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May, 2013

CRES-UPF Working Paper #201305-70

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THE SOCIOECONOMIC DETERMINANTS OF HEALTH: ECONOMIC GROWTH AND HEALTH IN THE OECD COUNTRIES DURING THE LAST THREE DECADES[i]

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ABSTRACT

In times of economic crisis most countries face the double challenge to fight against unemployment whilst restraining social expenditure and closing budget deficits. The lack of employment and the spending cuts affect a large number of decisions that have a direct or indirect impact on health. This impact is likely to be unevenly distributed among different groups within the population, and therefore, not only health levels but also their distribution may be at risk.

The main purpose of this paper is to explore links between unemployment, economic growth, inequality and health. We regress a measure of health, the Health Human Development Index, (HHDI), against a set of explanatory variables accounting for the countries' economic performance (GDP growth, unemployment and income inequality), and some institutional factors related to welfare spending and the nature of the health systems for the past three decades. In addition, we explore the causes for different results obtained using an inequality adjusted HHDI, versus the unadjusted HHDI.

We describe a panel data model, estimated by random effects, for 32 countries, for the 1980-2010 period in five year intervals. Our conclusion is that high economic growth of the type observed in the last decades, together with an increase in the levels of income inequality - and/or poverty, explain the observed changes of our index, particularly when this index is weighted by health inequality. The remaining institutional variables (the share of social spending, health care expenditure and the type of health systems) show the expected sign but are not statistically significant.

A comment on the methodological pitfalls of the approach completes the analysis.

Key words: economic crisis, health inequality, health distribution, income inequality, Human Development Index, intergenerational welfare policies.

JEL code: I150-*Health and Economic Development*

INTRODUCTION

The analysis of the impact of economic growth on health and the impact of health on economic growth is still today very challenging in the health economics literature (see Lopez-Casasnovas et al, 2005) In fact, there exists a literature that attempts at modeling the effects of health on economic growth (see Bhargava et al. JHE, 2001) as another one that focuses on the reverse: how health changes as a result of economic growth. Despite there may be some endogeneity problems in both approaches, particularly in the variable economic growth, since this may also be explained, among other things, by the level of health of a population, we pursue here a further step in the analysis of the effects of growth on health and particularly on health inequality.

Political scientists often claim that income inequality lowers poor people's health by frustrating their expectation and capacity for self-fulfillment expectations and instilling a sense of failure. However, this hypothesis is quite difficult to prove, since one cannot compare two countries or individuals with equal income but unequal distributions (e.g. average income in Ghana and that of low deciles in Harlem) without a proper adjustment of all the remaining parameters. The relevant links may be otherwise tested at the macro level through the dynamics of income in a specific country, or at the micro level, by testing whether the poorest today in a place of high income and inequality have better health than they had in the past. The relationship between income and health is likely non lineal and it may be unaffected by short run impacts. Finally, health and income cannot be analyzed in this respect, as two separate entities under a single causality link.

Health inequalities seem to relate mainly to poverty and not so much to income inequality (Leigh A et al, 2009), and given the dynastic patterns of health and poverty, more attention should be devoted to the dynamics of health over the individuals' life cycle and on the transmission mechanisms between generations.

After reviewing the existing literature in the first section, we will estimate the relationship between some of the above mentioned explanatory variables on health and on the inequality adjusted health index in the second section. In the final section we base some policy recommendations on our findings.

I.- PREVIOUS LITERATURE

Income rises with improving health, and the improvement of health serves multiple goals other than just income growth (Deaton, 2003). However, achieving this virtuous cycle does not imply an improvement in income redistribution, although these improvements can create a Pareto superior situation. The utilitarian Pigou-Dalton principle[1] and the Rawls maxi min rule[2] allow for an increase in welfare without loss of generality, even in a case of increased income inequality. This story falls short of stating whether it is desirable to improve the less well-off in a way that we end with more and not less inequality. There is no doubt that income losses reduce welfare while gains in health increase it. But 'who benefits and how much' is important since social weights are beyond the slope of the welfare function.

In fact, if health improvements are actually achieved by redistributing a pre-existing income level we need a welfare function (second theorem of welfare economics) in order to judge those social gains. A second round- incentive effect of this type of redistribution policy may be, however, that the absolute level of income to distribute may be, as a result, lower in the future. This gives us a word of caution on 'excessive' income distribution as a way to reduce income related health inequalities.

The analysis of the decomposition effect of the interrelationship between income and health goes beyond single links and focuses on the joint income-health distribution. Three main questions arise: (i) how an increase in income affects health across different health statuses; in a more precise manner, how greater income increases well being, especially for the less healthy; (ii) whether well being is concave in income, which would imply that by simply transferring income from better off individuals to poorer, one raises social welfare (Dalton-Pigou); (iii) whether the income concavity of social welfare decreases with higher health levels and, as a result, in order to improve social welfare, a transfer involving poor and sick people will have a greater impact than one aimed at poor but healthy people.

Notice some measurement differences between health and income. Firstly, commonly used health indicators, the self reported health assessments, are not cardinal, whereas income is. Secondly, there are upper bounds for health but not for income. Thirdly, perhaps except for the organ donation case, one can transfer income from one person to other, but that is not possible for health. Finally, initial health stocks, the different capabilities to transform resources into health and how far everyone is from their

[1] Under the Pigou-Dalton principle a transfer of income from a richer to a poorer person, so long as that transfer does not reverse the ranking of the two, will result in greater equity. In the single dimension setting this principle is theoretically consistent, because regressivity in terms of attribute amounts and regressivity in terms of individual well-being coincide in the case of a single attribute. In the multidimensional setting, however, the relationship between the various attributes and well-being is more complex. To formulate a multidimensional Pigou-Dalton transfer principle, a concept of wellbeing should therefore be first defined.

