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The Determinants of Health Expenditure: A Country-Level Panel Data Analysis

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Abstract

The rapid growth of health expenditure has become a great concern for both households and governments. There is extensive literature on the determinants of health expenditure in OECD countries, but the same is not true for developing countries. The aim of this study is to understand the trajectory of health expenditure in developing countries. We use panel data from 143 countries over 14 years, from 1995 to 2008 to study this. We apply both standard fixed effects and dynamic models to explore the factors associated with the growth of total health expenditure as well as its main components namely, government health expenditure and out-of-pocket payments. Our data show great variation across countries in health expenditure as a share of GDP, which ranges from less than 5% to 15%. Apart from income many factors contribute to this variation, ranging from demographic factors to health system characteristics. Our results suggest that health expenditure in general does not grow faster than GDP after taking other factors into consideration. Income elasticity is between 0.75 and 0.95 in the fixed effect model while, it is much smaller in the dynamic model. We found no difference in health expenditure between tax-based and insurance based health financing mechanisms. The study also confirms the existence of fungibility, where external aid for health reduces government health spending from domestic sources. However, the decrease is much small than a dollar to dollar substitution. The study also finds that government health expenditure and out-of-pocket payments follow different paths and that the pace of health expenditure growth is different for countries at different levels of economic development.

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1. Introduction

Across the globe there are great variations on the amount countries spend on health. In high income countries per capita health expenditure is over USD 3000 on average, while in resource poor countries it is only USD 30 per capita. In 2008, there were 64 countries per capita health expenditure was less than USD 100. There is also wide variation in health expenditure with respect to economic development. Some countries spend more than 12% of GDP on health, while others spend less than 3%, on health.

There is an extensive literature on health expenditures and their growth in OECD countries. However, evidence from developing countries is relatively scarce and this paper seeks to contribute to filling this gap by exploring data from 143 countries, both developed and developing. In this paper, we model the trajectory of the health expenditure over time. We examine the differences between country income groups in addition to overall trends, and our research questions were the following: 1. Does total health expenditure grow faster than income? 2. What other factors are associated with the growth of total health expenditure? 3. Do government health expenditure and out-of-pocket expenditure follow the same path? 4. Do countries at different income levels follow the same trend? Our paper seems to be the first study which addresses these issues by pooling data from such an extensive group of countries and over time.

We estimate static as well as dynamic panel data models to study the factors associated with per capita total health expenditure, government health expenditure and private out-of-pocket health expenditure (OOP). Our results suggest that health expenditure in general does not grow faster than GDP after taking into consideration other factors. Government health expenditure and out-of-pocket payments follow different paths. The pace of health expenditure growth is also different for countries at different levels of economic development.

The paper is structured as follows: section 2 contains a brief description of the literature on the determinants of health care expenditures in OECD as well as developing countries; section 3 we describe our variables and hypotheses, as well as the data used in the empirical work; econometric methods are presented in section 4; regression results are shown in section 5; and finally, section 6 discusses these results and suggests some conclusions.

2. Determinants of health care expenditures: A brief review of the literature

2.1 Approaches for modeling health care expenditures.

Several approaches for modeling health care expenditures are presented in the literature. A first distinction concerns the type of data used. Some studies used household data while others used aggregated macroeconomic data. Given the scope of this study the review is limited to the latter studies. Some previous literature has relied on cross-sectional techniques, while others have used panel techniques. In the latter, static and dynamic models have been used and the results obtained are often different.

A review of literature on the determinants of health expenditure in OECD countries is by Gerdtham and Jönsson (Gerdtham & Jönsson 2000). This paper surveyed different models, in particular: cross-section bivariate regressions, Newhouse (Newhouse 1977); cross-section multivariate regressions: Leu (Leu 1986) and Gerdtham et al. (Gerdtham, Sogaard, et al. 1992; Gerdtham, Søgaard, et al. 1992); panel data models: Gerdtham et al. (Gerdtham et al. 1998), Barros (Barros 1998) and Roberts (Roberts 1999), Gerdtham (Gerdtham, Sogaard, et al. 1992), Hitiris and Posnett (Hitiris & Posnett 1992); and unit root and

cointegration analyses. Further, Jönsson and Eckerlund (Jönsson & Eckerlund 2003) presented a cross-section regression analysis of health care expenditures using data for 1998 in the OECD countries. One of the objectives of the paper was to check whether the findings in Gerdtham et al. (Gerdtham et al. 1998), which used data up until 1991, were still valid. The determinants of health expenditure described by Jönsson and Eckerlund (Jönsson & Eckerlund 2003) may be complemented by other studies, such as Baltagi and Moscone (Badi H. Baltagi & Moscone 2010). There are fewer cross country studies from non-OECD countries.

2.2 Key findings from previous studies

Income

Income (per capita GDP) has been identified as a very important factor for explaining differences across countries in the level and growth of total health care expenditures. In literature from OECD countries, cross-section regressions of aggregate health expenditure per capita on GDP per capita consistently showed an income elasticity significantly above one, from about 1.20 to 1.50 (Kleiman 1974; Newhouse 1977; Leu 1986; Getzen 2000). Aggregate time-series regressions for individual countries most often showed similar results although with considerable variation between countries. Similarly, in global literature, Musgrove, Zeramdini and Carrin used cross section data from 191 countries in 1997 and found that income elasticity of health expenditure was between 1.133 and 1.275 depending on the data included. Income elasticity for OOP ranged from 0.884 to 1.033 while it was between 1.069 to 1.194 for government health expenditure (Musgrove et al. 2002). Another study by Gaag and Stimac using cross section data from a 175 countries in 2004 found that income elasticity for health expenditure was 1.09. They also presented the results by geographical region and found that income elasticity ranged from 0.830 in the Middle East to 1.197 in OECD countries. Murthy and Okunade used cross-sectional data in 2001 from 44 African countries and found an income elasticity between 1.089 and 1.121, depending on the specification used (van der Gaag & Stimac 2008). Schieber and Maeda used cross section data in 1994 estimated global income elasticity at 1.13 and found higher income elasticity for public spending than for private spending (Schieber & Maeda 1999).

The availability of panel data has made it possible to estimate panel data models for different time periods. Several studies in OECD countries using panel data found the income elasticity was larger than one which is in line with previous results based on cross section data (Gerdtham, Sogaard, et al. 1992). However, this result is sensitive to the choice of the underlying assumptions of the model. Under additional assumptions, some authors obtained income elasticity close to one (Hitiris & Posnett 1992). Literature using panel data model from non-OECD has not directly looked at the relationship between income and health expenditure. However, Lu et al looked at the effects of official development (ODA)on health spending using data from 1995 to 2006 in low and low middle income countries and found that GDP per capita had no significant relationship with government health expenditure as a share of GDP (Lu et al. 2010). Another study by Farag et al, examining the fungibility of ODA for health and domestic government health expenditure based on panel data from 1995 to 2006 for a 144 countries, found that a 1% increase in GDP was associated with 0.66% increase in domestic government health expenditure in low-income countries and 0.96% increase in middle-income countries (Farag et al. 2009).

One limitation of the above studies is that they have ignored the possibility of non-stationarity in health data and income. Several papers from OECD countries studied the non-stationarity and cointegration properties between health care spending and income and estimated the relationship between health expenditure and GDP controlling for non-income determinants and a proxy of technical progress. They concluded that the income elasticity was not greater than one (Hansen & King 1996; Blomqvist & Carter 1997; Gerdtham & Löthgren 2000; Gerdtham & Löthgren 2002; A. A. Okunade & Karakus 2001; Dreger & Reimers 2005). Note however that the available time series for some of these studies are rather short

which induces some uncertainty with respect to the properties of the time series analyzed in this field of research (Hartwig 2008).

More recently, Baltagi and Moscone (Badi H. Baltagi & Moscone 2010) studied the long-run economic relationship between health expenditure and income in 20 OECD countries over the period 1971–2004. The analysis indicated that health care expenditure and most of its determinants were non-stationary, and that they were linked in the long-run. Their results showed that health care elasticity with respect to income was about 0.87 which was much smaller than that estimated in other OECD studies.

It is worth noting at this stage that the above mentioned literature is mainly concerned with the direct effect of GDP on health care expenditures. In fact, as well explained in, for example in Erdil and Yetkiner (Erdil & Yetkiner 2009), the reverse causation, where GDP is a function of health care expenditure, also has a theoretical basis. One way of considering this reverse causation effect is to treat health as another component of human capital together with education. There are at least two mechanisms through which GDP is a function of health care expenditures. Firstly, if health expenditure can be regarded as an investment in human capital, and given that human capital accumulation is an essential source of economic growth, an increase in health care expenditure must ultimately lead to a higher GDP. Secondly, increase in health care expenditures associated with effective health intervention increases labor supply and productivity, which ultimately increase GDP.

