The Sustainability of European Health Care Systems: Beyond Income and Ageing

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The Sustainability of European Health Care Systems: Beyond Income and Ageing

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Abstract[d]

During the last thirty years health care expenditure (HCE) has been growing much more rapidly than GDP in all OECD countries. Against this background, we look at the determinants of HCE growth in Europe, explicitly taking into account the role of income, ageing population, life habits, technological progress, as well as institutional and budgetary variables. Our results confirm that the current trend of increasing HCE is rooted in a set of differentiated factors. Income levels lead to higher HCE, and the magnitude of the estimated elasticity poses serious concerns about long-term sustainability of current trends. All in all, HCE growth appears to be driven by structural factors that cannot be easily compressed if not through rationing. The key challenge for many European Governments seems to be the design of pluralistic systems, where a well-balanced mix of public and private financing can realize a balance between sustainability and access.

JEL Classification Codes: H51 - Government Expenditures and Health

Keywords: health care expenditure, sustainability, ageing population, income elasticity, welfare

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I. Introduction

During the last thirty years health care expenditure (HCE) has been growing much more rapidly than GDP in all OECD countries. All major players in the field, including the OECD and the European Commission (Working Group on Ageing Population – AWG), pose serious concerns about long-term sustainability of current trends.

Since the seminal works of Baumol (1967) and Newhouse (1977, 1992), the availability of international data on HCE has encouraged the development of several studies that have attempted to explain the trend and determinants of HCE growth. A wide array of factors has been taken into consideration, including demography, income, institutions, technological change (Gerdtham and Jönsson, 2000).

Not surprisingly, income is the prominent factor behind cross-country differentials in HCE. The magnitude of income elasticity is key to ascertain whether health is a luxury good (income elasticity above one) or a necessity (income elasticity below one). Unfortunately, this issue is largely unresolved, and empirical investigations which rely on different data, time frames and methodologies have come to conflicting results. Moreover, it has been noticed that income elasticity of health spending increases with the level of aggregation (see Dormont *et al.*, 2007). Demography, institutions and technology have been identified as important drivers of the rising HCE too. However, on the empirical ground, being them tightly interwoven, it has been extremely difficult to single out their specific contribution.

The relationship between age and HCE has been largely explored by the empirical literature. Nonetheless, previous studies relying on the composition of the population in terms of age cohorts to measure the effect of an ageing population have come to conflicting results (see Christiansen *et al.*, 2006 for a review). As a tentative explanation, micro-level studies have shown that it is not age per se that is relevant in explaining HCE, rather remaining lifetime. Accordingly, we focus

on increase in life expectancy and on decrease in fertility rates (see Zweifel *et al*., 1999).

In this paper we present an exploratory econometric framework aimed at identifying the determinants of HCE growth and at estimating the elasticity of HCE to income growth in European countries. We take into account the effect of ageing population, technological progress, as well as institutional and budgetary variables. We perform separate econometric analysis of the level of total, private and public HCE. Our study casts new light on the effect of the adoption and diffusion of new technologies and practices in national specific institutional settings, as well as on the impact of budgetary controls and constraints upon overall European HCE.

The paper is organized as follows. The next section describes the data and the hypothesis underlying the explanatory variables included in the analysis. Section III describes the methodology and reports the results of our analysis. Section IV concludes, discussing the main policy implications of our work.

II. Data sources and model specification

The paper aims at disentangling the key drivers of long-term HCE in Europe.

We estimate a set of equations in a panel of EU-15 Countries[5] for the period 1980-2003. .

Different equations are estimated for: a) total health care expenditure (THE); b) public health care expenditure (PHE); c) private health care expenditure (PrHE)[6].

We collected and integrated data from several sources ranging from OECD and WHO to PubMed and Eurostat. Data on HCE come from the OECD Health Data

[5] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.
[6] PrHE is obtained as the difference between THE and PHE.

(OECD, 2007) and the WHO's "European Health for All" databases (WHO, 2006). Only current expenditure has been considered in the analysis[7].

Different regression settings have been designed to identify and compare key drivers of total, public and private HCE. Five explanatory factors have been taken into account: national income (GDP), ageing of the population, technological progress, institutional and regulatory variables, composition of the welfare system and of public budget, life habits.

Different methodologies have been applied to deal with the different patterns of series stationarity, endogeneity of GDP, and the "small-N" characteristic of our dataset. We take into account the relationship between per capita HCE (THE, PHE, PrHE) and per capita GDP. Endogeneity of GDP is taken into account by considering a two-stage regression approach. Then, we estimate the relationship between HCE and ageing of the population, technological progress, institutional framework, as well as Government budget variables and life habits. When feasible, the pooled mean group (PMG) estimator proposed by Pesaran, Shin, and Smith (1999) is applied in order to estimate long-run elasticities, allowing short-run coefficients and error variances to differ across countries. Otherwise a country fixed effect regression is considered. Different methodologies complement each other allowing us to assess the impact of the different regressors on the level of expenditure.

a. Income

Since Baumol (1967), most studies have documented a positive relation between GDP and HCE. However, as stressed by Hartwig (2008), the evidence of a correlation between HCE and GDP does not tell much about any clear causal relationship. It can be argued that he higher HCE, the healthier the population. At the same time, a healthier population is likely to be more productive and GDP per

[7] Values have been converted into PPP US dollars, and the GDP deflator has been applied to obtain real values. Log-values (natural) have been used for all regressed variables but the dummy variables describing the institutional framework and the time trend.

capita could grow as an effect of an increase in HCE. If this effect is not taken into account, econometric techniques can lead to biased and inconsistent results.