[2] According to Rawls, social and economic inequalities are to be arranged so that they are to everyone's advantage and attached to positions open to all.

particular maximum requires a rather complex strategy to compensate for perceived health differences. As a result of these peculiarities, the heterogeneity of the composition of the observed health status is essential because when two distributions are compared, in order to show 'dominance' (say between countries or groups of individuals), apart from the central point, confidence intervals should be checked. The more the distributions overlap, the more ambiguous the results of the analysis will be, making policy decisions more difficult.

It is also worth to noticing that health inequality associated with income is related to mean income through income elasticity. This measures how mean health responds to a proportional increase in income and how this income elasticity varies with income levels. According to some sources[3], Greece and Germany the most dependent on income elasticity for health coverage among the European countries. In addition, health inequality related to income is influenced by other factors than pure income inequality. For this the effect of mean income on elasticity needs to be adjusted by factors other than income and the income rank. Income related inequalities from determinants such as age for instance -and how they do concentrate for social groups-, appear to be the most relevant factors. In this sense, Contoyannis and Forster (1999) show that a public policy that reduces income inequality may, under certain circumstances, and given the sign of the former effects, leave health inequality unchanged or even raise it. In this respect, income elasticity of health inequality may play a crucial role because if it increases with income, a proportional income growth may lead to higher income related health inequality. Otherwise, if income growth goes hand in hand with a reduction in health inequality, then greater social inclusion derives from both as a windfall profit.

In order to justify a policy based on income redistribution by lowering the average absolute levels, a very specific (and implausible) welfare function is needed that identifies 'all equally poor, all with the same levels of health' as welfare enhancing. For this reason, some authors (Fleurbaey and Schokkaert, 2009) advocate for the introduction of health inequalities into the general domain of welfare and consider inequalities from fields other than the socioeconomic ones, in order to minimize 'unfair' inequalities in welfare. Inequalities in these other factors are accounted for and then it is stated that the existing fairness gap should be valued as the distance between the actual distribution and a 'fair distribution' in which all the effects of illegitimate variables (such as those depending on the individuals' own responsibility, or those judged as unavoidable) are removed. This implies, 'a la Roemer' (Roemer, 1998) adjusting for *between* groups differences on exogenous social class gradients but not *within* groups of

[3] *Measuring Disparities in Health Status and Access*. OECD, 2009.

the same class. This is similar to a conventional standardization by adjusting the estimated regression for all the illegitimate variables above some given reference value.

On an individual basis, the correlation between income and health may be signed differently given the fact that someone may be willing to sacrifice health to earn more income, and vice versa, despite the fact that 'ex post' and at the aggregate level more income usually means better health. In order to understand this relationship, the exact income position of the individual is crucial. If the individual belongs to an upper income class, and average health improves by reducing income inequality but with no effect on the health of the lower income class, the income related health inequality would increase. Basically, for this result, three main factors influence health outcomes differences: the initial health endowment; the efficiency in health production; and how decreasing returns to scale are likely to appear as the individual gets closer to his optimum. Indeed, by redistributing income, inequalities may be reduced as well as average population health, but this ultimately will depend on the reaction of low income health producers to any income improvement.

As a consequence, the fight against income related health inequalities calls for rather complex strategies, once we capture the actual settings of the bidirectional links (see Rodriguez and Gonzalez, 2011 against Mackenbach, 2011). Economic interactions do not allow for lineal calculations without assuming individual and social behavior. Social inequalities indeed may kill. But there is a jump which falls short to claim therefore for 'politics' rather than for 'policies' and calling public health workers to act as political agents for preserving income equality and often advocating continuous health expenditure increases.

Van Ourti el al (2009) provide some evidence of the effects of income growth and inequality on health inequality in Europe. Indeed, they analyze how income distribution varies as income related health inequality (IRHI from now) changes, disentangling the effect of proportional income growth from the impact of changes in income inequality. This is made by estimating two hypothetical health levels: firstly, the health level that would prevail in case of a non-changing income distribution, and, secondly, the health level that would prevail in case of a proportional income growth. This enables isolating the effect of changes in the income distribution from the other health determinants as well as income inequality variations from proportional income growth. In both instances, there is a direct effect of the income redistribution on IRHI (which depends on the slope of the income elasticity), but also an indirect impact, through the other health determinants (which basically depends on the concentration index of the other health determinants). Evidence suggests that pro-poor changes in income inequality do not always lead to reductions in IRHI if income inequality and elasticity do not move together ’on average’.

For the European countries, Van Kippersluis et al (2009) find that health levels change little as individuals age between 20 and 40. But beyond 65-70, health begins to deteriorate rapidly. Although not in all countries, older generations usually have markedly worse health than their younger counterparts from a certain age onwards health differences are lower among them. For instance, in Spain, the variance significantly decreases with age once the cohort effect is considered (this is, under a larger number of more aged people in the oldest cohorts). As a result, in most of southern Europe they find a significant fall in health inequality over time (with some northern countries and France being an exception) and ageing may be the explanation. According to this result and some other related factors, the authors analyze the relationship between health and income across the life cycle of several generations in Europe. They try to find out: (i) how the distribution of health evolves over the life cycle, (ii) whether it changes across generations or not, (iii) how socioeconomics disparities in health fluctuate as individuals age and, finally, (iv) how they are narrowing or widening across generations. They apply age-cohort decomposition to panel data and indentify how the mean, overall inequality and income related inequality of self-assessed health evolve over the life cycle of the individuals and differ across generations. They observe in general a moderate and steady decline in mean health until the age of 70 and a steep acceleration in the rate of deterioration thereafter. In southern Europe and Ireland, where development has been most rapid, the average health of generations born in more recent decades is significantly higher than that of older generations. This is not observed in the northern countries. Moreover, in almost all countries of EU-11, health is more dispersed among older generations now with regard to the past, and indicates that despite this Europe has experienced a reduction in overall health inequality over time. In general, there is no evidence that health inequality increases as a given cohort ages. Finally, there is no overwhelming evidence that IRHI is greater among younger than older generations. Indeed, in some countries including the USA, the income gradient in health does peak around retirement age.