Therefore, a simultaneous causality in both directions may exist and needs to be checked. If GDP and health care expenditure determine each other simultaneously, then there is an endogeneity problem in their relationship. If this is the case, then standard estimation procedures which assume that GDP is exogenous will produce inconsistent estimates of the parameters. It seems logical, however, to expect that even if causality exists in both directions, it does not occur instantaneously but with a time lag. For this reason the best way to determine the potential direction of causality relationship between health care expenditure and GDP seems to apply the Granger-causality test (Granger 1969). To our knowledge, there are a very limited number of studies that do this and the evidence so far is mixed. For example, Erkan and Yetzinker (Erdil & Yetkiner 2009) applied a Granger-causality approach to panel data models. Their data covers a sample of 75 low to higher-income countries over the 90s. Their study finds significant bi-directional Granger-causality for 46 countries. In instances where one-way causality is found, the pattern depends on the GDP level of the countries. Their analysis shows that one-way causality usually runs from GDP to health care expenditure in low and middle-income countries, whereas the reverse holds for high income countries. In contrast, the study by Hartwig (Hartwig 2008) on Granger-causality analysis of a panel of 21 OECD countries finds no evidence that the health care expenditure causes per-capita GDP growth with a positive sign. When the other direction of Granger-causality is tested, in fact, the results support the hypothesis that GDP determines health expenditures with a positive sign.

Population age structure and epidemiological needs

Population age structure is often included as a covariate in health expenditure regressions. Commonly used indicators are the share of young (e.g., under 15 years) and old people (e.g., above 65 or 75 years) over the active or total population. These variables are generally insignificant when included in regression models explaining per-capita health spending (Leu 1986; Leu 1986; Hitiris & Posnett 1992; L. Di Matteo & R. Di Matteo 1998). Epidemiological need is sometimes also incorporated as a covariate through various proxies. Lu et al used HIV seroprevalence as a proxy and found that it had no significant relationship with general government health expenditure as a share of GDP (Lu et al. 2010). Murthy and Okunade found that maternal mortality rate had no relationship with health expenditure in African countries (Murthy & A. Okunade 2009).

Technological progress and variation in medical practice

Since the work by Newhouse (Newhouse 1992), technological progress has been seen as an important driver of health care expenditure. Several proxies for changes in medical care technology have been used according to the type of models under consideration. Examples of such proxies in cross-section studies are the surgical procedures and the number of specific medical equipment(Baker & Wheeler 1998; Weil 1995), and life expectancy and infant mortality (Dreger & Reimers 2005). On the other hand, a time index (Gerdtham & Löthgren 2000), or time-specific intercepts (L. Di Matteo 2004) have been used in time-series models. As one should expect a combination of these proxies have been used in panel data models (for instance in Dormont et al. 2006). All these studies concluded that technological progress and variation in medical practice were major determinants in the level and growth of health expenditure. Literature from non-OECD countries has not considered technological progress as a covariate, mostly because of a lack of reliable data on technological advances.

Health system characteristics

Service provision. The use of primary care gatekeepers seemed to result in lower health expenditure . Public sector provision of health services was associated with lower health expenditure (Gerdtham et al. 1998) .

Health financing. In terms of financing structure very few empirical studies found that the extent to which health care expenditure was financed by the government has a relationship with levels of health expenditure (Leu 1986; Culyer 1988; Hitiris & Posnett 1992; van der Gaag & Stimac 2008). Differences in health expenditure between tax-based vs. social-insurance based systems were examined in OECD countries and eastern European and central Asian (ECA) countries (A. Wagstaff & Bank 2009; A. Wagstaff & R. Moreno-Serra 2009). The OECD study found that health expenditure per capita was higher in countries where a social health insurance mechanism exists. The ECA study suggested per capita government health expenditure was higher in countries with social health insurance as compared to countries that relied solely on general taxation.

External funds. Recently, there has been much interest in relationship between external funds and national health expenditure in developing countries. Gaag and Stimac found that whereas there was no significant impact of health-specific official development aid (ODA) on total health expenditure, health-specific ODA has an elasticity of 0.138 against public spending on health (van der Gaag & Stimac 2008). Lu et al 2010 found that that health ODA channeled through the non-government sector had a positive relationship with general government health expenditure, while a negative correlation was found when it was channeled through government sector (Lu et al. 2010). Farag et al found that for a 1% increase in health ODA government health expenditure decreased by 0.027% in upper-middle income countries; 0.04% to 0.09% in lower-middle income countries; and 0.14% to 0.19% in low income countries (Farag et al. 2009).

Provider payment mechanisms. Fee-for-service systems tended to lead to higher expenditure on average than capitation systems (Gerdtham et al. 1998; Gerdtham & Jönsson 2000). A shift from financing hospitals through budgets to fee-for-services or patient-based payment mechanisms was associated with increases in both public and private components of health expenditure in a study from ECA countries (Rodrigo Moreno-Serra & Adam Wagstaff 2010). Furthermore, the ratio of in-patient expenditure to total health expenditure is positively related to health expenditures (Gerdtham & Jönsson 2000; Gerdtham et al. 1998). The total supply of doctors may have a positive effect on health expenditure (Gerdtham & Jönsson 2000; Gerdtham et al. 1998). However, the Murthy and Okunade study of African countries found no relationship between the density of doctors and health expenditure (Murthy & A. Okunade 2009).

"Baumol effect" or "cost-disease" (Baumol 1967; Baumol 1993): The so-called Baumol effect is the tendency for relative prices of some services to increase vis-à-vis other goods and services in the economy, reflecting a negative productivity differential and the equalization of wages across sectors. In particular, prices for health services will rise relative to other prices because wages in low productivity sectors must keep up with wages in high productivity sectors. With a price-inelastic demand, the share health care expenditure in GDP would tend to increase over time (Hartwig 2008). Therefore, the Baumol effect may also be an important factor for the growth of health care expenditures, but not necessarily for their levels, although it seems natural to assume that the costs of health care, which is a labor intensive good, will be higher in high wage economies. However, the Baumol effect is a phenomenon that affects mainly developed economies and it seems to be logical not to include it in studies on developing countries.

The literature review allows us to draw the following conclusions. Important factors for explaining the level and growth of total health care expenditures are: income (per capita GDP), technological progress and variation in medical practice, and health systems characteristics. The more recent studies recognize the importance of health system characteristics such as health financing parameters, provider payment mechanisms and service provision. However, the ability to test these variables is limited because of data availability. This implies that some important variables may be missing in the analysis and therefore care should be exercised in the interpretation of the econometric results. It is also worth noting that although income is positively related to health care expenditure, the conclusion regarding income elasticity is not clear. Although most of the studies tend to show that income elasticity is greater than one, some studies conclude that it is less than one. In fact the result for income elasticity is sensitive to the choice of underlying assumptions of the model and on the data used for its estimation. It is therefore an empirical issue.

In contrast, population age structure - expressed by the share of young (e.g., under 15 years) and old people (e.g., above 65 or 75 years) over the active or total population – or epidemiological need do not seem to be significant. Although they are unlikely to be important, one should not necessarily exclude them *a priori* if data are available.

As far as econometric models are concerned, the most interesting conclusions are from panel data models, static as well as dynamic, as opposed to cross-section models, even repeated cross-sections. One of the possible advantages of dynamic panel data is to allow for the possibility of testing for exogeneity of GDP in the health care expenditure regressions and examining the Granger-causality issue. However, for the latter, there are serious limitations when only a short time-series is available.

3. Variables, hypothesis and Data

3.1 Variables and hypothesis

Dependent variables

Health expenditure can be categorized as out-of-pocket payments and prepayments. Out-of-pocket payments refer to the payments made by the patients at the point of receiving services. Prepayments are contributions made through general taxation, payroll tax, compulsory insurance and voluntary insurance. The fundamental distinctions between out-of-pocket payments and prepayments is that prepayments are pooled across the population. In this study we focused on government health expenditures and out-of-pocket payments which are two major components of national health spending. Private prepayments into private risk-pooling funds, NGO and enterprise spending on health, which was trivial in most countries, were not analyzed as a separate category.

