

**UNIVERSITAT
JAUME I**

**ANALYSIS OF THE RELATIONSHIP BETWEEN
INEQUALITY AND ECONOMIC GROWTH**

ABSTRACT:

This paper studies the interaction between inequality and economic growth. In order to achieve this purpose, we have collected data of 25 countries around the world over the period 2000 – 2019. The model estimates how inequality and other variables which directly affect growth are related to the economic growth. We have estimated a regression for the whole sample and then we divided it into OECD and non-OECD countries. According to the results, in any of these cases the inequality has a significant effect on economic growth.

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1. INTRODUCTION

Inequality in the income distribution is a fact which is very persistent. By inequality we understand the unequal distribution of the income in a country. A few people earn much more than others, which forms a gap in the population between rich people and poor ones. This second class are much more than the rich ones. For instance, in the United States 400 people earn more in a year than half of its population¹. This is an unfair phenomenon for the society and a challenge of our time to reverse it.

This phenomenon will probably have an impact on the growth of an economy. For this reason, the issue of the relationship between has been an object of debate over the last decades. The existent literature is very inconclusive: although there most of the studies have found a negative relationship, some others have found a positive relationship.

The principal objective of this paper is to study if the inequality is a significant variable which may interfere with the economic growth. What is more, we will try to assess if inequality has a negative influence on growth, which is the most common trend of thought.² We will also focus on the effect of some other control variables for the growth determinant, that is, they directly affect economic growth, in order to isolate more the inequality effect.

There are several ways to measure inequality. For instance, we can compare the percentiles, deciles, and quartiles of the income distribution of the population in a country. The 90-10 ratio is a comparison of the income of the top decile (the 90th percentile) to the income of the bottom decile (the 10th decile), which can provide us a measure of the income distribution. Anyway, the most common measure of inequality is the Gini coefficient because of its simplicity to compute.

To analyse the relationship between inequality and growth, we will create a model in which we make depend the economic growth on the inequality (Gini coefficient) and variables such as saving rates or human capital, which directly affect growth. We will see the variables used in a later section.

¹ See "Inequality for All" by Robert Reich

² See "In It Together: Why less inequality benefits all", OECD (2015). It seems to be concluded that inequality is, definitely, a bad influence for economic growth.

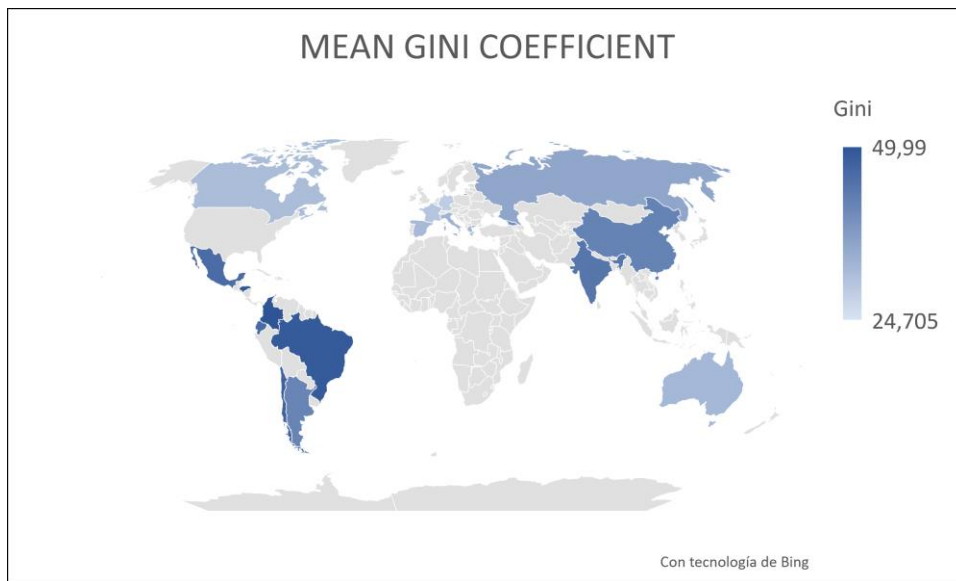
In order to do this purpose, we have collected a panel data of 20 countries with different level of development, to not focus on high-income countries or low-income ones and have some variety, over the period 2000-2019. Different econometric estimations were made to study the relationship of interest. What is more, we have divided the sample in developed in developing countries, according to if they form part of the OECD or not. According to the final results, in any of the cases inequality is significant to explain economic growth.

