



The Health Care Expenditure and Income: A Global Perspective

Badi H. Baltagi, Raffaele Lagravinese,
Francesco Moscone, and Elisa Tosetti

Paper No. 197
November 2016

ISSN: 1525-3066

Maxwell | CENTER FOR
Syracuse University | POLICY
RESEARCH
426 Eggers Hall
Syracuse University
Syracuse, NY 13244-1020
(315) 443-3114/ email: ctrpol@syr.edu
http://www.maxwell.syr.edu/CPR_Working_Papers.aspx

CENTER FOR POLICY RESEARCH –Fall 2016

**Leonard M. Lopoo, Director
Professor of Public Administration and International Affairs (PAIA)**

Associate Directors

**Margaret Austin
Associate Director, Budget and Administration**

**John Yinger
Trustee Professor of ECON and PAIA
Associate Director, Metropolitan Studies**

SENIOR RESEARCH ASSOCIATES

| | | |
|----------------------------------|----------------------------|----------------------------------|
| Badi Baltagi, ECON | Jeffrey Kubik, ECON | Stuart Rosenthal, ECON |
| Robert Bifulco, PAIA | Yoonseok Lee, ECON | Michah Rothbart, PAIA |
| Leonard Burman, PAIA | Amy Lutz, SOC | Rebecca Schewe, SOC |
| Thomas Dennison, PAIA | Yingyi Ma, SOC | Amy Ellen Schwartz, PAIA/ECON |
| Alfonso Flores-Lagunes, ECON | Katherine Michelmore, PAIA | Perry Singleton, ECON |
| Sarah Hamersma, PAIA | Jerry Miner, ECON | Michael Wasylenko, ECON |
| Madonna Harrington Meyer, SOC | Cynthia Morrow, PAIA | Peter Wilcoxen, PAIA |
| William Horrace, ECON | Jan Ondrich, ECON | |
| Yilin Hou, PAIA | David Popp, PAIA | |

GRADUATE ASSOCIATES

| | | |
|----------------------------|-----------------------------|-------------------------|
| Alejandro Alfaro Aco, PAIA | Hyunseok Jung, ECON | David Schwegman, PAIA |
| Emily Cardon, PAIA | Yusun Kim, PAIA | Shulin Shen, ECON |
| Ziqiao Chen, PAIA | Ling Li, ECON | Iuliia Shybalkina, PAIA |
| Jena Daggett, PAIA | Michelle Lofton, PAIA | Kelly Stevens, PAIA |
| Carlos Diaz, ECON | Judson Murchie, PAIA | Saied Toossi, PAIA |
| Alex Falevich, ECON | Brian Ohl, PAIA | Rebecca Wang, SOC |
| Wancong Fu, ECON | Jindong Pang, ECON | Xirui Zhang, ECON |
| Emily Gutierrez, PAIA | Krushna Ranaware, SOC | |
| Jeehee Han, PAIA | Laura Rodriguez-Ortiz, PAIA | |
| Boqian Jiang, ECON | Fabio Rueda De Vivero, ECON | |

STAFF

| | |
|--|---|
| Kathleen Nasto, Administrative Assistant | Laura Walsh, Administrative Assistant |
| Candi Patterson, Computer Consultant | Katrina Wingle, Administrative Specialist |
| Mary Santy, Administrative Assistant | |

Abstract

This paper investigates the long-run economic relationship between health care expenditure and income in the world using data on 167 countries over the period 1995-2012, collected from the World Bank data set. The analysis is carried using panel data methods that allow one to account for unobserved heterogeneity, temporal persistence, and cross-section dependence in the form of either a common factor model or a spatial process. We estimate a global measure of income elasticity using all countries in the sample, and for sub-groups of countries, depending on their geo-political area and income. Our findings suggest that at the global level, health care is a necessity rather than a luxury. However, results vary greatly depending on the sub-sample analyzed. Our findings seem to suggest that size of income elasticity depends on the position of different countries in the global income distribution, with poorer countries showing higher elasticity.

JEL No. C31; C33; H51

Keywords: Health Expenditure; Panels; Income Elasticity; World; Exploring the Geography of Health

Authors: Badi H. Baltagi, Syracuse University (USA); Raffaele Lagravinese, University of Bari (Italy); Francesco Moscone, Brunel University London (UK); and Elisa Tosetti, Brunel University London (UK)

*We thank Albert Okunade, Thomas Getzen and three anonymous referees for helpful comments. The authors appreciate the feedback received at the session "Medical care expenditure models across countries: What have we learned after almost 40 years?" at the 11th World iHEA Congress.

1 INTRODUCTION

Over the last decades aggregate health care expenditure has increased substantially in the US and in other developed countries, with several studies documenting a rising share of income spent on health as country per-capita income increases (Kleiman, 1974; Newhouse, 1977; and Hall and Jones, 2007). This has put pressure on policy makers and academics to understand the reasons for the rise in health expenditure, and assess whether it generates significant improvements in health and life expectancy (Nordhaus, 2002; Murphy and Topel, 2006; Cutler *et al.*, 2006). Possible factors contributing to excess growth in health care expenditure, namely the residual growth in health spending after having controlled for growth in an aging population and income, are the spread of insurance, supplier-induced demand and defensive medicine, factor productivity, and technology (Frogner *et al.*, 2011; Chernew and May, 2011).

A voluminous literature has been studying the income elasticity of health expenditure, with the aim to assess whether this income elasticity is above unity, which implies that health care is a luxury good, or below unity, indicating its a necessity.¹ Determining the size of the income elasticity has important policy implications for the financing and distribution of health care resources, with greater government involvement in the health care system justified if health care is determined to be a necessity (Culyer, 1988). Empirical results shown in the literature vary and are often conflicting in part due to the use of different data sets, the level of data aggregation (Getzen, 2000), and the adoption of different econometric methods, which have been evolving over time. Early studies were characterized by the use of small, mainly cross-sectional data sets, under the strong, often unrealistic, assumption of homogeneity across countries (e.g., Kleiman, 1974; Newhouse, 1977; and Leu 1986). Later on, researchers used longitudinal data in an attempt to introduce cross-country heterogeneity in the relationship between health spending and income (Gerdtham *et al.* 1992, Hitiris and Posnett 1992). Starting from the late 90s, the increasing availability of data from a higher number of countries and for longer periods has enabled researchers to address the issue of spurious relationships between health spending and income, and study their non-stationary and cointegration properties (e.g. Hansen and King 1996; Blomqvist and Carter, 1997; Okunade and Karakus, 2001). The more recent years witnessed the adoption of new methods developed in econometrics, in order to obtain more realistic models of health expenditure and estimate income elasticity more accurately. Among others, methods for non-stationary panels with structural breaks (Carrion-i-Sevestre, 2005; Hartwig, 2008); panels with spatial correlation and/or unobserved common factors (Moscone and Tosetti, 2010; Baltagi and Moscone, 2010), or estimation techniques for heterogeneous panels such as panel threshold regression (Chakroun, 2010) have been adopted.

Other factors may explain why there is not yet unanimous consensus on whether to consider health care as necessity or luxury. For example, it is plausible to expect income elasticity to change as income level grows; when a country is poor, a lot of goods and services are regarded by its citizens as luxuries, but when people are rich enough, luxuries may become necessities. However, the literature on how income elasticity varies as income rises has conflicting results too. Di Matteo (2003) as well as Lopez-Casasnovas and Saez (2007) show that income elasticity

¹For the purpose of our analysis, it is important to observe that the definitions of necessity and luxury coming from income elasticity map onto health expenditure elasticities only if health care products are supplied with perfect product price elasticities.

decreases as income grows, while Chen *et al.* (2009) and Bougnarasy (2011) conclude that rich countries have a larger income elasticity than poor countries. We refer to Table 1A in the Supplementary Material for an overview of the most relevant studies on income elasticity of health care expenditures over the last 40 years.

Despite the extensive literature on the topic, few studies so far have offered a global perspective, using a very large sample of countries. One limitation of these studies is that they have treated countries under the strong assumptions of homogeneity and cross sectional independence. In this paper we use data from the World Bank data set to analyze the association between health spending and Gross Domestic Product (GDP), for all countries in the world over the period 1995 to 2012. We carry the analysis both at the global level and by macro-areas using the United Nations geo-political classification and the income classification provided by the World Bank. The aim is to assess what happens to the size of the income elasticity when moving from richer to poorer countries. Given the significant heterogeneity in characteristics of countries across the world, we adopt a panel data model with heterogeneous slope coefficients, both at the global level and for macro areas, so that we allocate the otherwise “excess” growth to differing income-expenditure elasticities. In addition, we allow for country-specific effects and time trends, as well as cross section dependence in the form of spatial effects and/or unobserved common factors possibly correlated with income. The aim is to capture geographical concentration of unobservable risk factors (for example, smoking, obesity, pollution, etc.) that may increase the prevalence of disease or injury in the population thus impacting on health care expenditure (Revelli, 2006; Moscone and Knapp, 2005), as well as unobserved global effects such as technology or economic shocks that may affect health spending (Okunade and Murthy, 2002; Acemoglu *et al.*, 2013). We will also test the non-stationarity and cointegration properties of our variables, and examine the extent to which spending is driven by GDP. Our findings show that health care is a necessity good worldwide, although income elasticity rises to one as we move to poorer countries. We suggest that this result may be linked to differences in health care productivity across countries, the different levels of essential health care needs targeted by the health care systems, and the different complexity of various health care systems. To our knowledge this is the first paper that studies income elasticity worldwide, allowing for heterogeneity in the relationship between health expenditure and income, as well as for interdependence across countries in health spending.

The remainder of the paper is structured as follows: Section 2 describes the data offering a preliminary exploratory analysis; Section 3 introduces the empirical model. Section 4 goes through the empirical econometric evidence; Section 5 concludes.

2 DATA

Our investigation uses annual data on 167 countries of the world over 18 years, covering the period 1995 to 2012. We gathered data on per-capita health expenditure and per-capita GDP, both expressed at constant 2005 PPP prices, and on the percentage of public expenditure

over total health expenditure, from the World Bank Open data set². Given the significant heterogeneity across countries, and to better analyze income elasticity in different areas of the globe, we carry our analysis both globally and by macro-areas, using both the United Nations geo-political classification and the World Bank income grouping. A list of the countries included in each group is provided in the appendix (see also Figure 1A in the Supplementary Material).

We refer to Frogner *et al.* (2011) for a description of health systems in industrialized, high income countries, and Mills (2011, 2014) for an economic analysis of low- and middle-income countries health systems. Table 1 shows some descriptive statistics on the variables involved in the analysis, both at the global level and for each group of countries. In line with previous studies by WHO (Poullier *et al.*, 2002), countries with higher per-capita GDP, also have higher per-capita health spending. This table also provides estimates of the cross-sectionally estimated income elasticities at the beginning and at the end of the sample period, as well as an estimate of the impact of GDP (annual) growth on health care spending growth, by weighted Ordinary Least Squares (OLS), taking the country-level shares of spending as weights. These preliminary regressions indicate an income elasticity exceeding 1 for the wealthier countries and below 1 for poorer countries. Globally, income elasticity is slightly increased over time, moving from 1.04 in 1995 to 1.15 in 2012, with the largest increment registered for countries in the Western European and others group (WEOG). That health care is a luxury for industrialized countries is in line with a consistent body of literature focused mainly on the OECD countries (see Table 1A in the Supplementary Material). This table also shows that fast growing economies tend to increase their health care spending more than slow growing economies. As also pointed by Jakovljevic and Getzen (2016), low and middle income countries are likely to become more relevant contributors to the global health care market in the long-run.

