Does rising income inequality reduce life expectancy? New evidence for 26 European countries (1995-2014)

ABSTRACT *An open debate these days is about how national income inequality could affect individuals' health outcomes. Therefore, the present study aims to provide new evidence regarding life expectancy determinants and how they are related to the income inequality hypothesis. Precisely, it is provided new evidence on this relationship for 26 European countries during the period 1995-2014. The analysis is based on panel data techniques, with the latest data from both Eurostat and the OECD Health Statistics. Furthermore, data from the World Bank is also applied. Besides, we have tested the sensitivity of the estimates in our empirical analysis using three clusters of countries. Our results suggest that income inequality does not significantly reduce health in developed societies, like the European ones. Notwithstanding, as income inequality can be sometimes harmful for population health, these issues must be taken into account in order to improve health care policies.*

KEY WORDS: income inequality; population health; health outcomes; panel data; European countries

JEL CLASIFICATIONS: D31, D63, I10

Introduction

The study of income inequality and its implications are among the most important issues in modern societies. What it is known is that the significant increase in income inequality indicators not only raises social and political concerns, but also economic ones (OECD, 2015).[1]

As inequality may influence the future of Welfare States, there is a growing pool of literature in recent years seeking to understand the relationship between income and different socioeconomic outcomes (Mellor & Milyo, 2001 and 2003; Wilkinson & Pickett, 2006; Piketty, 2014; Avendano & Hessel, 2015; Lee & Son, 2016). At this regard, health economics literature has demonstrated how several socio-economic factors can affect health outcomes. In fact, the rise of income inequality, altogether with greater levels of gender gaps and wealth concentration against less redistribution policies, among others, will move these problems to the top of the policy agenda in many countries. Besides, the existing literature suggests that income inequality measured through Gini index might be influenced by decentralization, government size, economic growth, and other socioeconomics variables (Cantarero & Perez, 2012).

Does national income inequality affect individuals' health? In this sense, it is well known the Income Inequality Hypothesis (IIH) based on the fact that high income inequality is bad to human health (Wilkinson, 1996; Kawachi & Kennedy, 1997; Cantarero *et al.*, 2005; Pickett & Wilkinson, 2015; Latif, 2015). Nevertheless, there is currently a wide controversy due to the several methodologies that these studies are based on (Dorling & Barford, 2009; Jutz, 2015; Kragten & Rozer, 2017). Thereby, there is an open debate during these days and a deeper analysis of previous contributions is done in the following section to discuss theoretical foundation of the relationship between income inequality and health (Hu *et al.*, 2015). Altogether, additional studies are still needed, and our motivation is this study would be qualified as one. That is, we aimed to refine and extend previous studies by critically investigating life expectancy determinants and how they are related to the income inequality hypothesis. Indeed, new data are now available for developed countries and allow us to test different models (as more degrees of freedom are available and so, more test and modelling can be applied). The aim of this paper is to assess the impact that income inequality has on health outcomes, improving previous studies about it. In order to simplify a complex issue like this, the measure of health that we have considered here is life expectancy, a commonly used indicator in many studies (Cantarero *et al.*, 2005; Chetty *et al.*, 2016). Therefore, we have analysed some factors associated with differences in life expectancy by focusing on income and inequality in 26 European countries during the period 1995-2014.[2] Besides, we have checked the sensitivity of the estimates in our empirical analysis by using three subsamples (Nordic council, PIIGS countries and EU-15).[3]

[1] Today, the Gini coefficient – a common measure of income inequality that scores 0 when everybody has identical incomes and 1 when all the income goes to only one person – stands at an average of 0.315 in OECD countries (OECD, 2015).

[2] To test the income inequality hypothesis (IIH), per capita income and Gini coefficient are considered (other control variables are also included in our final estimates). The measure of income inequality, in our case, would be only the Gini coefficient of equalized disposable income - EU-SILC survey.

[3] The clusters are based on geographical location while also they correspond with welfare state typology most frequently used in public health studies. Here Scandinavian versus Southern, and EU-15 versus non-EU-15.

