Sanitation facilities	66.38	71.1	35.9	43.0	75.2	81.8	87.6	90.3	99.3	99.6
N		172	172	65	65	48	48	27	27	32	32

Sources: Own calculations based on WHO, 2013. *WHO Methods and Data sources for Global Burden of Disease Estimates 2000 - 2011,* Geneva: Department of Health Statistics and Information Systems WHO & World Development Indicators, 2000- 2012. The World Bank & United Nations Educational, Scientific and Cultural Organization, 1999 – 2013. The United Nations.

Notes: LIC = low income countries LMC = lower middle income countries, UMC = upper middle income countries, HIC = high income countries; Definitions of the World Bank for the base year 2000 apply.

Figure 1 Deviation of YLLs and YLDs from average by income group 2000

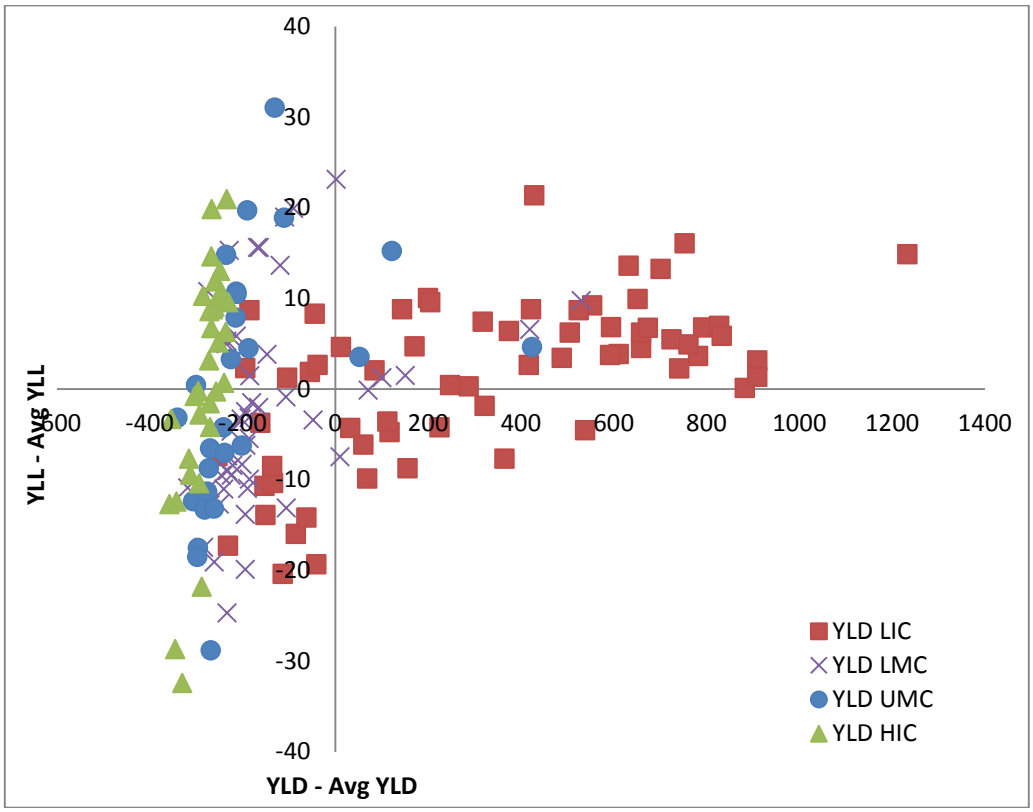

Figure 2 Deviation of YLLs and YLDs from average by income group 2012

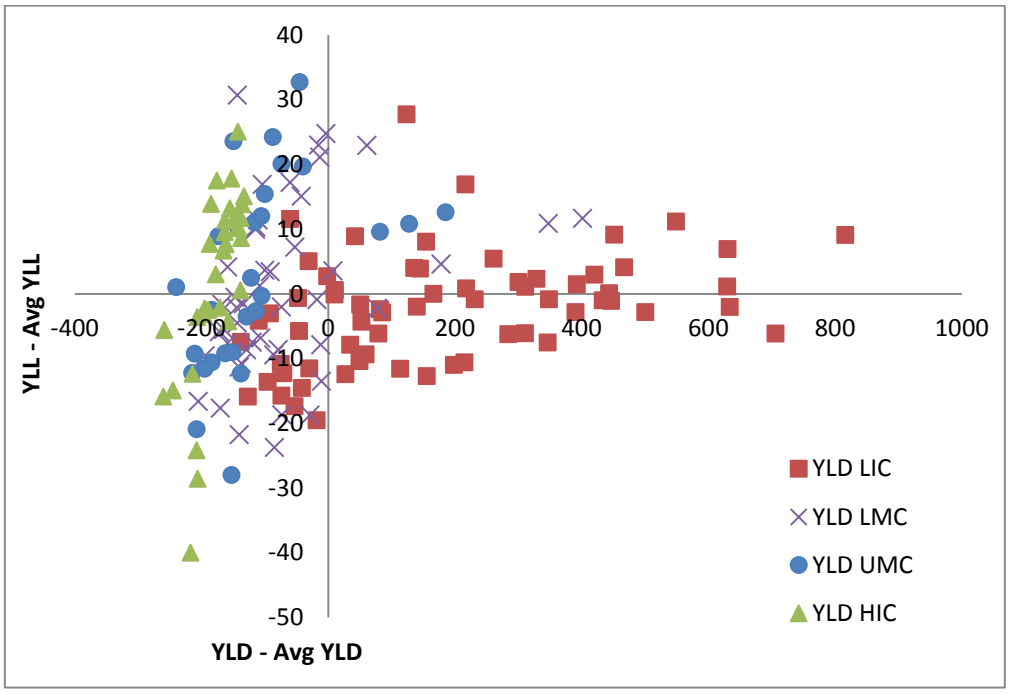

Figure 3 First difference (FD) in YLLs and YLDs between 2000 and 2012 by income group

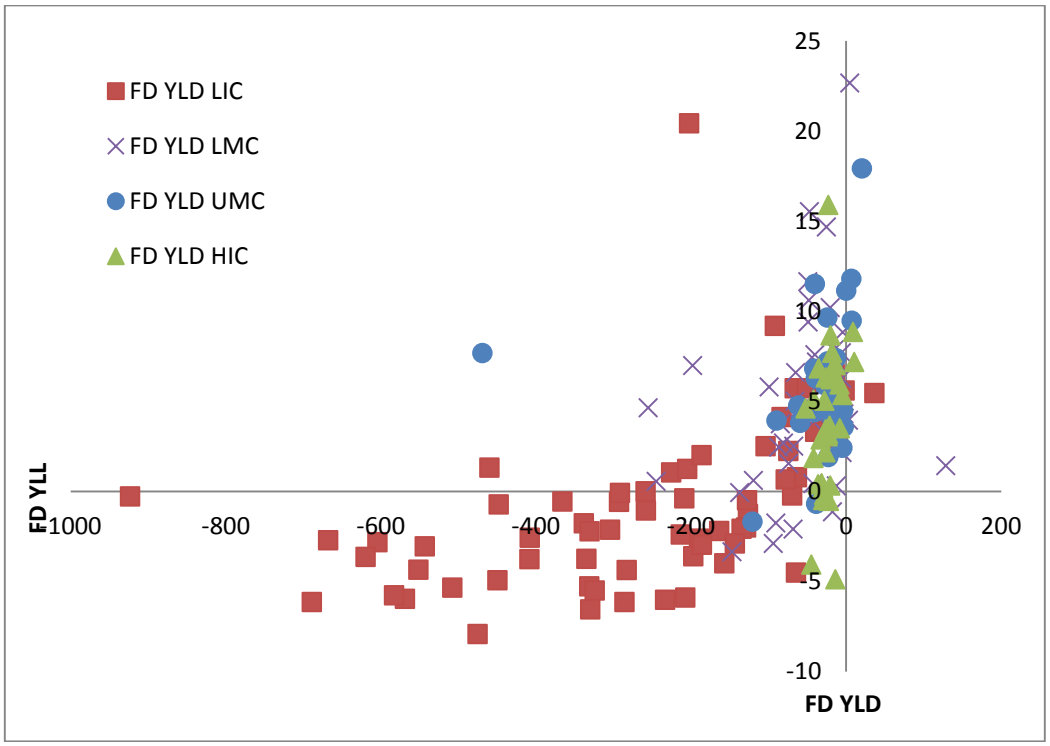

Table 2a) Determinants of disability adjusted life years lost (DALY) for all countries, 2000