For Sweden, Islam et al (2009) analyze precisely how aging may impact on income related health inequality. If health inequality increases as the population ages, then a question is whether aging generates inevitable inequality consequences, not amenable to public policy interventions. These authors conclude that good health is generally pro-rich and this bias increases as the cohorts become older. The age-gender standardization does not avert this trend. The increasing trend in health inequality is then partly explained by the decrease in the population mean of health, which is attributable to the aging population. It is also well known that the variation of health of different cohorts increases over time. To be precise, elderly people in lower health states remain in the poor group, which then drives the inequality upwards. On the opposite side, the 'student' effect or 'young effect' biases the index downwards since young people are on average poor and healthy. No evidence suggests that health profiles across individual-mean income groups diverge over time. However, the observed increase in income related health inequality may be an artifact related to the structure of the pension payments system (the 'retirement' effect) or to changes in the saving behavior at older ages. By using lifetime income data, the authors find that the concentration index is quite stable over time. Indeed the ranking of the individuals at a given moment in time is influenced strongly by the pension payments due to this influence on redistribution. In Sweden, however, when one controls for age related income mobility over the life cycle, there is little evidence that income related health inequality increases as the population ages.

For the French case, Trannoy et al (2009) use the 'SHARE'[4] data base and adopt an stochastic dominance methodology, in order to prove that the mothers' social economic status (SES) have a direct effect on health status of descendants in older ages (in coherence with the *latency's hypothesis*), while fathers' SES only have an indirect impact through the descendant's education level and SES, in accordance with the *pathway hypothesis*. Moreover, the *hypothesis of transmission of health from one generation to the next* holds as postulated since they observe a direct effect of fathers' vital status and of mothers' relative longevity on descendants' health in adulthood. As a consequence, all the channels through which the family background can influence health in adulthood are involved in the explanation of inequalities in health opportunities in France. As a result, by allocating the best circumstances in both parents' SES and parents' to all the citizens, health would halve health inequality in France, being the more relevant factor the mother's social status on the health of her offspring.

Finally, for United States of America, Deaton and Paxson (1998) argue that when health shocks are permanent, their cumulative effect will result in health being more widely dispersed at older ages. If health dispersion increases with age, ageing population would lead then to greater total inequality in health, assuming no offsetting differences across other generations. In general, however, income losses from illness related to job interruptions cease after retirement. Kunst and Mackenbach (1994) discuss the case where health problems, which inevitably arise in the course of time, act as levelers and, as a result, socioeconomic disparities tend to narrow in old ages. In particular, Deaton and Paxson (op. cit) found that health deteriorates with age in a persistent constant

[4] Survey of Health, Ageing and Retirement in Europe.

rate and that health variance increases up to the age of 60 after which it remains constant. In addition, they argue, if we assume that shocks are cumulative and not random, the prediction of increasing variance with age would not hold anymore. These authors also find that the health income gradient is greater among young cohorts and that the socioeconomics components of inequality in health have been rising while total health inequality, measured by the variance, has been falling.

II. - EMPIRICAL APPROACH AND HYPOTHESIS TESTING. THE OECD COUNTRIES 1980-2010.

In analyzing the observed relationships between economic performance of countries and then health and social welfare, we limit our analysis at the aggregate level. We take as a proxy for welfare the health component of the United Nations Human Development Index during the last thirty years. In order to test the impact of economic growth, unemployment and income inequality on health, we will take advantage of the new data on the Health index variation, once the HHDI is weighted by observed inequality. The idea of weighting health status indicators by inequality, in trying to capture welfare derived from health, is sound as it has been extensively argued in the former section. In fact, welfare from health is not just related to the size of the index, but also to its distribution. Both factors indeed influence social welfare.

In this sense, recently, the new Human Development index[5] has tried to capture the impact of inequality not just for Health but for any of the components of the Human Development Index (Health, Education and material welfare). Inequality in Health in the HDI Report is measured in terms of the variation between the 5 year cohorts in life expectancy at birth, as collected by the United Nations Department of Economics and Social Affairs. Life expectancy here is defined as the number of years a new born infant could expect to live if prevailing patterns of age specific mortality rates at the time of birth were to stay the same throughout the infant's life. Data are taken from abridged life table across age intervals of five years, with the mortality rates and average age of death specified for each interval. As an element of the general HDI, the health inequality component is taken for aggregation as a part of a geometric mean. Its dimension is defined as the difference between the actual (observed) and the minimum value of life expectancy, divided by the difference between the observed maximum value and the minimum (established at 20 years).

[5] A description can be found in A. Villar *El Desarrollo Humano 1980-2010*, Cuadernos de Capital Humano y Empleo, Bancaja-IVIE, 2010 and in http://hdr.undp.org/en/media/HDR_2010_EN_TechNotes_reprint.pdf

Among the OECD countries, to account for the inequality adjusted index means an average drop of 5% with regard to the unadjusted one (a 38% drop for Less Developed Countries, LDCs). In comparing health and income with and without inequality weighting, we observe however a lower drop for LDCs (and a higher figure for the developed ones) than that of the per capita income (weighted versus unweighted)[6]. From the estimated results and by comparing the index with and without inequality weights, we may capture some additional welfare losses and identify which factors may be behind the observed changes. In other words, in following this approach we try to understand what moves health inequality toward lower values of the index according to some explanatory factors.