Results from our panel data stated that income inequality does not significantly reduce health, which could be explained by the fact that we focus our analysis on advanced societies (Mackenbach, 2002; Zagorski *et al.*, 2014). Besides, we can postulate that our findings would be in accordance with those pointing out material interpretations versus the ones on psychosocial pathways. Even so, in order to apply a correct allocation of resources it should be better understood how inequality could influence health outcomes. That is, from a policy economic perspective, our article encourages the debate about the real implications of health services on final results.

Literature Review

In the literature on the relationship between income inequality and health, there is an extraordinary lack of scientific consensus. At this regard, different explanations have been proposed in order to understand this issue.

We present an overview of various studies to bear in mind all these possible scenarios and to further contextualize empirical results. Firstly, we have focused on the negative impact of income inequality on health, those that support the IIH. Secondly, we present some findings that demonstrate that income inequality may not have any negative impact on health, either because there are not significant effects, or because they could be positive.

On the one hand, the literature generally explains negative impacts between income inequality and health. The most common explanation for the IIH is that as income inequality grows, psychosocial stress rises, which declines the population health due to higher levels of competition and stress involved (Subramanian & Kawachi, 2004; Layte & Whelan, 2014). Moreover, income inequality causes that there are more poor people, who have relatively bad health status (Gravelle *et al.*, 2002; Brezinski, 2015). Thus, poor population might influence other people with unhealthy lifestyles or other activities related to low income (Kawachi & Kennedy, 1997). Unequal societies underinvest in social policies and which may avoid better overall health (Coburn, 2000; Subramanian & Kawachi, 2004). Thus, decreasing income inequality is the key to create healthier societies as Qi (2012), Karlsdotter *et al.* (2012) or Pop *et al.* (2013) show in their recent studies.

In addition, in Cantarero *et al.* (2005) the relationship between income inequality and health in the European Union is studied. Their results show strong support to the IIH and it holds across a variety of specifications using data based on the European Community Household Panel and different equivalence scales. The most important finding is the influence of income distribution on population health and that greater inequality is associated with higher mortality. Besides, the results for higher life expectancy are associated with lower inequality. More recently, Kragten & Rozer (2017) offer strongest support for the IIH. It is suggested that a better control for several factors and methodologies may result in a better understanding whether and how income inequality can be harmful for people's health.

On the other hand, there is evidence that does not support the IIH. Generally, this collection of papers demonstrate that the correlation between income inequality and population health is slowly dissipating. For example, in Mackenbach (2002) it was highlighted that evidence favouring a negative correlation between income inequality and life expectancy has disappeared. Indeed, such discrepancies were pointed by Wilkinson & Pickett (2006) review and show an explanation of the evidence. Hence, as pointed by Lynch *et al.* (2000) when analyzing effects on inequality in health it should be considered a material interpretation which points out that an unequal income distribution is one result of historical, cultural, and political economic processes.

Therefore, an aggregate relation between income inequality and health is not necessary; associations are contingent on the level and distribution of other aspects of social resources. One of the latest examples in this field is the one by Zagorski *et al.* (2014) who pointed out that national level of inequality, has no statistically significant effect, suggesting that income inequality does not reduce well-being, financial quality of life, or health in advanced societies. Besides, Maynou *et al.* (2015) studied the speed of convergence of (cause-specific) mortality and life expectancy at birth in European Union countries between 1995 and 2009, and they found that the effect of the Gini index (unequal income distribution), on health convergence was heterogeneous both between countries and period of time.

Data and Model

To test our model, we have collected data from Eurostat, the OECD Health Statistics and the World Bank data indicators. These datasets include panel data, and provide information on several socioeconomic characteristics and health, respectively, at national level. Table 1 presents the detail information concerning the definitions and sources of the variables.

[Insert Table 1]

Data set covers life expectancy at birth as main explanatory variable (*le*). To test differences by gender variables regarding males and females are also considered (*le males* and *le females*, respectively). Furthermore, to test the hypothesis, per capita income (*GDP*) and Gini coefficient (*Gini*) are included.[4] The election of the variables determining life expectancy is influenced by both previous literature and our preliminary estimates. Hence, other variables are used as controls, as for example primary enrollment rates (*Primary*), in order to avoid spurious regressions.[5] Besides, two supply health variables: total health care expenditure (*HEXP*) and hospital beds (*BEDS*) are considered, due to the acknowledged relationship between supply health variables and health outcomes (Blázquez-Fernández *et al.*, 2017).