This paper is organized as follows. Firstly, there is a review of the main literature which is the inspiration of this work: There will be included a theoretical framework and some empirical evidence. Second, we will present the principal hypotheses. Then, we will detail extensively the data and methodology used for the study. Lastly, the results will be presented, as well as the concluding remarks.

2. LITERATURE REVIEW

Inequality is a widespread phenomenon around the world. Every country in the world suffers from a certain degree of inequality, which may vary among countries, depending on the type they are. Figure 1 helps us to observe how is inequality in the recent years. It is a heat map made from the mean of the Gini coefficient of the countries selected for the sample.

Figure 1. Heat map of the Gini coefficient.



Source: Own elaboration

We can clearly see displayed that in the developed countries, the inequality is smaller than in developing countries. If we compare zones, Europe, North America and Australia have the lower values. Then, Asia is already showing greater inequality. However, the greater inequality is found in South America, where is really worrying how unfairly inequal it is its society.

In order to achieve a full understanding of why exists inequality and its relationship with economic growth, we will divide the literature review in three sections. First, we will talk about the definition of inequality and why it stills exists at high levels. Then, an explanation of how theoretically can affect to economic growth is given. Lastly, we will review some of the majors works done which treat about this issue, for checking what conclusions they reach.

2.1 DEFINITION AND REASONS OF INEQUALITY

The fight against poverty is one of the major economic problems in the world. It is necessary to consider two aspects to do this: economic growth and income inequality. By economic growth we understand that it refers to the increase in the value of the goods and services produced in an economy during a specified period. It is often measured by increases in the Gross Domestic Product (GDP) of a country over a year or quarter³. The fluctuations in the economic cycle that such indicator suffers over time reflects economic growth (or decrease).

On the other hand, income levels in a country can be concentrated in few people or be more equally distributed between its citizens. When is highly concentrated, we talk about a higher income inequality. Sometimes, to measure the disposable income it is used the consumption or consumption expenditure, as it can be smoothed over time and hence is less reliant on seasonal variation. Also is a better proxy of well-being.⁴

Anyway, most authors which study inequality use the Gini Index. This index is a number between 0 and 1, indicating income inequality in a country. When the index is equal to 0 it means the country is perfectly equal, that is, every person earns the same income. On the contrary, if it is equal to 1, the income is only earned by a person, indicating perfect inequality. It can also be expressed in 100 base, which implies the numbers range from 0 to 100.

Once we know about both concepts, we will try to explain why the inequalities in income are growing, above all in the developed countries (in the developing ones it seems it is decreasing, but its levels are still high). Some of the main reasons is explained by the *skills-biased technical changes*. This refers to the wages and demand growth of the high-skilled workers due to the increase of its productivity because of new technologies (Violante, 2008). The globalization plays an important role, especially because the OECD countries have suffered important structural changes due to the integration into the global economy and to a fast technological progress.

³ To compare the GDP levels between countries we might adjust them by the Purchase Parity Power (PPP). The exchange rate between two different currencies is equal to the ratio of price levels (Krugman, Obstfeld, & Melitz, 2012).

⁴ See Morelli (2015)

The *regulatory reforms* have an impact as well. The changes in policies and institutions affect the way of distribution changes: workers with temporary contracts have lost employment protection legislation and the minimum wages have declined relatively to median wages. Most policy and institutional reforms contributed to make the wages disparities wider even though it can contribute to increase the employment opportunities.