Premises for this exercise, according to the analysis of the previous section, are: (i) the trend in the economic performance during a range of years previous to the period analyzed, affects health, since it may be expected that greater income growth is associated to greater stress in an uneven (social gradient) manner. This means that countries with a higher average economic growth may impel their working populations towards situations that reflect into higher health index inequality; (ii) changes in employment status affect the health index, since redundancies create among population a sense of precariousness, depression, lack of self-esteem that may affect the deterioration of the indicator; (iii) finally, as argued in previous sections, the level of poverty and the income inequality of the countries as measured by the Gini coefficient may be expected to lower the health index once weighted by inequality.

In understanding the role of inequality in the observed health levels (Alkire and Foster, 2010), we must remember that health is a difficult domain in itself, both on a theoretical or empirical basis, particularly if we are concerned on the measure of inequality of achievement. Child mortality data, often used to represent health inequality in developing countries, are not always available nor is there an alternative international indicator of general health. Life expectancy data are commonly used in aggregate indicators but are not available at the individual level, or by population subgroups in all countries. At any rate, it is possible to estimate a lower bound of inequality by constructing the means of the distribution of life expectancy for different age cohorts of the population, relying on data from life tables. Of course, this measure of *between-group* inequality is only as accurate as the tables from which it is drawn.
This measure also smoothes inequality within each age cohort, and does not take into account disability or morbidity, but only presence of physical life. But given the absence of other data sources with sufficient coverage across countries, this seems the approach which will generate the most realistic approximation to health inequality. Thus, in

[6] See http://hdr.undp.org/en/media/HDR_2010_EN_Table3_reprint.pdf

pursuing health equality without controlling for life expectancy at birth across different generations (cohorts, age groups), progress in health might be viewed as undesirable if this goes with an increase in inequality. Otherwise, we should implicitly accept that society is willing to compensate with additional benefits to those who were born 'by accident' in early generations, and this is a rather controversial issue in itself.

Despite those difficulties and having considered the aforementioned aspects, we proceed to present the central part of our empirical study in estimating the links between health and a country economic performance, including wealth generation and income distribution. Our sample consists of 9 socioeconomic indicators for 32 OECD[7] countries. To be precise the main variables considered are the aforementioned health indices (the traditional health index and the health index adjusted for inequality), the growth rate of the GDP per capita, the unemployment rate, the inequality in the distribution of wealth (measured by the Gini coefficient), the poverty rate and 3 dummy variables capturing the level of social and health expenditure and the existence of a National Health System.

We base the first part of our empirical analysis on a panel data with the OECD countries from 1980 to 2010, with 7 observations for each country by taking periods of five years (since this is the interval that includes most of the defined variables). However, 88 missing values reduce our sample size to 136 observations. We begin by approaching a model in which the health index is explained by the economic performance (GDP per capita growth rate), the unemployment rate of the period and income inequality (the Gini coefficient):

(1.1)

Where for any OECD country i in year t:

HI health index
G GDP per capita growth rate
U unemployment rate
I Gini coefficient
e error term

To estimate this model, we use random effects. As it is known, fixed effects is more appropriate when the purpose is to control for omitted variables assuming that they are constant over time. But fixed effects would impede to include variables that

[7] Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States of America.

characterize the countries such as the type of health systems they have. The estimation by random effects allows regressors to be invariant over time, but it requires that the country specific effect is independent of the explanatory variables, which we we believe is the case in our sample. Most of our variables are constant across countries but change over time, and others are different across countries but constant over time such as the social expenditure, the health expenditure and the existence of a National Health System.

At any rate, the Hausman test allows us to accept the hypotheses that this is not biasing our results, once random effects are validated against fixed effects.

These are our main results:

Health index (HI)	Coefficient	95% Conf. interval	
			Number of obs. = 136 Wald chi2(3)=15,58
G_pchange	-0,286(0,07)**	(-0,43, -0,138)	Prob > chi2=0,0014
U_pchange	-0,122(0,12)	(-0,36, 0,123)	Overall R-squared=0,2405
I_gini	-0,196(0,11)*	(-0,41, -0,019)	
Constant	92,53(3,5)***	(85,67, 99,39)	Between R-squared=0,4220
Corr (G_pchange, U_pchange) =-0,0288 ; Corr (I_gini, U_pchange) = 0,1947; Corr (I_gini, G_pchange) = 0,0649			

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient.
Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

As postulated, higher average economic growth and higher observed Gini coefficients make for lower levels of health. Hence, it seems to confirm that economic growth has a cost in terms of more social stress and lower health indexes, as happens with income inequality. Neither the change in the unemployment rate for the period nor the average value are statistically significant despite having the expected sign (higher unemployment, lower health indexes)[8]. Notice how the value of the constant is significantly close to 100[9], the maximum value of the health index, showing the high development of most of the OECD countries.

To ensure that these results are robust to some potentially important omitted variables, we include in our estimation two dummies. The first one tries to collect the different role of social expenditure along the period for each country. We consider a value of 20%

[8] The idea that unemployment is good for health can be found in Rhum et al. However this may be a pure short run effect (more jogging and intake calories). More of the public health studies derive a negative sign given the associated factors to unemployment such as income reduction and depression.

[9] The health index takes values between 0 and 1 where the closer it is to 1, the better the health level of the populations is. We adjust the index to a 0-100 scale by multiplying it by 100 for practical purposes. This modification does not alter the essence of our results.

as the minimum proportion of social spending in GDP as a buffer for all those external fluctuations in the explanatory variables which can reduce the impact of the remaining variables on our health index. In other words, all other things equal, a relatively important welfare state may mitigate some of the otherwise negative effects on health. This dummy is stable across the entire 1980-2010 span for over 80% of the countries in our set, which supports the adequacy of the random effects model. Among the 32 countries and along the 30 years, only 5 countries change their ratio slightly, all of them moving upwards (Italy, Spain, UK, Norway and Poland).