Some descriptive statistics are shown in Table 2. It can be noticed that in our sample countries have, on average, a life expectancy of 78.043 years but with huge differences by gender (81.125 for females and 74.908 for males).

[Insert Table 2]

We apply panel data models to study the IIH for developed countries.[6] Precisely, random and fixed effects regressions are run, applying the Hausman's tests. Our main dependent variable is life expectancy at birth, a basic indicator in many recent studies. As in previous research, this measurement of health has been used to test the IIH, due to its objectivity, availability and generalizability. Specifically,

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[4] The Gini coefficient is defined by Eurostat as: "the relationship of cumulative shares of the population arranged according to the level of equalized disposable income, to the cumulative share of the equalized total disposable income received by them". That is, Gini after tax is used here.

[5] In spite of its relatively low variance and high rates.

[6] A longitudinal, or panel, data set is one that follows a given sample of individuals (here countries) over time, and thus provides multiple observations on each individual in the sample. The availability of this kind of information provides richer results that the ones related with traditional cross-sectional data or time series (Hsiao, 2014). That is the reason for using this technique.

our sample consists of 26 European countries during the period 1995-2014. These 26 countries are a selection of European countries due to availability in the databases here considered: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and United Kingdom.[7]

In this sense, there are many studies focused on the relationship between income and health, for example, using life expectancy, suggesting that population health improves with average income but at a decreasing rate (*Absolute Income Hypothesis*). Nevertheless, the *Relative Income Hypothesis* supports the idea that the health of individuals in a society also depends on the degree of income inequality in that society (Gravelle *et al.,* 2002; Cantarero *et al.,* 2005). The basic assumption is that the effects of absolute income are less important at higher income levels (epidemiological transition) following traditional models (Rodgers, 1979).

Hence, our macro-model can therefore be specified as:

$$le_{it} = \beta_0 + \beta_1 (1/y_{it}) + \beta_2 (1/y_{it}^2) + \beta_3 G_{it} + u_{it} \quad (1)$$

where le_{it} is population life expectancy for population in country *i* in year *t*, y_{it} is per capita income. G_{it} is the measure of income inequality, in our case, the Gini index, and u_{it} is an error term. So, life expectancy increases at a decreasing rate with income and tends to a maximum value. But this relationship is asymptotic, that is, there is a maximum life expectancy beyond which income increases have no impact. Hence, the relationship between income and life expectancy is considered as non-linear avoiding the aggregation problem. In other words, and in accordance with the previous section, the relationship between (*le*) and (*y*) is hypothesized to be positive but decreasing.

Besides, other control variables are going to be included in the analysis (φ). The subsequent model is specified as follows:

$$le_{it} = \beta_0 + \beta_1 (1/y_{it}) + \beta_2 (1/y_{it}^2) + \beta_3 G_{it} + \beta_4 \varphi_{it} + u_{it} \quad (2)$$

In the complete sample analysis, we will test whether the estimated coefficient for the interaction term between the income inequality variable and a "sample countries" dummy variable is significant. In the subsample analysis, we checked the latest Equation (2) taking into account these assumptions.

$$le_{it} = \beta_0 + \beta_1 (1/y_{it}) + \beta_2 (1/y_{it}^2) + \beta_3 \ (G * \text{"}sample\ countries\text{"}) + u_{it} \quad (3)$$

where the dummy variable "*sample countries*" equals 1 if country *i* is categorized as a member of this sample country and equals 0 otherwise.

Besides, after initial estimates of the linear one-way model, on a second scenario (two-way estimation) we use Feasible Generalized Least Squares (FGLS) estimator. Therefore, taking into account heteroscedasticity across panels and introducing temporal effects, the general linear model will be:

$$le_{it} = \beta_0 + \beta_1 (1/y_{it}) + \beta_2 (1/y_{it}^2) + \beta_3 G_{it} + d_t + u_{it} \quad (4)$$

where d_t is a time dummy variable.

