The link between social inequalities, health' system characteristics and R&D expenditure- worldwide evidence

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ABSTRACT:

The aim of this paper is to analyze the link between social inequality, measured by GINI index, health systems characteristics and R&D expenditure and to provide worldwide evidence. An undeveloped health system can have a negative impact on health status, can determine both the decrease of work capacity and earnings and can generate the increase of social inequality level measured by GINI index.

This paper analyses and measures the correlation between GINI Index and the number of infant deaths, health work force density, health infrastructure and research and development expenditures from GDP The analysis was conducted using data and information from World Bank and World Health Organization. The used sample included all the observations that had available data. Depending on the number of observations that we have, we used panel data model or linear regression models. The results confirms our assumptions that high levels of GINI Index can be reduced through the increase of health work force density and through a high level of allocation from GDP for research and development expenditure Moreover, GINI index is positively related with the need of health infrastructure and the number of infants deaths. For future research, higher attention should be paid for the causality relations between immigration control, health resources and social inequalities, aspects that could determine macroeconomic imbalances at the world level.

Key-words*: social equity, health system, GINI Index, infant deaths, health work force density, R&D expenditure*

JEL Classification*:A13, I14, I15, I18, D60*

1. INTRODUCTION

The global finances crisis impacted the economy at all levels, including the education and health sector. An important role in launching the economy was attributed to IMF (IMF, 2016) as it increased its financial power and agreed with large borrowing agreements. Moreover, the IMF undertook reform policies towards low income countries and increased the resources for concessional lending up to four times. The International Monetary Fund provided policy advices and risk analysis in order to help member countries to deal with the economic crisis. After the crisis, the IMF implemented major initiatives that deal with strengthening and surveillance requirements adapted to a more interlinked world. For emerging countries, the IMF agreed with several government reforms that help them launching the economy, while the underdeveloped countries remained under its influence. This behavior is in accordance with IMF's old policy (starting from 1999) that states that its aimed is to reduce the poverty level and to ensure growing facilities for underdeveloped and developing states (Androniceanu, Ohanyan, 2016).

Several studies such as the ones conducted by Bruno, Ravallion and Squire (1998), or Adams (2002) found both that there is a negative relationship between poverty growth and the mean income growth and that there is no statistically significant relationship between economic growth and income inequality. Moreover, Dagdeviren,Van der Hoeven and Weeks (2002) considers that economic growth is not the best way to reduce poverty and that it should be mixed with income redistribution in order to decrease the level of poverty. In the same time, redistribution policy effects depend on the characteristics of the developing country.

From a multidimensional approach, the income is a measure though which human capabilities can be achieved, including things like probability of living a healthy and a long life (Sen, 1999). As a consequence, the most important commitments that states have to achieve are the increase of human capital (Jakubowska, 2016) and the release of long term economic growth though the development of both national healthcare system and the educational one (Androniceanu, Ohanyan, 2016).

At global level, healthcare poverty and social inequality are one of the biggest concerns that people have. On one hand, the competitiveness between countries is based on improving the quality of human capital (Balcerzak, 2016) by increasing the accessibility to higher education and healthcare systems for all social categories (Androniceanu, 2015b). Thus,the competitiveness between countries looks at ensuring proper living conditions like lower unemployment, higher productivity, real knowledge of income indicators

(Bayar, 2016). According to Hayes et. all (1994), there is a bi-directional relationship between labor productivity and poverty, as poverty reduces the ability of people to become more productive, while rising productivity growth is associated with decreasing poverty growth.

At European level, the 2020 Strategy is based on fighting with poverty and social exclusion. At the end of 2020, the goal is to have with at least 20 million fewer people that are supposed to risk of poverty and social exclusion. According to Androniceanu (2015a), the goals are related with reducing extreme poverty and reducing child mortality. Moreover, at EU-28 level, the risk of poverty increases by 4% for people who have health problems compared with persons that do not have such problems (Jakubowska, 2016). As a consequence, eHealth Action Plan 2012-2020 was implemented and aims to prevent multi-morbidity and to ensure the sustainability of health systems in Europe (Kautsch, 2016).

