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Health Care Expenditure and Income: A Global Perspective

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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 crosssection 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 analysed. 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-Codes: C310, C330, H510.

Keywords: health expenditure, panels, income elasticity, world, exploring the geography of health.

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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

[1] For 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 Boungnarasy (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 set[2]. 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

$$h_{it} = \alpha_i + d_i t + \boldsymbol{\beta}_i' \mathbf{x}_{it} + u_{it},\ i = 1, 2, ..., N; t = 1, 2, ..., T, \tag{1}$$

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, $d_i t$ 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:

$$h_{it} = \alpha_i + d_i t + \boldsymbol{\beta}_i' \mathbf{x}_{it} + \boldsymbol{\gamma}_i' \mathbf{f}_t + e_{it}, \tag{2}$$

where $\mathbf{f}_t$ is the m-dimensional vector of unobserved common effects, with m being the number of unobserved factors, $\boldsymbol{\gamma}_i$ is the m-dimensional vector of coefficients associated with the m common factors and the ith 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, $\overline{h}_t = \frac{1}{N}\sum_{i=1}^{N} \mathbf{h}_{it}$, and the regressors, $\overline{\mathbf{x}}_t = \frac{1}{N}\sum_{i=1}^{N} \mathbf{x}_{it}$. 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 $H_0 : E\left(u_{it}u_{jt}\right) = 0$,for all t and $i \neq j$ in equation (1), and $H_0 : E\left(e_{it}e_{jt}\right) = 0$,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) $\widehat{\Delta}_{\mathrm{hom}}$ 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, Jaunky 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 heath 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.

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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.

[3] www.en.wikipedia.org/w/index.php?title=United_Nations_Regional_Groups&redirect=no
[4] http://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, Yemen, 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 1. Descriptive statistics for Health Care Expenditure and GDP and OLS income elasticity

	1995				2012				All years					
	HE	GDP	Elasticity		HE	GDP	Elasticity		HE	GDP	HE*	GDP*	Elasticity †	
Group	av.	av.	Coef.	Std.err.	av.	av.	Coef.	Std.err.	av.	av.	growth	growth	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
Income:														
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
Geo-politics:														
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 $h_{it} = \alpha + \beta y_{it} + \varepsilon_{it}$, 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

	(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					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]			$\hat{\Delta}_{hom}$	916.0 [0.00]	957.4 [0.00]		
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)	$Publ_{it}$		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]			$\hat{\Delta}_{hom}$	1,658.6 [0.00]	1,828.7 [0.00]		
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)	$Publ_{it}$		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]			$\hat{\Delta}_{hom}$	196.8 [0.00]	333.5 [0.00]		
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)	$Publ_{it}$		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]			$\hat{\Delta}_{hom}$	802.1 [0.00]	795.5 [0.00]		
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)	$Publ_{it}$		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]			$\hat{\Delta}_{hom}$	1,042.4 [0.00]	1,473.8 [0.00]		
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 LMadj 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					WEOG				
$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-0.813 (0.025)	-0.903 (0.027)	-1.316 (0.028)	-1.353 (0.030)	$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-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)		0.221 (0.292)
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					Asia-Pacific				
$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-0.74 (0.04)	-0.84 (0.04)	-1.21 (0.06)	-1.42 (0.06)	$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-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)	$\Delta publ_{it}$		0.644 (0.226)		0.721 (0.248)
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					Eastern EU				
$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-0.87 (0.05)	-0.97 (0.05)	-1.33 (0.57)	-1.47 (0.05)	$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-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)	$\Delta publ_{it}$		0.318 (0.147)		0.239 (0.166)
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					GRULAC				
$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-0.81 (0.05)	-0.87(0.06)	-1.23 (0.05)	-1.37 (0.06)	$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-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)	$\Delta publ_{it}$		0.684 (0.232)		0.384 (0.134)
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					African				
$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-0.82(0.04)	-094 (0.06)	-1.28(0.06)	-1.33 (0.07)	$h_{i,t-1}$ - $\hat{\beta}_{yi,t-1}$	-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)	$\Delta publ_{it}$		0.242 (0.067)		0.189 (0.098)
t-test for coeff of y_{it} -1	0.34	-0.68	-0.38	0.23	t-test for coeff of y_{it} -1	-0.9	-1.79	-0.96	-2.52
CD	3.20[0.00]	2.11[0.03]	-1.89[0.05]	-1.55[0.12]	CD	1.24 [0.21]	1.03 [0.30]	-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}	-7.059[0.000]	-7.946[0.000]	20.8 [0.000]	26.25 [0.000]
Westerlund cointegration tests (WORLD)	*Gt*	-2.544 [0.00]	-2.684 [0.01]	-2.544 [0.06]	-2.684 [0.10]				
	Ga	-9.044 [0.100]	-7.766 [0.100]	-9.044 [0.42]	-7.766 [0.12]				
	Pt	-48.477 [0.00]	-31.83 [0.006]	-48.477 [0.00]	-31.83 [0.10]				
	Pa	-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)
Hitiris 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)
Okunade and Karakus (2001)	1960-1997	Real per capita HE	Unit root and cointegration analysis	Income elastisticity (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 Theilen (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 percapita 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 ans 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				
Boungnarasy (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 governement 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				
Gbesemete, 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 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
$\Delta publ_{it}$	-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	3	0	1	2	3	0	1	2	3	0	1	2	3	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*	-2.868*	-2.470*	-1.961	-4.109*	-2.967*	-2.665*	-2.457*
Δy_{it}	-2.840*	-2.099*	-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
$\Delta publ_{it}$	-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*	-2.629*	-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.