Another dummy deals with the different nature of the health system under consideration; to be precise; it takes a value of 1 for those countries with a National Health Service (NHS) model and a value of 0 for those with a social health insurance system. The hypothesis is that more state administered systems, as the main characteristics of a NHS, should be better equipped to lower the impact of the remaining explanatory variables on health:

(1.2)

Where for any OECD country i in year t:

HI *health index*
G *GDP per capita growth rate*
U *unemployment rate*
I *Gini coefficient*
S=
N=
e *error term*

These are our main results:

Health index (HI)	Coefficient	95% Conf. interval	
			Number of obs. = 136
G_pchange	-0.287(0,07)**	(-0,43, -0,137)	Wald chi2(5)=15,98
U_pchange	-0,119(0,13)	(-0,37, 0,133)	Prob > chi2=0,0069
I_gini	-0,213(0,11)*	(-0,441, 0,15)	Overall R-
S_dummy	-0,37(1,58)	(-3,46, 2,733)	squared=0,2497
N_dummy	-0,42(1,50)	(-3,37, 2,524)	Between R-
Constant	93,44(4,01)***	(85,60, 101,29)	squared=0,4447

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

The nature of the health system does not alter the sign of the effects of the other variables on the health index. GDP and the Gini index maintain the expected statistically significant impacts, and despite the negative value of both dummy variables they are not statistically significant.

We finally explore the role of health care expenditure over GDP, on isolation and together with the nature of the health systems (NHS) for each country in our series. For this purpose, we create a new dummy variable which takes the value of 1 if the OECD country has a health expenditure equal or higher than 7,5% of the GDP (around the average of the OECD health expenditure), or a value of 0 if this indicator is lower than 7,5%. We obtain the following results:

(1.3)

Where for any OECD country i in year t:

HI *health index*
G *GDP per capita growth rate*
U *unemployment rate*
I *Gini coefficient*
HE
e *error term*

Health index (HI)	Coefficient	95% Conf. interval	
G_pchange	-0,268(0,075)**	(-0,42, -0,119)	Number of obs. = 136
U_pchange	-0,108(0,12)	(-0,35, 0,136)	Wald chi2(4)=23,22
I_gini	-0,105(0,116)	(-0,33, 0,124)	Prob > chi2=0,0001
HE_dummy	3,79(1,48)*	(0,881, 6,71)	Overall R-squared=0,2759
Constant	87,60(4,21)***	(79,35, 95,86)	Between R-squared=0,3873

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(1.4)

Where for any OECD country i in year t:

HI *health index*
G *GDP per capita growth rate*
U *unemployment rate*
I *Gini coefficient*

N =

HE

e *error term*

Health index (HI)	Coefficient	95% Conf. interval	
			Number of obs. = 136
G_pchange	-0.269(0.075)**	(-0,42, -0,12)	Wald chi2(5)=22,81
U_pchange	-0,105(0,13)	(-0,35, 0,146)	Prob > chi2=0,0004
I_gini	-0,095(0,12)	(-0,32, 0,135)	Overall R-squared=0,2768
N_dummy	-0,722(1,47)	(-3,61, 2,16)	Between R-squared=0,3786
HE_dummy	3,89(1,55)*	(0,86, 6,93)	
constant	87,56(4,23)***	(79,25, 95,87)	

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

The results show a positive and significant effect of health spending (higher expenditure, higher health index), together with a reduction (not statistically significant) on the impact of inequality. Notice how both models (1.3) and (1.4) improve the overall R-squared (from 0,2497 to 0,2768) but reduce the between R-squared (from 0,44 to 0,37). This decrease suggests that the differences in health expenditure among countries do not help much in explaining the disparities in their observed health levels.

In the second part of our analysis, we consider the Health Index adjusted for inequality, on a cross section basis, just for the year 2010, the single year for which this index is available at present. Despite the small sample size, we regress the above mentioned vector of explanatory factors (economic growth, income inequality and unemployment) during the period 2000-2010, aiming to understand the inertia of the main driving forces of the Health Index and the Health Index, once this is adjusted for inequality.

(2.1)

Where for any OECD country i:

HII *health index adjusted for inequality 2010*

G *GDP per capita growth rate, percentage change 2000-2010*

U *unemployment rate, percentage change 2000-2010*

I *Gini coefficient 2010*

e ≡ *error term*

Health index adjusted for inequality (HII)	Coefficient	95% Conf. interval	
			Number of obs. = 32
G_pchange	-0,03(0,01)*	(-0,06, -0,006)	F (3,28) = 4,71
U_pchange	-0,02(0,01)	(-0,04, 0,01)	Prob > F = 0,0088
I_gini	-31,4(12,5)*	(-57,1, -5,7)	R-squared = 0,335
constant	98,5(41,6)***	(90,0, 107,1)	Adjusted R-squared =0,264

Corr (G_pchange, U_pchange) = -0,38; Corr (I_gini, U_pchange) = 0,04; Corr (I_gini, G_pchange) = 0,08

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

As postulated, higher average economic growth and higher observed Gini coefficients make for lower levels of the inequality adjusted health index. Hence, it seems to confirm that economic growth has a cost in terms of welfare. Neither the change in the unemployment rate for the period nor the average show statistically significant parameters, although they hold the expected sign (higher unemployment, lower health indexes), likely to be due to the correlation between economic growth and unemployment. This result holds too when we include the poverty rate (the child poverty index[10]) rather than the Gini coefficient (income inequality). Notice the positive high correlation index between poverty rate among children and income inequality.