Even though little attention has been devoted to this issue in the empirical literature, income elasticity of health care demand and expenditure lies at the heart of a lively debate, focusing on whether health care is a "luxury good" in developed countries. The answer has important policy implications for HCE growth and public finances sustainability.

Some recent contributions (see Hall and Jones, 2007) point to the fact that health spending might well be a superior good, since it allows individuals to live longer and "purchase" additional periods of life and utility. Within this framework, in any period of time, people do not become saturated with health consumption, as it happens with non-health consumption. As income grows and people get richer, the most rewarding channel for spending is to purchase additional years of life (and consumption). As a result, the optimal composition of total spending shifts toward health, and health expenditure share grows along with income.

Empirically, health care spending might not represent optimal consumption, due to exogenous Government regulation that limits the choices of patients and aggregate HCE mainly for equity and budget control purposes. For this reason, we are not allowed to infer the "luxury good" versus "normal good" nature of health care from our estimates on income elasticity of public health expenditure.

b. Ageing population

Over the last decades developed countries have experienced a marked change in the age composition of population. The share of elderly people has increased, as a consequence of lower fertility rates and of higher life expectancy, due to improved living condition and medical progress. This trend is deemed to continue over the next decades. The impact of population ageing on the social structure and on the long-term sustainability of public finances is one of the main challenges for Europe in the upcoming years.

Ageing is placing an increasing burden on health care systems. The health care of the elderly is financed by those in work, and demographic change means that a smaller proportion of the population is in working age. The difficulties will be more pronounced in tax-based, pay as you go (Paygo) systems, but all health care systems are facing this issue.

In addition, ageing will push health spending up, since the elderly make a higher use of health care services, and individual health care costs tend to rise with age. This effect might be mitigated or offset by the fact that over time longevity gains correspond to more years in good health. This "healthy ageing" component tends to lower the average cost per individual at any older age, and in this scenario aggregate HCE will not necessarily increase with an ageing population.

In line with these arguments, most empirical studies in a static framework have shown a positive relationship between age, ageing and health expenditures; while a dynamic assessment, using time series or panel data, provides mixed evidence about the sign and significance of this relationship, reflecting the interplay of the different determinants (see Christiansen *et al*., 2006 for a review).

In order to account for the impact of demographic changes and ageing, we introduce two variables: life expectancy at age 65 (LEXP65)[8], and fertility rate (FERTILITY)..

c. Technological innovation

Technological innovation in medicine includes not only new physical capital and equipment, but also new surgical procedures, drugs, treatments, as well new procedures based on original combinations of the above. Analogously to the expected effect of the ageing population, economic theory does not predict a

[8] Increase in life expectancy lies at the root of the ageing population, leading us to expect a positive sign of its estimated coefficient. Nonetheless it can be argued that gains in life expectancy are largely driven by medical progresses, making LEXP65 also suited as a proxy for technological advances. However, by using LEXP65, we aim at capturing the effect of age on HCE, rather than the effect of technological advances. In order to disentangle both effects, besides the use of "technological innovation" variables, as described in the next section, all regressions will include a linear time trend that will capture the effect of unmeasured variables linearly evolving over time.

clear-cut effect of technological innovation on health care costs and expenditure: new technologies can reduce unitary costs, but there are factors that can offset the savings and induce an increase in aggregate health expenditure, such as the increasing number of applications and indications, the higher number of treatable conditions, the increase in the rate of use for the same condition, and the broadening of the definition of "disease" (Gelijns and Rosenberg, 1994). As a result of these contrasting effects, medical innovations which are cost reducing at the micro level can lead to an increase in overall aggregate expenditure. Indeed, available empirical evidence consistently shows that new medical technologies are a major determinant of the rise of health care expenditure (see Pammolli *et al*., 2005 for a review).

Empirical evaluation of the impact of technological innovation is restrained by the complexity in measuring technological change, as well as its direct and indirect effects. Studies at the macro level generally deduce the effect of technological change as the "residual" increase in expenditure not explained by the interplay of demographic change and GDP growth assuming unitary income elasticity. On a different ground, applied work has proxied the extent of medical technology adoption in a given country by the stock of available high-tech medical devices, such as magnetic resonance equipment, or medical practices based on high-tech equipments, e.g. patients undergoing dialysis (see Christiansen *et al*., 2006). Under the assumption that technological progress deploys its effect linearly over time, other studies represent technological change as a linear time trend (Blomqvist and Carter, 1997; Zweifel *et al*., 1999). Alternatively, measures of innovation input (such as research and development expenditure, or employees) or output (i.e. patent counts, patent citations…) can be employed (see Jaffe, Trajtenberg, 2002).