	Dependent Variable: DALY.per.1000, year: 2000						
Variables:	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Log GDP per capita	-210.4927***						
	(49.8401)						
Log Health Expenditure per capita	2.6947						
	(45.3719)						
GDP per capita		-0.0203***	-0.0201***	-0.0197***	-0.0187***	-0.0062	-0.0007
		(0.0025)	*(0.0053)*	*(0.0053)*	*(0.0047)*	*(0.0043)*	*(0.0039)*
GDP per capita^2		0.000000***	0.000000***	0.000000***	0.000000***	0.000000	-0.0000
		(0.000000)	*(0.000000)*	*(0.000000)*	*(0.000000)*	*(0.000000)*	*(0.000000)*
Health Expenditure per capita			-0.1257	-0.1144	-0.1569	-0.0083	0.0462
			(0.1163)	*(0.1174)*	*(0.1046)*	*(0.0769)*	*(0.0806)*
Health Expenditure per capita^2			0.00005*	0.00004*	0.0001**	0.00001	-0.000002
			(0.00003)	*(0.00003)*	*(0.00002)*	*(0.00001)*	*(0.00001)*
Public Health expenditure (% total health expenditure)	15.3182	-257.3625**	-356.7118	-400.2355	266.7191	853.2864**	604.6083
	(117.7029)	*(122.4468)*	*(606.3382)*	*(595.9799)*	*(572.6521)*	*(422.0767)*	*(406.1670)*
Public Health expenditure^2			144.0380	173.7275	9.5973	-469.1104*	-283.5451
			(514.5804)	*(504.0611)*	*(462.2577)*	*(275.5166)*	*(258.2486)*
Gender inequality for DALY				0.4762*	-2.6171***	-1.3693	-0.6552
				(0.2888)	*(0.9181)*	*(1.1856)*	*(1.1277)*
Interaction btw private health expenditure & gender inequality in DALY					5.9265***	4.4611*	3.8981*
					(1.7150)	(2.4478)	(2.2555)
School enrollment rates						-13.2042***	-9.9649***
						(2.1170)	*(2.2615)*
Gender inequality school enrollment rates						6.0965	3.1701
						(4.0089)	*(3.9874)*
Improved sanitation facilities							-4.2227***
							(1.2986)
Constant	2,377.7990***	882.8848***	916.7708***	881.9342***	612.5388***	1,320.6030***	1,305.7910***
	(237.0606)	*(75.8238)*	*(161.6415)*	*(159.2488)*	*(167.3100)*	*(236.6337)*	*(207.5063)*
Observations	163	163	163	163	163	131	129
Adjusted R^2	0.5498	0.3530	0.3637	0.3670	0.3882	0.6945	0.7289
F Statistic	66.95***(df=3;159)	30.46***(df=3;159)	16.43***(df=6;156)	14.41***(df=7;155)	13.85***(df=8;154)	30.55***(df=10;120)	32.27***(df=11;117)
Breusch-Pagan test	17.37,df=3,p=0.00	27.79,df=3,p=0.00	28.59,df=6,p=0.00	27.85,df=7,p=0.00	26.96,df=8,p=0.00	20.05,df=10,p=0.02	17.64,df=11,p=0.09

F-Tests on joint significance and extrema						
I(GDP.per.capita2)						
Extrema	61994.70	63777.69	62838.76	66969.60	99713.06	-40960.13
F-test	68.01, 0.00*** (df= 1;159)	14.54, 0.00 *** (df= 1;156)	13.59,0.00*** (df = 1;155)	15.55,0.00 *** (df= 1;154)	2.10, 0.14 (df=1;120)	0.02, 0.86 (df= 1;117)
I(Health.Exp2)						
Extrema			1352.09	1540.46	352.60	9578.48
F-test			1.16,0.28(df= 1; 156)	2.24,0.13(df = 1;154)	0.01, 0.91(df= 1;120)	0.32,0.56(df= 1;117)
I(Public.Health.exp2)						
Extrema				-13.89	0.90	1.06
F-test				1.63, 0.20(df=1;154)	2.79, 0.09* (df=1;120)	2.11, 0.14(df= 1;117)

Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 2b) Determinants of disability adjusted life years lost (DALY) for all countries, 2012