(Table 1)

3 THE EMPIRICAL MODEL

Given that our sample covers countries with very different health care systems and characteristics, we expect large heterogeneity in income elasticities of different areas of the globe, which, if ignored, may lead to biased estimates (see Blomqvist and Carter (1997)). In addition, an important characteristic of health expenditure is the presence of cross section dependence in the data. Strong forms of correlation across countries is likely to arise because countries react in a similar manner, although it would be of different intensity, to external forces and unanticipated events such as technological advances, like innovations in diagnostic tools and therapies, or health shocks, such as epidemics or diseases whose incidence suddenly rises regionally or worldwide. According to Deaton (2004), globalization has allowed the rapid transmission of health knowledge and therapies from one rich country to another, leading to a swift convergence of adult mortality rates among the rich of the world. Weak forms of correlation across countries may also arise because of financial aid, like official development assistance, given by

²<http://data.worldbank.org>.

governments and other agencies to support developing countries, thus impacting their health care spending (see, for example Farag *et al.*, 2009).

To incorporate such features into our empirical model, we consider two alternative panel specifications for health spending. First, we consider a linear panel with intercept, trend, and slope coefficients that vary across countries

$$h_{it} = \alpha_i + d_{it} + \beta'_i \mathbf{x}_{it} + u_{it}, \quad i = 1, 2, \dots, N; t = 1, 2, \dots, T, \quad (1)$$

where h_{it} is per-capita health spending in the i^{th} country at time t , \mathbf{x}_{it} is a vector of regressors including per-capita GDP (y_{it}), α_i is a country-specific effect, d_{it} is a country-specific time trend and u_{it} is the error term, which is allowed to be both serially and cross sectionally correlated. To estimate the above equation we adopt the Mean Group (MG) estimator by Pesaran and Smith (1995), which corresponds to the mean of country-specific ordinary least squares coefficients. Under slope heterogeneity, such estimator has been shown to be robust to serial correlation, as well as weak cross section dependence, such as spatial correlation, weak common factors, etc. (see Pesaran and Tosetti, 2011). As an alternative, more general specification, we also consider the following heterogeneous panel with unobserved factor structure for the error term:

$$h_{it} = \alpha_i + d_{it} + \beta'_i \mathbf{x}_{it} + \gamma'_i \mathbf{f}_t + e_{it}, \quad (2)$$

where \mathbf{f}_t is the m -dimensional vector of unobserved common effects, with m being the number of unobserved factors, γ_i is the m -dimensional vector of coefficients associated with the m common factors and the i th unit, and e_{it} is a country-specific error. In the above specification, common factors are serially correlated and potentially non-stationary, as well as correlated with the included regressors; the idiosyncratic error, e_{it} , is allowed to be serially correlated over t and weakly correlated across i (Chudik *et al.*, 2011). Non-stationary unobserved common factors possibly correlated with the regressors allow for shifts towards a new equilibrium determined by the income variable.

We estimate the above equation by Common Correlated Effects Mean Group (CCE MG) estimator proposed by Pesaran (2006), which corresponds to the MG estimator applied to model (1), augmented with cross section averages of the dependent variable, $\bar{h}_t = \frac{1}{N} \sum_{i=1}^N h_{it}$, and the regressors, $\bar{\mathbf{x}}_t = \frac{1}{N} \sum_{i=1}^N \mathbf{x}_{it}$. Both MG and CCE MG estimators rely on the assumption of heterogeneous slope coefficients. Hence, later in the paper, we will use the Pesaran and Yamagata (2008) statistic for slope homogeneity to test this assumption.

When looking at the link between spending and income, one important issue is whether the stationarity assumption holds for both time series variables. Hence, in this paper we will also investigate whether the stationarity assumption holds for the time series variables involved in the analysis, ultimately determining whether there is a long-run equilibrium between health care expenditure and income.

4 RESULTS

Table 2 shows results from the MG (column A) and CCE Mean Group (column B) estimators for World, Geopolitical and Income classifications. Results are reported when income is the

only variable included in the regression (model 1), as well as when public expenditure rate is added (model 2).

For the world, the MG estimation (model 1) shows an estimate of the coefficient on income that is roughly 0.84, while when adding the public health expenditure rate, this estimate rises to 0.87. For the CCE mean group estimates (Models 1 and 2) the GDP elasticity is smaller than one, 0.78 and 0.73 when including GDP only, or GDP and public expenditure, respectively, suggesting the necessity nature of health care. Looking at the results for the linear time trend (t), its estimated coefficient for MG estimation shows a growth in per-capita health care spending around 2.2–4.4 per cent, depending on the country, with the lowest level for low income, African countries. However, this coefficient becomes insignificant when accounting for the factor structure in CCE estimation, which already captures time varying components.

Table 2 also reports the Pesaran (2004) CD statistic and the Pesaran *et al.* (2008) bias-adjusted Lagrange Multiplier (LM_{adj}) statistic of cross section dependence on the residuals from the CCE regression, before (column A) and after having controlled for common factors (column B). For both CD and LM_{adj} tests the null hypothesis is absence of error cross section dependence, namely $H_0 : E(u_{it}u_{jt}) = 0$, for all t and $i \neq j$ in equation (1), and $H_0 : E(e_{it}e_{jt}) = 0$, for all t and $i \neq j$ in equation (2). We observe a sizeable reduction of contemporaneous correlation when passing from MG to CCE MG estimation. In the latter, the Pesaran (2004) CD test statistic indicate that there is no significant long-range cross section dependence left in the residuals, once one controls for common factors. On the contrary, the LM_{adj} points to the existence of some cross section dependence left in the residuals, even after controlling for unobserved common effects. Such result may be explained by some weak correlation left in the data, perhaps linked to geographical concentration of unobserved risk factors. The table also reports the Pesaran and Yamagata (2008) $\widehat{\Delta}_{hom}$ test of slope homogeneity, having as null hypothesis $H_0: \beta_i = \beta$ for all i , against the alternative $H_1: \beta_i \neq \beta$, for a non-zero fraction of the slope coefficients. This test points at significant heterogeneity in slope coefficients across countries, hence supporting the validity of mean group estimation with these data, as opposed to homogeneous pooling techniques.

(Table 2)

Interesting findings emerge when looking at estimates of income elasticity in different groups. Focusing on Geo-political groups, the income elasticity is significantly less than 1 for countries from WEOG and Asia-Pacific. For WEOG, the estimated income elasticity is not significantly different from zero after controlling for unobserved common factors. These results support the hypothesis that for these countries health care is a necessity, which confirms other findings for developed countries.

In contrast, African and Latin American (GRULAC) countries display a much larger income elasticity, equal to one when using the MG estimator. However, the estimated coefficient is smaller than unity when controlling for unobserved common effects. These results point at health care being a necessity for these countries, although with a larger coefficient than in wealthier countries. It is important to observe that these findings are in contrast with those from simple cross-section OLS regressions presented in Table 1, where health care is

found to be above 1 for wealthier countries and below 1 for poorer countries. However, the significant heterogeneity across countries as well as our heterogeneity tests cast doubt upon the appropriateness of assuming homogeneity across these countries. Since health expenditure represents a sizeable proportion of GDP, as a robustness check to the endogeneity problem we have tried re-estimating all regressions with health expenditure removed from GDP. Results, both globally and by group of countries, are very similar to those displayed in Table 2 and hence are not reported.

Income elasticities greater than one have been found in previous works for African countries (Murthy and Okunade, 2009). For example, Jaunkay and Khadaroo (2008) also find that public health expenditure is a luxury while private health expenditure is a necessity good. According to the authors, in the African context, public health is failing to provide adequate basic health services to the poor majority, but at the same time allows a minority of a few oligarchs to take advantage of high-tech health services. These results are in line with those in income classification groups. Indeed, wealthier countries, in the high and upper-high income groups, have smaller, though significant, income elasticities than poorer nations. These findings point at the position of countries in the global income distribution as a key factor explaining the level of income elasticity and support earlier empirical results by Zhang (2013) that an increasing level of wealth has a **positive** effect on the magnitude of the income elasticity of demand for health care.

It is important to remark that the MG estimator accounts for persistent differences across countries in the regression intercept and in income elasticity, for example due to different size of countries and associated health care spending, and characteristics in their health care system. However, one limitation of this estimator is that it assigns the same weight to each country-specific OLS coefficient, irrespective of the size or amount of spending of the country. As a robustness check we have modified this estimator to weigh each country-specific coefficient for the share of health spending over total spending (averaged over time). Results confirm the necessity nature of the health care good at the world level and for higher income countries.

We now focus on estimation of error correction models, again using the MG and CCE MG estimators, and provide a set of cointegration tests. Table 3 reports the error correction models attached to the MG and CCE MG estimation. The coefficient attached to $h_{i,t-1} - \hat{\beta}y_{i,t-1}$ measures the speed of adjustment of health care spending to a deviation from the long-run equilibrium relation between expenditure and its determinants. For all estimators, the coefficient of the error correction term has the expected negative sign. However, the CCE MG estimator reveals a speed of adjustment of -1.3, much higher than that assessed by the MG (-0.8).

The table also reports the panel cointegration tests by Westerlund (2007) for the world. These tests are able to accommodate serially correlated error terms, country-specific intercepts, trends, and slope parameters. In Column B, the bootstrap approach has been applied to obtain *p*-values robust to cross sectional dependence. The G_τ and G_α statistics test the null hypothesis of no cointegration for all cross-sectional units against the alternative that there is cointegration for at least one cross-sectional unit, while the P_τ and P_α test statistics pool information over all the cross-sectional units to test the null of no cointegration for all cross-sectional units against the alternative of cointegration for all cross-sectional units. Our tests carried at the global level

provide evidence of cointegration for the panel as a whole. These results are confirmed when we use bootstrapped p-values to allow for cross-section dependence (column B).

These results are confirmed in the geo-political and income classifications. Estimates also show a positive, significant coefficient attached to Δy_{it} , indicating that health spending reacts to short-run variations in GDP. However, it is interesting to observe that the reaction of wealthier countries to short-run changes in income is much smaller than that of poorer countries, with a coefficient attached to Δy_{it} rising from 0.1 for High income to 1.05 for Low income countries. Such result may be explained by the fact that Western countries have highly regulated and complex health care systems, that reduce their capacity to promptly adjust their health spending to short-run variations in GDP. These health care systems are designed to satisfy the essential needs of the population, with the aim to gradually improve its health outcomes. On the contrary, health care systems in poorer countries struggle to provide basic health care to the poor majority, thus overall failing to meet the essential health care needs of the population. Cointegration tests for different geographical areas confirm findings at a global level. Due to space constraints cointegration tests at the level of macro-area have not been included in this table but are reported in Tables 5A and 6A of the Supplementary Material.