(2.2)

Where for any OECD country i:

HII health index adjusted for inequality 2010

average GDP per capita growth rate 2000-2010

PRC poverty rate among children (mid 2000)

e error term

Health index adjusted for inequality (HII)	Coefficient	95% Conf. interval	
			Number of obs. = 30
			F (2,27) = 7,69
G_average	-1,9(0,80)*	(-3,70, -0,30)	Prob > F = 0,0023
PRC	-0,41(0,160)*	(-0,73 -0,07)	R-squared = 0,363
Constant	98,9(2,60)***	(93,6, 104,3)	Adjusted R-squared =0,316

Corr (G_average, PRC) = 0,236 ; Corr (PRC, Gini) = 0,864

[10] See *Model 2.3* in *Appendix 1* where we use 'poverty among working adults' as an explanatory variable. According to our results, neither this variable nor the unemployment rate seem to be significant variables in explaining the Health Index.

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient.
Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

We obtain negative and significant coefficients for both average economic growth and child poverty which suggests that higher levels of these variables are bad for the Health Index, as postulated by most of the literature previously reviewed.

We finally explore what causes the change in the Health Index once we weight it by inequality; thus, we try in these final regressions to estimate the explanatory factors behind the difference between the conventional Health Index and the Health Index adjusted for inequality as calculated in the new HDI.

(3.1)

Where for any OECD country i:
ΔHI difference between the traditional health index and the health index adjusted for inequality
G GDP per capita growth rate, percentage change 2000-2010
U unemployment rate, percentage change 2000-2010
I Gini coefficient 2010
e error term

Difference traditional health index-health index adjusted for inequality (ΔHI)	Coefficient	95% Conf. interval	Number of obs. = 32 F (3, 28) = 9,53
G_pchange	0,012(0,005)**	(0,0025, 0,24)	Prob > F = 0,0002
U_pchange	0,007(0,004)	(-0,0012, 0,02)	R-squared = 0,505
I_gini	17,0(4,0)***	(8,86, 25,3)	Adjusted R-squared =0,452
Constant	-0,26(1,33)***	(-2,96, 2,46)	

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient.
Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

From the regression results, we can show that, in absolute terms, the drop of the ΔHI (the Health Index when it is adjusted for inequality) is basically explained by economic variables, particularly economic growth and, with less statistical significance, by the unemployment rate. Evidence suggests that higher economic growth leads to a higher difference between weighted and unweighted values. The Gini coefficient seems to explain the larger part of the variation: a higher income inequality means a higher change between the adjusted and unadjusted index. Notice the high F-test value for the latter specification which reinforces the significant coefficients obtained.

In similar terms,[11] we confirm the former result by taking the % rather than the absolute value of the drop of the index:

(3.2)

Where for any OECD country i:

HIL % loss in health index when it is adjusted for inequality

G GDP per capita growth rate percentage change 2000-2010

U unemployment rate, percentage change 2000-2010

I Gini coefficient 2010

e error term

% Loss in health index when adjusted for inequality (HIL)	Coefficient	95% Conf. interval	
G_pchange	1,50(0,60)*	(0,30, 2,70)	Number of obs. = 32 F (3, 28) = 8,36 Prob > F = 0,0004 R-squared = 0,472 Adjusted R-squared =0,42
U_pchange	0,93(0,54)	(-0,19, 2,04)	
I_gini	2012,0(515,0)**	(956,6, 3066,0)	
Constant	-80,2 (171,1)***	(-430,6, 270,2)	

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

We observe therefore that, again, higher unemployment rates, greater Gini Index and greater economic growth lead to a larger percentage fall in our health index once we adjust it for inequality. Notice how the adjusted R-squared suggests that these three explanatory variables account for more than 40% of the variation in the percentage loss in the Health Index once inequality is considered.

Finally, we introduce age as an explanatory variable in models (3.1) and (3.2). The underlying hypothesis is that the difference between the un-weighted and the weighted health index (rather than its absolute value, basically approached by life expectancy), should be sensitive to differences in the share of the aged population of the countries. This might be the case given the fact that increasing depreciation rates of health at older ages 'within' each country make for a quick convergence towards relatively worse health states, but with a relatively more equal distribution, being less dependent on income inequality. This larger share of aged population would partially offset any other values of health inequalities for the rest of age cohorts. In our sample the introduction of the share of population over 65 years old does not prove to be statistically significant.

[11] For the remaining variations of this model (3.3-3.6), see *Appendix 1* where we analyze how this results change if, instead of considering the percentage change, we use the average value of the independent variables for the period.

This is the case (see Appendix 3.7 and 3.8) when we either regress age on the total level of the inequality adjusted health index or on its drop with regard to the unadjusted level.

To sum up, the results of our empirical exercise seem to confirm a significant negative influence of economic growth, income inequality, poverty and unemployment on the Health Index adjusted for inequality. Indeed, the variation of the difference between the traditional Health Index and the one adjusted for inequality seems to be mostly explained by economic growth and income inequality.

III.-DISCUSSION AND FURTHER RESEARCH

At the present state of knowledge, despite the observed relationship between income variations and health, more analysis is needed on the epidemiology and macroeconomics of social factors when we move from individual to collective aggregate behavior of income and health. This requires improving modeling at the individual level such as for rational behavior or postponing addictions, and better empirical approaches to deal with endogeneity of health and income and vice versa, by instrumenting adequate variables. The endogeneity is mostly due to the existence of cumulative causation processes related to social conditioning, labor employment/ capital input technologies and factor interactions. At the aggregate level we need to focus on the epidemiology and macro social determinants of health such as those derived by the intergenerational impact on equity (the welfare of children: cognitive and non cognitive human capital accumulation). In addition we should be more aware of the consequences of taxation practices in financing public spending (dual fiscal systems lead at present to regressivity), of the tax wedges on residual income, the education gap (and its effects on smoking and overweight, among others), and of zoning laws and housing prices (due to the mobility and obesity effects). Corporate practices and nutrition habits (production and design, marketing, retail distribution and pricing) may be influential too.