	Dependent Variable: DALY.per.1000, year 2012						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Log GDP per capita	-97.1091***						
	(36.7210)						
Log Health Expenditure per capita	-27.3653						
	(34.1965)						
GDP per capita		-0.0118***	-0.0100***	-0.0100***	-0.0098***	-0.0114***	-0.0064**
		(0.0017)	*(0.0032)*	*(0.0033)*	*(0.0033)*	*(0.0039)*	*(0.0027)*
GDP per capita^2		0.000000***	0.000000**	0.000000**	0.000000***	0.000000**	0.000000**
		(0.000000)	*(0.000000)*	*(0.000000)*	*(0.000000)*	*(0.000000)*	*(0.000000)*
Health Expenditure per capita			-0.0611	-0.0599	-0.0557	0.0340	0.0686***
			(0.0408)	*(0.0411)*	*(0.0418)*	*(0.0321)*	*(0.0266)*
Health Expenditure per capita^2			0.00001**	0.00001**	0.00001*	-0.000001	-0.000005*
			(0.000005)	*(0.00001)*	*(0.00001)*	*(0.000003)*	*(0.000003)*
Public Health expenditure (% total health expenditure)	19.4182	-71.5552	-593.1024	-643.7831	-990.9445	506.2546	674.0196*
	(93.5583)	*(99.4429)*	*(546.3280)*	*(544.2145)*	*(621.3315)*	*(418.8863)*	*(405.9511)*
Public Health expenditure^2			510.7110	553.3021	596.9314	-346.7221	-599.3380*
			(469.6956)	*(467.6204)*	*(448.6395)*	*(352.8840)*	*(347.1061)*
Gender inequality for DALY				0.3181	2.3254**	0.6785	1.1062*
				(0.3466)	*(1.1070)*	*(0.5844)*	*(0.6048)*
Interaction btw private health expenditure & gender inequality in DALY					-4.8107*	0.5210	0.1262
					(2.8951)	*(1.5802)*	*(1.5482)*
School enrollment rates						-7.2341***	-3.0454**
						(1.7323)	*(1.3585)*
Gender inequality school enrollment rates						13.2236***	11.0873***
						(4.2361)	*(4.0556)*
Improved sanitation facilities							-3.9166***
							(0.5859)
Constant	1,471.6730***	613.9226***	745.7011***	736.6627***	916.6448***	910.3368***	715.5224***
	(151.7059)	*(57.3131)*	*(151.5064)*	*(157.2551)*	*(218.8977)*	*(209.4717)*	*(180.6299)*
Observations	165	165	165	165	165	141	130
Adjusted R^2	0.4839	0.3400	0.3562	0.3551	0.3655	0.5988	0.7011
F Statistic	52.26***(df=3;161)	29.15***(df=3;161)	16.12***(df=6;158)	13.90***(df=7;157)	12.80***(df=8;156)	21.89***(df=10;130)	28.50***(df=11;118)
Breusch-Pagan test	17.37,df=3,p=0.00***	7.79,df =3, p=0.00***	28.59,df=6,p=0.00***	27.85,df=7,p=0.00***	26.96,df=8,p=0.00***	20.05,df=10,p= 0.02**	17.64,df=11,p=0.09*

F-Tests on joint significance and extrema						
I(GDP.per.capita2)						
Extrema	71908.27	77597.50	75250.83	69118.35	58333.55	57.383.49
F-test	46.92, 0.00 *** (df=1;162)	9.41, 0.01 ** (df=1;158)	9.345, 0.01 ** (df= 1;157)	8.91, 0.01 ** (df=1;156)	8.48, 0.01** (df=1;130)	5.78, 0.02** (df=1;118)
I(Health.Exp2)						
Extrema		3040.16	2962.64	2905.28	22447.04	6984,73
F-test		2.24, 0.13(df=1;158)	2.13, 0.15(df=1;158)	1.77, 0.18(df=1;156)	0.01, 0.29(df= 1;130)	6.65, 0.01*(df=1;118)
I(Public.Health.exp2)						
Extrema		0.58	0.58	0.83	0.73	0.56
F-test		0.45, 0.50(df=1;158)	0.54, 0.46(df=1;158)	2.54, 0.11 (df= 1;156)	1.07, 0.30(df=1;130)	0.26, 0.61 (df=1;118)

Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 3 Determinants of disability adjusted life years lost (DALY), Model 7 (full model), for all countries by income group, 2000 & 2012