Available time series of data on medical technology equipment stock and usage are severely incomplete, and thus unsuitable for this study. However, technological progress spills over institutional and national boundaries and diffuses across institutions and countries leveling off productivity and innovation differentials. Accordingly, we consider the number of scientific publications in

areas related to the assessment of new medical technologies, as a proxy for technological adoption. We rely on this indicator rather than on patent statistics since innovation in this field is mostly related to the exploitation of existing medical technologies. This likely does not lead to a patentable claim, rather to a scientific publication. Our variable, "Number of publications per 1,000 inhabitants" (TECH_AD) comes from the PubMed database, that we queried for publications on "Equipment and Supplies" and "Surgical procedure, operative" in the countries and time periods considered in the analysis[9] to proxy the extent of informed adoption of medical technologies .

We also consider the number of death associated with pathologies treated with high-tech devices, focusing on coronary diseases. Ford *et al*. (2007) show that improvements in medical treatments accounted for approximately 47% of the decrease in mortality rate due to coronary diseases. The wider the adoption of high-tech devices, the lower the mortality rate. Therefore, we take the number of deaths caused by coronary diseases as a proxy for technological adoption[10]. Contrary to TECH_AD, this variable captures the cost-enhancing effect of medical technologies through an increase of individual life expectancy. This effect has been rigorously documented by a series of highly influential recent contributions (Murphy and Topel, 2003; Lichtenberg, 2007).

Given the multi-facet characteristics of the innovation process in health, we are aware of the fact that our proxies imperfectly capture the effect of technological advances. Even though imperfectly measured, our analysis will allow us to empirically assess the effect of technological change on HCE.

[9] PubMed is a service maintained by the US National Library of Medicine, covering over 17 million citations from MEDLINE and other life science journals for biomedical articles back to the 1950s.

[10] In previous versions of the model, we also considered deaths due to diabetes mellitus, but the effect of this variable was not statistically significant. Moreover, contrary to cardiovascular deaths, available information does not allow us to interpret the dynamics in diabetes mellitus deaths as a function of the adoption of new technologies. Therefore, the variable has been removed from the analysis.

d. Life habits

Life habits are among the most important determinants of the health status of a population, and therefore deeply linked to HCE. In our regressions we attempt at measuring life habits by considering per capita consumption of sugar (SUGAR) and fruits and vegetables (FVEG) in kilos, extracted from OECD Health Data. To our knowledge, only the study by Christiansen *et al*. (2006) takes behavioral variables into account when analyzing the determinants of HCE. The authors consider alcohol and tobacco consumption. However, series for alcohol and tobacco are largely incomplete and we chose to use sugar and fruits and vegetables consumption with a lower incidence of missing cases. Tightly linked to problems of obesity and cardiovascular diseases, we expect the sugar consumption to positively affect HCE, whereas we expect a negative effect of the consumption of fruit and vegetables[11].

e. Institutional and regulatory framework

We account for the institutional and regulatory features of the EU health systems by means of a set of dummies.

The first dummy variable (GATE) controls for the General Practitioners (GP) gatekeeper role, that is to say the GP refers patients to in-patient hospital care (Christiansen *et al*. 2006). Even in the presence of a significant cross-country and within-country heterogeneity in ambulatory care organization and financing (see Docteur, Oxley, 2003), countries where GPs play as gatekeepers are expected to register lower health expenditure, *ceteris paribus*, given that ambulatory care is generally less expensive than hospital care.

The dummy variable COPAY is included for countries that adopt a co-payment system for hospital inpatient[12] (see Docteur & Oxley 2003, Christiansen *et al*.,

[11] Luxembourg,has been omitted from the analysis when life habits are included in the regressions due to missing data.

[12] Since it has not been possible to collect data on the exact level of cost sharing, the co-payment dummy variable is only a crude indication for restriction in consumption induced by patient contribution to health

2006). A negative sign is expected, since co-payment could contain HCE, by stimulating an efficient access to medical facilities therefore decreasing the impact of non-necessary access. However, since co-payment schemes have been generally introduced in Europe to contain HCE growth, determinants and consequences of these measures are hard to disentangle.

On a different ground, it is important to control for the substitution effect between informal and formal assistance due to the increase of female labor participation rate. Indeed, the participation of women to the labor force implies a substitution between informal and formal health care and presumably an increase in aggregate health expenditure. The female labor participation rate is included among the explanatory variables to account for this effect. On the one hand, a positive coefficient should pose additional concern on the sustainability of current HCE trends. On the other hand, it should be noticed that, as argued by Freeman and Schettkat (2005) and Rogerson (2006, 2007), a higher female participation in the service economy and formal assistance is key to GDP growth in Europe and to the development of a complementary private health care sector.

f. Public budget variables

We include a set of variables aimed at capturing public budget constraints and characteristics that are expected to affect Governments' attempts and policies to curb expenditure, in order to pursue long-term sustainability of public finances. To our knowledge, no previous empirical account of the determinants of HCE has taken into account budget variables; nonetheless these are likely to exert strong constraints on public expenditure (Gerdtham and Jönsson, 2000). Implementing a durable budgetary reform requires the reduction of the budget deficit and of the debt to GDP ratio. Since budgetary variable are deeply intertwined, only the public debt to GDP ratio (DEBT/GDP) is included in the regressions.