(Table 3)

5 DISCUSSION AND CONCLUDING REMARKS

The main objective of this empirical exercise has been to study the association between health care spending and income, using a large data set on health indicators for 167 countries observed for eighteen years. Different from the existing literature that focuses mainly on OECD countries, we have offered a global perspective, providing new evidence on developing and low income areas of the world. The marked differences of health care systems and needs of the population across countries poses many challenges to modelling the demand of health care. To deal with these issues, we have adopted recently developed advanced econometric techniques for large panel data, to account for unobserved global shocks and heterogeneity. Our results show that when moving from wealthier to poorer countries, income elasticity rises to around unity, either if we use geo-political or income level groups (Zhang, 2013). Higher short-run coefficients attached to GDP for poorer countries are also observed. One reason for the higher income elasticity in poorer geographic areas is linked to what is regarded as "essential" in health care. This is likely to depend on the context and the level of richness of nations, with many goods and services that turn from luxury to necessity as incomes rises. Health care systems in wealthier countries are set to a relatively high standard of needs, having as ultimate aim the increase of the life expectancy and well being of citizens. On the contrary, health care systems in many low and middle income countries do not have a clear understanding of their national health priorities, with health care provision historically shaped around acute care due to contingent, emergency events such as infectious disease outbreaks.

Given the consistent heterogeneity existing across the health care systems in our data, our empirical results should be taken with caution. Although our econometric model **allows** one

to account for persistent differences in countries and is able to control for strong and weak correlations across countries, there still exists great unexplained variation in per-capita health care spending.

References

- [1] Acemoglu D, Finkelstein A, Notowidigdo MJ. 2013. Income and health spending: evidence from oil price shocks. *Review of Economics and Statistics* **95**(4): 1079-1095.
- [2] Baltagi BH, Moscone F. 2010. Health care expenditure and income in the OECD reconsidered: Evidence from panel data. *Economic Modelling* **27**(4): 804-811.
- [3] Blomqvist AG, Carter RAL. 1997. Is health care really a luxury? *Journal of Health Economics* **16**(2): 207–230.
- [4] Bougnarasy M. 2011. Health care expenditures in Asia countries: Panel data analysis. *Economics Bulletin* **31**(4): 3169-3178.
- [5] Carrion-i-Silvestre JL. 2005. Health care expenditure and GDP: are they broken stationary? *Journal of Health Economics* **24**: 839–854.
- [6] Chakroun M. 2010. Health care expenditure and GDP: An international panel smooth transition approach. *International Journal of Economics* **4**(1): 189-200.
- [7] Chen MY, Lin FL, Chang CK. 2009. Relations between health care expenditure and income: an application of local quantile regressions, *Applied Economics Letters* **16**: 177-181.
- [8] Chernew ME, May D. 2011. Health Care Cost Growth. In: The Oxford Handbook of Health Economics (Chapter 14), Edited by Sherry Glied and Peter C. Smith.
- [9] Chudik A, Pesaran MH, Tosetti E. 2011. Weak and strong cross-section dependence and estimation of large panels. *The Econometrics Journal* **14**(1): C45-C90.
- [10] Culyer AJ, 1988. Health Care Expenditures in Canada: Myth and Reality; Past and Future. Tax Paper n. 82. Canadian Tax Foundation.
- [11] Cutler, DM, Rosen AB, Vijan S. 2006. The value of medical spending in the United States, 1960-2000. *New England Journal of Medicine* **355**(9): 920-7.
- [12] Deaton A. 2004. Health in an Age of Globalization. NBER Working Paper No. 10669.
- [13] Di Matteo L, 2003. The income elasticity of health care spending: a comparison of parametric and nonparametric approaches. *European Journal of Health Economics* **4**: 20–29.
- [14] Farag M, Nandakumar AK, Wallack SS, Gaumer G, Hodgkin D. 2009. Does funding from donors displace government spending for health in developing countries?. *Health Affairs* **28**(4): 1045-1055.
- [15] Frogner BK, Hussey PS, Gerard F, Anderson GF. 2011. Health Systems in Industrialized Countries. In: The Oxford Handbook of Health Economics. Edited by Sherry Glied and Peter C. Smith

- [16] Getzen TE. 2000. Health care is an individual necessity and a national luxury: applying multilevel decision models to the analysis of health care expenditures. *Journal of Health Economics* **19**(2): 259-270.
- [17] Gerdtham UG, Sogaard J, Andersson F, Jonsson B. 1992. An econometric analysis of health care expenditure: a cross-section study of the OECD countries. *Journal of Health Economics* **11**: 63–84.
- [18] Hall RE, Jones CI. 2007. The Value of Life and the Rise in Health Spending. *Quarterly Journal of Economics* **122**(1): 39–72
- [19] Hansen P, King A. 1996. The determinants of health care expenditure: a cointegration approach. *Journal of Health Economics* **15**: 127–137.
- [20] Hartwig J. 2008. What drives health care expenditure? Baumol's model of unbalanced growth revisited. *Journal of Health Economics* **27**: 603–623.
- [21] Hitiris T, Posnett J. 1992. The determinants and effects of health expenditure in developed countries. *Journal of health economics* **11**(2): 173-181.
- [22] Leu R, 1986. The public–private mix and international health care costs. In: Culyer, A., Jonsson, B. Ž . Eds. , Public and Private Health Services. Blackwell, London.
- [23] López-Casasnovas G, Saez M. 2007. A multilevel analysis on the determinants of regional health care expenditure: a note. *The European Journal of Health Economics* **8**(1): 59-65.
- [24] Jakovljevic M, Getzen TE. 2016. Growth of Global Health Spending Share in Low and Middle Income Countries. *Frontiers in Pharmacology* **7**: 21.
- [25] Jaunky VC, Khadaroo AJ. 2008. Health care expenditure and GDP: an African perspective. *Applied Econometrics and International Development* **8**(1): 131-146.
- [26] Kleiman E. 1974. The determinants of national outlay on health. In: Perlman, M. Ed. , The Ž .Economics of Health and Medical Care. Macmillan, London.
- [27] Mills A. 2011. Health Systems in Low- and Middle-Income Countries. In: The Oxford Handbook of Health Economics, Edited by Sherry Glied and Peter C. Smith.
- [28] Mills A. 2014. Health Care Systems in Low- and Middle-Income Countries. *New England Journal Medicine* **370**: 552-557.
- [29] Moscone F, Knapp M. 2005. Exploring the spatial pattern of mental health expenditure. *The Journal of Mental Health Policy and Economics* **8**: 205-217.
- [30] Moscone F, Tosetti E. 2010. Health expenditure and income in the United States. *Health economics* **19**(12): 1385-1403.
- [31] Murphy KM, Topel RH. 2006. The Value of Health and Longevity. *Journal of Political Economy* **114**(5): 871-904.

- [32] Murthy VN, Okunade AA. 2009. The core determinants of health expenditure in the African context: Some econometric evidence for policy. *Health policy* **91**(1): 57-62.
- [33] Newhouse JP. 1977. Medical care expenditure: a cross-national survey. *Journal of Human Resources* **12**: 115–125.
- [34] Nordhaus WD. 2002. The Health of Nations: The Contribution of Improved Health to Living Standards. NBER Working Paper No. 8818.
- [35] Okunade AA, Karakus MC. 2001. Unit root and cointegration tests: time-series versus panel estimates for international health expenditure models. *Applied Economics* **33**: 1131–1137.
- [36] Okunade AA, Murthy VNR. 2002. Technology as a ‘major driver’ of health care costs: a cointegration analysis of the Newhouse conjecture. *Journal of Health Economics* **21**: 147–159.
- [37] Pesaran MH. 2004. General diagnostic tests for cross section dependence in panels, Cambridge Working Papers in Economics, 0435, University of Cambridge.
- [38] Pesaran, MH. 2006. Estimation and inference in large heterogenous panels with multifactor error structure. *Econometrica* **74**, 967-1012.
- [39] Pesaran MH, Smith RP. 1995. Estimating Long-Run Relationships from Dynamic Heterogeneous Panels. *Journal of Econometrics* **68**: 79-113.
- [40] Pesaran MH, Tosetti E. 2011. Large panels with common factors and spatial correlation. *Journal of Econometrics* **161**(2): 182-202.
- [41] Pesaran MH, Yamagata T. 2008. Testing slope homogeneity in large panels. *Journal of Econometrics* **142**(1): 50-93.
- [42] Pesaran MH, Ullah A, Yamagata T. 2008. A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal* **11**: 105-127.
- [43] Poullier JP, Hernandez P, Kawabata K, Savesoff W. 2002. Patterns of Global Health Expenditures: Results for 191 Countries. EIP/HFS/FAR Discussion Paper No. 51. WHO.
- [44] Revelli F. 2006. Performance rating and yardstick competition in social service provision. *Journal of Public Economics* **90**: 459-475.
- [45] Zhang Li. 2013. Income growth and technology advance: the evolution of the income elasticity of health expenditure, University of Oslo, Unpublished research. <http://j.mp/2zhang>
- [46] Westerlund J. 2007. Testing for error correction in panel data. *Oxford Bulletin of Economics and statistics* **69**(6): 709-748.

6 Appendix

The Countries considered in this study are divided into five geo-political regional groups according to United Nations classification:³

1. **WEOG (Western European and Others Group):** Australia, Austria, Belgium, Canada, Denmark, Ireland, Finland, France, Germany, Greece, Iceland, Israel, Italy, Luxembourg, Malta, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.
2. **Asia-Pacific:** Bahrain, Bangladesh, Solomon Islands, Bhutan, Brunei Darussalam, Cambodia, Sri Lanka, China, Cyprus, Fiji, Micronesia, Indonesia, India, Iran, Islamic Rep., Iraq, Japan, Jordan, Kyrgyz, Kiribati, Republic, Korea, Rep., Kuwait, Kazakhstan, Lao PDR, Lebanon, Mongolia, Malaysia, Oman, Vanuatu, Nepal, Pakistan, Papua New Guinea, Qatar, Philippines, Saudi Arabia, Singapore, Thailand, Tajikistan, Tonga, Turkey, Turkmenistan, Uzbekistan, Vietnam, Samoa, United Arab Emirates, Yemen, Rep.
3. **Eastern European:** Azerbaijan, Albania, Armenia, Bosnia and Herzegovina, Belarus, Bulgaria, Estonia, Czech Republic, Georgia, Croatia, Hungary, Latvia, Lithuania, Slovak Republic, Moldova, Macedonia, FYR, Montenegro, Poland, Romania, Russian Federation, Slovenia, Ukraine.
4. **GRULAC (Latin American and Caribbean Group):** Antigua and Barbuda, Barbados, Bahamas, The Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, **Honduras**, Mexico, Suriname, Paraguay, Peru, Panama, St. Lucia, Trinidad and Tobago, Uruguay, St. Vincent and the Grenadines, Venezuela.
5. **African:** Algeria, **Angola**, Botswana, Benin, Burundi, Chad, Congo Dem Rep., Congo Rep., Cameroon, Comoros, Central African Republic, Cabo Verde, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Gabon, Ghana, Guinea, Cote d'Ivoire, Kenya, Lesotho, Madagascar, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Niger, Nigeria, Guinea-Bissau, Rwanda, Seychelles, South Africa, Senegal, Sierra Leone, Sudan, Togo, Tunisia, Tanzania, Uganda, Burkina Faso, Namibia, Swaziland, , Zambia.