Before presenting the empirical results from the estimation of the panel data models, we have performed some preliminary tests. On the one hand, some further correlation analysis would be helpful. Table 3 encloses the partial correlation coefficients showing the independent relations of income

[7] Besides, the sensitivity of the estimates in the sample used in our empirical analysis is tested, i.e. by using three different clusters or subsamples.

inequality and GDP to life expectancy among our 26 European countries.[8] That is, it contains the correlation matrix of main variables. As expected the variables considered are positively (and highly significantly) correlated with life expectancy. The Gini index is negatively correlated with both life expectancy, income and health expenditures.

[Insert Table 3]

On the other hand, because this study is based on panel data we analyse the variables involved in to ensure that there are not spurious regressions in the estimates. Furthermore, Figures 1-2 show the associations between our baseline model variables. That is, life expectancy at birth, GDP, and Gini index, respectively.

[Insert Figure1]

[Insert Figure 2]

As a common feature of first generation of panel unit root tests is that they suffer from loss of power when individual specific trends are included, second generation CIPS test which assumes cross-section dependence (Pesaran, 2007) are performed. Table 4 contains the analysis for baseline model, Equation (1), variables.

[Insert Table 4]

Taking into account lag orders p = 0, 1, 2 and 3, test indicates that in most of the cases the variables are not integrated of order 1, I(1). As indicated sample-countries is a selection of European ones due to availability data on both surveys. In order to perform the test a minimum number of observations are required.[9]

In any case, life expectancy, *GDP* and *HEXP* variables are considered in logarithms in our estimates in this study.

Results

In this section, we present the empirical findings from the estimation of the panel data model that we have described before. Equations (1-4) suggest a relationship between life expectancy at birth and a set of variables (income, Gini and control). Firstly, for the econometric estimation, standard panel data techniques are used (fixed and random effects models).

Tables 5 and 6 summarize the estimation of the baseline panel data model (1) using STATA 14. The level of explanation, as measured by R^2, is acceptable. These tables contain results for both fixed effects (FE) and random ones (RE).

[Insert Table 5]

[8] There might be multicolinearity in the model if we put some variables at the same time (i.e. income and health expenditure). This needs to be considered. That is the reason why we use different specifications when “conflict variables” go with each other that is the case between income and health expenditure. That is, from Equation (1) to Equation (2).

[9] Due to availability data countries like Czech Republic, Iceland, Latvia, Slovak Republic, Switzerland, and Turkey, are not considered here.

At this regard, we can observe that signs of income variables are those to be expected and their statistical significance is also good. However, it is important to highlight that the Gini coefficient shown is not statistically significant. Thus, greater life expectancy would not be associated with neither, lower inequality nor greater one.

In order to test the importance of these assumptions Table 6 shows the results when trying to look for differences by gender. Has the traditional gender income gap any role here? Therefore, when we focus upon the effect of socioeconomic variables on life expectancy (males and females), almost analogous results are obtained when distinguishing by gender. That is, it is not corroborate the IIH. What is more, results suggest that income inequality does not reduce health in advanced societies, as our sample.

[Insert Table 6]

Furthermore, other control variables are included in the analysis as previously indicated in order to avoid spurious regression. Hence, results from Equation (2) are summarized in Table 7 which are similar on those reported for the baseline scenario (specifications i-iii).

If we focus on the latest control variables included, no effect is found for our schooling variable (*primary*) or health expenditure one. Nonetheless, statistically significant are found for one of the ones related with supply health variables. Although there are clearly aspects of rising material living standards which contribute directly to better health even in the richest countries, these effects could not exist in international comparisons either because they are relatively small, or cause they are offset by other factors, like social status differentiation. In any case, more information is needed. Precisely, it is obtained that the number of hospital beds would have a positive effect on life expectancy, however, coefficients are low.

[Insert Table 7]

Further estimates

Given that some interest variables have been found to be important, we concisely discuss the robustness of the results presented above. Indeed, we check the sensitivity of the estimates in the sample used in our empirical analysis.

Precisely, we deal with heterogeneity across countries and focus in three main clusters/subsamples. These clusters are based on geographical location and they correspond with the welfare state typology most frequently used in public health studies (here Scandinavian versus Southern, and EU-15 versus non-EU-15).[10] These subsamples are called as follows: Nordic council: Denmark, Finland, Iceland, Norway, and Sweden; PIIGS countries: Portugal, Ireland, Italy, Greece, and Spain; EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom. Doing so, we first focus on Equation (3), at this regard Table 8 presents the results.