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care costs. We do not discern among different co-payment schemes: fixed-fee co-payment, co-payment as a share of expenditure, co-payment as a function of patient income.

We also take into account the structure of social expenditure by considering a concentration index computed on the basis of the resources allocated to main social policy areas[13]. EU-15 countries are largely diversified in terms of the structure of social expenditure, as shown in Figure 1, which reports the share of expenditure in the main social policy areas considered over GDP in the year 2003. The larger share of resources is devoted to old age benefits, followed by social expenditure for health. The share of resources devoted to the other policy areas vary widely across countries.

// FIGURE 1 ABOUT HERE: Main policy areas, % GDP, 2003 (Source: OECD, 2007) //

We use the Herfindahl index to measure the level of concentration of social expenditure[14]. Two versions of the index are computed: the first one takes into account all main policy areas; the second one excludes the resources devoted to health from computations[15].

Two contrasting effects can be captured by the variable. First, as a result of a substitution effect, lower expenditure in pensions and other policy areas can lead to increases in HCE (under budget constraints, lower resources devoted to one area makes larger resources available for other policy items). We argue that this is not the main effect that the variable is able to capture. Indeed, by including the variable in the regressions we aim at measuring the gains in efficiency spanning from a wider coverage of the social expenditure and improved social and market

[13] We considered aggregations as reported in OECD data: (i) pensions and services for the elderly; (ii) pensions and services for survivors; (iii) health; (iv) incapacity-related benefits; (v) family support; (vi) active labor market policies; (vii) unemployment; (viii) housing allowances and rent subsidies; (ix) and a residual category (other social policy areas).

[14] The index is computed as the sum of the shares (squared) of expenditure in all the areas considered. When all areas are included in computations, the index takes values between 1/9 (if all social policy areas have the same allocated resources) to 1 (when only one area exhibits a positive allocation, whereas all the other areas have an allocation equal to zero).

[15] In this case, the Herfindahl index ranges from 1/8 to 1. As, excluding health, about one half of resources are devoted to old age and survivors benefits, a higher value of the Herfindahl means more concentration on expenditure for pensions.

labor conditions, promoting endogenous economic growth and opening the possibility for higher HCE without compromising financial sustainability[16]. Second, a well articulated welfare system (promoting labor participation and effective employment, and targeted to contrast poverty/needs) can help enhancing the conditions of the population, and preventing the worsening of the health status and the incidence of illnesses and pathologies. This effect can coexist with the ones previously described, allowing to devote more resources to the unhealthy part of the population, and to enlarge the possibility of treatment with the best available techniques. Though there is not a foreseeable physiologic upper bound to demand for care, unlimited spending will never be an option; and the optimal design for welfare system is at the core of the possibility to find the most appropriate balance between the goal of sustainability and that of social equity and technological adequacy of treatments.

As a preliminary support to our claims, Table 1 analyzes the correlation between the measure of expenditure concentration and (a) deficit and (b) GDP growth[17].

Table 1(a) reports the correlation coefficients from the year 1995, between the deficit of a country and the level of concentration of social expenditure. We consider both versions of the Herfindahl index. The deficit (measured as share of GDP) can assume both positive and negative values, where negative values indicate a positive Government balance. A positive correlation emerges in recent years, where countries with less concentrated social expenditure also exhibits lower deficit, supporting the view that wider dispersion of welfare expenditure is associated with improved labor and social conditions, therefore allowing a reduction of public deficit in the long run.

Table 1(b) shows that the correlation coefficient between real GDP growth[18] and the level of concentration of public expenditure is always negative over the period

[16] Either a minor incidence on GDP for a given level of expenditure, or a higher expenditure corresponding to the initial incidence on GDP, or even a sustainable higher incidence of expenditure on GDP (see, for example, the case of Sweden, where the high quality level of social expenditure allows to sustain the highest share of expenditure on GDP in EU-15; see Figure 1).

[17] The years included in Table 1 are chosen on the basis of data availability. Correlations are reported for the years when at least 13 countries are observed.

1986-2003, and in seven years significant at the 5 per cent level. Though the relationship deserves further investigation, the negative sign suggests that a diversified welfare system fosters economic growth.

Table 1. Correlation coefficients between social expenditure concentration (CONC) and (a) of deficit (% GDP); (b) GDP growth

(a) CONC and deficit (% GDP)									
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Including Health	-0.0524	0.4170	0.1957	0.5226	0.6165*	0.4949	0.6568*	0.5413*	0.5934*
Excluding Health	-0.0270	0.4397	0.2411	0.5695*	0.6324*	0.4804	0.6556*	0.5421*	0.5949*
(b) CONC and GDP growth									
	1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
Including Health	-0.4372	-0.6764*	-0.5910*	-0.4203	-0.6028*	-0.4321	-0.3751	-0.6103*	-0.7622*
Excluding Health	-0.4357	-0.6866*	-0.5857*	-0.3920	-0.5749*	-0.4265	-0.3541	-0.6063*	-0.7700*
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Including Health	-0.7176*	-0.7704*	-0.6784*	-0.2761	-0.1139	-0.1561	-0.0726	0.2043	-0.0235
Excluding Health	-0.7640*	-0.7991*	-0.7217*	-0.2612	-0.1126	-0.1530	-0.0760	0.1502	-0.0482