Considering these, the aim of this paper is to reveal the link between several factors such as infant deaths, health infrastructure, health work force density and research and development expenditure as a percentage of GDP with GINI index, the measure for social inequality. The research is based on four hypotheses of research

- H1. Higher value of GINI index is, higher the value of infant deaths is.
- H2 Higher the value GINI index is, higher the need for health infrastructure is
- H3 Higher the health work force density is, lower the value of GINI Index is
- H4. Higher the expenditures for R&D are, lower the value of GINI Index is.

The structure of the paper is divided in several sections: the first one looks at the literature review, the second one deals with data collection and the used methodology, the third one presents the results and the discussion of them, while the last one presents the conclusions, reveals the problem of research and provides future research ideas.

2. LITERATURE REVIEW

One of the major problems that the global economy has is dealing with income inequality. The literature in the field reveals that an important factor of income inequality comes with the increase of mortality at all levels, without depending on the level of income per capita (Lynch et al., 1998). According to Kennedy at al (1996), there is a positive relationship between the level of total mortality and the value of Robin Hood index or the value of GINI index (as a measure of poverty or income inequality). That means that when the index increases, the level of total mortality also increases. Similar conclusions were found by Leiyu Shi et al. (2003). Using a weighted multivariate regression, they reveal that income inequalities, measured by the GINI index and by Robin Hood index, are significantly associated with all-causes of mortality. Moreover, Kawachi et al. (1997) provided evidence that income inequality is correlated with social trust and with group membership that were affected by total mortality rate, including infant mortality. A negative correlation between GINI index and infant mortality only exists in the case children are early registered to certain forms of education (Deaton, 2003)

New evidence emphasizes that there is a link between income inequalities, life expectancy and specific causes of high mortality. According to Yannan, Frank, Mackenbach, 2015), higher the mortality is, higher the inequality in terms of income is.

It can be emphasized that inequality appears especially in areas with high concentration of poverty, in specific environments where the quality of living is low and where the level of infant mortality is high (Szwarcwald et al 2002). Consequently, by improving the aspects of the health care system, the negative effects of social inequities on the health of the population can be offset (Macinko, et al., 2004).

One feature of the healthcare system is related with health infrastructure. The development of public networks that provide health facilities is not enough to sustain and to ensure equity regarding the access of individuals to healthcare services (Valdivia, 2002). Hospital's infrastructure can be strengthened by equitable distribution of resources and healthcare services (Starfield, Leiyu Shi, 2002). On the other hand, unequal expenditures for healthcare, including infrastructure and health work force, can generate gaps between rural and urban areas and can affect vulnerable groups (Zare et al., 2013). This is why rethinking the ways of financing health systems can restore the social equity. As a fact, the costs involved for isolated areas that do not provide medical care should be reconsidered (Botman, Porter, 2008) together with the increase the population's access to health insurance scheme (Acosta, 2014).

Moreover, the inequality regarding the access to health care services, with or without income inequalities, negatively affects individual health and weakens the economic growth (Grimm, 2011, Kondo, 2012) as macroeconomic differences have impact on living standards (Rodriguez-Pose, Maslauskaite, 2011).

On the other hand, the increase of national wealth is linked with high or improved health status. According to Suhrcke et al. (2005), Grossman made the first distinction between health as a commodity that has utility for individuals and health as a capital good which contribute to the development of activities on the economic market. As a fact, the existence of good health status increases the work productivity, and thus, human capital performance (Muhamamad, 2010). Opposite to this, the deterioration of health because of the reduction of income leads to an increase in the rate of illnesses and to an increase in the rate of mortality that society has (Peykarjou et al., 2011).

Considering the fact that healthcare system is a major sector that has long-term effects on personnel and on local economies (Kabajulizi, 2016), it is important to establish the relationship between health system and economy, at macroeconomic level. According to Bloom, Canning (2008), although not a direct effect on the economy was detected, the values associated with health reflect economic stability. Moreover, poor health affects the dynamics of savings, while the increase of saving levels allows their use for the purpose of medical care when retirement comes (Chovancova et al., 2015) and for the purpose to reduce the risk of aging early (Popescu, Dumitrescu, 2016).