Thus, we can observe that signs of income variables again are those to be expected and their statistical significance is also high. The Gini coefficient shown is not significant for Nordic council sample countries and EU-15 ones. Further, it is significant for PIIGS's one. This group of countries tend to have the higher life expectancy at birth and maybe the higher Gini, so this may drive this result. In any

[10] Statistical analysis also confirms our groups.

case, the sign is positive so, greater life expectancy would be associated with greater inequality. That is, these results reject IIH.[11]

[Insert Table 8]

Furthermore, we focus on specifications (i and v), baseline and the most complete, and consider three different clusters of the 26 European selected countries. Table 9 shows the results for the different subsamples (Nordic council, PIIGS countries and EU-15).

[Insert Table 9]

Based on this analysis we should note that findings are similar to the full sample. Thus, greater life expectancy would not be associated with lower (or greater) inequality. What is more, when statistically significant, empirical results found here show, that greater life expectancy would be associated with greater inequality. Moreover, if we focus on the latest control variables considered, no effects were previously found for schooling or health expenditure variables. Here all of them are statistically significant. For all subsamples it is obtained that the number of hospital beds would have a low positive effect on life expectancy. Low results are also found for *primary* having the reverse effect for PIIGS countries. Moreover, results for health expenditure may have the reverse expected effect for Nordic council countries.

In order to have another view, after initial estimates of the linear one-way fixed effect model, we use Feasible Generalized Least Squares (FGLS) estimator, introducing temporal effects (two-way estimation), to check for the sensitivity of the results to specification problems. First of all, Table 10 contains the results for the full sample when comparing one-way with two-way estimation taking into account our baseline scenario. In addition, Table 11 shows two-way estimation results for the full sample when distinguishing by gender. Findings are similar and when significant, results found here indicate that greater life expectancy would be associated with greater inequality supporting the opposite idea of IIH.

[Insert Table 10]

[Insert Table 11]

Results in Tables 10-11 point out both a positive effect of income on life expectancy and that that greater life expectancy would be associated with greater inequality. Low effects are here obtained for the schooling and beds variables. As expected, and relation with income results, health expenditures would have a positive effect on health outcomes. We have presumed that included in our health care expenditures variable is spending on health education, and research and development, which potentially could benefit some countries. Therefore, government expenditure on health is needed for enhancing life expectancy. However, it has been previously found that not always spending more produce better outcomes. Thus, from a policy economic perspective it would be valuable to implement health policies after applying cost-effectiveness analysis. Similarly, our findings are presented by subsamples in Table 12. Besides, and to test the sensitivity to alternative measures of income inequality in the Appendix-Tables 14 and 15 the income quintile share ratio (or the S80/S20 ratio) is used as an alternative measure

[11] As income inequality can affect life expectancy but it can also affect income inequality, in Appendix Table 13 it is consider that drawback. To deal with this obstacle, we instrument for lagged variables of income inequality. The validity of instruments can be tested by the use of Sargan tests of over identifying restrictions. It can be observed estimates are similar to those on previous Tables. So that, we maintain the abovementioned results and the ones that follows.

of the inequality of income distribution. Results are somehow stable, but no statistically significant effects are obtained for the S80/S20 ratio when subsamples of countries are considered.

[Insert Table 12]

Thus, when we analyse different subsamples, significant expected effects are only observed for Nordic-council countries. Nonetheless, representative is lower for these countries. Therefore, previous discussed results are maintained for the remaining sample. All in all, empirical results from our sample indicate that income inequality does not reduce population health, supporting the opposite idea of IIH.

Conclusions

As income inequality can be harmful for population health, in recent years there has been a bulk of academic evidence on this field. One of the main issues is related to the IIH where there is still now an open debate. As previously suggested, one possible explanation for this is that the hypothesis has been tested with different methods and data sets. Nevertheless, there is no a general agreement about it.