Dependent Variable: DALY.per.1000 for years 2000 and 2012 by income group						
	LIC 2000	**MIC 2000**	**HIC 2000**	**LIC 2012**	**MIC 2012**	**HIC 2012**
GDP per capita	-0.2063	0.0285**	0.0003	-0.0182	-0.0026	-0.0018
	(0.2296)	*(0.0121)*	*(0.0025)*	*(0.0421)*	*(0.0076)*	*(0.0020)*
GDP.per.capita^2	0.00002	-0.000001**	-0.0000	0.000001	0.0000	0.0000
	(0.00003)	*(0.000000)*	*(0.000000)*	*(0.000003)*	*(0.000000)*	*(0.000000)*
Health Expenditure	3.6707	-0.1312	0.0194	0.1303	0.1185	0.0245*
	(5.5963)	*(0.3209)*	*(0.0567)*	*(1.0319)*	*(0.1149)*	*(0.0140)*
Health.Expenditure^2	-0.0139	0.000002	-0.000002	-0.0004	-0.00003	-0.000001
	(0.0194)	*(0.0002)*	*(0.00001)*	*(0.0013)*	*(0.00003)*	*(0.000001)*
Public Health expenditure	872.1150	1,034.2120*	-484.7706	1,003.9910	245.7974	570.2192
	(720.9343)	*(617.2959)*	*(671.0853)*	*(739.9245)*	*(515.2894)*	*(352.6127)*
Public Health expenditure^2	-1,092.6390*	-614.9889	452.2248	-885.2618*	-159.3143	-98.2081
	(570.1750)	*(431.8371)*	*(559.6495)*	*(524.1508)*	*(474.3855)*	*(221.2789)*
Gender inequality for DALY	2.2144	-0.6912	0.8242	-885.2618*	-159.3143	-98.2081
	(2.3933)	*(1.3002)*	*(2.1958)*	*(524.1508)*	*(474.3855)*	*(221.2789)*
Interaction of Private Health Expenditure and Gender inequality in DALY	0.1123	1.6719	1.1896	1.1700	0.1202	7.4587*
	(3.9813)	*(2.7956)*	*(7.5252)*	*(7.2247)*	*(1.4647)*	*(3.9707)*
School enrollment rates	-9.7506**	-8.1293**	2.9352	-1.7284	-7.4112***	-1.8470
	(3.7914)	*(3.2816)*	*(2.7411)*	*(1.7937)*	*(1.4996)*	*(2.0036)*
Gender inequality in school enrollment rates	1.6044	4.9469	-4.6786	12.7865***	-1.2431	-2.7418
	(4.1523)	*(12.1679)*	*(4.6167)*	*(4.4785)*	*(4.0877)*	*(5.0577)*
Improved sanitation facilities	-2.5789	-4.3233***	-4.3238	-3.5441***	-2.1092**	-6.5892**
	(1.7792)	*(1.2261)*	*(4.2032)*	*(1.1560)*	*(0.9680)*	*(2.7909)*
Constant	1,394.8920***	938.1486***	450.1305	509.9426*	987.5859***	680.6122***
	(375.9902)	*(362.3550)*	*(492.8885)*	*(309.1650)*	*(241.2513)*	*(261.6450)*
Observations	45	58	26	51	53	26
Adjusted R^2	0.5440	0.3806	0.5256	0.4441	0.4883	0.8270
F Statistic	5.77*** (df = 11;33)	4.18*** (df =11; 46)	3.51** (df =11; 14)	4.63*** (df =11; 39)	5.51*** (df =11; 41)	11.86*** (df =11;14)
Breusch-Pagan test	10.27,df =11,p= 0.5	22.97,df=11,p= 0.017	12.05,df=11,p=0.35	17.65,df=11,p = 0.09	10.05,df=11,p= 0.52	6.90,df=11,p= 0.80

Tests on joint significance and Extrema						
I(GDP.per.capita2)						
Extrema	5052.90	24471.05	24564.52	6260.28	90093.18	304998.34
F-test	0.80,0.37(df=1;33)	5.55, 0.022 * (df=1;46)	0.01, 0.90 (df= 1;14)	0.18, 0.66(df= 1;39)	0.11, 0.73(df=1;41)	0.82, 0.3(df= 1;14)
I(Health.Exp2)						
Extrema	131.62	36183.91	5367.39	160.35	1941.25	14579.02
F-test	0.42,0.51(df=1;33)	0.16, 0.68(df=1;46)	0.11, 0.73(df= 1;14)	0.01,0.90(df= 1;39)	1.06,0.30 (df=1;41)	1 3.06,0.10(df=1;14)
I(Public.Health.exp2)						
Extrema	0.39	0.84	0.53	0.56	0.77	2.90
F-test	0.35,0.55(df=1;33)	1.9, 0.17(df=1;46)	0.01,0.91 (df= 1;14)	0.06, 0.80(df=1;39)	0.25, 0.61 (df=1;41)	7.55, 0.01(df= 1;14)

Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 4a) Sign and significance of the determinants for disability adjusted life years lost (DALY) and life expectancy (LE), all models, all countries, year 2000