*Note: * statistically significant at 5% level*

III. Methodology and Results

In line with previous work in this field (e.g. Christiansen *et al*., 2006; Dormont *et al*., 2007), we perform a set of exploratory econometric tests aimed at identifying the factors affecting the level of (per capita) HCE. In particular, we aim at ascertaining the impact of six categories of variables on total, private and public HCE: income, ageing, technology, institutional framework, budget constraints, and health habits. Table 2 summarizes the main descriptive statistics of the variables included in our regressions.

[18] The growth rate of real GDP is computed between period *t* and *t*+1, while the variable CONC refers to year *t*. For example the column "1996" in Table 1(b) reports the correlation between the rate of growth of GDP over the years 1995-1996 and the level of concentration in 1995.

Table 2. Descriptive Statistics, EU-15 countries, wider coverage corresponds to the period 1980-2003

	Obs	Mean	S.E.	Min.	Max.
Dependent variables					
THE (log of total health care expenditure, deflated)	337	7.36	0.29	6.73	8.42
PHE (log of public health care expenditure, deflated)	321	7.08	0.35	6.29	8.07
PrHE (log of private health care expenditure, deflated)	321	5.82	0.49	4.28	7.61
Independent variables					
a) Income/Wealth					
GDP (log of the Gross Domestic Product, deflated)	360	9.95	0.27	9.36	11.14
b) Ageing					
LEXP65 (log of life expectancy at age 65)	340	2.83	0.07	2.64	2.97
FERTILITY (log of fertility rate)	360	0.47	0.16	0.15	1.18
c) Technological progress					
TECH_AD (log of number of publications per 1,000 inhabitants in selected applied research fields)	360	-4.35	2.24	-11.02	-1.96
DCIRC (log of circulatory disease death over 1,000,000 population)	348	5.75	0.26	5.01	6.30
d) Life habits					
SUGAR (log of per capita consumption of sugar, kilos)	336	3.67	0.18	3.21	4.09
FVEG (log of per capita consumption of fruits and vegetables, kilos)	336	5.32	0.33	4.67	6.14
e) Health care cost control and institutions					
GATE (equals 1 if GPs play a gatekeeper role)	360	0.17	0.37	0.00	1.00
COPAY (equals 1 if co-payment schemes are in place)	360	0.11	0.31	0.00	1.00
FLPR (log of female labor participation rate)	360	4.02	0.22	3.47	4.41
f) Budgetary variables					
DEBT/GDP (log of debt to GDP ratio)	261	4.05	0.55	2.07	4.94
CONC (log of Herfindahl index of concentration of social expenditure)	310	-1.30	0.30	-1.83	-0.62

Given the panel structure of our data, country-specific fixed effects are included to control for time-invariant country characteristics which are not (or cannot be) observed. On the contrary, time effects are captured with the inclusion of a linear trend.

A set of test for stationarity of the variables has been conducted country by country[19]. For most series the hypothesis of trend stationarity is not rejected in our

[19] We jointly considered the KPSS test where the null hypothesis is that the series are level/trend-stationary, and the (augmented) Dickey-Fuller and Phillips-Perron tests where the null hypothesis is that the series exhibits a unit root.

data, the only exception being the GDP series[20]. In order to tackle this issue and avoid spurious results, we apply different methodologies.

Whenever available data allow us, the PMG estimator is applied. The estimator constraints the long-run coefficient to be identical, while allowing for differences among short-run coefficients and error variances of different countries. The method can be applied both to I(0) or I(1) regressors, but the number of observations available for each country must be large enough to estimate the model for each country separately (Pesaran, Shin, Smith, 1999). Therefore, we are not able to estimate the "full" model by PMG, rather the demographic and technological change variables, and the female participation rate are added separately to the regressions in order to investigate the effect of the inclusion on the magnitude and significance of the GDP coefficient. Missing data on DEBT/GDP and CONC prevent us to include these variables in the analysis. In addition PMG estimation is not feasible when considering the institutional dummy variables (COPAY and GATE). In order to assess the effect of these variables a fixed effect regression is undertaken, where first differenced variables have been considered in the analysis. Differently from previous studies (see e.g. Dormont *et al*., 2007), we explicitly consider the possibility of endogeneity of the GDP during estimation[21].

We run different sets of regressions for total, public and private HCE (Table 3-5).

In line with previous findings in the literature, we identify a positive relationship between HCE and GDP. Estimates are obtained both by PMG estimation and by instrumental variable (IV) techniques applied to first differences[22], explicitly dealing with the endogeneity of GDP and non-stationarity of the series. Given the

[20] Carrion-i-Silvestre (2005) provides evidence that HCE and GDP series can be characterized as stationary processes evolving around a broken trend. Similar results are reported in Jewell *et al.* (2003). A throughout investigation of the pattern of series stationarity is beyond the scope of this paper and it is carried trough only as a preliminary step to the regression analysis. In addition, the empirical size and power of the unit root tests largely depend on the available data. Therefore, we prefer employing an estimation strategy that is "robust" to stationarity patterns.