In addition, Countries considered in this study are divided into four groups according to their income level, using the United Nations classification:⁴

1. **High:** Antigua and Barbuda, Australia, Austria, Bahamas, The Bahrain, Barbados, Belgium, Brunei Darussalam, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Equatorial Guinea, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea Rep., Kuwait, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Oman, Poland, Portugal, Qatar, Russian Federation, Saudi Arabia, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States, Uruguay.

³www.en.wikipedia.org/w/index.php?title=United_Nations_Regional_Groups&redirect=no

⁴http://en.wikipedia.org/wiki/United_Nations_geoscheme

2. **Upper-middle:** Albania, Algeria, Angola, Azerbaijan, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Fiji, Gabon, Grenada, Hungary, Iran, Islamic Rep., Iraq, Jordan, Kazakhstan, Lebanon, Macedonia, FYR, Malaysia, Mauritius, Mexico, Montenegro, Namibia, Panama, Peru, Romania, Seychelles, South Africa, St. Lucia, Vincent and the Grenadines, Suriname, Thailand, Tonga, Tunisia, Turkey, Turkmenistan, Venezuela RB.
3. **Lower-middle:** Armenia, Bhutan, Bolivia, Cabo Verde, Cameroon, Congo, Rep., Cote d'Ivoire, Djibouti, Egypt, Arab Rep., El Salvador, Georgia, Ghana, Guatemala, Guyana, Honduras, India, Indonesia, Kiribati, Kyrgyz Republic, Lao PDR, Lesotho, Mauritania, Micronesia, Fed. Sts., Moldova, Mongolia, Morocco, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Paraguay, Philippines, Samoa, Senegal, Solomon Islands, Sri Lanka, Sudan, Swaziland, Ukraine, Uzbekistan, Vanuatu, Vietnam, Rep., Zambia.
4. **Low:** Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Eritrea, Ethiopia, Gambia, The, Guinea, Guinea-Bissau, Kenya, Madagascar, Malawi, Mali, Mozambique, Nepal, Niger, Rwanda, Sierra Leone, Tajikistan, Tanzania, Togo, Uganda.

Tables

Table I. Descriptive statistics for Health Care Expenditure and GDP and OLS income elasticity

| Group | 1995 | | | | 2012 | | | | All years | | | | | |
|----------------------|-----------|------------|------------|----------|-----------|------------|------------|----------|-----------|------------|---------------|----------------|--------------|----------|
| | HE av. | GDP av. | Elasticity | | HE av. | GDP av. | Elasticity | | HE av. | GDP av. | HE* growth | GDP* growth | Elasticity † | |
| | | | Coef. | Std.err. | | | Coef. | Std.err. | | | | | Coef. | Std.err. |
| World | 476 | 9,702 | 1.042 | 0.039 | 1,158 | 13,129 | 1.151 | 0.042 | 791 | 11,630 | 6.421 | 2.658 | 0.431 | 0.041 |
| <i>Income:</i> | | | | | | | | | | | | | | |
| High | 1,221 | 23,500 | 1.146 | 0.278 | 2,874 | 30,009 | 1.089 | 0.167 | 2,016 | 27,736 | 5.939 | 1.975 | 0.317 | 0.078 |
| Upper-Middle | 273 | 6,542 | 0.922 | 0.134 | 743 | 10,469 | 0.853 | 0.163 | 463 | 8,297 | 7.289 | 2.591 | 0.626 | 0.071 |
| Low-Middle | 92 | 2,396 | 0.981 | 0.146 | 257 | 3,658 | 0.758 | 0.165 | 158 | 2,936 | 6.747 | 3.429 | 0.581 | 0.088 |
| Low | 36 | 813 | 0.778 | 0.127 | 77 | 1,115 | 0.829 | 0.225 | 52 | 931 | 5.354 | 2.398 | 0.931 | 0.122 |
| <i>Geo-politics:</i> | | | | | | | | | | | | | | |
| WEOG | 1,764 | 26,617 | 0.96 | 0.221 | 4,231 | 33,817 | 1.09 | 0.174 | 2,996 | 31,663 | 5.339 | 1.572 | 0.468 | 0.081 |
| Asian-Pacific | 328 | 10,819 | 0.806 | 0.062 | 689 | 12,908 | 0.816 | 0.079 | 476 | 11,821 | 6.727 | 2.719 | -0.109 | 0.122 |
| Eastern EU | 352 | 6,853 | 1.014 | 0.075 | 1,145 | 13,238 | 0.912 | 0.089 | 711 | 10,114 | 8.39 | 4.808 | 0.614 | 0.065 |
| GRULAC | 358 | 7,872 | 1.026 | 0.139 | 832 | 10,997 | 0.927 | 0.106 | 552 | 9,486 | 6.044 | 2.19 | 0.548 | 0.099 |
| African | 97 | 2,571 | 0.909 | 0.048 | 257 | 4,187 | 0.871 | 0.046 | 159 | 3,380 | 5.339 | 2.433 | 0.646 | 0.086 |

Notes: All variables are expressed in US\$, per-capita and at constant 2005 PPP prices. Elasticites have been computed applying weighted Ordinary Least Squares to the simple regression $h_{it} = \alpha + \beta y_{it} + \epsilon_{it}$, using country-specific share of health care spending as weights. (*): Average annual growth in %. (†): In this regression, h_{it} and y_{it} are in first-differences.

Table 2. Determinants of Health Expenditure for World, Geo-Politics and Income classifications

| Income | (A) MG | | (B) CCE MG | | Geo-Politics | (A) MG | | (B) CCE MG | |
|------------------------------------|---------------------|----------------|---------------|---------------|------------------------------------|----------------|----------------|---------------|-----------------|
| | Model 1 | Model 2 | Model 1 | Model 2 | | Model 1 | Model 2 | Model 1 | Model 2 |
| WORLD | WEOG | | | | | | | | |
| y_{it} | 0.837 (0.096) | 0.875 (0.095) | 0.778 (0.108) | 0.729 (0.112) | y_{it} | 0.691 (0.143) | 0.665 (0.147) | 0.196 (0.253) | 0.142 (0.203) |
| t | 0.03(0.003) | 0.03(0.003) | -0.001(0.007) | -0.001(0.007) | t | 0.044(0.002) | 0.043(0.003) | 0.002(0.006) | -0.002(0.009) |
| $Publ_{it}$ | - | 0.433 (0.087) | - | 0.519 (0.109) | $Publ_{it}$ | - | 0.701 (0.276) | 0.075 (0.241) | |
| t -test for coeff. of $y_{it}=1$ | -1.77 | -1.31 | -2.12 | -2.5 | t -test for coeff. of $y_{it}=1$ | -2.21 | -2.31 | -3.2 | -4.22 |
| CD | 22.84 [0.00] | 20.59 [0.00] | 0.05 [0.96] | -0.53 [0.59] | CD | 17.34 [0.00] | 16.76 [0.00] | -2.18 [0.03] | -2.04 [0.04] |
| LM _{adj} | 125.4[0.00] | 57.54[0.00] | 84.02[0.00] | 59.42[0.00] | LM _{adj} | 55.75[0.00] | 36.84[0.00] | 17.03[0.00] | 1.532 [0.1255] |
| $\hat{\Delta}_{hom}$ | 3,115.2 [0.00] | 3,538.4 [0.00] | 3006 | 3006 | $\hat{\Delta}_{hom}$ | 916.0 [0.00] | 957.4 [0.00] | 432 | 432 |
| n. obs | 3006 | 3006 | 3006 | 3006 | n. obs | 432 | 432 | 432 | 432 |
| High | Asia-Pacific | | | | | | | | |
| y_{it} | 0.57 (0.12) | 0.62 (0.11) | 0.48 (0.17) | 0.45 (0.18) | y_{it} | 0.515 (0.214) | 0.505 (0.218) | 0.492 (0.248) | 0.422 (0.204) |
| t | 0.04(0.004) | 0.039(005) | -0.001(0.010) | 0.001(0.006) | t | 0.039(0.007) | 0.038(0.008) | 0.010(0.023) | 0.002(0.025) |
| $Publ_{it}$ | - | 0.533 (0.219) | 0.47 (0.20) | 0.47 (0.20) | $Publ_{it}$ | 0.555 (0.213) | 0.571 (0.195) | | |
| t -test for coeff. of $y_{it}=1$ | -3.58 | -3.45 | -3.05 | -3.05 | t -test for coeff. of $y_{it}=1$ | -2.26 | -2.29 | -2.048 | -2.833 |
| CD | 24.34 [0.00] | 25.58 [0.00] | 2.00 [0.04] | 0.96 [0.33] | CD | 2.37 [0.01] | 2.63 [0.00] | -1.10 [0.27] | -1.71 [0.08] |
| LM _{adj} | 67.32 [0.00] | 39.54 [0.00] | 34.27 [0.00] | 14.29 [0.00] | LM _{adj} | 22.00 [0.00] | 16.08 [0.00] | 5.92 [0.00] | 4.965 [0.00] |
| $\hat{\Delta}_{hom}$ | 444.4 [0.00] | 535.3 [0.00] | 918 | 918 | $\hat{\Delta}_{hom}$ | 1,658.6 [0.00] | 1,828.7 [0.00] | 810 | 810 |
| n. obs | 918 | 918 | 918 | 918 | n. obs | 810 | 810 | 810 | 810 |
| Upper-middle | Eastern EU | | | | | | | | |
| y_{it} | 0.60 (0.16) | 0.63 (0.18) | 0.57 (0.21) | 0.65 (0.22) | y_{it} | 0.984 (0.131) | 0.865 (0.103) | 0.778 (0.224) | 0.830 (0.165) |
| t | 0.04(0.006) | 0.04(0.007) | -0.007(0.023) | 0.003(0.021) | t | 0.036(0.005) | 0.042(0.006) | 0.006(0.009) | 0.014(0.008) |
| $Publ_{it}$ | - | 0.34 (0.14) | 0.43 (0.13) | 0.43 (0.13) | $Publ_{it}$ | 0.268 (0.229) | 0.191 (0.169) | | |
| t -test for coeff. of $y_{it}=1$ | -2.5 | -2.05 | -2.04 | -1.59 | t -test for coeff. of $y_{it}=1$ | -0.15 | -1.31 | -0.99 | -1.03 |
| CD | 2.66 [0.00] | 2.97 [0.00] | -0.83 [0.40] | -0.63 [0.52] | CD | 6.81 [0.00] | 6.56 [0.00] | -2.03 [0.04] | -1.89 [0.06] |
| LM _{adj} | 27.32 [0.00] | 13.08 [0.00] | 18.92 [0.00] | 17.55 [0.00] | LM _{adj} | 23.25 [0.00] | 6.74 [0.00] | 9.701 [0.00] | 2.33 [0.019] |
| $\hat{\Delta}_{hom}$ | 816.2 [0.00] | 797.5 [0.00] | 810 | 810 | $\hat{\Delta}_{hom}$ | 196.8 [0.00] | 333.5 [0.00] | 396 | 396 |
| n. obs | 810 | 810 | 810 | 810 | n. obs | 396 | 396 | 396 | 396 |
| Low-middle | GRULAC | | | | | | | | |
| y_{it} | 1.17 (0.23) | 1.22 (0.22) | 1.14 (0.27) | 0.90 (0.30) | y_{it} | 1.000 (0.231) | 1.330 (0.238) | 1.084 (0.339) | 1.365 (0.3697) |
| t | '0.037(0.006) | 0.034(0.006) | 0.009(0.014) | 0.008(0.015) | t | 0.033(0.005) | 0.027(0.005) | 0.0008(0.013) | 0.005(0.014) |
| $Publ_{it}$ | - | 0.555 (0.213) | 0.61 (0.21) | 0.61 (0.21) | $Publ_{it}$ | 0.533 (0.219) | 0.397 (0.163) | | |
| t -test for coeff. of $y_{it}=1$ | 0.73 | 1 | 0.51 | -0.33 | t -test for coeff. of $y_{it}=1$ | 0 | 1.38 | 0.247 | 0.98 |
| CD | 0.19 [0.84] | -0.62 [0.53] | -1.29 [0.19] | -2.05 [0.04] | CD | 2.36 [0.02] | 0.53 [0.59] | -2.12 [0.03] | -2.00 [0.04] |
| LM _{adj} | 31.55 [0.00] | 19.34 [0.00] | 13.73 [0.00] | 14.01 [0.00] | LM _{adj} | 25.76 [0.00] | 12.21 [0.00] | 17.03 [0.00] | 6.186 [0.00] |
| $\hat{\Delta}_{hom}$ | 1634.0 [0.00] | 1576.1 [0.00] | 792 | 792 | $\hat{\Delta}_{hom}$ | 802.1 [0.00] | 795.5 [0.00] | 504 | 504 |
| n. obs | 792 | 792 | 792 | 792 | n. obs | 504 | 504 | 504 | 504 |
| Low | African | | | | | | | | |
| y_{it} | 1.15 (0.24) | 1.17 (0.25) | 1.00 (0.19) | 0.95 (0.21) | y_{it} | 1.049 (0.206) | 1.066 (0.194) | 0.936 (0.226) | 0.809 (0.176) |
| t | 0.024(0.007) | 0.022(0.007) | 0.003(0.012) | -0.002(0.011) | t | 0.035(0.006) | 0.034(0.006) | 0.002(0.013) | 0.008(0.014) |
| $Publ_{it}$ | - | 0.21 (0.09) | 0.23 (0.07) | 0.23 (0.07) | $Publ_{it}$ | 0.202 (0.074) | 0.249 (0.074) | | |
| t -test for coeff. of $y_{it}=1$ | 0.625 | 0.68 | 0 | -0.23 | t -test for coeff. of $y_{it}=1$ | 0.237 | 3.4 | -0.28 | -1.08 |
| CD | 5.96 [0.00] | 5.52 [0.00] | -2.64 [0.00] | -1.80 [0.07] | CD | 3.52 [0.00] | 3.49 [0.00] | -1.16 [0.24] | -1.25 [0.21] |
| LM _{adj} | 14.49 [0.00] | 6.99 [0.00] | 6.57 [0.00] | 10.74 [0.00] | LM _{adj} | 25.74 [0.00] | 12.76 [0.00] | 16.05 [0.00] | 4.359 [0.00] |
| $\hat{\Delta}_{hom}$ | 2688.0 [0.00] | 2910.7 [0.00] | 486 | 486 | $\hat{\Delta}_{hom}$ | 1,042.4 [0.00] | 1,473.8 [0.00] | 864 | 864 |
| n. obs | 486 | 486 | 486 | 486 | n. obs | 864 | 864 | 864 | 864 |