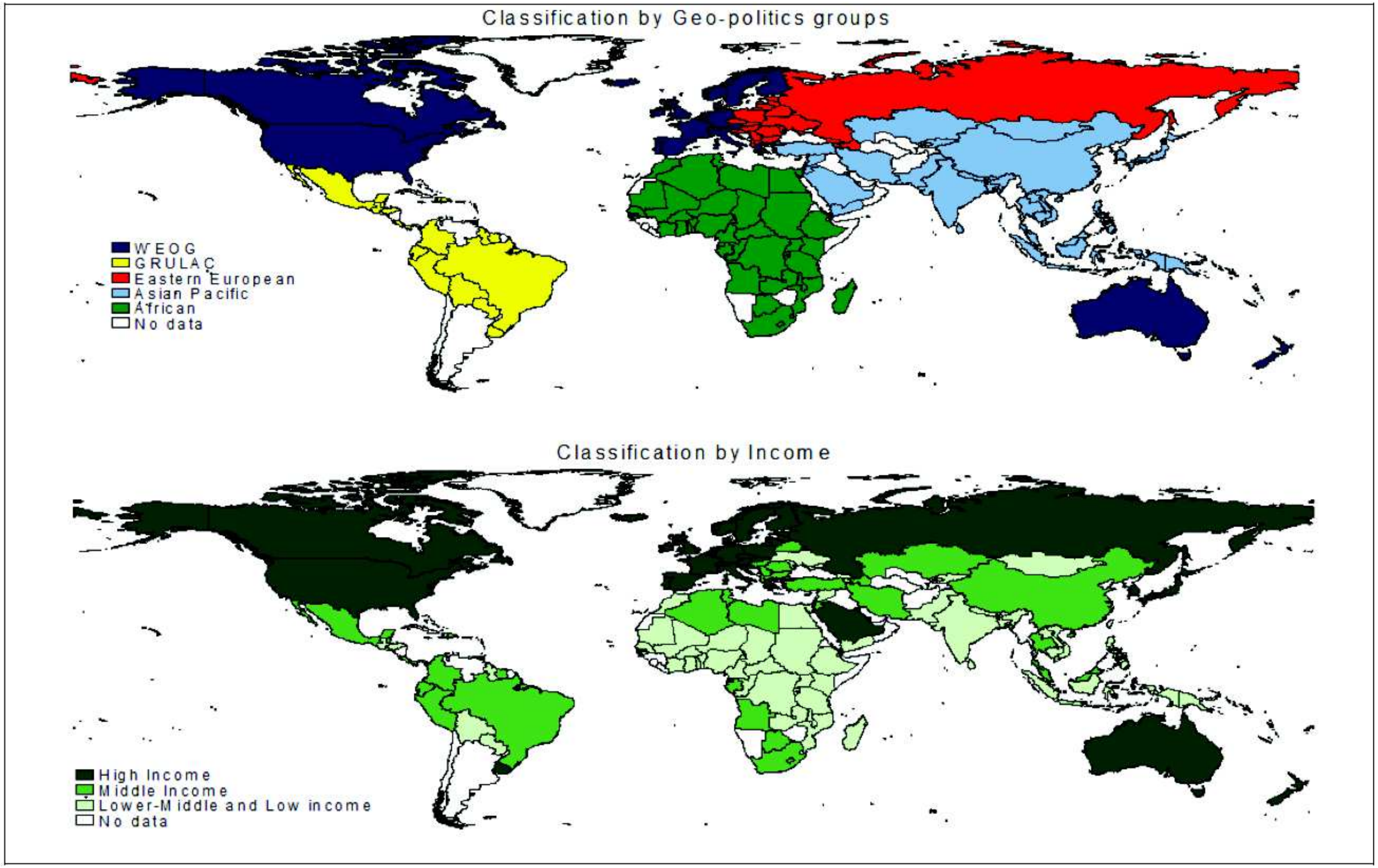
Table 5A. Cointegration test, Income classification

	(A) MG				Robust	
Income	**Model 1**		**Model 2**		Model 1	Model 2
High	Value	p-value	Value	p-value	p-value	p-value
G *t*	-2.649	0.01	-2.521	0.53	0.63	0.815
G *a*	-9.506	1	-8.654	1	0.625	0.615
P *t*	-19.196	0	-19.725	0	0.44	0.53
P *a*	-10.961	0.01	-10.706	0.41	0.275	0.315
Upper-middle						
G *t*	-3.371	0	-2.945	0	0.05	0.525
G *a*	-11.81	0.58	-9.117	1	0.19	0.825
P *t*	-23.953	0	-19.005	0	0.24	0.995
P *a*	-12.439	0	-10.754	0.4	0.36	0.95
Low-middle						
G *t*	-2.995	0	-3.217	0	0.175	0.51
G *a*	-10.078	0.97	-4.947	1	0.35	0.715
P *t*	-16.635	0	-14.673	0.71	0.705	0.855
P *a*	-7.86	0.88	-6.259	1	0.78	0.885
Low						
G *t*	-2.717	0.01	-3.074	0	0.675	0.34
G *a*	-9.549	0.97	-4.627	1	0.79	0.525
P *t*	-12.474	0.04	-13.556	0.03	0.55	0.915
P *a*	-8.767	0.56	-8.725	0.91	0.47	0.855

Table 6A. Cointegration test, Geo-politics classification

	(A) MG				Robust	
Geo-Politics	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 1A. Geo-Politics and Income Classification



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