[21] A two-stage approach is considered when estimating the relationship between HCE and GDP. The instruments considered for estimation are energy use (kg of oil equivalent per capita) and an index of openness, computed as the sum of imports and exports of goods and services (as a share of GDP). Data are extracted from the World Bank (World Development Indicators). The validity of the selected variables is assessed via the Hansen test.

log-log specification of the model, estimated coefficients can be interpreted as the elasticity of HCE with respect to income. As for the magnitude of this coefficient, both total and public expenditures exhibit an elasticity that is higher than one, whereas the estimated elasticity of private expenditure is below the unity[23]. The results add insights to the current debate on the nature of health care. Available evidence shows that health care behave as an inferior good at the micro level, while becoming a luxury good when data are aggregate at regional, national or even global scale. Coherently with these findings, the estimated elasticity of total HCE provides empirical support to the luxury good hypothesis, where the impact of economic growth on health expenditure passes mainly trough the public component. Even though, as previously stressed, the empirical evidence provided needs to be treated with caution given the presence of exogenously imposed regulation limiting the choices of patients and aggregate HCE (which therefore might not represent optimal consumption), this result points directly to the core of the sustainability problem. Growth cannot be invoked to stabilize the incidence of HCE on GDP and to expand the level of the demand for care. Paradoxically, if analysis is confined to the HCE-GDP relationship, lower growth rates would rather help.

Next, we include in our regressions the variables aimed at capturing ageing population, technological change, the institutional framework, budget constraints, and life habits. When available data allow us, the PMG estimator is applied to per capita variables; otherwise we resemble to first difference estimation coupled with a two-stage approach (FD-IV).

If only GDP is taken into account, PMG estimates[24] confirm the results of FD-IV estimation. On the contrary, by including all other variables the coefficients of GDP in total and public HCE regressions decrease below unity.

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[22] Still country fixed effects are considered, in order to allow for different trends across countries.

[23] Need it here to stress the fact that, in the countries analyzed, the private component of HCE represents, on average, less than 25 per cent of total expenditure.

[24] Due to the high incidence of missing data, Belgium is excluded from PMG estimation of PHE and PrHE. The lag structure of the dependent and independent variable(s) has been chosen on the basis of Schwarz Bayesian criterion, where the maximum number of lags is allowed to be equal to 1.

Whatever the definition of expenditure (total, public, and private), increased life expectancy at age 65 (LEXP65) and decreases in fertility rate (FERTILITY) imply higher HCE. Interpreted as the causes at the root of an ageing population, the results confirm the fact that ageing population leads to an increase in the level of expenditure. It is noticeable that the elasticity of LEXP65 is higher for the public component than for the private one. The public component is more exposed to the ageing driver, as well to the economic growth driver since private health care plays a residual role in most EU countries.

Table 3. The determinants of total per capita HCE

Model	FD-IV1	PMG1	PMG2	PMG3	PMG4	FD-IV2	FD-IV3	PMG5
GDP	**1.3202 (0.1640)*** **	**1.4653*** (0.0699)**	**0.7182*** (0.0391)**	**0.5685*** (0.0297)**	**0.7226*** (0.0375)**	**0.7547** (0.3782)**	**0.7138* (0.3719)**	**0.9735*** (0.0608)**
LEXP65			**2.7543*** (0.2873)**					
FERTILITY			**-0.3023*** (0.1176)**					
TECH_AD				**0.0119*** (0.0034)**				
DCIRC				**-0.7395*** (0.0444)**				
GATE							-0.0124 (0.0087)	
COPAY							**-0.0162*** (0.0057)**	
FLPR					**1.0422*** (0.0764)**			
DEBT/GDP (lagged)						**-0.0655* (0.0340)**	**-0.0662* (0.0340)**	
CONC (lagged)						**0.1110** (0.0495)**	**0.1196** (0.0504)**	
FVEG								0.0110 (0.0377)
SUGAR								**0.3596*** (0.0852)**
R-squared	0.3945	n.a.	n.a.	n.a.	n.a.	0.5785	0.5913	n.a.
N	318	322	302	267	316	206	206	299

*Statistically significant at: *** 1% level; ** 5% level; 10% level. Standard errors in parenthesis.*

As far as the "technology" variables, TECH_AD exerts a positive effect on HCE, whereas the coefficient of DCIRC is negative, pointing to a positive long-run effect of technological change on HCE. Our results support the view that in the long run technical change leads to an increase in the aggregate expenditure. Even

though the empirical literature provides examples of single new technologies that exert both positive and negative effects on health costs, increases in aggregate expenditure are expected. However, no account is made in our analysis of the benefits associated with medical technology improvements, therefore no conclusions can be drawn on the issue of the net value accrued to patients from innovation.