Here, the aim of this paper was to contribute to support new evidence on the relationship between income inequality and life expectancy at birth for 26 European countries during the period 1995-2014. Precisely, we focus the analysis on life expectancy at birth, because it is a common used indicator in order to measure health status. Our empirical results do not support the negative influence of income inequality on health indicators using aggregate data. Indeed, results for the full sample are compared within three clusters of the 26 European selected countries (Nordic council, PIIGS countries, and EU-15). That is, our findings (IIH is not supported) are in accordance with those which point out material interpretations (Mackenbach, 2002; Wilkinson & Pickett, 2006; Zagorski *et al.*, 2014). Therefore, as was also previously supported directing policies and resources towards inequality reduction is unlikely to benefit the general public in advanced societies, either because there are not significant effects, or because they could be positive.

Besides, our results reported here may be interpreted in light of some restrictions. Mainly, because we have analysed data for a selected group of European countries only, results could not be directly extrapolated to other sample countries, like lower income ones. Moreover, we have not adjusted for national differences or their healthcare system model (National Health Service, Social Security Social model, mixed or private system), neither did we adjust for factors such political ideology, which may influence health objectives and outcomes but is beyond the scope of this empirical paper. In addition, during the 21-year period under this analysis, it covers the period of Great Recession. Despite the fact, the crisis has affected these countries in different ways, almost all of them are suffering financial problems. All in all, we have focused on the (possible) direct relationship between health outcomes and income. Indirect associations of income and income inequality on health outcomes through different channels, in spite they are beyond the scope of this study, should be bear in mind.

Overall, our paper has some drawbacks that should be mentioned. On the one hand, as most evidence does, we only apply in the principal text one inequality measure, the Gini coefficient (the S80/S20 ratio is used as an alternative measure of the inequality of income distribution in the Appendix). On the other hand, we develop our analysis only at the macro-level. In addition, our models could have more observations (but we have 26 European selected countries) and years (21-year period) we are considering), by using regions instead of countries. All these limitations could be addressed in future research when more data on health and economic references would be available.

Nonetheless, we speculate that if income inequality continues up to now, adequate health care policies should better understand how income in general, and inequality in particular, could influence in order to apply a correct allocation of resources. In fact, there is explicit acknowledgment regarding the political and economic processes that generate income inequality which influence population outcomes. Besides, individual resources could also have indirect results on public resources or generally, social welfare (health care, labor market or schooling). All in all, different strategies would be needed in order to reduce health inequalities, both in rich and poor countries along this century. Thus, further evidence is still needed.

Appendix

See Tables 13, 14 and 15.

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Tables and Figures legends

Table 1 Variables and definitions

Variable	*Definition*	*Source*
le le females le males	Life expectancy (years), dependent variable	OECD Health Statistics
GDP	Gross Domestic Product, per capita, US$ Purchasing Power Parity (PPPs)	OECD Health Statistics
Gini	Gini coefficient of equalized disposable income - EU-SILC survey	Eurostat
Primary	Primary school enrollment[a]	World Bank data indicators
HEXP	Health care expenditure (total), per capita, constant prices, constant PPPs, OECD base year	OECD Health Statistics
BEDS	Total hospital beds, number	OECD Health Statistics

Source: Authors' elaboration.

[a]Primary education provides children with basic reading, writing, and mathematics skills along.

Table 2 Variables and summary statistics - 26 selected European countries (1995-2014)

Variable	*Mean*	*Standard deviation*	*Minimum*	*Maximum*	*Observations*
le	78.043	3.156	67.900	83.300	513
le females	81.125	2.650	71.300	86.200	513
le males	74.908	3.811	61.400	81.600	513
GDP	29579.420	14336.480	5960.300	98459.500	520
Gini	0.292	0.045	0.200	0.460	394
Primary	102.411	4.881	85.98	123.21	497
HEXP	2771.018	1358.828	265.181	6451.660	514
BEDS	112714.600	164092.800	1038.000	790756.000	461

Source: Authors' elaboration.

Table 3 Correlation matrix of main variables

	le		*GDP*		*Gini*		*Primary*		*HEXP*		*BEDS*
le	1.000										
GDP	0.720	***	1.000								
Gini	-0.258	***	-0.341	***	1.000						
Primary	0.205	***	0.038		0.206	***	1.000				
HEXP	0.777	***	0.911	***	-0.425	***	0.118	***	1.000		
BEDS	0.137	***	-0.039		0.063		0.142	**	0.093	**	1.000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations.