Out-of-pocket payments and government health expenditure have different impacts on financial risk protection and access to needed services. They may also have different relationships with the drivers of expenditure. As such, the study modeled per capita total health expenditure, government health expenditure and private out-of-pocket health expenditure separately. More details on these dependent variables are presented below:

- Total current health expenditure (*the*) included both public and private spending on health. External funds were automatically included as they flow through either public or private channels into national health systems. However, investments by the government and private entities were not included.
- Government health expenditure from domestic sources (*gghe0*) included government spending on health from general government revenue and payroll taxes. External funds channeled through governments were excluded.
- Out-of-pocket expenditure (*oop*) included payments for doctor's consultation fees, medication, laboratory tests and hospital bills. It can be in the form of user charges in general or cost sharing under insurance policies. Independent variables associated with health expenditures

A country's health spending depends on many factors. Capacity to pay, in other words its GDP and fiscal constraints of the government set the limits on how much a country can spend on health. Demographic aspects such as the share of the populations that is elderly and disease patterns reflect the amount and the types of health services that are important. Furthermore, health system indicators and technological advances may also have impact on health expenditure as has been documented in previous literature.

Country's income. Country's income, often simply measured as GDP per capita has (*gdp)* has been intensively studied among OECD countries. However, whether health expenditure grows faster than income is not conclusive. In most low income countries, total health expenditure is lower than the minimum amount necessary for providing a basic package of services to reach health-related MDG goals. In more than half of the low income countries, government expenditure on health is less than 50% of total health expenditure. As such we would expect both governments and households in low income countries to allocate a bigger share of their budget on health as income increases.

Overall government fiscal capacity. Total government expenditure as a share of GDP (*gge_gdp*) reflects fiscal space for a given GDP level. We are interested in examining whether governments spend more on health when more resources are available. We believe this is the case in general, but the magnitude may vary among different country income groups. In most low income countries, governments recognize the important role of health systems. The Abuja declaration is a demonstration of governments' desire to increase health spending. We expect that in low income countries, governments would spend larger share of their budget on health when more resources are available. On the other hand, in middle and high income countries where health systems are much better developed, we expect that the budget allocation to different social sectors will be more dominated by political negotiation. For out-of-pocket payments, we are not sure about the impact.

Demographic structure. Population structure would have an impact on health expenditure. Commonly used indicators in previous studies include the percentage of the population above 60 years old *(over60*) and the population under 5 or 15 years old. As the proportions of population under 5 and above 60 are highly correlated, the share of the population above 60 years old was used in this study as we are more interested in the effects of an aging population. It is well understood that elderly populations require more health services which could result in higher health expenditure. We expect a positive correlation between an aging population and health expenditure particularly for upper middle and high income

countries where population aging is advancing fast. Health systems in these countries are face pressure to cope with increasing needs specific to the elderly population. For low income countries, aging is not dominant issue and we would not expect health spending to react to increases in the elderly population, particularly for government health expenditure.

Disease pattern. Disease patterns have a direct link with the amount and types of health services that are needed. The impact of certain dominant diseases on national health expenditure by the government and by households would be worth exploring. For the infectious diseases we used the incidence of tuberculosis per 100,000 people (*tb*) as a tracer for disease prevalence. Other diseases can also be considered, such as HIV and malaria. Non-communicable diseases, such as diabetes, hypertension and cancer, have been becoming more and more important in high income countries as well as in developing countries. However, the time series data for other infectious diseases and non-communicable diseases is not available. In order to retain the longest possible panel, only TB incidence was included in this study. We hope to see that governments devote more domestic resources to health in response to high TB incidence in low income countries. However, this may not be observed as increased resources may mainly be reflected in external aid through disease programs.

Health system characteristics. The way a health system is organized, in particular the design of health financing functions, are likely to have impact on health expenditure. We included out-of-pocket expenditure as a percentage of total health expenditure (*oop_the*) in the regression of total health expenditure. A larger share of prepayment would allow better access to services which in turn may increase utilization and total health expenditure. However, a larger share of prepayment would also give more leverage to control costs.

Previous studies have explored the question of whether tax-based systems or insurance based systems perform better in a group of countries. To examine this further, we included a set of dummy variables for tax dominated system *(sys_tax*) where government general revenue contributed to more than 60% of prepayment; social health insurance dominated system (*sys_ssh*) where the expenditure (from payroll tax and general tax subsidies to insurance) through social health insurance was more than 60% of prepayment; and the mixed system (sys_*mix*) which included the rest of the countries. The social health insurance system was used as reference group. We would not expect to see significant differences between tax funded system and social health insurance system as they both perform similar pooling functions.

Substitution of among different components of health expenditure. Furthermore, OOP (*oop)*, government health expenditure (*gghe0)* and external funds *(ext)* were included in the respective equations to test for substitution effects. External funds mainly occur in low and low-middle income countries. Although a few upper and high income countries receive external funds for health, a meaningful discussion should focus only on low and low middle income countries.

Time. We also explored whether health expenditure had grown over time. There is often a belief that health expenditure has risen because governments and people continue to place a higher importance on health and health care, and as such, there is an increase in health care costs. We explored the time trend in health expenditure after adjusting for GDP growth and other factors discussed earlier.

3.2 Data

In this study, we included countries with population greater than 300,000. Data from 143 countries from 1995 to 2008 were used in the analysis. Health expenditure and health systems financing information were from the National Health Accounts (NHA) database of the World Health Organization. This was complemented with data from the World Bank on country-income groups and inflation. This section firstly presents the data used in this study and then goes on the present the methodology used.

All expenditure variables were adjusted for purchasing power parity and expressed as per capita international dollars. They were further converted into the real terms using inflation data from the World Bank. All expenditure variables and TB prevalence were log-transformed. We also used World Bank's country income group classification in the year of 2007. The four income groups are low (*inc1*), low-middle (*inc2*), upper middle (*inc3*) and high income countries (*inc4*). Summary statistics of these variables are presented in Table 1.

4. Econometric Methods

We started with a standard static fixed effects panel model and then applied a dynamic panel model.

The static model allows for variable intercepts to represent country effects. The model takes on the following general form, where *i* represents a country, and *t* represents a year:

$$y_{it} = \beta' x_{it} + v_i + e_{it} \qquad (1)$$

In this setting v_i represents the effects of those variables particular to the i-th country which are invariant over time. We assume that the country effects, v_i , are treated as fixed rather than random. This is essentially because the differences between countries are due more to the mean of the dependent variables than to their variance. We also assume that e_{it} is uncorrelated with $(x_{i1},\ldots,x_{iT})$, i.e. that x_{it} is a strictly exogenous vector of variables. We will return to this assumption below.

It should be noted that we did not allow the components of the vector β to vary by country as with the limited number of observations, estimates would not be reliable. In the specifications below, β is a vector of coefficients for the vector of variables x_{it}.

Overall, the fixed-effects model, also called the analysis-of-covariance model, allows for a very intuitive interpretation of the results. We used this model to run the three multivariate regressions described below. Interaction terms between country income dummies *(inc)* and covariates were used to examine different effects in different country income groups.

Total health expenditure - fixed effects (Model 1A)

$the_{it} = \beta'$ *(inc1*gdp , inc2*gdp , inc3*gdp , inc4*gdp , inc1*over60 , inc2*over60 , inc3*over60 , inc4*over60 , inc1*gge_gdp , inc2*gge_gdp , inc3*gge_gdp , inc4*gge_gdp , inc1*tb , inc2*tb , inc3*tb , inc4*tb , inc1*oop_the , inc2*oop_the , inc3*oop_the , inc4*oop_the , inc1*sys_tax , inc2* sys_tax , inc3* sys_tax , inc4* sys_tax , inc1*sys_mixed , inc2* sys_mixed , inc3* sys_mixed , inc4* sys_mixed , inc1*time , inc2*time , inc3* time , inc4* time)* $+ v_i + e_{it}$

General government expenditure on health -fixed effects (Model 2A)

$ggheo_{it} = \beta'$ *(inc1*gdp , inc2*gdp , inc3*gdp , inc4*gdp , inc1*over60 , inc2*over60 , inc3*over60 , inc4*over60 , inc1*gge_gdp , inc2*gge_gdp , inc3*gge_gdp , inc4*gge_gdp , inc1*ext , inc2*ext , inc3*ext , inc4*ext , inc1*oop , inc2*oop , inc3*oop , inc4*oop , inc1*tb , inc2*tb , inc3*tb , inc4*tb , inc1*sys_tax , inc2* sys_tax , inc3* sys_tax , inc4* sys_tax , inc1*sys_mixed , inc2* sys_mixed , inc3* sys_mixed , inc4* sys_mixed , inc1*time , inc2*time , inc3* time , inc4* time)* $+ v_i + e_{it}$

Out-of-pocket payments - fixed effects (Model 3A)

$oop_{it} = \beta'$ *(inc1*gghe0 , inc2* gghe0 , inc3* gghe0 , inc4* gghe0 , inc1*tb , inc2*tb , inc3*tb , inc4*tb , inc1*sys_tax , inc2* sys_tax , inc3* sys_tax , inc4* sys_tax , inc1*sys_mixed , inc2* sys_mixed , inc3* sys_mixed , inc4* sys_mixed , inc1*time , inc2*time , inc3* time , inc4* time , inc1*gdp , inc2*gdp , inc3*gdp , inc4*gdp , inc1*over60 , inc2*over60 , inc3*over60 , inc4*over60 , inc1*gge_gdp , inc2*gge_gdp , inc3*gge_gdp , inc4*gge_gdp , inc1*ext , inc2*ext , inc3*ext , inc4*ext)* $+ v_i + e_{it}$

Assuming that all the explanatory variables are strictly exogenous implies that none of these variables, in particular GDP, are endogenous. In fact, as indicated in the literature review, it is natural to assume that direct causation and reverse causation do not act contemporaneously. However, they may exist with some lag, but given the data limitations, Granger causality cannot be tested in our setting.