	Dependent Variable: DALY.per.1000 and Life Expectancy, year: 2000													
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	DALY	LE	DALY	LE	DALY	LE	DALY	LE	DALY	LE	DALY	LE	DALY	LE
Log (GDP per capita)	---	0												
Log (Health Expenditure)	0	+++												
GDP per capita			---	+++	---	+++	---	+++	---	+++	0	0	0	0
GDP per capita^2			+++	---	+++	---	+++	---	+++	---	0	0	0	0
Health Expenditure per capita					0	+++	0	+++	0	+++	0	+++	0	+++
Health Expenditure per capita^2)					+	---	++	---	++	0	0	---	0	--
Public Health expenditure (% total health expenditure)	0	0	--	0	0	0	0	0	0	0	++	---	0	--
Public Health expenditure (% total health expenditure)^2					0	0	0	0	0	0	-	++	0	++
Gender inequality for DALY							+	0	---	+++	0	+	0	0
Interaction btw Private health & Gender inequality in DALY								0	+++	---	+	--	+	--
School enrollment rates											---	+++	---	+++
Gender inequality .school enrollment rates											0	0	0	0
Improved sanitation facilities													---	+++
Constant	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++

Note: Significance levels: for positive coefficients +++ p<0.01, ++ p<0.05, + p<0.1, for negative coefficients: --- p<0.01, -- p<0.05, - p<0.1, 0: p>0.1 (coefficient not significantly different from zero).

Table 4b) Sign and significance of the determinants for disability adjusted life years lost (DALY) and life expectancy (LE), models 1-7, all countries, year 2012

Dependent Variable: DALY.per.1000 and Life Expectancy, year: 2012														
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**		**Model 7**	
	DALY	**LE**	**DALY**	**LE**	**DALY**	**LE**	**DALY**	**LE**	**DALY**	**LE**	**DALY**	**LE**	**DALY**	**LE**
Log (GDP per capita)	---	0												
Log (Health Expenditure)	0	+++												
GDP per capita			---	+++	---	+	---	+	---	+	---	++	--	0
GDP per capita^2			+++	---	++	-	++	-	+++	--	++	--	++	0
Health Expenditure per capita				0	0	+++	0	+++	0	+++	0	+++	+++	+++
Health Expenditure per capita^2)					++	---	++	---	+	---	0	---	-	---
Public Health expenditure (% total health expenditure)	0	0	0		0	0	0	0	0	0	0	--	+	---
Public Health expenditure (% total health expenditure)^2					0	0	0	0	0	0	0	+	-	++
Gender inequality for DALY							0	0	++	0	0	0	+	0
Interaction btw Private health & Gender inequality in DALY									-	0	0	0	0	0
School enrollment rates											---	+++	--	++
Gender inequality .school enrollment rates											+++	--	+++	0
Improved sanitation facilities													---	+++
Constant	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++

Note: Significance levels: for positive coefficients +++ $p<0.01$, ++ $p<0.05$, + $p<0.1$, for negative coeffcients: --- $p<0.01$, -- $p<0.05$, - $p<0.1$, 0: $p>0.1$ (coefficient not significantly different from zero).

Table 4c) Sign and significance of the determinants for disability adjusted life years lost (DALY) and life expectancy (LE), model 7, countries by income groups, years 2000 and 2012

	Dependent Variable: DALY.per.1000 and Life expectancy for Year 2000 and 2012											
	LIC 2000		**MIC 2000**		**HIC 2000**		**LIC 2012**		**MIC 2012**		**HIC 2012**	
	DALY	LE	DALY	LE	DALY	LE	DALY	LE	DALY	LE	DALY	LE
GDP per capita	0	0	++	0	0	-	0	0	0	0	0	--
GDP.per.capita^2	0	0	--	0	0	0	0	0	0	0	0	++
Health Expenditure per capita	0	0	0	0	0	+++	0	0	0	0	+	++
Health Expenditure per capita^2	0	0	0	0	0	--	0	0	0	0	0	--
Public Health expenditure (% total expenditure)	0	0	-	0	0	0	0	0	0	0	0	0
Public Health expenditure^2 (% total expenditure)	-	0	0	0	0	0	-	0	0	0	0	0
Gender inequality in DALY	0	0	0	0	0	0	-	0	0	0	0	0
Interaction btw Private health & Gender inequality in DALY	0	0	0	0	0	0	0	0	0	0	+	---
School enrollment rates	--	+++	++	+++	0	0	0	0	---	+++	0	0
Gender inequality .school enrollment rates	0	0	0	0	0	0	++	---	0	0	0	0
Improved sanitation facilities	0	+	---	0	0	+++	---	+++	--	+++	--	0
Constant	+++	+++	+++	+++	0	+++	+	+++	+++	+++	+++	+++

Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 5 Asymmetric effects of model determinants on standardized life years lost (YLL) and life years with disability (YLD), Model 7 (full model), for all countries by income group, years 2000 and 2012