In general, the economics and welfare models such as those for dual earner-families; general family policies or the impact of market oriented policy models, and the incidence of migration in particular, cannot be disregarded in policy making (Putnam and Galea, 2008). This is essential to achieve better foundations of health policy, to disentangle some sample biases- due to unobserved individual heterogeneity- and some habit correlations such as drinking or smoking and obesity. These correlations affect productivity and wages, among others. For instance, if average alcohol consumption is independent of the business cycle, universal actions to prevent alcoholic abuse during hard time will be fruitless. Specific policies for different groups are needed for subtle relationships such as when unemployment increases, drinking habits but the conditional intake of alcohol is not affected[12]. A more general discussion needs to consider issues such as equity and efficiency effects of social expenditure in the new public finance context. The trend towards regressivity in financing public expenditure through dual fiscal systems (more indirect taxes, lower fiscal burden for capital than for labor) calls for increasing progressivity in public spending and this may lead to less universal systems.

In our estimation, some methodological pitfalls remain. Firstly, we need structural models rather than reduced form equations and longitudinal-panel data analysis[13]. For instance, Eurostat[14] follows this methodology to determine how income-related health inequalities change in short and long run perspectives, using an index of health-related income mobility based on a concentration index (CI)[15]. For the European member states, results indicate the existence of long term income-related inequalities in health and low income individuals seem more vulnerable to suffer health limitations. Moreover, the values of the mobility proxies suggest that income dynamics should be taken into account when inequalities are computed in health limitations in order to avoid overestimation. Aware of the drawbacks of the CI[16], in a further step, the before mentioned EU report uses the ‘adjusted’ CI (Erreygers, 2009) to compare groups with a different average health[17].

Other methodologies which need further improvements include those related to fixed effects estimation (aimed at mitigating unobservable factors), instrumental variables,

[12] See Todeschini, 2010 UPF Ph D. mimeo.
[13] Since health policy is concerned with lifetime analysis.
[14] See Methodological issues in the analysis of the social determinants of health using UE-SILC data (Eurostat, 2010).
[15] The concentration index provides a summary measure of the magnitude of socioeconomic-related inequality in a health variable of interest. It is the result of multiplying by 2 the area between the concentration curve and the 45º line. The two key variables underlying the concentration curve are: the health variable, the distribution of which is the subject of interest ; and a variable capturing living standards, against which the distribution is to be assessed (Source: site resources World Bank).
[16] Firstly, the bounds of the CI depend on the mean of the health variable. Secondly, different rankings are obtained when comparing inequalities in health with inequalities in ill-health (Clarke et al, 2002). Thirdly, the index becomes arbitrary if qualitative health variables are used.
[17] The values are in general negative and different from 0. Income-related inequalities in health limitations are suffered particularly by those at the bottom of the income distribution. For 2007, countries such as Estonia or Latvia had the highest inequality, while Sweden or Luxemburg had the lowest among the European countries. Across time, inequalities increased in all the countries with the exception of UK, Hungary, Spain and Estonia. Regarding unmet need for health care, which is considered as an indicator of care access, a *probit model* is used to determine which elements influence this variable. The main explanatory variables are age, gender, health variables, equivalised household disposable income and education, among others. The results show how worse health, higher education, less income, being unemployed (or half time employed) increase the chances of suffering unmet need for health care. Notice how the results vary significantly across countries. For instance, Belgium, Spain and Slovenia have a relatively low probably while Germany, Greece, Ireland or Sweden have high chances.

better matching techniques for quasi random experiments and pseudo panel in order to deal properly with endogeneity decisions[18]. Moreover, in microeconometric approaches, with individual disaggregate data, reporting bias and sample selection bias should be carefully considered. Reporting bias arises from the subjective nature of self-reported health status (Hernández-Quevedo et al, 2010, Ziebarth 2010 and Contoyanis et al 2004 on state dependence in self assessed health). Culture, language, social context, gender and age, among others, may influence the health rating leading to different results across individuals with the same health status. *Methodological issues in the analysis of the socioeconomic determinants of health using EU-SILC data* (Eurostat, 2010) suggests dealing with it by calculating an indicator of suffering health limitations in daily activity using longitudinal data. Sample selection bias considers dubious relationships between variables, such as quitting smoking and a lower propensity of overweight (for instance, does it come from the fact that those who quit smoking are more concerned with health or because quitting the addiction improves health itself?).

In addition, further attention should be paid to non linearities, adjustment costs, accounting for time in habit formation, unobserved heterogeneity and overtime changing conditions. Identifying substitution effects is essential, as is the impact of exogenous shocks, technological change, the production model and more stress, more sitting than exercise; and positive complementarities such as unemployment, spare time and self-care, and negative complementarities such as unintended effects on the less wealthy, the less educated and more addicted. Also, it is necessary to distinguish the sign and direction of the relationships such as unemployment and alcohol consumption; alcohol abuse and risky sex; loss of income and higher intake of calories for obesity; budget restrain effects-higher tobacco prices and less expenditure, on healthy nutrition. The result of all this may be a dangerous causative accumulation: less wealthy, less educated and more addicted. We therefore need to disentangle the recursive process for a better evidence based health policies on income and health.

[18] This is, pseudo panel for cohort analysis by dividing population in groups according to observable heterogeneity characteristics, taking the population mean of the different cohorts (being unknown, relying on its sample analog and a certain trade-off between bias-size of the cohort-and variance-characteristics of the defining cohort), with the cohort fixed effect to be imposed and/or instrumentalising the estimation, regarding the extensive marginal analysis conditioned to participation (i.e. reduction of intakes versus switching…).