Note that for all the three models we also carried-out a Hausman test (Hausman 1978) to test the null hypothesis H_0 of random effects against the alternative H_a of fixed effects. The calculations which are not reproduced here lead to rejection of H_a which is a strong indication of the validity of the fixed effects assumption.

In order to better understand the dynamics of adjustment for the three forms of health care expenditures considered in this paper, we also specified dynamic relationships which are characterized by the presence of a lagged dependent variable among the regressors, i.e.

$$y_{it} = \gamma y_{i,t-1} + \beta' x_{it} + v_i + e_{it} \qquad (2)$$

We assume that e_{it} are serially uncorrelated. This assumption is testable as we shall see in the econometric estimation presented below.

In the model (2), the vector x_{it} may contain strictly (or strongly) exogenous variables as well as predetermined (or weakly exogenous) variables or endogenous variables. Recall that a variable, x_{itk}, is said to be strictly exogenous if $E(x_{isk}e_{it}) = 0$ for all t and s. If $E(x_{isk}e_{it}) = 0$ for all $s \le t$ but $E(x_{isk}e_{it}) \neq 0$ for all $s > t$, the variable is said to be predetermined. Intuitively, if the error term at time t has some feedback on the subsequent realizations of x_{itk}, x_{itk} is a predetermined variable. A variable, x_{itk}, is said to be endogenous if $E(x_{isk}e_{it}) = 0$ for all $s < t$ but $E(x_{isk}e_{it}) \neq 0$ for all $s \ge t$. According to this definition, endogenous variables differ from predetermined variables only in that the former allow for correlation between the x_{itk} and the e_{it} at time t, whereas the latter do not.

We assume, as in the static framework, that the country effects, v_i, are treated as fixed rather than random. As a consequence we do not need to consider different sets of assumptions about the possible correlation of the regressors, other than the lagged dependent variable, with the individual effects.

As is well known, the analysis-of-covariance estimator that we used earlier is inconsistent for a panel-dynamic model in situations where, like in this paper, the number of time periods is small and the number of individual observations is large, whether the effects are treated as fixed or random (Sevestre & Trognon 1985). In that case, one should resort to an alternative method; the most commonly used being that of Generalised Method of Moments (GMM), relying on a properly defined set of instrumental variables. These methods depend on the set of identifying or orthogonality conditions deduced from all

the assumptions defining the model. For further information, see Baltagi (B. H. Baltagi 2008) and Harris et al. (Harris et al. 2008).
To illustrate, consider the first-difference of model (2) which eliminates the fixed effect,

$$y_{it} - y_{i,t-1} = \gamma(y_{i,t-1} - y_{i,t-2}) + \beta'(x_{it} - x_{i,t-1}) + e_{it} - e_{i,t-1} \quad (3)$$

All the strictly exogenous variables x_{itk} are valid instruments for the level equation (2) as well as for the first-differenced equation (3). In addition, one can also associate to the predetermined and endogenous variables GMM-type of instruments obtained from orthogonality conditions deduced from assumptions on these variables. On the other hand, even if e_{it} are serially uncorrelated the regressor $y_{i,t-1} - y_{i,t-2}$ is correlated with the first-difference model error $e_{it} - e_{i,t-1}$ because $y_{i,t-1}$ depends on $e_{i,t-1}$. However, $e_{it} - e_{i,t-1}$ is uncorrelated with $y_{i,t-k} - y_{i,t-k-1}$ for $k \geq 2$, making possible to use lagged variables as instruments. More generally, Arellano and Bond (Arellano & Bond 1991) argued that additional instruments can be obtained in models (2) and (3) if one utilizes the orthogonality conditions that exist between lagged values of y_{it} and the disturbances e_{it}. This is the basis of the one-step and two-step GMM estimators derived by Arellano and Bond (Arellano & Bond 1991) using orthogonality (moments) conditions in which lagged levels of the dependent and predetermined variables were instruments for the first-difference model (3).

Blundell and Bond (Blundell & Bond 1998) pointed out that a weak instruments problem may occur in the Arellano and Bond (Arellano & Bond 1991) procedure due to the lack of correlation between the lagged values of the endogenous variables used as instruments, and the regressors in the first-difference model. Building on the work of Arellano and Bover (Arellano & Bover 1995), Blundell and Bond (Blundell & Bond 1998) proposed a "system GMM" that consists of stacking the model in levels (2) and that in first-differences (3) and estimating this system using GMM. This estimator uses moment conditions in which lagged differences are used as instruments for the model in levels in addition to the moment conditions of lagged levels as instruments for the model in first-difference.

We used the Blundell and Bond (Blundell & Bond 1998) to estimate the panel-dynamic models described below. The estimations have been performed using the xtdpdsys command in Stata 11. A crucial preliminary step in the estimation procedure consists in classifying the regressors as strictly exogenous, predetermined or endogenous variables. This classification has important implications in terms of the proper choice of instruments. In our models, we classified health financing and GDP as endogenous variables. On the other hand, non-health financing specific variables were considered to be strictly exogenous. The exogenous variables are incidence of TB, government expenditure as a share of GDP and the percentage of population over 60 years of age. No variables were assumed to be predetermined.

We estimated the following three panel-dynamic models:

Total health expenditure - dynamic (Model 1B):

$the_{it} = \gamma * the_{it-1} + \beta'$ *(gdp , over60 , tb , gge_gdp , oop_the , sys_tax , sys_mixed)* $+ v_i + e_{it}$

General government expenditure on health - dynamic (Model 2B):

$ggheo_{it} = \gamma * ggheo_{it-1} + \beta'$ *(gdp , oop , over60 , tb , gge_gdp , ext , sys_tax , sys_mixed)* $+ v_i + e_{it}$

Out-of-pocket payments - dynamic (Model 3B):

$$oop_{it} = \gamma * oop_{it-1} + \beta' (gdp , gghe0 , over60 , tb , gge\_gdp , ext , sys\_tax , sys\_mixed) + v_i + e_{it}$$

In the dynamic panel models, looking at the effect of country income level through interactions is quite cumbersome. As such we ran the regressions separately for each country income group.

We are aware that certain variables, in particular health system variables such as provider payment mechanisms, population coverage and service coverage by prepayment schemes, may well have an impact on health expenditure. Missing variables could affect results, particularly the coefficients of variables in the regression. However, at a global level, this type of information is not available and hence we are restricted in the variables we can include in the analysis. It should also be mentioned that with the variables included in the regression we also tested for the presence of multicollinearity, including with the Ridge regression, and concluded that this hypothesis could be rejected.

5. Results

5.1 General descriptive results

Figure 1 shows total health expenditure as a share of GDP over time by different country income groups. It ranged from well under 5% up to almost 15%. At any given point in time, cross-section data showed the general trend of higher income countries having higher health expenditures. No prominent upward or downward trends over time were observed.

Figure 2 shows general government expenditure on health and out-of-pocket payments as a share of GDP. As expected, opposite trends were seen for these two variables- government expenditure on health was higher in higher income countries, whereas OOP was lower. For GGHE, the median level in low income countries was around 2% of GDP, while for high income countries it was over 5%. On the other hand, for OOP, the median share was around 2% of GDP in low income countries, whereas it was around 1% in high income countries. The trend in GGHE over different country income groups was also more pronounced. Similarly, there seemed no particularly striking trends over time for total health expenditure,

Figure 3 shows general government expenditure on health as a share of total government expenditure. It ranged from under 5% to over 20%. There was considerable overlap among country income groups but in general higher income countries seemed to devote a larger government budget share to health. Once again there seemed no obvious evidence of this share increasing over time. It was worth noting that only a few countries allocated more than 15% of government budget despite commitments such as the Abuja declaration of 2001.