Table 4 Second generation CIPS test: Pesaran (2007) for baseline model

Variable	INTERCEPT ONLY			
	number of lags			
	0	*1*	*2*	*3*
le	1.185	2.588	9.457	13.688
GDP	1.678	3.197	6.971	13.694
Gini	0.403	3.205	7.029	14.166
Variable	INTERCEPT and TREND			
	number of lags			
	0	*1*	*2*	*3*
le	-3.208 ***	0.360	7.258	17.059
GDP	1.555	1.860	7.716	16.241
Gini	0.095	2.678	8.006	17.059

Null hypothesis CIPS: series are I(1). ***, **, *and* * *denote significant at 1%, 5%, and 10%.*
Source: Authors' calculations.

Table 5 Results Panel data approach, dependent variable: life expectancy at birth (total population)

Specification/ Variable	(i)		(ii)		(iii)	
	RE	*FE*	*RE*	*FE*	*RE*	*FE*
(1/*GDP*)	-7.067 ***	-7.059 ***	-27.152 ***	-27.872 ***	-32.682 ***	-34.179 ***
$(1/GDP)^2$			99.479 ***	103.074 ***	125.452 ***	132.992 ***
Gini					0.010	0.006
constant	5.0507 ***	5.0505 ***	6.061 ***	6.098 ***	6.350 ***	6.427 ***
Observations	513		513		393	
R^2	0.742	0.742	0.716	0.715	0.564	0.561
Hausman test result	RE		FE		FE	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. FE: Fixed Effects. RE: Random Effects.
Source: Authors' calculations.

Table 6 Results Panel data approach, dependent variable: life expectancy at birth (males and females)

Variables	Males				Females			
	RE		*FE*		*RE*		*FE*	
(1/*GDP*)	-47.668	***	-48.997	***	-18.617	***	-19.908	***
$(1/GDP)^2$	193.482	***	200.236	***	61.291	***	67.725	***
Gini	0.001	**	-0.003		0.013		0.010	
constant	7.125	***	7.193	***	5.627	***	5.694	***
Observations	393				393			
R^2	0.563		0.561		0.492		0.490	
Hausman test result	FE				FE			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. FE: Fixed Effects. RE: Random Effects.
Source: Authors' calculations.

Table 7 Extended results panel data approach, dependent variable: life expectancy at birth (total population)

Specification/ Variable	(i)				(ii)				(iii)				(iv)				(v)			
	RE		*FE*		*RE*		*FE*		*RE*		*FE*		*RE*		*FE*		*RE*		*FE*	
(1/GDP)	-7.067	***	-7.059	***	-27.152	***	-27.872	***	-32.682	***	-34.179	***	-32.161	***	-33.787	***	-26.641	***	-27.520	***
$(1/GDP)^2$					99.479	***	103.074	***	125.452	***	132.992	***	123.099	***	131.272	***	96.384	***	100.770	***
Gini									0.010		0.006		0.001		-0.004		0.007		-0.016	
primary													$0.006*10^{-2}$		$0.002*10^{-2}$		$0.008*10^{-2}$		$-0.001*10^{-2}$	
health expenditure																	0.003		-0.001	
beds																	$-0.003*10^{-5}$	**	$-0.001*10^{-4}$	***
constant	5.0507	***	5.0505	***	6.061	***	6.098	***	6.350	***	6.427	***	6.318	***	6.406	***	6.014	***	6.111	***
Observations	513				513				393				374				350			
R^2	0.742		0.742		0.716		0.715		0.564		0.561		0.569		0.565		0.555		0.341	
Hausman test result	RE				FE				FE				FE				FE			

*** *$p < 0.01$*, ** *$p < 0.05$*, * *$p < 0.10$.*

Source: Authors' calculations.

Table 8 Sensitivity to alternative samples, dependent variable: life expectancy at birth (total population)

Variables	*RE*		*FE*	
(1/*GDP*)	-33.116	***	-35.132	***
$(1/GDP)^2$	127.443	***	137.399	***
Gini* Nordic council	0.019		0.018	
Gini* PIIGS countries	0.092	**	0.132	*
Gini* EU-15	-0.002		-0.036	
constant	6.370	***	6.475	***
Observations	393			
R^2	0.674		0.633	
Hausman test result	RE			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. FE: Fixed Effects. RE: Random Effects.
Source: Authors' calculations.