The *changes in hours worked* is also an important factor. It affects differently to high-wage workers and low-wage ones: most of the temporary and part-time workers are in the bottom of the wage distribution. Furthermore, the loss of working hours is more among the low-wage workers, contributing to increase inequality.

But the major role is played by the *redistribution policies and income taxes*. Redistribution is not only about cash transfers, but also of the Government expenditure on public social services (health, education...). This second term is more important because the key is trying to give the poor opportunities to catch up with the wealthy, cash transfers will not solve this problem.

About the income taxes, they play a relatively minor role in moderating inequality. There are trends towards lower income taxes, but also a progressive taxation so they partly cancel each other. Some countries benefit the rich by lowering the taxes they must pay. This is the case of United States, where this group reached to pay the 91% in tax rate and then decreased around 35%. They also can buy policies because they have a large amount of money to pay politics: Here enters the concept of the Government failure.

The policies which its target is to redistribute wealth are necessary to promote growth in a specific country, due to inequality influences economic growth. This encourages the government to invest more in health, education, infrastructures... Basically, aspect that promotes growth and slow down poverty. For this, over the last decades, there has been wide economic research trying to find the relationship between income inequality and growth, having an important role in research developing economy, with contradictions in the economy thinking.

The next step will be determining the relationship between income inequality and economic growth. We will address this issue from a theoretical point of view and then we will review some of the most significant empirical evidence.

2.2 THEORETICAL FRAMEWORK

The unequal distribution of income and resources in a country may affect its economic growth for several reasons. There have been identified various transmission mechanism in which economic growth is affected by inequality⁵, which are discussed below.

- **Social-political unrest:** This a considerable factor because it can slow down growth. In countries with a high level of inequality of wealth, this cause people, especially the poor, to commit crimes, riots, and other disruptive activities (Barro, 2000). These antisocial actions represent a waste of resources, it causes uncertainty in the government and slows down productivity in the economy, while discouraging investment.

By contrast, other studies affirm the fact that, in an unrest situation in a country, politicians will favour redistribution, with the purpose of reducing inequality and regaining confidence in the institutions. These will return political stability to the country, promoting economic growth (Benhabib and Rustichini, 1996).

- **Political economy:** It is demonstrated by political economy models that high income inequality may slow down growth (Alesina and Rodrik, 1994) (Barro, 200). The government plays a significant role in the economy because they carry out income and resources redistribution policies. If the mean income in a country is higher than the median voter one, people support redistribution from rich to poor (transfer payments, or to a lesser degree, public-expenditure programs, or regulatory policies). However, this kind of redistribution reduces growth in the long run because it discourages innovation and investment, hence causing low productivity.

In addition, in the less democratic economies, the rich may influence redistributive policies by preventing them through lobbying or buying votes of legislators. This results in a wastage of government funds and corruption, which damages economic growth.

⁵ See Mdingi and Ho (2021)

- **Credit-market imperfections⁶:** In a model with imperfect credit markets, it is demonstrated that income inequality is negatively associated with growth (Piketty, 1997). A high degree of income inequality limits the poor from borrowing loans and returns on investment. Because investment depends on how much income and how many assets a person has, the poor (their income is only for basic needs) cannot afford high-return investment opportunities (such as investing in human capital or property). For this reason, extreme income inequality reduces investment opportunities, resulting in lower long-term growth.

- **Saving rates:** Individual saving rates increase with the level of income. If this is true a redistribution of resources from rich to poor tends to lower the aggregate rate of saving in an economy (Barro, 2000). If the rich have lower income, they can invest less, resulting harmful for economic growth.

- **The fertility rate:** The study made by De La Croix and Doepke (2003) finds an interesting fact: income inequality affects growth in a negative way through differences in fertility. They document that the gap in income inequality raises differences in fertility between the poor and rich population. Low-income groups usually have many children and tend to invest less in their children's education due to lack of financial resources. In contrast, people with higher incomes tend to have fewer children and spend more on education. Thus, when income inequality is extreme, high fertility gaps can negatively affect human capital and lead to slower economic growth.