Table 4. The determinants of public per capita HCE

	FD-IV1	PMG1	PMG2	PMG3	PMG4	FD-IV2	FD-IV3	PMG5
GDP	**1.6594 (0.2485)*** **	**1.3955*** (0.0613)**	**0.9268*** (0.0541)**	**0.8037*** (0.0556)**	**0.7817*** (0.0402)**	**0.7733** (0.3952)**	**0.7594* (0.3894)**	**1.3974*** (0.0602)**
LEXP65			**2.0005*** (0.3074)**					
FERTILITY			**-0.8542*** (0.2039)**					
TECH_AD				0.0020 (0.0054)				
DCIRC				**-0.4418*** (0.0832)**				
GATE							**-0.0200** (0.0102)**	
COPAY							**-0.0136* (0.0076)**	
FLPR					**1.7257*** (0.1166)**			
DEBT/GDP (lagged)						**-0.0885* (0.0454)**	**-0.0898** (0.0452)**	
CONC (lagged)						**0.1284** (0.0586)**	**0.1418** (0.0616)**	
FVEG								0.1122 (0.0750)
SUGAR								**0.3887*** (0.1032)**
R-squared	0.2556	n.a.	n.a.	n.a.	n.a.	0.5074	0.5202	n.a.
N	307	298	285	253	296	196	196	275

*Statistically significant at: *** 1% level; ** 5% level; * 10% level. Standard errors in parenthesis.*

As expected, a higher rate of female participation rate (FLPR) corresponds to higher levels of expenditure. We argue that this is driven by wider reliance on the formal assistance provided by the health care system as opposed to informal family assistance, leading to higher expenditure. Given the trend of increasing FLPR across European countries, the result deserves policy attention in order to ensure sustainability of the current trends.

Not surprisingly, the GP gatekeeper role effectively decreases the level of public HCE (in the case of total HCE, the coefficient is still negative but not statistically significant). In addition, the presence of significant hospital and GP co-payment (COPAY) exerts a negative effect on all items of HCE.

Table 5. The determinants of private per capita HCE

	FD-IV1	**PMG1**	**PMG2**	**PMG3**	**PMG4**	**FD-IV2**	**FD-IV3**	**PMG5**
GDP	0.4446 (0.3044)	**0.3707*** (0.0636)**	**0.5890*** (0.0489)**	**0.5654*** (0.0296)**	**0.5172*** (0.0297)**	0.5272 (0.4917)	0.4174 (0.4854)	**0.3986*** (0.0637)**
LEXP65			**1.8309*** (0.2218)**					
FERTILITY			**0.7745*** (0.1020)**					
TECH_AD				-0.0004 (0.0031)				
DCIRC				**-0.8622*** (0.0480)**				
GATE							0.0053 (0.0159)	
COPAY							**-0.0315* (0.0187)**	
FLPR					**1.0200*** (0.0659)**			
DEBT/GDP (lagged)						0.0455 (0.0400)	0.0480 (0.0390)	
CONC (lagged)						0.0465 (0.0913)	0.0463 (0.0898)	
FVEG								**-0.0753* (0.0206)**
SUGAR								-0.0162 (0.0725)
R-squared	0.1606	n.a.	n.a.	n.a.	n.a.	0.4412	0.4501	n.a.
N	302	298	285	253	296	196	196	275

*Statistically significant at: *** 1% level; ** 5% level; 10% level. Standard errors in parenthesis.*

Over time, the design of co-payment schemes has been able to stimulate the responsibility by citizens and, through their behaviors, responsibility of all actors in the health care system, leading to the beneficial effects in terms of cost containment.

Turning to the budget constraints variables[25], DEBT/GDP has a negative impact on levels of both total and public HCE, whereas no effect is detected when analyzing private expenditure. Highly indebted Countries have to pay relevant

[25] A one-year lag of the variables DEBT/GDP and CONC is considered in the regressions.

amounts of resources as passive interests, and so budget constraints inevitably become stronger on other balance items that can be more easily compressed. High public debt and correspondently high interests payments tie the hands of the policy makers, year by year.

As predicted, the variable aimed at capturing the structure of the social expenditure has a positive effect on total and public HCE. The result preludes to the view that a wider coverage of the public expenditure across different social policy areas (i.e. lower concentration of expenditure, especially on pensions) leads to gains in growth, efficiency and welfare diffusion, being strongly interlinked to improved social and market labor conditions. Therefore, the results support the thesis that a social public expenditure less concentrated on pensions - currently the main item in welfare system budgets and the main source of concentration of public social expenditure - helps ameliorating the financial sustainability, allowing also to channel more resources to those institutions better suited for efficient redistribution and to realize the goal of universalistic cohesion.

Coupled with previous finding of a positive correlation between public deficit (%GDP) and social expenditure concentration (Table 1a), the result allows us to infer that the enlargement of the functions covered by the public welfare system is not financed, on average, out of an increase in public borrowing and public debt, but rather thanks to a better functioning of the economic system. Higher expenditure and sustainability do not contrast each other, under the appropriate design for welfare systems. Another possible confirmation of this virtuous circle is provided by the correlation coefficient between GDP growth (real values) and the level of concentration of social public expenditure which is always negative over the period 1985-2003 (Table 1b). Though preliminary, the negative sign adds some evidence in favor of the thesis that a diversified welfare system fosters economic growth, and indeed is a source of economic growth and larger resources.