Notes: Standard errors in paranthese, p-values in square brackets. For both CD and LM_{adj} tests, the null hypothesis is absence of error cross section dependence, namely $H_0: E(u_{it} u_{jt})=0$, for all t and i,j in equation 1, and $H_0: E(u_{it} u_{jt})=0$, for all t and i,j in equation 2.

Table 3. Error Correction Model for World, Geo-Politics and Income classifications

| | (A) MG | | (B) CCE MG | | | (A) MG | | (B) CCE MG | |
|---------------------------------------|--|----------------|----------------|----------------|---------------------------------------|---|--------------------------------|----------------|----------------|
| Income | Model 1 | Model 2 | Model 1 | Model 2 | Geo-Politics | Model 1 | Model 2 | Model 1 | Model 2 |
| WORLD | | | | | | | | | |
| $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.813 (0.025) | -0.903 (0.027) | -1.316 (0.028) | -1.353 (0.030) | $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.686 (0.059) | -0.751 (0.057) | -1.023 (0.069) | -1.627 (0.113) |
| $\Delta h_{i,t-1}$ | 0.281 (0.017) | 0.255 (0.017) | 0.339 (0.021) | 0.306 (0.019) | $\Delta h_{i,t-1}$ | 0.384 (0.053) | 0.347 (0.054) | 0.368 (0.057) | 0.369 (0.064) |
| Δy_{it} | 0.437 (0.095) | 0.467 (0.084) | 0.570 (0.100) | 0.505 (0.106) | Δy_{it} | 0.168 (0.110) | 0.203 (0.080) | 0.133 (0.225) | 0.031 (0.168) |
| $\Delta publ_{it}$ | - | 0.494 (0.083) | - | 0.471 (0.096) | $\Delta publ_{it}$ | 0.655 (0.202) | t-test for coeff of y_{it-1} | -7.56 | -9.96 |
| t-test for coeff of y_{it-1} | -6 | -6.42 | -4.3 | -4.71 | t-test for coeff of y_{it-1} | -7.56 | -9.96 | -3.85 | -5.76 |
| CD | 7.16 [0.00] | 4.22 [0.00] | -0.10 [0.92] | -0.74 [0.45] | CD | 3.26 [0.00] | 4.72 [0.00] | -1.89 [0.06] | -1.18 [0.24] |
| LM _{adj} | -21.45[0.00] | -21.62[0.00] | 71.3[0.00] | 81.13[0.00] | LM _{adj} | -1.317[0.18] | 0.61[0.54] | 7.0[0.00] | 9.27[0.00] |
| High | | | | | | | | | |
| $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.74 (0.04) | -0.84 (0.04) | -1.21 (0.06) | -1.42 (0.06) | $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.928 (0.052) | -1.004 (0.053) | -1.454 (0.068) | -1.378 (0.064) |
| $\Delta h_{i,t-1}$ | 0.29 (0.03) | 0.25 (0.03) | 0.32 (0.04) | 0.30 (0.03) | $\Delta h_{i,t-1}$ | 0.242 (0.030) | 0.222 (0.029) | 0.375 (0.041) | 0.303 (0.031) |
| Δy_{it} | 0.07 (0.09) | 0.25 (0.09) | 0.09 (0.20) | 0.10 (0.24) | Δy_{it} | 0.224 (0.224) | 0.216 (0.227) | 0.480 (0.260) | 0.264 (0.200) |
| $\Delta publ_{it}$ | 0.69 (0.17) | 0.63 (0.20) | 0.63 (0.20) | 0.63 (0.20) | $\Delta publ_{it}$ | 0.644 (0.226) | t-test for coeff of y_{it-1} | -3.46 | -3.45 |
| t-test for coeff of y_{it-1} | -10.33 | -8.33 | -4.55 | -3.75 | t-test for coeff of y_{it-1} | -3.46 | -3.45 | -2 | -3.68 |
| CD | 4.17[0.00] | 6.04[0.00] | -0.12[0.90] | 0.43[0.66] | CD | 2.42 [0.01] | 1.22 [0.22] | -2.22 [0.03] | -1.73 [0.08] |
| LM _{adj} | -4.14[0.00] | -2.66[0.00] | 9.27 [0.00] | 18.26[0.00] | LM _{adj} | -5.963[0.000] | -5.697[0.000] | 9.972[0.000] | 19.57[0.000] |
| Upper-middle | | | | | | | | | |
| $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.87 (0.05) | -0.97 (0.05) | -1.33 (0.57) | -1.47 (0.05) | $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.733 (0.065) | -0.867 (0.047) | -1.142 (0.108) | -1.344 (0.078) |
| $\Delta h_{i,t-1}$ | 0.24 (0.02) | 0.24 (0.02) | 0.32 (0.03) | 0.29 (0.03) | $\Delta h_{i,t-1}$ | 0.267 (0.039) | 0.242 (0.036) | 0.200 (0.043) | 0.260 (0.043) |
| Δy_{it} | 0.19 (0.17) | 0.24 (0.16) | 0.47 (0.20) | 0.50 (0.21) | Δy_{it} | 0.653 (0.106) | 0.584 (0.108) | 0.625 (0.152) | 0.477 (0.179) |
| $\Delta publ_{it}$ | 0.51 (0.15) | 1.00 (0.54) | 0.55 (0.15) | 0.55 (0.15) | $\Delta publ_{it}$ | 0.318 (0.147) | t-test for coeff of y_{it-1} | -3.27 | -3.85 |
| t-test for coeff of y_{it-1} | -4.76 | -4.76 | -2.65 | -2.38 | t-test for coeff of y_{it-1} | -3.27 | -3.85 | -2.46 | -2.96 |
| CD | 1.38[0.16] | 0.96 [0.33] | -2.20[0.02] | -2.12[0.03] | CD | 1.08 [0.28] | 0.31 [0.75] | -1.99 [0.04] | -0.82 [0.41] |
| LM _{adj} | -8.58[0.00] | -10.06 [0.00] | 19.20[0.00] | 20.06 [0.00] | LM _{adj} | -1.47[0.140] | -2.108[0.350] | 9.092[0.00] | 11.32[0.00] |
| Low-middle | | | | | | | | | |
| $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.81 (0.05) | -0.87(0.06) | -1.23 (0.05) | -1.37 (0.06) | $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.752 (0.065) | -0.856 (0.064) | -1.262 (0.093) | -1.489 (0.096) |
| $\Delta h_{i,t-1}$ | 0.30 (0.02) | 0.27 (0.03) | 0.38 (0.02) | 0.37 (0.04) | $\Delta h_{i,t-1}$ | 0.250 (0.045) | 0.204 (0.0448) | 0.316 (0.062) | 0.263 (0.045) |
| Δy_{it} | 0.71 (0.23) | 0.68 (0.21) | 0.82 (0.31) | 0.56 (0.37) | Δy_{it} | 0.167 (0.245) | 0.577 (0.174) | 0.158 (0.346) | 0.926 (0.291) |
| $\Delta publ_{it}$ | 0.40 (0.17) | 0.68 (0.23) | 0.68 (0.23) | 0.68 (0.23) | $\Delta publ_{it}$ | 0.684 (0.232) | t-test for coeff of y_{it-1} | -3.4 | -2.47 |
| t-test for coeff of y_{it-1} | -1.26 | -1.52 | -0.58 | -1.18 | t-test for coeff of y_{it-1} | -3.4 | -2.47 | -2.45 | -0.27 |
| CD | -0.08[0.93] | -0.91[0.36] | -0.12[0.90] | -0.68[0.49] | CD | -0.67 [0.50] | -0.57 [0.57] | -1.28 [0.20] | -1.00 [0.31] |
| LM _{adj} | -1.52[0.12] | -3.53[0.00] | 11.35[0.00] | 13.66[0.00] | LM _{adj} | -3.524[0.00] | -4.192[0.00] | 8.636 [0.00] | 15.15 [0.00] |
| Low | | | | | | | | | |
| $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.82(0.04) | -0.94 (0.06) | -1.28(0.06) | -1.33 (0.07) | $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.841 (0.044) | -0.930 (0.059) | -1.293 (0.045) | -1.256 (0.067) |
| $\Delta h_{i,t-1}$ | 0.25 (0.04) | 0.24 (0.03) | 0.27 (0.04) | 0.11 (0.04) | $\Delta h_{i,t-1}$ | 0.290 (0.030) | 0.276 (0.029) | 0.328 (0.040) | 0.288 (0.038) |
| Δy_{it} | 1.08 (0.23) | 0.87 (0.19) | 0.93 (0.18) | 1.05 (0.21) | Δy_{it} | 0.829 (0.189) | 0.7158 (0.159) | 0.803 (0.205) | 0.538 (0.186) |
| $\Delta publ_{it}$ | 0.22 (0.07) | 0.24 (0.08) | 0.23 | 0.23 | $\Delta publ_{it}$ | 0.242 (0.067) | t-test for coeff of y_{it-1} | -0.9 | -1.79 |
| t-test for coeff of y_{it-1} | 0.34 | -0.68 | -0.38 | 0.23 | t-test for coeff of y_{it-1} | 1.24 [0.21] | 1.03 [0.30] | -0.96 | -2.52 |
| CD | 3.20[0.00] | 2.11[0.03] | -1.89[0.05] | -1.55[0.12] | CD | -7.059[0.000] | -7.946[0.000] | -1.34 [0.18] | -2.01 [0.04] |
| LM _{adj} | -2.07[0.03] | -4.10[0.00] | 7.93[0.00] | 9.35[0.00] | LM _{adj} | 20.8 [0.000] | 26.25 [0.000] | | |
| African | | | | | | | | | |
| $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -2.544 [0.00] | -2.684 [0.01] | -2.544 [0.06] | -2.684 [0.10] | $h_{i,t-1} - \hat{\beta}_{y_{i,t-1}}$ | -0.841 (0.044) | -0.930 (0.059) | -1.293 (0.045) | -1.256 (0.067) |
| Gt | -2.544 [0.00] -2.684 [0.01] -2.544 [0.06] -2.684 [0.10] | | | | Ga | -0.841 (0.044) -0.930 (0.059) -1.293 (0.045) -1.256 (0.067) | | | |
| cointegration | -9.044 [0.100] -7.766 [0.100] -9.044 [0.42] -7.766 [0.12] | | | | Pt | -9.044 [0.100] -7.766 [0.100] -9.044 [0.42] -7.766 [0.12] | | | |
| tests (WORLD) | -48.477 [0.00] -31.83 [0.006] -48.477 [0.00] -31.83 [0.10] | | | | Pa | -48.477 [0.00] -31.83 [0.006] -48.477 [0.00] -31.83 [0.10] | | | |
| | -7.159 [0.00] -8.639 [0.02] -7.159 [0.00] -8.639 [0.00] | | | | | -7.159 [0.00] -8.639 [0.02] -7.159 [0.00] -8.639 [0.00] | | | |