Another important point to understand is *the evolution of the income inequality*. This issue is based in the Kuznets (1955) curve. The idea is focused on the movements of population from agriculture to industry. Attending this model, the rural sector represents initially most of the economy, with low per capita income. Then, the industrial sector starts out little, but with higher per capita income and, possibly, with higher inequality within the sector than the rural.

With that in mind, economic development occurs when there is a shift of people and resources to industry from agriculture. The person who moves will see his per capita income increased, and this changes the degree of inequality of the economy. Initially,

⁶ Credit-market imperfections refers to asymmetric information and limitations of legal institutions.

the dominant effect is the expansion of the rich group of persons in the industrial and urban sector, with the consequence of a positive relationship between the level of inequality and per capita product at the early stages of development.

Then, at later stages of development, this relationship becomes negative, because the continued urbanization enables more agricultural workers to join the industrial sector and, in addition, many of the workers who started at the lower rungs of the industrial sector tend to move up in relation to the richer workers within this sector. Hence, the full relationship between an indicator of inequality (Gini coefficient) and the income per capita adopts the form of an inverted-U, such as the Kuznets one.

So, in a developing country, an initial income inequality is necessary for enabling economic growth: some people need to concentrate wealth for starting businesses and, therefore, economic activity. Over time, inequality decreases because there are more people working and earning a salary. This is what is happening nowadays, we are seeing a decrease in inequality in developing countries.

2.3 EMPIRICAL EVIDENCE

After reviewing how theoretically inequality may affect economic growth, we proceed to review some of the main empirical works that have been made in this topic. The findings are ambiguous and there is not a clear idea about the effect of inequality, although generally it is found to be harmful for growth (it can also be insignificant or inconclusive).

The empirical work made by Barro (2000), considers a large group of countries between the years 1965 and 1995. He found out that there exists little overall relation between income inequality and rates of growth and investment. For poor countries, there is an indication that inequality retards growth, but encouraging it in richer places. Growth tends to fall with greater inequality when per capita GDP is below around 2000\$ (1985 U.S dollars) and to rise when is above that GDP per capita limit.

There are some other works, such as the one made by Forbes (2000), which its results conclude that there exists a positive relationship between economic growth and inequality. He estimates growth as a function of initial inequality, income, male and female human capital, market distortions, and country and period dummy variables, for

a panel data estimation of 45 countries from 1966 to 1995. Focusing on a Generalized Method of Moments (GMM) developed by Arellano and Bond (1991), the estimation shows that, in the short and medium term, an inequality increase in a country has a significant positive relationship with his economic growth. This is due to the fact that inequality could increase saving rate and investment in human capital. This not necessarily implies that inequality is desirable or sustainable in the long-term.

A positive relationship has been also found in studies like the one made by Barro (2008), or the paper by Li and Zou (1998). In the first one, Barro made another study on the effect of inequality, as an extension of his previous work in the year 2000, but now with cross-section country research. The number of countries depend on the period selected, being between 54 and 120, depending on the availability of data. He found out that, with an interaction term in the regression between the Gini coefficient and the log of per capita GDP, the relation is positive for the countries with a level per capita GDP higher than 11.900\$ (2000 US \$). So, this result resembles the one for his earlier work, but with a higher breakpoint.

Li and Zou (1998) also found a positive relationship. They re-examined the regression analysis in Alesina and Rodrik (1994), including more variables in growth empirics and perform the sensitivity analysis. They used a sample of 46 countries between the years 1947-94. The regression coefficients of the Gini coefficients are positive in all the four regressions they made (base one, adding time-specific dummy variables, democratic dummy variables and a combination of both previous options). The fixed effect model shows significant estimates in all cases, while random effects only have two cases that the coefficient is significative.

Despite there have been found positives results in the relationship between inequality and growth, needless to say there are lots of studies that concluded a negative relationship. One of it, frequently cited, which I mentioned before, is the paper made by Alesina and Rodrik (1994). The results are the contrary of what Li and Zou (1998) found modifying their work.