The investment in health is an instrument of macroeconomic policy that reduces economic disparities and social inequalities (Aguayo Rico, et al, 2005). The reanalysis of research and development systems (Paunica et al, 2009) and the investments in research provide not only economic and social benefits but also determine the increases of quality of life and reduce the mortality. (MRC, 2011). For example, in countries where certain facilities exists for the investors, there is a high level of quality of life. (Belas et al., 2015)

3. DATA AND METHODOLOGY OF THE RESEARCH

The variables used in this analysis, were selected both from the online database of the World Bank and World Health Organization. They were included into regression models (linear or panel ones) and are presented in brief in Table 1.

The Variables Used in the Conducted Analysis

Table 1

Variable	Meaning	Data source
1.Gini index (poverty and equity	Measures the extent to which income distribution (or in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. It looks at poverty and income distribution	World Bank
2.Infant deaths	Measures the magnitude of child mortality.	World Health Organization- Global Health Observatory
3.Health infrastructure	Measures the number of medical units per 100.000 inhabitants;	World Bank
4. Health work force density	Measures Health workforce density per 1000 inhabitants.	World Health Organization
5. Research and development expediture (% of GDP) - R&D	Represents current capital expenditures (both public and private sources) for research and development used for increasing the level of new knowledge and the usage of new applications.	World Bank – UNESCO

We used the five indicators in order to reveal the link between poverty, measured by GINI index and health characteristics like the number of infants deaths, the value of health infrastructure and the value of health work force. Moreover, we looked at the relationship between GINI index and the research and development expenditure as a percentage from GDP. The data was collected from 2010 and 2013 for all countries that have available information. The selection was made from more than 100 countries that reported data on World Health Organization and on World Bank, by applying VLOOKUP function on data contained in Excel. The variables included into the analysis are presented in Table 2.

The Variables' Definition

Table 2

Variable	Explanation
GINI Index	The value of GINI Index is between 0- that means perfect equality and 100 that implies perfect inequality. It measures relative and not absolute welfare, worldwide. There are particular cases when GINI index of a developed country increases, while the number of population that lives in absolute poverty decreases. Even though World Bank have information regarding the income distribution for all the states that provided the data, it displays poverty level only for low and middle income countries that are eligible to receive loans from the World Bank. In general, income distribution is more unequal than the distribution of consumption. GINI Index provides a summary regarding acceptable degree of inequality worldwide
Total number of infant deaths	The number of infant deaths (expressed in thousands) before reaching the age of five and the number of infant deaths (expressed in thousands) before reaching the age of one
Number infant deaths under-five	The number of infant deaths (expressed in thousands) before reaching the age of five
Number infant deaths under-one	The number of infant deaths (expressed in thousands) before reaching the age of one
Total Health infrastructure	The value of care units per 100000 inhabitants worldwide composed of: the number of hospitals per 100000 inhabitants, the number of health centers per 100000 inhabitants, the number of health posts per 100000 inhabitants, the number of rural hospitals 100000 inhabitants, the number of provincial hospitals per 100000 inhabitants, the number of specialized hospitals that provide care to 100000 inhabitants;
Total health work force density	The value of health work force density per 1000 people composed of: physicians density per 1000 population, nursing and midwifery personnel density per 1000 population, dentistry personnel density per 1000 population, pharmaceutical personnel density per 1000 population, laboratory health workers density per 1000 population, Laboratory health workers density per 1000 population, environmental and public health workers density per 1000 population, community and traditional health workers density per 1000 population, Other health workers density per 1000 population, Health management and support workers density per 1000 population
Total R&D Expenditures (% of GDP)	The research and development expenditure that a country has as a percentage from GDP