Note: The G_t and G_a statistics test the null hypothesis of no cointegration for all cross-sectional units against the alternative that there is cointegration for at least one cross-sectional unit.

The P_t and P_a test statistics pool information over all the cross-sectional units to test the null of no cointegration for all cross-sectional units against the alternative of cointegration for all cross-sectional units

SUPPLEMENTARY MATERIAL

Table 1A. Estimated income elasticity from a variety of studies over the last 60 years

| Study | Time span | Key variable | Econometric methods | Findings |
|----------------------------------|-----------|---|---|---|
| OECD countries | | | | |
| Newhouse (1977) | 1970 | per-capita HE | Cross section regression | Income elasticity (range 1.15-1.31) |
| Leu (1986) | 1974 | per-capita HE | Cross section regression | Income elasticity (1.2) |
| Parkin, McGuire, and Yule (1987) | 1980 | per-capita HE in PPPs & HE share of GDP | Cross section regression | Income elasticity (0.9) |
| Gerdtham et al. (1992) | 1987 | Per capita HE in PPPs | Cross section regression | Income elasticity (range 1.39-1.56) |
| Getzen and Poullier (1992) | 1965-1987 | Annual percent change of health expenditure | Exponential smoothing, moving average and ARIMA methods | Income elasticity (1.39) |
| Hitriss and Posnett (1992) | 1960-1987 | Per capita real HE | Pooled regression | Income elasticity (range 1.02-1.16) |
| Hansen and King (1996) | 1960-1987 | Real per capita HE | Unit root and cointegration analysis | Variables are non stationary, absence of cointegration |
| Blomqvist and Carter (1997) | 1960-1991 | Per capita HE in PPPs | Unit root and cointegration analysis | Variables are non stationary, significant heterogeneity |
| Gerdtham et al. (1998) | 1970-1991 | Per capita real HE | Pooled regression | Income elasticity (range 0.67-0.82) |
| Di Matteo and Di Matteo (1998) | 1965-1991 | Real per capita HE | Pooled regression | Income elasticity (0.77) |
| Barros (1998) | 1960-1990 | Growth rate of per capita HE | Panel regression analysis | Income elasticity (0.60, 0.92) |
| Fogel (1999) | 1875-1996 | Health care expenditure | Long run analysis | Income elasticity (1.6) |
| Roberts (1999) | 1960-1993 | Real Per capita HE | Mean Group, Pooled, Cross section | Income elasticity (range 1.25-2) |
| Oskunade and Karakus (2001) | 1960-1997 | Real per capita HE | Unit root and cointegration analysis | Income elasticity (range 1.20-1.46) |
| Okunade and Murthy (2002) | 1960-1997 | Real per capita HE | Unit root and cointegration analysis | Income elasticity (1.64) |
| Freeman (2003) | 1966-1998 | Health care expenditure | Dynamic OLS cointegrating regression | Income elasticity (range 0.81-0.84) |
| Herwartz and Theilien (2003) | 1961-1979 | Growth rate of per capita HE | Panel regression analysis | Income elasticity (0.74) |
| Clemente et al (2004) | 1960-1977 | Public and Private HE | Cobb-Douglas utility function | Variables are non stationary, significant heterogeneity |
| Crivelli and al. (2006) | 1996-2002 | socialised per capita HE | Panel regression analysis | Income elasticity with negative value (-0.08, -0.11) |
| Hall and Jones (2007) | 1950-2000 | HE share of GDP | Generalised Method of Moments (GMM) | HE shares rise is a rational response to growth of income |
| Costa-Font and Pons-Novell | 1992-1999 | Public per capita HE | OLS and MLE | Income elasticity (range 0.66- 0.98) |
| Carrion-i-Silvestre (2005) | 1960-1997 | Real per capita HE | Unit root with structural break | Variables can be characterised as stationary processes evolving around a broken trend |
| Moscone and Tosetti, 2010 | 1980-2004 | Per capita HE in PPPs | Unit root and cointegration analysis (FE, CCE) | Income elasticity (range 0.36-0.90) |
| Baltagi and Moscone, 2010 | 1971-2004 | Real per capita HE | Unit root and cointegration analysis ((FE, CCE, Spatial Model)) | Income elasticity (range 0.44-0.89) |
| Darmont et al., 2010 | 1970-2002 | Per capita HE in PPPs | Panel regression analysis | Income elasticity (range 0.75-1.59) |
| Chakroun, 2010 | 1975-2003 | Per capita HE in PPPs | Panel threshold regression | Income elasticity below 1 |
| Acemoglu et al. (2013) | 1960-2005 | Area hospital expenditures | IV regression with oil prices as instruments | Income elasticity (0.7) |

Table 1A. continued.

| Asian countries | | | | | |
|------------------------------|-----------|---|---|--|-------------------------------------|
| Boungnaratay (2011) | 1975-2006 | Real per-capita HE | | Unit root and cointegration analysis | Income elasticity (range 0.36-2.53) |
| Pan and Liu (2012) | 2002-2006 | Real per-capita government HE | Panel regression analysis | Income elasticity below 1 (range 0.22, 0.40) | |
| Samadi and Rad (2013) | 1995-2009 | Per capita HE PPPs | Panel regression analysis | Income elasticity below 1 (0.46, 0.82) | |
| Khan and Mahumud (2015) | 1995-2010 | Per capita Private and Public HE | Panel regression analysis | Income elasticity below 1 (range 0.41-0.91) | |
| African countries | | | | | |
| Gbeseme, and Gerdtham (1992) | 1984 | Per-capita HE | Cross section regression | Income elasticity (1.07) | |
| N.R.V. Murthy (2004) | 2001 | Real per capita HE | Cross section regression | Income elasticity (1.11) | |
| Okunade (2005) | 1995 | Per capita HE in PPPs | Flexible Box-Cox model regression methods and cross section | Income elasticity (0.6) | |
| Jaunky and Khadaroo (2008) | 1991-2000 | Real per-capita total, private and public HEs | Panel regression analysis (FE, GMM, ECM) | Income elasticity (range 0.75-1.19) | |
| Murthy and Okunade (2009) | 2001 | Real per-capita HE | Cross section regression | Income elasticity (range 1.07-1.11) | |
| Mehara et al (2012) | 1995-2005 | Per capita HE | Unit root and cointegration analysis | Income elasticity (0.94) | |
| Lv and Zhu (2014) | 1995-2009 | Per capita HE | Panel regression analysis | Income elasticity (0.98) | |
| World | | | | | |
| Xu et al. (2011) | 1995-2008 | Real per-capita HE | Fixed effects static and dynamic panels | Income elasticities (range 0.36-1.30) | |
| Farag et al. (2012) | 1995-2006 | Real per-capita Government HE | Fixed-effect generalized least squares (GLS) | Income elasticity (range 0.02-0.19) | |
| Liang and Mirelman (2014) | 1995-2010 | Per capita HE in PPPs | Two-stage least squares regression | Income elasticity (range 0.66-0.94) | |
| Fan and Savedoff (2014) | 1995-2009 | Per-capita HE | Pooled regression in levels and in first-differences | Income elasticity (0.7) | |

Note: Since methodologies vary and elasticities must be interpolated in many cases, readers are cautioned to carefully refer to original sources in the list of references.

Table 2A CIPS panel unit root tests statistics WORLD

| Number of lag | | | | |
|------------------------------------|---------|---------|---------|---------|
| | 0 | 1 | 2 | 3 |
| h_{it} | -2.004* | -1.865* | -1.898* | -1.805 |
| y_{it} | -1.735 | -1.697 | -1.559 | -1.153 |
| $Publ_{it}$ | -2.187* | -1.911* | -1.870* | -1.808 |
| Δh_{it} | -3.696* | -2.903* | -2.294* | -2.411* |
| Δy_{it} | -3.293* | -2.682* | -2.059* | -2.661* |
| $\Delta publ_{it}$ | -4.078* | -2.664* | -2.181* | -1.689 |
| With an intercept and trend | | | | |
| h_{it} | -2.625* | -2.607* | -2.425* | -2.851* |
| y_{it} | -2.258 | -2.372 | -2.133 | -2.813* |
| $Publ_{it}$ | -2.562* | -2.181 | -2.146 | -1.97 |

Notes: (*): significant at the 5 per cent significance level.
 See Pesaran (2007) for the exact critical values of the CIPS statistic.