Using a cross-sectional data of 38/67 countries from 1960 to 1985, their model establishes connections between regime type, distribution of wealth and growth. They found out the coefficient is negative in all cases and, what is more, there is a difference between democracies and non-democracies. In non-democracies, the coefficients of the

income distribution variable are insignificant, having the correct sign. For the democracies, it is significant, and if they have an equally distribution, they grow faster.

Another important paper is the one made by Perotti (1996). He investigates the relationship between income distribution, democratic institutions and growth. His sample is formed by 67 countries, between years 1960 and 1985. His equation includes as independent variables: the share of the middle class (as an inequality measure) per capita GDP in 1960, average years of secondary schooling in the female and male population in 1960 (proxies for the stock of human capital) and the PPP value of the investment deflator relative to the U.S. in 1960 (proxy of market distortions).

The main finding is that a larger share of the middle class, this is, more equality, is positively associated with growth. If it is added to the regression regional dummies, like the level of urbanization, the relation becomes insignificant. What is more, the addition of an interaction between the inequality indicator and a democracy dummy variable, turns out in a coefficient of the inequality variable much higher and significant in democracies, while it is insignificantly different from 0 in non-democracies. Finally, if we separate the sample into rich and poor countries, the result is very similar when splitting the sample into democracies and non-democracies: the coefficient of the inequality variable is very high and significant in the sample of rich countries, and very low and insignificant in the poor countries.

As we have seen, the studies made about the relationship between income inequality and economic growth are very inconclusive. Some authors found out it exists a positive relationship, while others have reach opposite results. This confirms what suggest Banerjee and Duflo (2003): *Studies which emphasize the cross-sectional variability of inequality data find a negative correlation between inequality and growth, while studies that use the time-series variability find the opposite result.*

Remark that, although there can be find a positive relationship, this not necessarily implies the fact that inequality is desirable in the long term. The table 1 summarizes the empirical literature reviewed in this section.

Table 1. Summary of the empirical literature reviewed.

AUTHORS	SAMPLE	DATA STRUCTURE	ESTIMATION METHOD	EFFECT OF INEQUALITY ON GROWTH
Barro (2000)	84 countries 1965-1995	Panel	3SLS	Insignificant for the whole sample. Positive in rich and negative in poor countries
Forbes (2000)	45 countries 1966-1995	Panel	First-diff GMM	Positive and significant in the short and middle term
Barro (2008)	45 countries 1965-1995	Cross-section	3SLS	Positive with per capita levels higher than 11.900 \$
Li and Zou (1998)	46 countries 1947-1994	Panel	FE and RE	Positive for the whole sample
Alesina and Rodrik (1994)	38/67 countries 1960-1985	Cross-section	OLS and 2SLS	Negative for the whole sample. Insignificant in non-democracies
Perotti (1996)	67 countries 1960-1985	Cross-section	OLS and 2SLS	Negative for the whole sample. Insignificant when regional dummies are added. Negative in democracies and non-democracies. Insignificant in poor countries.

Source: Own elaboration

3. HYPOTHESES

As we will see in the data and methodology section, we will study the impact that has income inequality in economic growth, controlled by variables that directly affect economic growth. This is, for example, labour force participation rate, human capital, saving or growth capital formation.

We will propose some initial hypothesis that we expect to corroborate at the end of this work. These hypotheses are the following:

Hypothesis 1: Income inequality will be negatively related with economic growth.

Although it is not very clear its impact, most of the literature reviewed previously affirms that the effect of inequality on growth is harmful. It also depends on the data selection. In this work it is used a panel data structure, which can interfere with the final results.

Hypothesis 2: Human capital stock will have a positive impact on economic growth.

There exist endogenous growth models which highlights the importance of human capital on economic growth and development. If a country has an educated and healthy population, they will be more productive, thus higher income per capita. Chang and Shi (2016) consider that human capital encourage economic development through technology innovation. This also may lead into a decrease in the inequality, as the poorer population might have more opportunities of enrolling at the university and seek for better jobs.