In order to conduct the analysis and to reveal the impact of healthcare system characteristics on social inequality and the influence of R&D expenditure on social inequality, we provided descriptive statistics of the variables included into the analysis, revealing their maximum and their minimum level. We conducted Granger test in order to provide evidence on the direction of correlation, if inequality influences healthcare system characteristics and R&D expenditure or if healthcare system characteristics and R&D expenditure impacts the social inequality. The method of estimation was both panel data models and linear regression, depending on the available information. As a fact, if the data was found for more than one year (without gaps between the beginning period and the ending one), the panel model was used. The model was tested for fixed effects and random effects. The selection between them was based on Hausman Test, while the selection between random and pooled model was realized considering the statistically significance of the coefficients of variables included into the analysis. Otherwise, if gaps between the beginning period and the ending one were detected, the simple linear regression model was used. This is the main reason why the dimension of the samples varies from one analysis to another and why the panel model analysis is conducted on 2010-2013 and the regression model analysis is conducted on 2010 or 2013. The independent variable was chosen based on the Granger test. The analysis was conducted using Eviews 7.0.

The aim of the paper was to reveal what the relationship between social inequality and healthcare system characteristics is and if R&D expenditures can affect the value of Social inequality. In order to conduct this analysis, we restate the hypothesis of research.

H1. Higher the value of GINI index is, higher the value of infant deaths is.

H2. Higher the value GINI index is, higher the need for health infrastructure is

H3. Higher the health work force density is, lower the value of GINI Index is

H4. Higher the expenditures for R&D are lower the value of GINI Index is.

4. ANALYSIS OF THE RESULTS

The purpose of this research was to provide evidence on the correlation of social inequality with health system characteristics and with research and development expenditure. In order to conduct this analysis, we reveal the highest values and the lowest values of the variables included. It has to be mentioned that for each variable the highest or the lowest values were presented according the worst situation. For example, for infant deaths is worst to have a highest number, while for health work force density is worst to have lowest values. As the dataset is different base on the available information, we decided to present two summaries, the first one being related with 2010 and the second one revealing with 2013. The sample included consists of all countries that reported data on the analyzed period of time.

In Table 3 it can be seen the top ten states with the highest values for GINI Index, the values being reported at the end of 2010. Therefore, for Zambia the GINI index has the highest value (55.62), followed by Colombia (55.5) and Lesotho (54.18).It should be noted that the values for the GINI Index should be as small as possible to reflect an acceptable level of social justice among individuals. If the GINI Index has a high value and close to 100, this means the wealth is low and the incomes are unequal distributed.

Regarding the number of Infants Deaths, at the end of 2010, Nigeria has the highest value (513), followed by Pakistan (383) and Democratic Republic of the Congo (238). In terms of economic significance, it can be said that higher the number of infant deaths is, lower is the equality between individuals and higher is the discrepancy considering their living conditions.

The third variable: health infrastructure has alarming values when they are really small. The lowest values were detected for Democratic Republic of the Congo (0.46), Malaysia (0.48) and Haiti (0.55). We consider that lower health infrastructure could be correlated with higher values for infants deaths lower values of health work force density that leads to poverty and social inequalities between individuals.

When we look at Health work force density we concluded that there are still countries where the density of medical force is less than 1 per 1000 inhabitants. The smallest values at the end of 2010 were recorded in Saint Lucia (0.167), Sierra Leone (0.398) and Afghanistan (0,561)

Worst Values for the Analyzed Variables at the End of 2010

Tabel 3

Top 10 highest values at the end of 2010		Top lowest values at the end of 2010	
GINI index	**Infants deaths**	**Health infrastructure**	**Health work force density**
Zambia (55.62)	Nigeria (513)	Democratic Republic of the Congo (0.46)	Saint Lucia (0.167)
Colombia (55.5)	Pakistan (383)	Malaysia (0.48)	Sierra Leone (0.398)
Lesotho (54.18)	Democratic Republic of the Congo (238)	Haiti (0.55)	Afghanistan (0,561)
Honduras (53.39)	India (235)	Israel (0.59)	Mozambique (0.575)
Panama (51.91)	China (216)	Jamaica (0.76)	Nauru (0.714)
Paraguay (51.83)	Ethiopia (150)	Netherlands (0.77)	Cape Verde (0.919)
Rwanda (51.34)	Indonesia (127)	Poland (0.94)	Iraq (0.929)
Guinea-Bissau (50.66)	Bangladesh (123)	Saudi Arabia (1.09)	Burkina Faso (0.974)
Ecuador (49.25)	Angola (108)	Luxembourg (1.19)	Ghana (1.022)
Mexico (48.13)	Afghanistan (82)	Sierra Leone (1.26)	Kenya (1.047)

Source: authors ‘computation on available data

In order to conduct a comparison between the values registered in 2010 and the values registered in 2013, we decided to present the highest values, respectively the lowest values also for 2013, based on their worst values. The data is presented in Table 4. The idea is to detect if countries with worst conditions have improved their situation or not.