Table 9 Sensitivity to alternative subsamples of countries, dependent variable: life expectancy at birth (total population)

	Nordic council		PIIGS countries		EU-15	
Variables/Specification	(i)	(v)	(i)	(v)	(i)	(v)
(1/GDP)	-14.578	72.035 **	-49.807 ***	-53.083 ***	-29.738 ***	-34.070 ***
$(1/GDP)^2$	35.982	-453.503 ***	209.646 **	235.722 ***	110.005 ***	138.800 ***
Gini	0.033	-0.094	0.122 *	0.115 **	0.008	-0.030
primary		0.001 ***		-0.002 ***		$-0.004*10^{-1}$ ***
health expenditure		-0.093 ***		0.019 **		0.010 *
beds		$-0.001*10^{-3}$ ***		$-0.001*10^{-4}$ ***		$-0.001*10^{-4}$ ***
constant	5.434 ***	2.313	7.204 ***	7.324 ***	6.216 ***	6.370 ***
Observations	72	63	93	87	271	237
R^2	0.528	0.789	0.469	0.301	0.313	0.141
Hausman test result	RE	RE	FE	FE	FE	FE

*** *p < 0.01*, ** *p < 0.05*, * *p < 0.10*. FE: Fixed Effects. RE: Random Effects.
Source: Authors' calculations.

Table 10 Results FGLS approach, dependent variable: life expectancy (total population)

Variables/Specification	(i)				(v)			
	one-way estimation		*two-way estimation*		*one-way estimation*		*two-way estimation*	
(1/GDP)	31.701	***	43.401	***	42.809	***	64.109	***
$(1/GDP)^2$	-201.738	***	-256.396	***	-239.505	***	-323.170	***
Gini	0.108	***	0.101	***	0.144	***	0.165	***
primary					$0.001*10^{-1}$		$-0.004*10^{-1}$	***
health expenditure					0.038	***	0.069	***
beds					$0.002*10^{-6}$		$-0.001*10^{-5}$	
constant	3.161	***	2.536	***	2.116	***	0.637	***
Observations	393				350			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations.

Table 11 Results FGLS approach two-way estimation, dependent variable: life expectancy (males and females)

Variables/Specification	(i)				(v)			
	Males		Females		Males		Females	
(1/GDP)	34.178	***	42.151	***	66.854	***	49.484	***
$(1/GDP)^2$	-222.358	***	-237.602	***	-355.016	***	-244.853	***
Gini	0.202	***	0.054	***	0.231	***	0.118	***
primary					$-0.003*10^{-1}$	**	$-0.004*10^{-1}$	***
health expenditure					0.063	***	0.052	***
beds					$-0.001*10^{-5}$	*	$-0.001*10^{-5}$	
constant	3.048	***	2.528	***	0.652		1.486	***
Observations	393				350			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations.

Table 12 Results FGLS approach two-way estimation, sensitivity to alternative subsamples of countries, dependent variable: life expectancy at birth (total population)

Variables/Specification	Nordic council		PIIGS countries		EU-15	
	(i)	(v)	(i)	(v)	(i)	(v)
(1/GDP)	141.907***	164.235***	80.354***	-67.755***	-10.155	2.504
$(1/GDP)^2$	-775.237***	-969.085***	-401.537	357.686***	54.590	-11.284
Gini	-0.143**	-0.114**	-0.478***	0.013	-0.008	0.036
primary		0.001***		-0.001***		-0.001***
health expenditure		-0.131****		0.014**		0.007
beds		0.000****		0.000***		0.000***
constant	-2.096	-1.495	0.496	7.518***	4.816***	4.204***
Observations	72	63	93	87	271	237

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations.

Figure1 Life expectancy at birth (total population) and GDP in 26 selected European countries (1995-2014)

Source: Authors' elaboration based on OECD Health Statistics.

Figure2 Life expectancy at birth (total population) and Gini index in 26 selected European countries (1995-2014)

Source: Authors' elaboration on OECD Health Statistics and Eurostat.