5.2 Regression results

We ran both static and dynamic panel models on government health expenditure, out-of-pocket payments and total health expenditure. Besides GDP, health expenditures also responded to other factors included in this study. Furthermore, government health expenditure and OOP did not follow the same path and countries at different income levels responded to the same factors differently.

Government health expenditure

GDP. The results from both the static and dynamic showed that GDP increases led to increased government health expenditure (Table 2A and 2B). This result held in all country income groups. Income

elasticity was greater than one for low income countries in the static model (1.3), while it was smaller than one for other income groups. In general the income elasticity from dynamic model was smaller than from the static model.

Demographic structure and disease pattern. TB prevalence was not associated with government health expenditure in any of the income groups. In the static model, the percentage of population over 60 years old was positively associated with government health expenditure in lower-middle income countries, while in the dynamic model, population had no significant relationship in any income group.

Health system characteristics. There was no difference between social health insurance-based or tax-based systems and government health expenditure except in the static model, where mixed systems had a positive significant relationship in lower-middle income countries and tax systems had a negative relationship in upper-middle income countries, but the latter was only marginally significant.

Government fiscal space. A larger share of government expenditure in GDP was associated with more government health expenditure. In the static model, although the result held in all income groups, the impact was much smaller for upper middle income countries compared with the other income groups and only marginally significant. In the dynamic model, the impact was the greatest in low-income countries, and decreased in size in richer country income groups. The relationship, however, was only marginally significant in low and upper-middle income countries.

Different components of health expenditure. When OOP increased government expenditure increased in lower-middle and upper-middle income countries in the dynamic model, although the relationship is only marginally significant in the latter. The relationship was insignificant in the static model, as well as in the other income groups in the dynamic model. In the static model, external funding was negatively associated with government spending on health from domestic sources in low, lower-middle income countries and high-income countries, but the relationship in the latter was only marginally significant. In the dynamic model, external funding was only significantly associated with a decrease in government spending in low and high-income countries, while the relationship was insignificant in the other income groups.

Time. Time had a positive significant relationship with government health expenditure.

Out-of-pocket payments

GDP. Similarly, to government health expenditure, the results showed that GDP increase seems to lead to increases in OOP (Table 3A and 3B). In the static models, the income elasticity was greater than 1 only in high income countries (1.50). For the low income countries the elasticity was around one, while it was smaller than 1 in low-middle and upper-middle income countries. In the dynamic model, income elasticity was consistently less than 1 and the relationship was insignificant in lower-middle and high income countries.

Demographic structure and disease pattern. TB prevalence was not associated with OOP in general. Among the high income countries the relationship was positive in the static model, while negative in dynamic model and had marginal significance in both models. In low income countries, TB was positively associated with OOP but the significance level is once again marginal. Population over 60 was positively associated with OOP only for upper-middle income countries in the static model.

Health system characteristics. Similarly to government health expenditure, in the dynamic model, no difference was found between tax, social health insurance and mixed systems. In the static model, tax-based and mixed systems had a positive association in lower-middle income countries as compared to

insurance-based systems. In addition, mixed systems had a marginally positive relationship in high-income countries.

Government fiscal space. Government expenditure as a share of GDP had no impact on out-of-pocket expenditure except a marginally significant positive relationship in lower-middle income countries in the static model and a significant negative relationship in high income countries in the dynamic model.

Different components of health expenditure. In the static model, when government expenditure increased, OOP payments increased in low and upper-middle income countries and decreased in high income countries. In the dynamic model, increases in government health expenditure were not significantly associated with increases in OOP in any income group. In the static model, the relationship between external funding and OOP was positive for lower-middle income countries and negative for high-income countries, while it was insignificant for low and upper-middle income countries. The results were similar in the dynamic model.

Time. Time seemed to generally have negative relationship with OOP. However, the relationship was insignificant for upper-middle income countries.

Total health expenditure

GDP. Results showed that GDP increase led to increases in total health expenditure in all income groups in both the static and dynamic model (Table 4A and 4B). In the static model, the income elasticity was less than 1 for low-middle and upper-middle income countries, while it was around 1 in low and high income countries. As with the other dependent variables, the elasticities in the dynamic model were considerably lower.

Demographic structure and disease pattern. In the static model, TB prevalence had a positive, but only marginally significant, relationship with total health expenditure in upper-middle income. This relationship was negative in high income countries. In the dynamic model, once again, there was a negative association in high income countries, while the association in low income countries was positive.

Health system characteristics. There was no difference between social health insurance-based, tax-based systems or mixed systems, except in the dynamic model, mixed systems were positively associated with total health expenditure in high income countries. In the static model, the relationship between the share of OOP in total health expenditure and absolute levels of total health expenditure was found to be negative in low and high income countries, although the significance was marginal in the former; while in lower-middle income countries the relationship was positive and significant. In the dynamic model, the relationship was found to be significant only in high income countries, where it was positive.

Government fiscal space. Government expenditure as a share of GDP had a positive relationship with total health expenditure in both models for all income groups, except in the case of upper-middle income countries in the dynamic model, where the relationship was not significant. The impact in upper-middle income countries was also much smaller than in the other income groups in the static model.

Time. Time seemed to have a positive significant relationship total health expenditure.

6. Discussion and conclusions

6.1 Limitations of the study

The recent available time series data from a wide range of developing countries gave us the unique opportunity to explore the factors associated with health expenditure in 134 countries. However, certain limitations remained and results should be interpreted with great caution. First, the panel is only 14 years and hence the long term impact could not be identified. Second, the variables included in this study were still limited and some important variables were missing. For example, health system characteristics, such as the provider payment mechanisms and the degree of private provision of the services, were not included in the study due to of the lack of time series data. Third, data quality varied by country. Some countries may have good data reporting systems while others may rely on estimation to fill in data gaps. The methods used in computing health expenditure data are country specific and not necessarily predicted based on GDP. Forth, some methodological issues remained problematic, among which the endogeneity problem was the most challenging. In this study we tried both standard fixed effects and dynamic models in order to test the sensitivity of the results.

6.2 Comparison with previous studies

Results from this study are consistent with previous studies, which showed that when GDP increased, health expenditure in general increases. The result in the dynamic model for OOP and income, where GDP was only strongly significant in low income countries may be related to better developed pooling mechanisms in middle and high income countries. Indeed, out-of-pocket expenditure in these settings may not simply be driven by economic growth, but rather through more complex pathways related to their health financing and health systems. We also found that total government expenditure as a share of GDP had a positive association with government health expenditure. On the external funds for health, our study confirmed the conclusion from previous studies that health-specific aid reduced government domestic spending on health, but increased total government spending on health.

In an in-depth analysis, our results showed the income elasticity for total health expenditure was the highest in low-income countries, but still not greater than one. In the static models the income elasticity ranged from 0.753 to 0.949. In the dynamic model, income elasticity in all countries was smaller and ranged from 0.152 to 0.462. The differences in elasticity between low-income and higher income countries may be related to missing variables, particularly coverage levels. Low-income countries have much lower coverage in comparison to higher income countries. The coefficient of GDP may in part be reflecting this inadvertently as the costs associated with rapidly expanding coverage (i.e. the case in low-income countries) may be higher than the costs of marginally expanding coverage (i.e. the case in high-income countries that have already reached universal coverage).

However, more generally, the income elasticities from this study are considerably lower than estimates from earlier cross-section studies and we found no evidence supporting that health is a luxury good. One possible explanation may be similar to the argument put forward by Friedman (Friedman M 1957) in his study on the theory of consumption function and the permanent income hypothesis. His argument made a distinction between permanent income and transitory income. These two types of income become distinguishable with time-series and panel data models, whereas they mix-up in cross-section studies. The result was similar to an error-in-variable model which may induce a bias in the cross-section estimate of regression parameters. A similar interpretation was suggested by Søgaard (Søgaard 2000) in the context of health expenditure models. In this interpretation which was highly speculative as the author himself admits, the cross-section income elasticity was made of two factors which mix up in cross-section studies whereas they become distinguishable with panel-data. Additionally, it should be noted that in determining the income elasticity of health expenditure, the identification of non-income determinants are essential for avoiding the missing variable effect. This identification may be difficult for

a number of reasons, notably the limited availability of health care data at the macro as well as the micro level. The missing variable effect would induce either a downward or an upward bias depending of the sign of the correlation between the explanatory variables and the omitted variables.