Table 3A. CIPS panel unit root tests statistics by Income classification

| | High | | | | Upper-middle | | | | Lower-middle | | | | Low | | | |
|------------------------------------|----------------|---------|---------|--------|----------------|---------|---------|---------|----------------|---------|---------|---------|----------------|---------|---------|--------|
| | Number of lags | | | | Number of lags | | | | Number of lags | | | | Number of lags | | | |
| | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 |
| h_{it} | 0.985 | 1.107 | 1.728 | 0.183 | -4.838* | -4.894* | -4.522* | -4.269* | -3.129* | -4.371* | -0.914 | 0.481 | -5.333* | -3.873* | -1.651 | -1.162 |
| y_{it} | 3.11 | -0.52 | -1.03 | -2.993 | 0.668 | -0.426 | 0.464 | 1.872 | 0.683 | -0.03 | 2.112 | 1.564 | -0.518 | -1.813 | -0.482 | 2.193 |
| Publ_{it} | -0.835 | 0.087 | 1.662 | 3.082 | -3.014* | -1.382 | -2.380* | -1.712 | -3.226* | -2.598 | -0.378 | -0.365 | -2.920* | -0.649 | 0.866 | -0.214 |
| Δh_{it} | -11.991* | -2.107* | 0.943 | 4.305 | -15.788* | -6.923* | -4.120* | -2.159* | -12.297* | -8.027* | -2.759* | -1.036 | -14.331* | -7.008* | -3.901* | -1.591 |
| Δy_{it} | -6.511* | -2.131* | -0.45 | -1.387 | -9.863* | -5.289* | 0.674 | 1.537 | -7.568* | -2.973* | 0.933 | 2.625 | -8.892* | -5.819* | -4.531* | -0.97 |
| Δpubl_{it} | -15.104* | -6.544* | -2.270* | 0.513* | -14.449* | -4.421* | -0.507 | 0.588 | -15.684* | -7.853* | -4.337* | -3.281* | -13.465* | -7.426* | 0.901 | 2.335 |
| With an intercept and trend | | | | | | | | | | | | | | | | |
| h_{it} | 3.687 | 4.574 | 6.201 | 7.562 | -2.042 | -1.449 | -1.816 | 0.157 | -0.778 | -2.524* | 1.605 | 1.993 | -3.784* | -3.111* | -1.772* | 1.042 |
| y_{it} | 5.051 | 1.585 | -0.271 | 0.253 | 2.444 | 2.512 | 4.748 | 4.717 | 2.96 | 1.801 | 5.483 | 4.94 | -1.772* | -2.662* | -2.003* | 2.247 |
| Publ_{it} | 0.27 | 1.045 | 2.394 | 2.941 | 0.27 | 1.045 | 2.394 | 2.941 | -3.102* | -2.497* | -2.130* | 0.174 | -1.162 | 1.738 | 4.636 | 3.821 |

Notes: (*): significant at the 5 per cent significance level. See Pesaran (2007) for the exact critical values of the CIPS statistic.

Table 4A. CIPS panel unit root tests statistics by geo-politics classification

| | | WEOG | | | Asia-Pacific | | | Eastern EU | | | GRULAC | | | African | | | | | | |
|------------------------------------|---------|----------------|---------|--------|----------------|---------|---------|----------------|---------|---------|----------------|---------|---------|----------------|---------|--------|---------|---------|---------|---------|
| | | Number of lags | | | Number of lags | | | Number of lags | | | Number of lags | | | Number of lags | | | | | | |
| | | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 | 3 | | | |
| h_{it} | -1.762 | -1.654 | -1.459 | -1.455 | -2.227* | -2.292* | -1.765 | -1.964 | -2.694* | -2.217* | -2.604* | -2.256* | -2.502* | -2.364* | -1.805 | -1.57 | -2.439* | -2.315* | -2.122* | -1.878 |
| y_{it} | -0.908 | -1.057 | -1.19 | -1.532 | -1.884 | -1.92 | -1.761 | -1.51 | -2.472* | -2.508* | -2.144* | -2.045* | -1.224 | -1.633 | -1.714 | -2.102 | -1.799 | -2.169* | -1.71 | -1.6 |
| Publ_{it} | -1.899 | -2.185* | -1.592 | -1.918 | -2.023 | -1.817 | -1.865 | -1.689 | -2.199* | -2.111* | -2.355* | -2.319* | -2.255* | -1.884 | -1.666 | -1.314 | -2.360* | -2.371* | -2.075* | -1.716 |
| Δh_{it} | -3.788* | -2.631* | -1.803 | -1.666 | -3.900* | -2.964* | -2.148* | -1.591 | -4.516* | -2.618* | -2.464* | -2.216* | -4.172* | -2.888* | -2.470* | -1.961 | -4.109* | -2.967* | -2.665* | -2.457* |
| Δy_{it} | -2.840* | -2.059* | -1.578 | -1.654 | -2.982* | -2.180* | -1.879 | -1.282 | -2.974* | -2.686* | -2.192* | -1.822 | -2.825* | -2.084* | -1.536 | -1.715 | -3.297* | -2.705* | -2.258* | -1.73 |
| Δpubl_{it} | -3.827* | -2.816* | -2.057* | -1.937 | -3.687* | -2.398* | -1.956* | -1.329 | -3.935* | -2.944* | -2.240* | -2.173* | -4.056* | -2.669* | -2.288* | -1.774 | -4.060* | -2.881* | -2.220* | -1.808 |
| With an intercept and trend | | | | | | | | | | | | | | | | | | | | |
| h_{it} | -2.398 | -1.895 | -1.795 | 1.738 | -2.506 | -2.565 | -1.954 | -1.657 | -2.799* | -2.082* | -2.639* | -2.445 | -2.648 | -2.449 | -2.458 | -2.199 | -2.808* | -2.817* | -2.684* | -2.456 |
| y_{it} | -1.812 | -1.902 | -1.858 | -1.986 | -2.051 | -2.078 | -1.98 | -1.362 | -2.272 | -2.635* | -2.167 | -2.059 | -1.203 | -1.609 | -1.578 | -1.93 | -1.956 | -2.34 | -2.087 | -1.723 |
| Publ_{it} | -2.523 | -2.528 | -2.085 | -1.926 | -2.053 | -1.867 | -1.855 | -1.526 | -2.579* | -2.4 | -2.423 | -2.245 | -2.437 | -2.296 | -2.444 | -1.745 | -2.489 | -2.597 | -2.196 | -1.835 |

Notes: (*) significant at the 5 per cent significance level. See Pesaran (2007) for the exact critical values of the CIPS statistic.

Table 5A. Cointegration test, Income classification

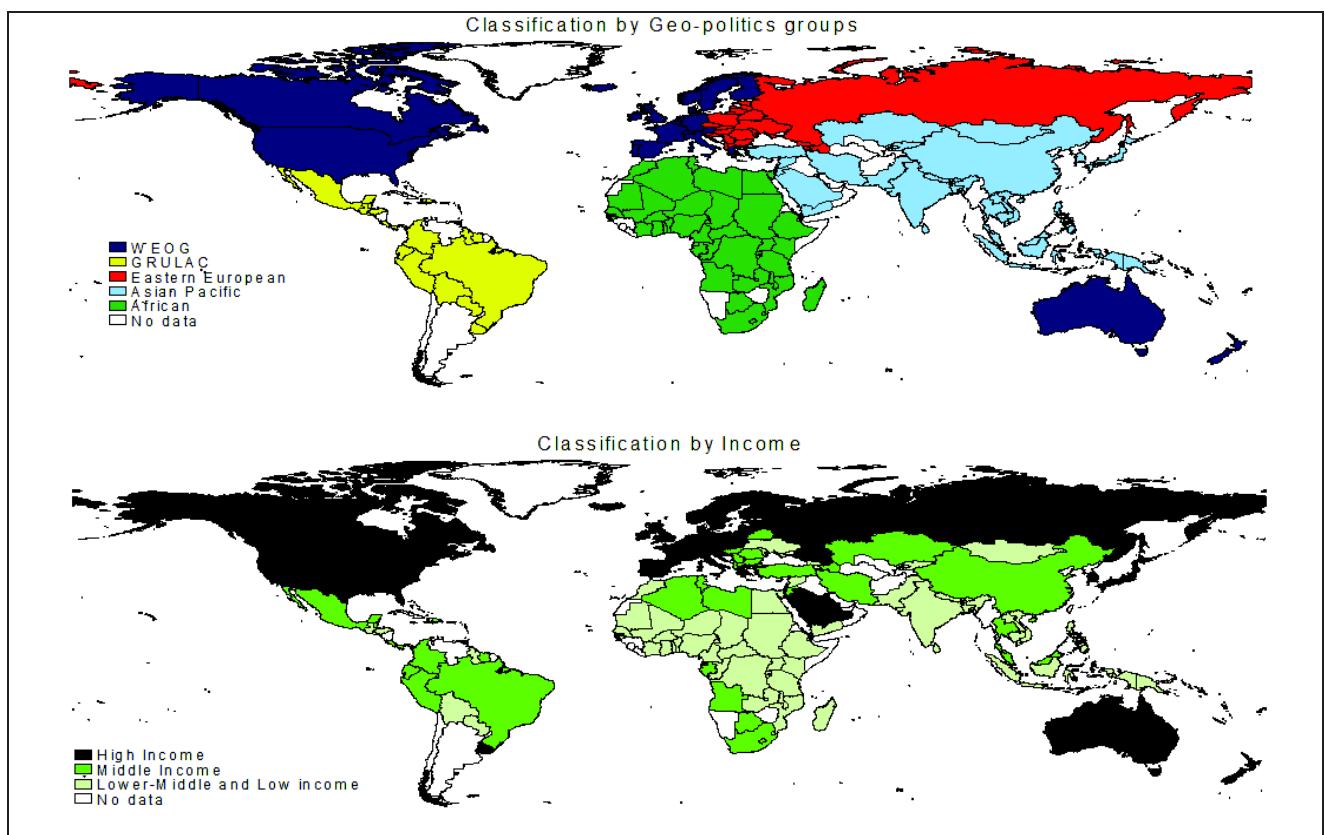
| Income | (A) MG | | | Robust | |
|---------------------|---------|---------|---------|---------|---------|
| | Model 1 | | Model 2 | | Model 1 |
| High | Value | p-value | Value | p-value | p-value |
| G <i>t</i> | -2.649 | 0.01 | -2.521 | 0.53 | 0.63 |
| G <i>a</i> | -9.506 | 1 | -8.654 | 1 | 0.625 |
| P <i>t</i> | -19.196 | 0 | -19.725 | 0 | 0.44 |
| P <i>a</i> | -10.961 | 0.01 | -10.706 | 0.41 | 0.275 |
| Upper-middle | | | | | |
| G <i>t</i> | -3.371 | 0 | -2.945 | 0 | 0.05 |
| G <i>a</i> | -11.81 | 0.58 | -9.117 | 1 | 0.19 |
| P <i>t</i> | -23.953 | 0 | -19.005 | 0 | 0.24 |
| P <i>a</i> | -12.439 | 0 | -10.754 | 0.4 | 0.36 |
| Low-middle | | | | | |
| G <i>t</i> | -2.995 | 0 | -3.217 | 0 | 0.175 |
| G <i>a</i> | -10.078 | 0.97 | -4.947 | 1 | 0.35 |
| P <i>t</i> | -16.635 | 0 | -14.673 | 0.71 | 0.705 |
| P <i>a</i> | -7.86 | 0.88 | -6.259 | 1 | 0.78 |
| Low | | | | | |
| G <i>t</i> | -2.717 | 0.01 | -3.074 | 0 | 0.675 |
| G <i>a</i> | -9.549 | 0.97 | -4.627 | 1 | 0.79 |
| P <i>t</i> | -12.474 | 0.04 | -13.556 | 0.03 | 0.55 |
| P <i>a</i> | -8.767 | 0.56 | -8.725 | 0.91 | 0.47 |