Worst Values for the Analyzed Variables at the End of 2013

Table 4

Top 10 highest values at the end of 2010		Top lowest values at the end of 2010	
GINI index	**Infants deaths**	**Health infrastructure**	**Health work force density**
Honduras (53.67)	Pakistan (369)	Haiti (0.77)	Portugal (0.76)
Colombia (53.49)	Democratic Republic of the Congo (234)	Democratic Republic of the Congo (0.9)	Afghanistan (0.792)
Brazil (52.87)	Ethiopia (136)	Malaysia (0.94)	Kenya (1.135)
Panama (51.67)	Indonesia (129)	Israel (1.13)	Vietnam (2.426)
Chile (50.45)	Bangladesh (106)	Sierra Leone (1.21)	Costa Rica (2.498)
Costa Rica (49.18)	Afghanistan (72)	Jamaica (1.51)	Ireland (2.67)
Paraguay (48.3)	Uganda (63)	Netherlands (1.52)	Oman (3.334)
Bolivia (48.06)	Sudan (62)	Egypt (1.87)	Argentina (3.859)
Ecuador (47.29)	Kenya, Cote d'Ivoire Egypt (56)	Poland (1.88)	Georgia (4.411)
Dominican Republic (47.07)	Mali (55)	Saudi Arabia (2.08)	Nicaragua (5.152)

Source: authors 'computation on available data

From Table 4, we can observe that in 2010 the values of the indicators are worst then the values found in 2013. This could reveal that states are trying to improve the living conditions of their citizen, are trying to improve the level of health that the country has and moreover, are promoting fiscal and budgetary policies in order to re-launch the health sector. According to the data presented, it can be seen that we have in both statistics countries that have high value of GINI index (high level of inequality between individuals) like Ecuador, Colombia or Honduras. Similar results are found when the number of infant deaths exists. For example, Democratic Republic of the Congo, Pakistan, Ethiopia, Bangladesh have a high number of infant deaths both in 2010 and 2013.

When the lowest values are analyzed, we observed that for the health infrastructure among the top ten there is Democratic Republic of the Congo, Haiti, Israel, Jamaica. Important discrepancies could be found when the information about health work force is disseminated as there seems to be other countries that registered lowest values in health work force density. One explanation is based on the fact that there are only 33 world countries that reported data on the value of health work force

The statistics presented in Table 4 are related with all the available information that we had. However, the number of countries included into the analysis could be different as information for all the variables included was necessary.

In order to see if the reveal what the relationship between social inequality and healthcare system characteristics is, we conducted several analyzed considering both the regression model and the panel data model (when available information exists). The idea was to conduct additional analysis with the purpose of making the results trustworthy.

Descriptive Statistics, Correlation Between GINI Index & Infant Deaths, 2010-2013

Table 5

Common sample		
	GINI Index	Infant deaths
Mean	39.184	5.6667
Median	39.4	3
Maximum	57.4	42
Minimum	24.55	1
Std. Dev.	9.2782	6.8747
Skewness	0.1329	3.0850
Kurtosis	1.7792	15.2582
Jarque-Bera	6.8294	823.9677
Probability	0.03288	0
Observations	105	105

Data source: authors ‘computation on available data

As we observe in Table 5, the minimum value for GINI index at world level for the years 2010-2013 it was 24.55 (in Ukraine, in 2011) and the maximum value is 57.4 (in Honduras, both in 2011 and 2012). In terms of standard deviation, if its value is lower than the analyzed values are grouped around the mean. In our case, we consider that the dataset values are more clustered around the mean value, respectively 39.184. As regarding Skewness and Kurtosis, indicators that concern normal distribution, we can conclude that the distribution is not normal as the difference between them is not 3. The relationship between GINI index and the number of infant deaths is presented in Table 6. Based on the Granger test, the GINI index does Granger Cause Infant Deaths.