In previous studies, population structures were tested in the OECD studies using panel data with inconclusive results. A cross country study for African countries found that population over 65 had no impact on total health expenditure. Our study also did not find a consistent relationship between ageing and health expenditure.

On health system characteristics, there was limited evidence of differences in expenditure being associated with tax-based systems and social health insurance-based systems. Our study did not find evidence consistent with the two previous studies on OECD and CEA countries. However, this is not surprising as the definition of social health insurance used in the previous studies is quite different from this study.

6.3 Policy implications

Globally the total amount of expenditure on health is increasing as countries are becoming richer. While it is useful to know what drives health expenditure increases, it is important for policymakers to know whether increased spending on health facilitates achieving universal coverage, and ultimately improves people's health. This study provides insights on the current policy dialogues in countries, particularly on health systems financing.

Income is not the sole factor associated with health expenditure. A country's income plays an important role on how much can be spent on health by both governments and households. However, it is not the only factor. There are huge variations in health expenditure among countries which have a similar level of income. For low income countries where health expenditure is lower than the minimum required to provide very basic services, great effort is needed to make more resources available for heath from both public and private sources. Countries with high health expenditure may need to find ways to increase the value they are getting for their money.

Out-of-pocket payments and prepayment follow different path, but are inter-linked. It is well understood that out-of-pocket payment prevents some households from accessing needed care, while others face financial hardship when they access services. Our study showed that the national level of out-of-pocket expenditure in absolute terms is not as responsive to national level indicators in the regression as government health expenditure. This is not surprising as the distribution of out-of-pocket payment among households is a much more important factor for health system design.

Countries are encouraged to increase prepayment and reduce the reliance on out-of-pocket payments in financing health care. Increase in government spending does not automatically reduce the total amount of out-of-pocket expenditure. This is particularly true in countries where government health spending is low. More government spending is very often translated into more available services, but without changing the structure of total health expenditure, this also means that people pay more out-of-pocket in order to obtain these services. Improving financial risk protection against out-of-pocket health expenditure in most low income countries requires a significant increase in government spending and a well developed health financing system.

Government spending on health is constrained by government fiscal space. In general governments can spend more on social sectors, including on health when fiscal space increases. However, different budget allocation methods, such as a fixed budget share or a fixed absolute amount of funding, may have different impacts on health spending in practice. With economic growth, the fixed budget share at least

guarantees the increase in absolute amount, even without giving higher priority to health. During economic crises or negative economic growth a fixed budget share means a reduction in absolute amount of funding going to health sector. Our results suggested that government health expenditure responded to fiscal space positively with a most pronounced effect among low income countries. The weakest effect appeared among the upper middle income countries which consist of mostly Latin America and East European countries.

External resources for health are essential for low income country although they may reduce government spending on health from domestic sources. For low income countries, external aid counts for more than 20% of national health expenditure on average. Currently, external resources on health are mainly through health specific funds (sectoral and program supports). While health ministries receive external funds, the ministries of finance reduce the health budget. This has been generating intensive discussions on aid effectiveness. Among other reasons, fungibility is one of the reasons for proposing another aid modality-general budget support. However, early evidence did not show that general budget support was more efficient than health specific support in terms of increase overall resources on health (Antunes et al. 2010). Our results confirmed the existence of fungibility, but the substitution was much less than dollar to dollar replacement. Hence, overall spending on health increases with higher external assistance.

Our results also showed that the increase in external aid on health increased the out-of pocket payments in some lower-middle income countries. This would relate to how external funds are channeled and how are they used. For example, if a significant proportion of external funds are channeled through NGOs that provide certain defined services, these NGOS would attract more health workers from public facilities, weakening the already low capacity of the public sector to provide services. As a result, people may be even more likely to seek care at non-public facilities, where they often incur higher out-of-pocket payments. Another possibility may occur when external funds are used to provide free medicines for treatment of some diseases, such as TB. However, other services related to the treatment of the same diseases may not be free and people still need to first pay out-of-pocket to be able to access the free medicines. This study cannot conclude on what may be the key drivers of this result. However, it draws attention to this potential negative impact so that in the future policies could mitigate these effects to build a more balanced and coherent system.

Different health financing mechanisms do not have different impacts on total health expenditure. The way a health system collects revenue such as prepayment or out-of-pocket payments, has great importance on financial protection and access to services. In this study we did not find a robust relationship between the level of prepayment and total health expenditure. Indeed, given the same level of economic development, a country does not necessarily spend more on health when prepayment is the dominant funding source. Similarly, whether a system adopts a tax-based or insurance-based scheme has no difference in its total health expenditure. Indeed the two systems co-exist in most countries. Revenue collection methods are not necessarily associated with a specific arrangement of fund pooling, service provision and purchasing. Efforts should be made to improve the efficiency and equity of the system instead of the ideological debate.

Financing is one of the most important elements of health system. Knowledge of factors associated to health expenditure would help policy makers to better plan for the future. From this study we found a general increase in health expenditure during the period of 1995 and 2008. However, this increase may not be able to continue for some countries in the coming years. The current economic crises will not only have impact on health systems in developed countries but also in developing countries where external funding is essential. Innovative financing methods as well as improving efficiency will be important for increasing resources for low income countries to provide basic services and for high income countries to retain the progress that has made on universal coverage.

Descriptive statistics

Table 1 - Summary statistics

	Low income countries			*Lower-middle*			*Upper-middle*		
Variable	Mean	Standard deviation	Inter-quartile range	Mean	Standard deviation	Inter-quartile range	Mean	Standard deviation	Inter-quartile range
GDP per capita	1144.282	503.722	654.013	3929.487	1821.043	2803.873	9242.277	2694.592	3280.860
THE per capita	58.653	26.582	34.313	221.054	131.207	175.385	587.796	238.554	351.194
GGHE per capita	19.174	15.048	14.733	112.590	84.903	101.985	362.395	182.213	222.064
OOP as a share of THE	28.806	18.542	23.940	90.115	64.804	93.739	172.115	102.502	135.591
External funds per capita	9.955	9.292	9.397	9.070	12.690	10.750	6.466	11.992	5.968
GGE as a share of GDP	0.224	0.073	0.091	0.289	0.094	0.135	0.339	0.102	0.130
OOP as a share of THE	0.491	0.203	0.254	0.421	0.175	0.247	0.294	0.127	0.198
Social health insurance-based system	0.006	0.077	NA	0.095	0.293	NA	0.236	0.425	NA
Tax-based system	0.992	0.089	NA	0.739	0.439	NA	0.559	0.497	NA
Mixed system	0.002	0.044	NA	0.166	0.372	NA	0.205	0.405	NA
Percentage of population over 60 years of age	0.053	0.012	0.013	0.088	0.039	0.035	0.135	0.062	0.112
TB prevalence	267.679	115.770	150.000	167.063	199.468	121.988	102.949	175.985	66.973
	High			*All countries*					
Variable	Mean	Standard deviation	Inter-quartile range	Mean	Standard deviation	Inter-quartile range			
GDP per capita	28879.480	11361.150	11999.760	11002.650	12824.970	14720.240			
THE per capita	2123.708	1139.693	1731.851	766.156	1044.607	832.594			
GGHE per capita	1558.993	838.825	1441.793	529.312	781.399	570.131			
OOP as a share of THE	415.223	244.097	300.295	178.226	206.712	201.066			
External funds per capita	2.453	8.463	0.000	7.169	11.133	9.333			
GGE as a share of GDP	0.412	0.092	0.129	0.315	0.114	0.172			
OOP as a share of THE	0.215	0.120	0.098	0.359	0.195	0.330			
Social health insurance-based system	0.368	0.483	NA	0.172	0.378	NA			
Tax-based system	0.595	0.491	NA	0.731	0.443	NA			
Mixed system	0.037	0.190	NA	0.096	0.295	NA			
Percentage of population over 60 years of age	0.188	0.076	0.077	0.115	0.074	0.131			
TB prevalence	19.238	18.116	15.967	140.703	170.920	177.494			

Government health expenditure

Table 2A: Static model

	Low-income	Lower-middle income	Upper-middle income	High income
gdp	1.305**** (0.107)	0.557**** (0.092)	0.661**** (0.125)	0.702*** (0.170)
over60	0.492 (5.133)	5.858** (2.610)	0.282 (3.126)	0.263 (1.473)
gge_gdp	2.953**** (0.263)	2.000**** (0.246)	0.413* (0.245)	2.248*** (0.336)
ext	-0.256**** (0.018)	-0.033** (0.014)	-0.010 (0.009)	-0.020* (0.011)
oop	-0.023 (0.078)	-0.028 (0.060)	-0.018 (0.064)	0.016 (0.056)
TB	-0.076 (0.142)	-0.075 (0.069)	-0.059 (0.063)	-0.090 (0.203)
sys_tax	0.142 (0.261)	-0.012 (0.060)	-0.106* (0.061)	0.036 (0.162)
sys_mix	0.042 (0.055)	0.122*** (0.044)	-0.001 (0.059)	0.075 (0.066)
time	0.012*** (0.004)	0.017**** (0.005)	0.019*** (0.007)	0.019*** (0.005)
_cons	-2.659*** (0.574)			