Finally, we consider the effect of life habits, as measured by per capita consumption of sugar and fruits and vegetables. As expected, higher consumption of sugar is linked to higher levels of expenditure, whereas higher consumption of

fruits and vegetables is associated with lower levels of private expenditure (no relationship is detected with total and public expenditure). This result is important in light of the recent policy actions aimed at promoting a "healthy" life-style undertaken in some European countries.

IV. Conclusions

Even though preliminary in nature, the analyses presented in this paper contributes to our understanding of the key driving forces of HCE in Europe. We consider multiple factors and incentives, trying to take into account technological change, consumer preferences, ageing of the population, life habits, and budgetary and institutional variables.

Income, as measured by GDP levels, is one of the key drivers of HCE, where the estimated elasticity provides evidence of public (and total) health being a "luxury good", whereas estimated elasticity for the private component of the expenditure is below unity. This is a key point, since HCE projections are highly sensitive to assumptions on the elasticity value, and elasticity to income is key for health care budget sustainability in the long run and along the business cycle. Confirmation of the "luxury good" hypothesis would imply that policy actions to sustain health care budget cannot rely on an increase in GDP (leading to a more than proportionate increase in HCE), and would provide further support to the statement that economic growth cannot be advocated as a way to smooth or reduce budgetary controls in the health sector. Even though the result needs to be interpreted with caution as observed HCE might not reflect optimal consumption (due to the presence of exogenously imposed Government budget constraints), it points directly to the core of the sustainability problem.

Private expenditures are paid out from households income and/or from insurance products, and for this reason the level of individual responsibility in consumption tends to be constantly high, leading to less than proportionate increases. On the contrary, public systems tend to pursue universality through the full/partial gratuitousness of provisions, and so encounter difficulties in combining

adequacy/equity with efficiency/efficacy (they are exposed to phenomena of over consumption, inappropriate consumption, and the so called problem of "the third payer" makes it difficult to promote the adoption of best practices by doctors and providers).

Besides GDP, higher life expectancy, female labor participation and decreasing fertility rate, contribute to the rising of HCE. Results also stress the importance of health habits and technological change in determining differences in the level of HCE across countries[26]. Budget constraints significantly explain the level of expenditure, as well as the framework variables. No single recipe exists for keeping health care budgets under control, and different countries have applied different methods and undertaken different policy actions. Nonetheless the rules for accessing medical services, and co-payment systems on citizens exert an effect on the level of expenditure.

All in all, the structural features of health care systems make it difficult to sustain the current trend in the long run. On the one side, the effect of technological change in the health care sector with respect to the other sectors inexorably lead to an increasing share of public finances allocated to health. Hartwig (2008) provides an empirical account of the Baumol model of unbalanced growth. The health care sector is indeed labor intensive, characterized by negative productivity differentials with respect to other goods and services in the economy. The equalization of wages across sectors, then, produces the inexorable rise of relative prices (Baumol, 1967). Coupled with the crucial role of consumer preferences in the growing share of health spending to GDP (Hall and Jones, 2007), the finding seems to leave little room for public policy.

On the contrary, we argue that the finding should drive policy maker's attention towards the burden that this expenditure item will produce on public finances, rapidly promoting a political debate at European level aimed at designing those structural reforms which are needed to assure long-term sustainability and prosperity. A significant fraction of EU health care is tax funded: healthy young

[26] Needless to say, the benefits associated with longer healthy life are not easily accounted for in this type of regressions, nonetheless being an important implication of technological progress.

workers pay for the care of sick, usually older and poorer citizens. In turn, young generations rely on future generations to pay for their care. But demographic changes – a falling birth rate, growing life expectancy and increasing female labor participation – are likely to cause severe funding problems within the existing framework, which will worsen over the years.

Against this background, we posit that both in Europe and in the US the key challenge for Governments is how to design pluralistic systems of health care delivery and financing, where a well-balanced mix of public and private financing can sustain investment and innovation, without imposing unsustainable burdens on public budgets, and without denying care to the disadvantaged population.

System reforms should be framed within a wide perspective. Health care reforms should be accompanied by regulation on supply and demand side; the reform of the welfare system structure and of the labor market; the adoption of the "selective universalism" perspective; the development of fully founded financing schemes based on funds, both for health care and for pensions. Results on the CONC variable supports the rationale at the basis of the so called "Lisbon agenda", aiming at reinforcing welfare instruments capable of promoting participation to labor market, effective employability - especially for the young, women and the old persons (55-64) - and productivity: human capital formation, active labor policies, family and children assistance, housing assistance, formal assistance for dependants who need long term cares. From this perspective, we argue in favor of a change from the traditional welfare perspective to the so called workfare perspective, stressing the fact that, in order to implement it, Governments have not only to devise structural reforms in their welfare systems, but also to accompany them with reforms of the labor market and of the markets of goods and services, in the sense of an higher openness to changeover and competition. This would be beneficial as would allow financing a sustainable redistribution, embedded in a process of general economic growth.

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