Hypotheses 3: Saving and gross capital formation is positively correlated with the economic growth.

The growth model of Solow (1956) indicates that if there are increases in savings, is translated into more investment, which in turn stimulates economic growth. The effect of higher saving is more availability of investment funds. The more capital goods produce a country, the more goods and services it can produce. It increases the productive potential of the nation, leading into a boost of production, employment creation and economic growth in the long term.

So, an increase in aggregate demand caused by an increase in saving, drive in a positive effect in the economic growth.

4. DATA AND METHODOLOGY

Once we have analysed the literature background which motivated this investigation and the hypothesis of this paper, the following procedure is to explain the data and methodology which have constructed this study.

4.1 DATA

The purpose of this work is to find out which is the impact of income inequality on economic growth. For this reason, we have collected statistical data from 25 different countries around the world. Such countries have been selected according to the availability of the data and to observe how is the inequality situation globally, not only in a determined region or continent. What is more, there is a variety between high-income countries and middle-income countries. There have not been included African countries because of the data availability, which is poorer than the rest of the countries.

The twenty-five final countries that have been selected are the following: Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Cyprus, Denmark, Ecuador, France, Georgia, Germany, Greece, Honduras, India, Indonesia, Italy, Korea, Mexico, Russia, Singapore, Spain and finally the United States. The considered time period is from 2000 up to 2019 in an annual frequency. This leads into a panel data of 500 observations, which allows us to combine observations of different variables and countries over time. Remark not all the data is available, for some countries there are some years which the data is not available of some variables.

The data used in this work was collected in two different sources. It is important the reliability in the observations, so we have chosen reliable sources, which are: World Bank and the Standardized World Income Inequality Database (SWIID).

In this point is very important to know about data quality. The literature is also largely limited by the availability and quality of income distribution data across countries, which are usually constructed based on heterogeneous national sources. This means that the inequality measures often vary in coverage, units of reference, weights, and definition of income.

The impact of inequality on growth has been analysed typically by the Gini coefficient, a single synthetic measure of income inequality. However, the positive and negative relationship of inequality and growth are mostly associated with inequality in different parts of the income distribution (Voitchovsky, 2005). The negative links are attached with inequality at the bottom of the distribution and most of the positive links are more dependent on the top of income distribution. For this, a single inequality number might result in an average effect of inequality.

On one hand, SWIID provided us the Gini coefficient. This is a high-used variable which considers the whole income distribution. It measures inequality from 0 (perfect equality, everybody earns an equal income) to 1 (perfect inequality, all income is earned by one person). It can also be expressed as a percentage, so we multiply by 100 the number. We have chosen this database because it offers data from 1960 to the present. The Standardized World Income Inequality Database aims to meet the needs of the large population by maximizing the comparability of income inequality data while providing the broadest possible cross-country covering needs for large-scale transnational research.

On the other hand, the rest of the variables are collected of the World Bank database, specifically World Development Indicators (WDI) which are: GDP per capita growth, gross capital formation per capita, current health expenditure per capita, primary education enrolment rate, gross domestic savings per capita, and GDP per person employed. Then, we transform them into growth rates, in order to have a better interpretation of the coefficients and to achieve greater statistic stability. This database is conformed by a compilation of high-quality, relevant, and internationally comparable statistics about global development and the fight against poverty.

Many authors have studied the relationship between inequality and growth in many ways. In this paper, we have used as proxies of the human capital the health expenditure per capita and primary school enrolment due to the unavailability of the Human Capital Index. The WDI offers few observations of this variable. For example, Perotti (1996) includes the average years of secondary schooling in the male and female population as proxy for the stock of human capital. Li and Zou (1998), in contrast, use primary school enrolment ratio, just like we do.

In general, authors have included variables which affect directly to economic growth due to it may be correlated with income inequality, in order to isolate the specific effect of inequality. This is made because there are many factors which have an influence

in economic growth, and it is important to control these factors to estimate more precisely the inequality effect. It also helps to make more robust findings between the relationship of inequality and economic growth. If we do not control properly these factors, it can lead to wrong or biased conclusions. The next we will detail is the variables included in this study and their main features.