Number of observations : 1966
Number of groups: 143
F-statistic: 852.58
Prob > F: 0.0000
Adj R-squared: 0.9872
**** p < 0.001, *** p < 0.01, ** p <0.05, * p<0.1

Table 2B: Dynamic model

	Low-income[1]	Lower-middle income[2]	Upper-middle income[3]	High income[4]
gdp	1.178**** (0.314)	0.371**** (0.073)	0.543* (0.294)	0.369*** (0.127)
over60	5.107 (25.621)	-2.331 (2.083)	5.28 (5.471)	-0.159 (0.744)
gge_gdp	1.622* (0.876)	1.355**** (0.344)	1.059* (0.557)	0.788**** (0.198)
ext	-0.191**** (0.039)	-0.012 (0.01)	0.005 (0.012)	-0.013**** (0.002)
oop	-0.174 (0.173)	0.212** (0.096)	-0.219* (0.122)	0.018 (0.038)
TB	0.143 (0.203)	-0.223 (0.169)	-0.22 (0.284)	-0.011 (0.011)
sys_tax	-0.39 (0.909)	-0.008 (0.043)	0.031 (0.078)	-0.086 (0.106)
sys_mix	0.019 (1.013)	-0.016 (0.06)	0.033 (0.061)	0.008 (0.114)
_cons	-6.742*** (2.359)	-0.99 (1.049)	-0.998 (3.068)	-2.021 (0.963)

[1] Number of observations: 466, Number of groups: 37, Wald chi2: 836.3, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[2] Number of observations: 520, Number of groups: 40, Wald chi2: 24083.38, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[3] Number of observations: 329, Number of groups: 27, Wald chi2: 3908.25, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[4] Number of observations: 497, Number of groups: 39, Wald chi2: 41736.53, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
**** p < 0.001, *** p < 0.01, ** p <0.05, * p<0.1

Out of pocket payments

Table 3A: Static model

	Low-income	Lower-middle income	Upper-middle income	High income
gdp	1.098**** (0.085)	0.869**** (0.076)	0.842**** (0.109)	1.503**** (0.133)
over60	-5.743 (4.442)	0.231 (2.274)	11.906**** (2.642)	0.212 (1.277)
gge_gdp	-0.038 (0.242)	0.420* (0.226)	0.242 (0.214)	-0.041 (0.346)
ext	0.022 (0.017)	0.056**** (0.012)	0.010 (0.008)	-0.024** (0.010)
gghe0	0.136** (0.067)	0.012 (0.052)	0.116** (0.056)	-0.182**** (0.047)
TB	-0.015 (0.123)	0.040 (0.059)	-0.002 (0.055)	0.319* (0.175)
sys_tax	-0.026 (0.226)	0.210**** (0.051)	0.061 (0.053)	0.025 (0.140)
sys_mix	0.014 (0.027)	0.122*** (0.039)	-0.002 (0.068)	0.155* (0.082)
time	-0.009*** (0.004)	-0.010** (0.004)	0.000 (0.006)	-0.014*** (0.005)
_cons	-6.000**** (0.467)			

Number of observations : 1966
Number of groups: 143
F-statistic: 518.33
Prob > F: 0.0000
Adj R-squared: 0.9791
**** p < 0.001, *** p < 0.01, ** p <0.05, * p<0.1

Table 3B: Dynamic model

	Low-income[1]	Lower-middle income[2]	Upper-middle income[3]	High income[4]
gdp	0.411**** (0.104)	0.091 (0.061)	0.557* (0.297)	0.058 (0.075)
over60	-7.956 (4.515)	-0.856 (2.919)	-6.085 (5.934)	0.710 (0.596)
gge_gdp	-0.059 (0.249)	0.477 (0.381)	0.451 (0.574)	-0.332** (0.164)
ext	0.007 (0.015)	0.027** (0.013)	0.012 (0.014)	-0.011** (0.006)
gghe0	0.006 (0.035)	-0.069 (0.056)	0.069 (0.26)	0.064 (0.065)
TB	0.05* (0.062)	-0.082 (0.085)	0.326 (0.31)	-0.025* (0.014)
sys_tax	-0.066 (0.234)	-0.014 (0.048)	-0.015 (0.08)	0.460 (0.282)
sys_mix	-0.013 (0.475)	0.050 (0.049)	-0.023 (0.068)	0.329 (0.21)
_cons	-1.251* (0.646)	0.501 (0.618)	-4.983* (2.933)	-0.263 (0.68)

[1] Number of observations: 468, Number of groups: 37, Wald chi2: 1404.6, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[2] Number of observations: 520, Number of groups: 40, Wald chi2: 3363.21, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[3] Number of observations: 339, Number of groups: 27, Wald chi2: 1900.48, Prob > chi2: 0.000,0 Sargan test Prob>chi2: 1.0000
[4] Number of observations: 497, Number of groups: 39, Wald chi2: 86351.09, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
**** p < 0.001, *** p < 0.01, ** p <0.05, * p<0.1

Total health expenditure

Table 4A: Static model

	Low-income	Lower-middle income	Upper-middle income	High income
gdp	0.926**** (0.046)	0.823**** (0.043)	0.753**** (0.060)	0.949**** (0.072)
over60	-8.852*** (2.647)	3.042** (1.386)	6.482**** (1.655)	0.477 (0.783)
gge_gdp	1.044**** (0.144)	1.294**** (0.132)	0.406*** (0.130)	1.504**** (0.188)
TB	0.009 (0.040)	0.051 (0.031)	0.063* (0.034)	-0.06** (0.029)
sys_tax	0.075 (0.075)	-0.017 (0.036)	-0.049 (0.033)	0.110 (0.108)
sys_mix	0.103 (0.139)	0.039 (0.031)	-0.024 (0.032)	0.050 (0.086)
time	0.012**** (0.002)	0.010**** (0.002)	0.008** (0.004)	0.010*** (0.003)
oops_the	-0.147* (0.088)	0.476**** (0.102)	0.021 (0.141)	-0.405** (0.188)
_cons	-2.467**** (0.280)			

Number of observations : 1972
Number of groups: 143
F-statistic: 1922.22
Prob > F: 0.0000
Adj R-squared: 0.9941
**** p < 0.001, *** p < 0.01, ** p <0.05, * p<0.1

Table 4B: Dynamic model

	Low-income[1]	Lower-middle income[2]	Upper-middle income[3]	High income[4]
gdp	0.395**** (0.065)	0.222** (0.102)	0.462**** (0.083)	0.152** (0.062)
over60	6.869 (19.288)	4.716** (2.118)	0.696 (5.908)	1.484**** (0.398)
gge_gdp	0.527**** (0.134)	0.639*** (0.24)	0.079 (0.277)	0.336*** (0.1)
TB	0.158*** (0.057)	0.203 (0.132)	-0.037 (0.171)	-0.018** (0.007)
sys_tax	0.017 (0.268)	-0.001 (0.044)	0.050 (0.075)	0.08 (0.064)
sys_mix	0.060 (0.394)	0.017 (0.029)	0.035 (0.067)	0.164** (0.067)
oop_the	-0.125 (0.229)	-0.008 (0.268)	0.239 (0.398)	0.256*** (0.086)
_cons	-2.501** (1.170)	-1.667* (1.001)	-1.872* (1.077)	-0.275 (0.439)

[1] Number of observations: 474, Number of groups: 37, Wald chi2: 6561.02, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[2] Number of observations: 520, Number of groups: 40, Wald chi2: 13024.97, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[3] Number of observations: 339, Number of groups: 27, Wald chi2: 5788.81, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
[4] Number of observations: 497, Number of groups: 39, Wald chi2: 103543.2, Prob > chi2: 0.0000, Sargan test Prob>chi2: 1.0000
**** p < 0.001, *** p < 0.01, ** p <0.05, * p<0.1