APPENDIX 1

(2.3)

Where for any OECD country i:

HII health index adjusted for inequality 2010

average GDP per capita growth rate 2000-2010

average unemployment rate 2000-2010

PRW poverty rate among people of working age (mid 2000)

e error term

Health index adjusted for inequality (HII)	Coefficient	95% Conf. interval	
G_average	-1,8(0,9)	(-3,7, 0,1)	Number of obs. = 30
PRW	-0,44(0,33)	(-1,1, 0,23)	F (3,26) = 4,04
_average	-0,41(0,32)	(-1,0, 0,24)	Prob > F = 0,0175
Constant	100,4(3,58)***	(93,0, 100,7)	R-squared = 0,318
			Adjusted R-squared =0,239

Corr (G_average, U_average) = 0,344; Corr (PRW, U_average) = 0,18; Corr (PRW, G_average) = 0,21; Corr (PRW, Gini)=0,855

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient.
Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(3.3)

Where for any OECD country i:

HIL % loss in health index when it is adjusted for inequality

average GDP per capita growth rate 2000-2010

U percentage change in unemployment rate 2000-2010

e error term

% Loss in health index when adjusted for inequality (HIL)	Coefficient	95% Conf. interval	
G_average	83,1(40,5)*	(0,18, 166,1)	Number of obs. = 32
U_pchange	0,63(0,63)	(-0,67, 1,93)	F (3, 28) = 2,39
Constant	312,4(113,0)***	(81,6, 543,4)	Prob > F = 0,109
			R-squared = 0,142
			Adjusted R-squared =0,08

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient.
Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(3.4)

Where for any OECD country i:

HIL % loss in health index when it is adjusted for inequality

average GDP per capita growth rate 2000-2010

average unemployment rate 2000-2010

e error term

% Loss in health index when adjusted for inequality (HIL)	Coefficient	95% Conf. interval	
G_average	70,91(43,8)	(-18,8, 160,6)	Number of obs. = 32
U_average	7,55(15,74)	(-2,46, 39,7)	F (2, 29) = 1,97 Prob > F = 0,1578
Constant	315,8(129,2)***	(51,5, 580,0)	R-squared = 0,1196 Adjusted R-squared =0,058

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(3.5)

Where for any OECD country i:

HIL % loss in health index when it is adjusted for inequality

average GDP per capita growth rate 2000-2010

average unemployment rate 2000-2010

I gini coefficient 2010

e error term

% Loss in health index when adjusted for inequality (HIL)	Coefficient	95% Conf. interval	
G_average	45,7(38,1)	(-3,22, 123,7)	Number of obs. = 32 F (3, 28) = 5,78
U_average	3,97(13,4)	(-23,6, 31,53)	Prob > F = 0,0033
I_gini	1971,0(570,8)**	(801,6, 3140,4)	R-squared = 0,3825
Constant	-229,0(192,4)***	(-623,2, 165,1)	Adjusted R-squared =0,3163

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(3.6)

Where for any OECD country i:

HIL % loss in health index when it is adjusted for inequality

GDP per capita growth rate, percentage change 2000-2010

U unemployment rate, percentage change 2000-2010

e error term

% Loss in health index when adjusted for inequality (HIL)	Coefficient	95% Conf. interval	Number of obs. = 32 F (2, 29) = 3,29 Prob > F = 0,0514 R-squared = 0,1851 Adjusted R-squared =0,1289
G_pchange	1,76(0,72)*	(0,28, 32,3)	
U_pchange	1,10(0,66)	(-0,26, 2,5)	
Constant	565,7(53,4)***	(456,5, 675,0)	

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(3.7)

Where for any OECD country i:

HII health index adjusted for inequality 2010

GDP per capita growth rate, percentage change 2000-2010

U unemployment rate, percentage change 2000-2010

I Gini coefficient 2010

E elderly population (aged 65 and over as a percentage of total population) in 2010.

e error term

Health index adjusted for inequality (HII)	Coefficient	95% Conf. interval	Number of obs. = 32 F (4, 27) = 3,37 Prob > F = 0,0232 R-squared = 0,339 Adjusted R-squared =0,235
G_pchange	-0,035(0,015)*	(-0,066, -0,004)	
U_pchange	-0,015(0,014)	(-0,043, 0,013)	
I_gini	-26,59(20,58)	(-68,82, 15,63)	
E_elderly	0,143(0,35)	(-0,588, 0,874)	
Constant	94,78(10,42)***	(73,41, 116,1)	

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient. Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

(3.8)

Where for any OECD country i:

ΔHI difference between the traditional health index and the health index adjusted for inequality

GDP per capita growth rate, percentage change 2000-2010

U unemployment rate, percentage change 2000-2010

I Gini coefficient 2010

E elderly population (aged 65 and over as a percentage of total population) in 2010.

e *error term*

Difference traditional health index-health index adjusted for inequality (ΔHI)	Coefficient	95% Conf. interval	
			Number of obs. = 32
			F (4, 27) = 5,98
G_pchange	0,012(0,0057)*	(0,0013, 0,024)	Prob > F = 0,0014
U_pchange	0,00714(0,0058)	(-0,0048, 0,019)	R-squared = 0,469
I_gini	16,22(9,10)	(-2,45, 34,89)	Adjusted R-squared
E_elderly	0,027(0,13)	(-0,29, 0,239)	=0,391
Constant	0,455(4,16)***	(-8,07, 8,98)	

Notes: The robust standard deviations are presented in parentheses beside the estimated coefficient.
Significance levels: * p < 0,05, ** p < 0,01, *** p < 0,001.

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[1] - We would like to acknowledge useful comments from Beatriz González from University of Las Palmas de Gran Canaria and Ana Mosterin (CRES-UPF). Usual disclaims apply. Author for correspondence: guillem.lopez@upf.edu

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