Model of Relationship Between GINI Index & Infant Deaths 2010-2013

Table 6

Dependent variable log(infant_deaths)	
Variables	Coefficient
Constant	0.3676 (p=0.3799)
GINI INDEX	**0.0219 ****
Quality of the model indicators	
R squared	4.21%
F statistic and probability	4.5380**
DW	0.0008
Fixed effect cross sectional	525.16**
Fixed effect period	0.6416 (p=0.59)
Random effect cross sectional	1.4575 (0.2273)
Random efect period	1.2718 (0.2594)
Number of obs	105
Cross sectional included	33

Data source: authors 'computation,
Where ** shows the significance threshold at 5%

The results from Table 6 reveal that there is a positive correlation between the value of GINI index and the number of infant deaths. The higher the value of GINI Index is, the higher the value of infant deaths is. This aspect is economically relevant, taking into account that higher the GINI Index is, higher the inequity between individuals is. Thus, the discrepancy between the rich people and the poor people increases having a negatively impact on the number of infant deaths (the living condition are harder for poor people). For example, if we consider the median of infants deaths 3 than an increase in GINI generates an increase in the number of infant deaths with 0.0219%. In this case, the null hypothesis is rejected because the probability of rejecting the null hypothesis (That the value of the coefficient is not statistically different from zero) is under 5%. Regarding the constant term, it is not statistically significant as its coefficient probability is higher than 10% (0.3799). R-squared illustrates the fraction of the variation of dependent variable that is explained by the independent variable. Regarding F statistic, this is 4.5380 and its probability is below the tested significance threshold (the model is valid) D.W shows that there are evidences of positive serial correlation of the residuals, but they cannot be corrected due to the lower number of years on which the analysis was conducted The results provide evidence that H1 is confirmed.

As the data that we have were different for each indicator and as the panel analysis was not possible for testing the hypotheses H2-H4, we tried to demonstrate their relevance by conducting linear regression on 2010 or 2013 based on where we have larger observations. In Table 7 the descriptive statistics of the variables that are in relationship with GINI are presented for year 2010.

Descriptive Statistics for 2010

Table 7

Common sample	Correlation between GINI index and health infrastructure		Correlation between GINI index and health work force density		Correlation between GINI index and R&D expenditure	
Element	GINI Index	Heath Infrastructure	GINI Index	Health work force density	GINI Index	R&D Expenditures
Mean	36.3542	26.395	36.1937	8.3348	34.667	1.1827
Median	33.55	12.94	33.76	7.382	33.21	0.7640
Maximum	55.62	230.81	55.62	27.58	55.5	3.9299
Minimum	24.94	0.59	26.43	1.094	24.82	0.0672
Std. Dev.	8.1564	41.2413	7.9281	6.2318	7.1574	0.9849
Skewness	0.7890	3.0220	1.1621	1.2349	1.0416	1.0423
Kurtosis	2.4221	13.2838	3.4943	4.3389	3.4976	3.2806
Jarque-Bera	6.5908	332.0079	8.2351	11.5117	10.3229	9.9547
Probability	0.0370	0	0.0162	0.0031	0.0057	0.0068
Observations	56	56	35	35	54	54

Data Source: authors ‘computation

From Table 7 we can observe that the number of observation differs from one situation to another. For example, when the GINI index is considered, we can see that its minimum and maximum values differ from one scenario to another. For example, in the first case, the maximum level is 55.62 and is associated to Zambia, while for the third scenario the maximum value is 55.5 and is associated for Colombia. Regarding the minimum values, less inequality, we have Slovenia with 24.94, Iceland with 26.43 and Ukraine with 24.82.

When health infrastructure is analysed, we observed that the minimum and maximum values are found in Israel with 0.59 units per 100000 inhabitants and in Czech Republic.

In terms of minimum and maximum values for health work force density, the maximum is 27 doctors per 1,000 inhabitants for Iceland and 1 doctor per 1,000 inhabitants is for Cambodia

Regarding the minimum and maximum values for expenditures for research and development (% of GDP) at the world level, the maximum is 3.92% and the minimum is 0.06%.