Figures

Figure 1

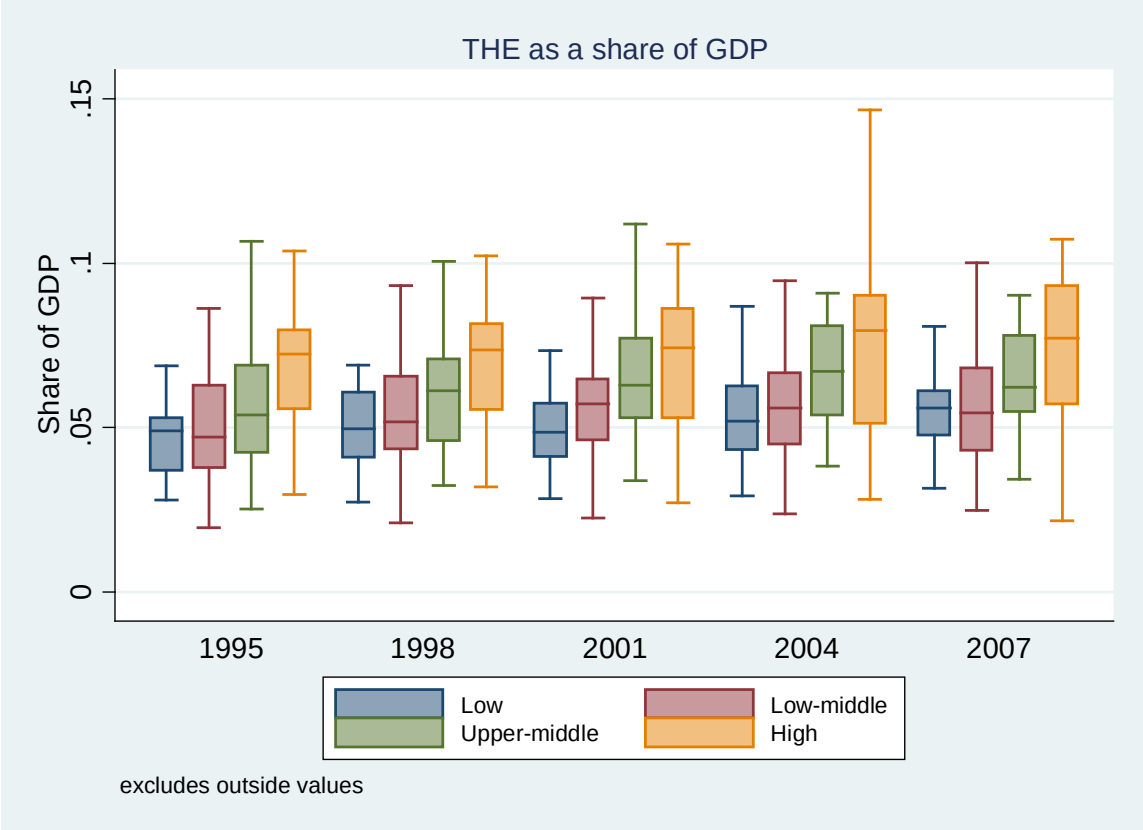


Figure 2

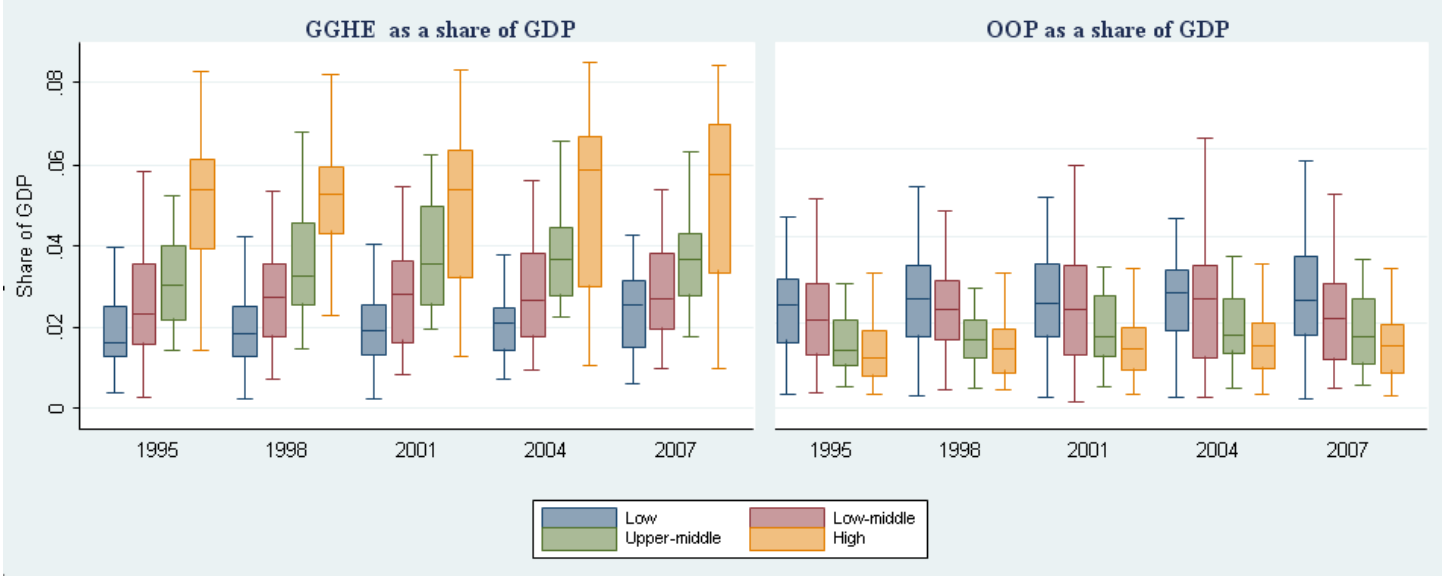
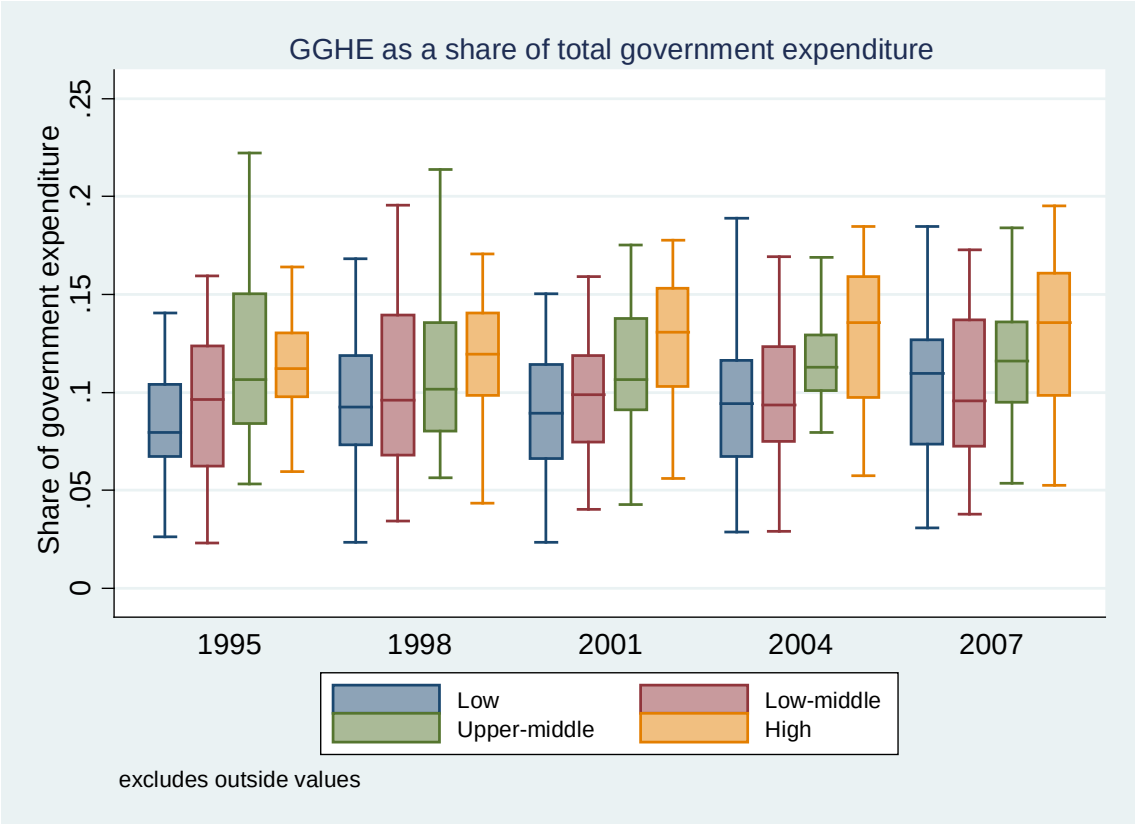


Figure 3



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