Table 6A. Cointegration test, Geo-politics classification

| Geo-Politics | (A) MG | | | | Robust | |
|---------------------|---------|---------|---------|---------|---------|---------|
| | Model 1 | | Model 2 | | Model 1 | Model 2 |
| | Value | p-value | Value | p-value | p-value | p-value |
| WEOG | | | | | | |
| G _t | -2.208 | 0.83 | -2.76 | 0.09 | 0.825 | 0.97 |
| G _a | -8.11 | 0.998 | -5.075 | 1 | 0.79 | 0.905 |
| P _t | -9.465 | 0.844 | -11.173 | 0.52 | 0.705 | 0.6 |
| P _a | -6.715 | 0.962 | -8.326 | 0.94 | 0.625 | 0.28 |
| Asia-Pacific | | | | | | |
| G _t | -3.556 | 0 | -3.117 | 0 | 0.01 | 0.36 |
| G _a | -12.175 | 0.44 | -8.981 | 1 | 0.05 | 0.27 |
| P _t | -22.187 | 0 | -18.168 | 0 | 0.29 | 0.995 |
| P _a | -11.946 | 0 | -10.518 | 0.49 | 0.345 | 0.975 |
| Eastern EU | | | | | | |
| G _t | -2.81 | 0.01 | -3.352 | 0 | 0.59 | 0.36 |
| G _a | -8.292 | 1 | -7.946 | 1 | 0.865 | 0.65 |
| P _t | -10.975 | 0.11 | -13.144 | 0 | 0.655 | 0.475 |
| P _a | -6.874 | 0.94 | -7.614 | 0.98 | 0.78 | 0.685 |
| GRULAC | | | | | | |
| G _t | -3.08 | 0 | -3.27 | 0 | 0.225 | 0.27 |
| G _a | -11.063 | 0.77 | -7.536 | 1 | 0.345 | 0.625 |
| P _t | -15.454 | 0 | -15.254 | 0 | 0.43 | 0.515 |
| P _a | -10.003 | 0.18 | -9.311 | 0.82 | 0.505 | 0.405 |
| African | | | | | | |
| G _t | -2.726 | 0 | -2.984 | 0 | 0.605 | 0.675 |
| G _a | -10.059 | 0.98 | -7.53 | 1 | 0.615 | 0.89 |
| P _t | -17.481 | 0 | -17.249 | 0.06 | 0.525 | 0.93 |
| P _a | -9.4 | 0.3 | -8.269 | 0.99 | 0.395 | 0.865 |

Figure

Figure 1 Geo-Politics and Income Classification



Reference

- Acemoglu D, Finkelstein A, Notowidigdo MJ. 2013. Income and health spending: evidence from oil price shocks. *Review of Economics and Statistics* **95**(4): 1079-1095.
- Baltagi BH, Moscone F. 2010. Health care expenditure and income in the OECD reconsidered: Evidence from panel data. *Economic Modelling* **27**(4): 804-811.
- Barros PP. 1998. The black box of health care expenditure determinants. *Health Economics*, **7**: 533-44
- Blomqvist AG, Carter RAL. 1997. Is health care really a luxury? *Journal of Health Economics* **16**(2): 207-230.
- Bougnarasy M. 2011. Health care expenditures in Asia countries: Panel data analysis. *Economics Bulletin* **31**(4): 3169-3178.
- Carrion-i-Silvestre JL. 2005. Health care expenditure and GDP: are they broken stationary? *Journal of Health Economics* **24**: 839--854.
- Chakroun M. 2010. Health care expenditure and GDP: An international panel smooth transition approach. *International Journal of Economics* **4**(1): 189-200.
- Clemente J, Marcuello C, Montañés A, Pueyo F. 2004. On the international stability of health care expenditure functions: are government and private functions similar?. *Journal of Health Economics* **23**(3): 589-613.
- Costa-Font J, Pons-Novell J. 2007. Public health expenditure and spatial interactions in a decentralized national health system. *Health economics*: **16**(3): 291-306.
- Costa-Font J, Gemmill M, Rubert G. 2011. Biases in the healthcare luxury good hypothesis?: a meta-regression analysis. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* **174**(1): 95-107.
- Crivelli L, Filippini M, Mosca I. 2006. Federalism and regional health care expenditures: an empirical analysis for the Swiss cantons. *Health Economics* **15**(5): 535-541.
- Di Matteo L, Di Matteo R. 1998. Evidence on the determinants of Canadian provincial government health expenditures: 1965-1991. *Journal of Health Economics* **17**(2): 211-228.
- Dormont J, Oliveira MF, Pelgrin M. 2010. Health expenditures, longevity and growth. In Ageing, Health and Productivity. Edited by Garibaldi P, Oliveira Martins J, and Jan van Ours. Oxford University Press
- Fan VY, Savedoff WD. 2014. The health financing transition: a conceptual framework and empirical evidence. *Social science & medicine* **105**: 112-121.
- Farag M, Nandakumar AK, Wallack SS, Gaumer G, Hodgkin D. 2009. Does funding from donors displace government spending for health in developing countries?. *Health Affairs*, **28**(4): 1045-1055.
- Freeman DG. 2003. Is health care a necessity or a luxury? Pooled estimates of income elasticity from US state-level data. *Applied Economics* **35**(5): 495-502.
- Fogel RW. 1999. Catching up with the economy. *The American Economic Review* **89**(1): 1-21.
- Gbesemete KP, Gerdtham UG. 1992. Determinants of health care expenditure in Africa: a cross-sectional study. *World development*, **20**(2): 303-308.
- Getzen, TE, Poullier JP. 1992. International health spending forecasts: concepts and evaluation. *Social Science & Medicine* **34**(9): 1057-1068.
- Gerdtham UG, Sogaard J, Andersson F, Jonsson B. 1992. An econometric analysis of health care expenditure: a cross-section study of the OECD countries. *Journal of Health Economics* **11**: 63-84.

- Gerdtham UG, Jönsson B, MacFarlan M, Oxley H. 1998. The determinants of health expenditure in the OECD countries: a pooled data analysis. In *Health, the medical profession, and regulation* (pp. 113-134). Springer US.
- Hall RE, Jones CI. 2007. The Value of Life and the Rise in Health Spending. *Quarterly Journal of Economics* **122**(1): 39-72.
- Hansen P, King A. 1996. The determinants of health care expenditure: a cointegration approach. *Journal of Health Economics* **15**: 127-137.
- Hartwig, J. 2008. What drives health care expenditure? Baumol's model of unbalanced growth revisited. *Journal of Health Economics* **27**: 603-623.
- Herwartz H, Theilen B. 2003. The determinants of health care expenditure: testing pooling restrictions in small samples. *Health Economics*, **12**(2): 113-124.
- Hitiris T, Posnett J. 1992. The determinants and effects of health expenditures in developed countries. *Journal of Health Economics* **11**(2): 173-181
- Leu R. 1986. The public--private mix and international health care costs. In: Culyer, A., Jonsson, B. Ź . Eds. , *Public and Private Health Services*. Blackwell, London.
- Lv Z, Zhu H. 2014. Health Care Expenditure and GDP in African Countries: Evidence from Semiparametric Estimation with Panel Data. *The Scientific World Journal*. doi.org/10.1155/2014/905747
- Jauny VC, Khadaroo AJ. 2008. Health care expenditure and GDP: an African perspective. *Applied Econometrics and International Development* **8**(1): 131-146.
- Khan JA, Mahumud RA. 2015. Is healthcare a 'Necessity'or 'Luxury'? an empirical evidence from public and private sector analyses of South-East Asian countries?. *Health economics review* **5**(1): 1-9.
- Mehrara M, Fazaeli AA, Fazaeli AA, Fazaeli AR. 2012. The Relationship between Health Expenditures and Economic Growth in Middle East & North Africa (MENA) Countries. *International Journal of Business Management & Economic Research* **3**(1): 425-428
- Murthy NRV. 2004. Health care expenditure in Africa: an econometric analysis (anthology section). *Atlantic Economic Journal* **32**(4):358-359
- Moscone F, Knapp M. 2005. Exploring the spatial pattern of mental health expenditure. *The Journal of Mental Health Policy and Economics* **8**: 205-217.
- Moscone F, Tosetti E. 2010. Health expenditure and income in the United States. *Health economics* **19**(12): 1385-1403.
- Murthy VN, Okunade AA. 2009. The core determinants of health expenditure in the African context: Some econometric evidence for policy. *Health policy* **91**(1): 57-62.
- Newhouse JP. 1977. Medical care expenditure: a cross-national survey. *Journal of Human Resources* **12**: 115-125.
- Okunade AA, Karakus MC. 2001. Unit root and cointegration tests: time-series versus panel estimates for international health expenditure models. *Applied Economics* **33**: 1131-1137.
- Okunade, AA, Murthy VNR. 2002. Technology as a 'major driver' of health care costs: a cointegration analysis of the Newhouse conjecture. *Journal of Health Economics* **21** 147-159.
- Okunade, AA. 2005. Analysis and implications of the determinants of healthcare expenditure in African countries. *Health Care Management Science* **8**(4): 267-276.
- Pan J, Liu GG. 2012. The determinants of Chinese provincial government health expenditures: evidence from 2002-2006 data. *Health economics* **21**(7): 757-777.
- Parkin D, McGuire A, Yule B. 1987. Aggregate health care expenditures and national income: is health care a luxury good?. *Journal of health economics* **6**(2): 109-127.
- Roberts J. 1999. Sensitivity of elasticity estimates for OECD health care spending: analysis of a dynamic heterogeneous data field. *Health Economics* **8**(5): 459-472.

- Samadi A, Rad EH. 2013. Determinants of Healthcare Expenditure in Economic Cooperation Organization (ECO) Countries: Evidence from Panel Cointegration Tests. *International journal of health policy and management* 1(1): 73-79.
- Xu K, Saksena P, Holly A. 2011. The determinants of health expenditure: a country-level panel data analysis. WHO Working Paper.