For all the scenarios, the distribution is not normal.

Based on the data presented in Table 7, we conducted regression analysis using Eviews 7.0. The dependent and independent variables were established considering the Granger cause test. The results are presented in Table 8

MODEL OF THE RELATIONSHIP FOR 2010

Table 8

Common sample	Between GINI index and health infrastructure	Between GINI index and health work force density	Between GINI index and R&D expenditure
Dependent variable	Health infrastructure	GINI index	GINI index
	Coefficient	Coefficient	Coefficient
Constant	-26.7284 (p=0.2808)	41.7520***	37.3330***
Independent variable	GINI index **1.4612****	Health work force density **-0.6668*****	R& D expenditure **-2.2534****
Quality of the model indicators			
R squared	8.35%	27.47%	9.61%
F statistic and probability	4.9211**	12.5034***	5.5324**
DW	1.83	2.001	1.66
Heteroscedasticity	No	yes, corrected with covariance White matrix	yes, corrected with covariance matrix White
Normality	No	Almost	Almost

Data Source: authors ‘computation

Where ***, ** shows the significance threshold at 1% and 5%

The results presented in Table 8 reveal a positive correlation between GINI Index and Health infrastructure. Higher the GINI index is, higher the need for health infrastructure is. We interpret the results in the sense that the level of poverty at the world level it is influenced by the limited access of the population to the health care services because of underdeveloped infrastructure. Considering that, an increase of 1 for GINI Index determines an increase with 1.4612 of the need of total health infrastructure at world level. The coefficient is statistically significant at a threshold of 5%. The model is statistically significant and about 8.35% of health infrastructure is due to the value of GINI index and there is almost no correlation between residuals (the value of DW is 1.83) Based on these, a relationship between GINI index and health infrastructure exists. As the model is statistically significant, we consider that the results confirm the H3.

Regarding the relationship between GINI index and health work force density, we identify a negative correlation between Health work force density and GINI index. Higher the density of health work force is, lower the GINI index is. Thus, when health work force density increases with 1 doctor per 1.000 inhabitants then the GINI index decreases with 0.66 units. The value of DW threshold shows us that between the residues of the regression there is no autocorrelation. Regarding heteroscedascky (the volatility of the residuals- their variance is not constant) it was corrected with covariance White matrix. The results confirm the H4 that higher the health work force density is, lower the value of GINI Index is.

The last relationship that was tested was based on the link between R& D expenditure and GINI index. The results reveal that there is a negative correlation between the expenditures for R&D (as a % from GDP) and the GINI Index. When the expenditures for R&D increases with 1% from GDP, the GINI index decreases with 2.25 (the coefficient is statistically significant at 5% - its value is not zero). The results present the fact that the higher the expenditures for R&D are the lower GINI Index is. More than 9% of the variation of the GINI index is explained by the R&D expenditure as a %from GDP. The probability associated to F statistic shows that the model is valid (at least one coefficient differs significantly from zero). The errors of the model could be positively correlated, , while heteroscedasticity was corrected with covariance White matrix. The results confirm H4 that higher the expenditures for R&D are, lower the value of GINI Index is.

Subsequently we tried to link these indicators also for 2013, in order to see to what extent the values have changed, but the small number of observations generated irrelevant statistical models. Only the relationship between GINI index and health work force density was validated for 2013. The data – the descriptive statistics and the model of the relationship between the two variables are presented in Table 9.

Descriptive Statistics and Model of the Relationship Between GINI Index & Health Work Force Density, 2013

Table 9

Common sample	Correlation between GINI index and health work force- descriptive statistics			Model of the relationship between GINI index and health work force	
Element	GINI Index	Health work force density		Dependent variable GINI index	
Mean	37.1	9.2868			
Median	34.4	8.408		Constant	40.9947***
Maximum	63.1	33.653		Health work force density	**-0.4193****
Minimum	25.6	0.792		Quality of the model indicators	
Std. Dev.	9.4532	6.8616		R squared	9.26%
Skewness	1.1964	1.6538		F Statistic and probability	2.45*
Kurtosis	3.6637	7.1074		DW	1.35
Jarque-Bera	6.6801	30.129		Heteroscedasticity	No
Probability	0.0354	0		Normality	No
Observations	26	26			