Dependent Variable: difference in norm(YLL) – norm(YLD) for years 2000 and 2012						
	LIC 2000	**MIC 2000**	**HIC 2000**	**LIC 2012**	**MIC 2012**	**HIC 2012**
GDP per capita	-0.0002	-0.00004	0.00001	-0.0182	-0.0026	-0.0018
	(0.0005)	*(0.0001)*	*(0.0001)*	*(0.0421)*	*(0.0076)*	*(0.0020)*
GDP per capita^2	0.000000	0.0000	-0.0000	0.000001	0.0000	0.0000
	(0.000000)	*(0.0000)*	*(0.0000)*	*(0.000003)*	*(0.000000)*	*(0.000000)*
Health Expenditure per capita	0.0025	-0.0012	-0.0017	0.1303	0.1185	0.0245*
	(0.0181)	*(0.0014)*	*(0.0015)*	*(1.0319)*	*(0.1149)*	*(0.0140)*
Health Expenditure per capita^2	-0.0001	-0.000000	0.000000	-0.0004	-0.00003	-0.000001
	(0.0001)	*(0.000001)*	*(0.000000)*	*(0.0013)*	*(0.00003)*	*(0.000001)*
Public Health expenditure (% total health)	1.5725	1.1559	-4.1399	1,003.9910	245.7974	570.2192
	(2.6399)	(2.9928)	(16.9019)	(739.9245)	(515.2894)	(352.6127)
Public Health expenditure (% total health)^2	0.9148	-1.6342	-1.1031	-885.2618*	-159.3143	-98.2081
	(2.1810)	*(2.6955)*	*(13.7030)*	*(524.1508)*	*(474.3855)*	*(221.2789)*
Gender inequality in DALY	0.0007	-0.0151*	0.0039	1.2011	1.0033*	-0.8160
	(0.0077)	*(0.0079)*	*(0.0550)*	*(3.6938)*	*(0.5468)*	*(1.2650)*
Interaction btw Private health & Gender inequality in DALY	-0.0001	0.0214	-0.0946	1.1700	0.1202	7.4587*
	(0.0131)	*(0.0179)*	*(0.1884)*	*(7.2247)*	*(1.4647)*	*(3.9707)*
School enrollment rate	-0.0166*	-0.0029	-0.0333	-1.7284	-7.4112***	-1.8470
	(0.0096)	*(0.0088)*	*(0.0913)*	*(1.7937)*	*(1.4996)*	*(2.0036)*
Gender inequality in school. enrollment rates	0.0077	0.0195	0.1344	12.7865***	-1.2431	-2.7418
	(0.0147)	*(0.0495)*	*(0.1135)*	*(4.4785)*	*(4.0877)*	*(5.0577)*
Improved sanitation facilities	0.0076	-0.0005	0.0333	-3.5441***	-2.1092**	-6.5892**
	(0.0073)	*(0.0103)*	*(0.1010)*	*(1.1560)*	*(0.9680)*	*(2.7909)*
Constant	1.2469	1.1509	5.7227	509.9426*	987.5859***	680.6122***
	(1.2596)	*(1.5467)*	*(13.3554)*	*(309.1650)*	*(241.2513)*	*(261.6450)*
Observations	45	58	26	51	53	26
Adjusted R^2	0.2047	0.3549	0.2338	0.4441	0.4883	0.8270
F Statistic	2.0298* (df = 11; 33)	3.85*** (df = 11; 46)	1.69 (df = 11; 14)	4.63*** (df = 11; 39)	5.51*** (df = 11; 41)	11.86*** (df = 11; 14)
Breusch-Pagan test	13.04,df=11,p=0.29	12.19,df=11,p=0.34	9.31,df=11,p=0.59	9.47,df=11,p=0.57	7.93,df=11,p=0.71	8.05,df=11,p=0.70

F-Tests on joint significance and extrema						
I(GDP.per.capita2)						
Extrema	110244.72	2369.28	15675.34	2436.80	19533.60	-3080981.22
F-test	0.86, 0.353 (df= 1;117)	0.08,0.77(df= 1;33)	0.21, 0.64 (df= 1;46)	0.29, 0.58 (df= 1;39)	0.54, 0.46 (df=1;41)	0.08, 0.77 (df= 1;14)
I(Health.Exp2)						
Extrema	3263.66	22.11	-21828.37	38.78	-542.788	10140.26
F-test	12.85,0.00***(df=1;117)	0.019,0.89(df= 1;33)	0.75, 0.39(df= 1;46)	0.01, 0.89(df= 1;39)	0.85,0.033(df=1;41)	0.91,0.35(df= 1;14)
I(Public.Health.exp2)						
Extrema	0.56	-0.85	0.35	0.2426	0.65	1.01
F-test	0.39, 0.53(df= 1;117)	3.42, 0.07 (df=1;33)	0.09, 0.75 (df=1;46)	0.24, 0.62 (df=1;39)	0.39,0.53 (df=1;41)	19.42,0.0***(df=1;14)

Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Appendix

Table A1 List of countries by income group, World Bank definition 2000

Low income countries (LICs)			Lower-middle income countries (LMICs)		Upper-middle income countries (UMICs)		High income countries (HICs)	
Afghanistan	Guinea	Rwanda	Albania	Jamaica	Argentina	Slovakia	Australia	Portugal
Angola	Guinea-Bissau	Senegal	Algeria	Jordan	Bahrain	South Africa	Austria	Qatar
Armenia	Haiti	Sierra Leone	Belarus	Kazakhstan	Barbados	Trinidad & Tobago	Belgium	Singapore
Azerbaijan	India	Solomon Islands	Belize	Latvia	Botswana	Uruguay	Bahamas	Slovenia
Bangladesh	Indonesia	Somalia	Bolivia	Lithuania	Brazil	Venezuela	Brunei Darussalam	Spain
Benin	Kenya	South Sudan	Bosnia and Herzegovina	Maldives	Chile		Canada	Sweden
Bhutan	Kyrgyzstan	Sudan	Bulgaria	Montenegro	Croatia		Cyprus	Switzerland
Burkina Faso	DPR* Lao	Tajikistan	Cape Verde	Morocco	Czech Republic		Denmark	UAE
Burundi	Lesotho	Timor-Leste	China	Namibia	Estonia		Finland	UK
Cambodia	Liberia	Togo	Colombia	Papua New Guinea	Gabon		France	USA
Cameroon	Madagascar	Turkmenistan	Costa Rica	Paraguay	Hungary		Germany	
Central African Republic	Malawi	Uganda	Cuba	Peru	Lebanon		Greece	
Chad	Mali	Ukraine	Djibouti	Philippines	Libya		Iceland	
Comoros	Mauritania	UR**** Tanzania	Dominican Republic	Romania	Malaysia		Ireland	
Congo	Mongolia	Uzbekistan	Ecuador	Russian Federation	Malta		Israel	
Côte d'Ivoire	Mozambique	Viet Nam	Egypt	Serbia	Mauritius		Italy	
DPR* of Korea	Myanmar	Yemen	El Salvador	Sri Lanka	Mexico		Japan	
DR* of Congo	Nepal	Zambia	Equatorial Guinea	Suriname	Oman		Kuwait	
Eritrea	Nicaragua	Zimbabwe	Fiji	Swaziland	Panama		Luxembourg	
Ethiopia	Niger		Guatemala	Syrian Arab Republic	Poland		Netherlands	
Gambia	Nigeria		Guyana	Thailand	Republic of Korea		New Zealand	
Georgia	Pakistan		Honduras	Macedonia (FYR***)	Saudi Arabia		Norway	
Ghana	Moldova		Iran (IslamicRepublic)	Tunisia				
			Iraq	Turkey				
Total: 65			**48**		**27**		**32**	

*DPR= Democratic People's Republic of, **DR= Democratic Republic, ***FYR= Former Yugoslavian Republic, ****UR=United Republic

Table A2 share of originally missing values per variable and income group

Percentage of Missing values for:	All, 2000	All, 2012	LIC 2000	LIC, 2012	LMC, 2000	LMC, 2012	UMC, 2000	UMC, 2012	HIC, 2000	HIC 2012
GDP per capita, PPP (constant 2011 US $)	4.65	3.49	7.69	4.62	4.17	4.17	3.70	3.70	0.00	0.00
Total health expenditures per capita, PPP (constant 2011 US $)	2.91	1.74	7.69	4.62	0.00	0.00	0.00	0.00	0.00	0.00
Share of health expenditures on GDP (%)	2.91	1.74	7.69	4.62	0.00	0.00	0.00	0.00	0.00	0.00
Share of public health expenditures on total health expenditures (%)	2.91	1.74	7.69	4.62	0.00	0.00	0.00	0.00	0.00	0.00
School Enrollment rates, total	17.44	12.79	26.15	15.38	10.42	8.33	22.22	22.22	6.25	6.25
Difference in School enrollment rates btw. men and women	21.51	16.28	29.23	18.46	16.67	10.42	22.22	29.63	12.5	9.38
Improved Sanitation facilities	2.33	7.56	1.54	4.62	0.00	6.25	0.00	14.81	9.38	9.38

Note: The values for Life Expectancy, DALY index, YLL and YLD were complete for all countries in the chosen sample.

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