Data Source: authors ‘computation

Where ***, **, * shows the significance threshold at 1% 5% and 10%

Regarding the values of minimum and maximum for GINI Index they are 63.1 to South Africa and 25.6 for Ukraine. The maximum number of doctors reported per 1000 inhabitants is 33.65 and corresponds to Belgium and the minimum value for the health work force density is 0.792, less than 1 doctor per 1000 inhabitants and is for Afghanistan. The number of observations included in the small (26 observation- available data) and the interpretation could not be generalized

The result found in Table 9 provides evidence that there is a negative correlation between health work force density and GINI index. Higher the density of health work force is, lower the GINI index is. If the health work force density increases with 1 doctor per 1,000 inhabitants, then the GINI index decreases with 0.41. The model is statistically significant, but the coefficient could be biased due to the small number of observations**.** The results confirm the H4 that higher the expenditures for R&D are, lower the value of GINI Index is for 2013.

5.**CONCLUSIONS AND DISCUSSIONS**

The purpose of this research was to reveal the link between social inequality or poverty, measured by GINI index and medical system characteristics, together with the influence of R&D expenditure.

In order to conduct this analysis, worldwide data from World Bank and World Health Organization was collected for 2010 -2013. The analysis consists both on panel models and linear regression models based on the available information that we have. As a fact, the research tried to investigate the relationship between GINI index and the number of infant deaths, health infrastructure, health work force density and R&D Expenditure. Consequently, for the first relationship a panel model was used, while for testing the other hypotheses only simple linear regressions were possible.

The results reveal that higher the value of GINI index is, higher the value of infant deaths is. Thus, an increase in GINI index with 1 generates an increase in the number of infant deaths with 0.0219%. According to Kawachi et al. (1997) income inequality is correlated with total mortality rate, including infant mortality. It seems that the relationship between income inequality, measured by GINI index and infants mortality is bidirectional. The sign of the correlation remains the same, no matter if GINI index or the number of infant deaths is the dependent variable. In order to state this, we affirm that our results are similar in terms of sign with the results found by Yannan, Frank, Mackenbach (2015), but are different in terms of the direction of correlation.

Regarding the relationship between GINI index and health infrastructure, it seems that higher the value of GINI index is, higher the need for health infrastructure is. The results are somehow opposite to the results found by Starfield, Leiyu Shi (2002) who considers that Hospital's infrastructure can be strengthened by equitable distribution of healthcare services.

The third relationship that was tested was between GINI index and world health work force. Our results reveal that higher the health work force density is, lower the value of GINI Index is. As a fact, when health work force density increases with 1 doctor per 1.000 inhabitants then the GINI index decreases with 0.66 units. The results are in accordance with Muhamamad (2010) assumptions that the existence of good health status increases the work productivity, and thus, human capital performance. As a fact, good health status is ensured by adequate number of health work force workers that helps in decreasing social inequalities.

The last relationship that we took into account was the one between GINI index and R&D expenditure. The results point out that an increase with 1% in R&D expenditure as a % from GDP reduces GINI index with 2.25. The results are in accordance with Aguayo Rico, et al, (2005) as they demonstrated that investment in health is an instrument of macroeconomic policy that reduces economic disparities and social inequalities

Overall, in terms of practical application, this research states the need for fiscal and budgetary policy to reduce social inequalities between individuals, to ensure proper and reliable work health force conditions, adequate infrastructure and to increase the percentage for R&D expenditure, the purpose being the increase of the quality of life and the decrease of social inequalities.

The limitations of this research are related with the number of observations included in the analysis and the method used. The statistically relevance of models was conditioned by the number of states that reported the same type of indicators for a certain period of time.

For a future analysis, it will be interesting to observe what effects produces the migration phenomena on the management of health system resources, to what extent the migration phenomena determine certain macroeconomic imbalances and if the migration increase the risk of poverty and social inequity as a consequence of the increase of number of inhabitants that have need for medical care and social assistance.

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