Dependent variable

- *Growth*: Annual Gross Domestic Product per capita growth in percentage points (%). GDP per capita it is often used as a proxy of economic growth in countries. It is the result of dividing the GDP of a year by the population.

Independents variables

- *Gini*: Gini coefficient of each country. It is expressed as a percentage; therefore, it goes from 0 to 100. It is the inequality indicator for this paper.
- *K_form*: Gross capital formation per capita growth rate. It consists of expenditure on additions to the fixed assets of the economy plus net changes in the level of inventories. It is equal to gross domestic investment. It has been calculated dividing the Gross capital formation of each year between the population of the corresponding year.
- *Health_Exp*: Current expenditures on health per capita growth rate. Estimates of current health expenditures include healthcare goods and services consumed during each year. It is used as a proxy of Human Capital
- *Educ*: Primary education net enrolment rate. Is the ratio of children of official school age who are enrolled in school to the population of the corresponding official school age. Also used as a proxy for Human Capital.
- *Saving*: Gross domestic savings per capita growth rate. This variable is the result of the subtraction of the GDP and the final consumption expenditure. It is calculated by the division of gross domestic savings and population.
- *Labor*: GDP per person employed growth rate. This measure can be used to evaluate the economic productivity in a country, because it relates the production

level (measured by the GDP) with the employed people in the economy. Is the GDP divided by total employment in the economy.

4.2 DESCRIPTIVE STATISTICS

In this section we are going to display the main statistics of the variables which we mentioned before. For this, we will observe the main univariate statistics (which are mean, median, maximum, minimum, and standard deviation), the correlation matrix of all the variables and the individual correlation of each independent variable with the GDP per capita growth.

The main univariate statistics of this data set are showed in the Table 2, and are the following:

Table 2. Principal univariate statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Growth	500	2.269	3.273	-11.846	13.636
Gini	500	37.858	7.822	22.6	53.2
K_Form	449	3.515	24.619	-137.145	428.497
Health_Exp	475	5.143	11.262	-67.346	44.673
Educ	362	95.109	4.469	77.964	99.956
Saving	500	5.984	54.852	-255.563	1100.221
Labor	500	1.789	3.064	-7.413	13.876

Source: Own elaboration

The mean of the variable associated with the Gini coefficient is a generalization of the countries selected for the sample. It is quite interesting to have a look at the table A.1 in the Annex, which displays the mean of each different country, and where it can be observed a different pattern between developed and developing countries. This first group have a significantly lower mean. For instance, in the European countries, the mean for Belgium is 26,58 in the period selected, or for Denmark is 24,70. Spain's mean is 31,97, we have room for improvement. The exception is the United States, despite being the first economy in the world, they have a high level of income inequality. Commenting this issue could take up an entire paper, so we will not entertain on this.

On contrast, if we have a look at the developing countries, we can observe higher values for the Gini mean. In the South American zone there are high levels of inequality. The highest mean observed corresponds to Colombia, with a value of almost 50, then we can look at Brazil or Argentina, where the income inequality is notorious; it is strange to have a mean less than 40 points.

Now, we can observe the relationship between the indicated variables in the next Spearman's correlation matrix, reflected in Table 3.

Table 3. Correlation matrix of variables.

Variable	Growth	Gini	Kform	Health_Exp	Educ	Saving	Labor
Growth	1.0000						
Gini	0.1880	1.0000					
K_Form	0.2858	0.0517	1.0000				
Health_Exp	0.5084	0.1216	0.2387	1.0000			
Educ	-0.1549	-0.3839	-0.0587	-0.0559	1.0000		
Saving	0.3322	0.0642	0.1408	0.2580	-0.1442	1.0000	
Labor	0.7903	0.1216	0.2194	0.4177	-0.1002	0.2017	1.000

Source: Own elaboration

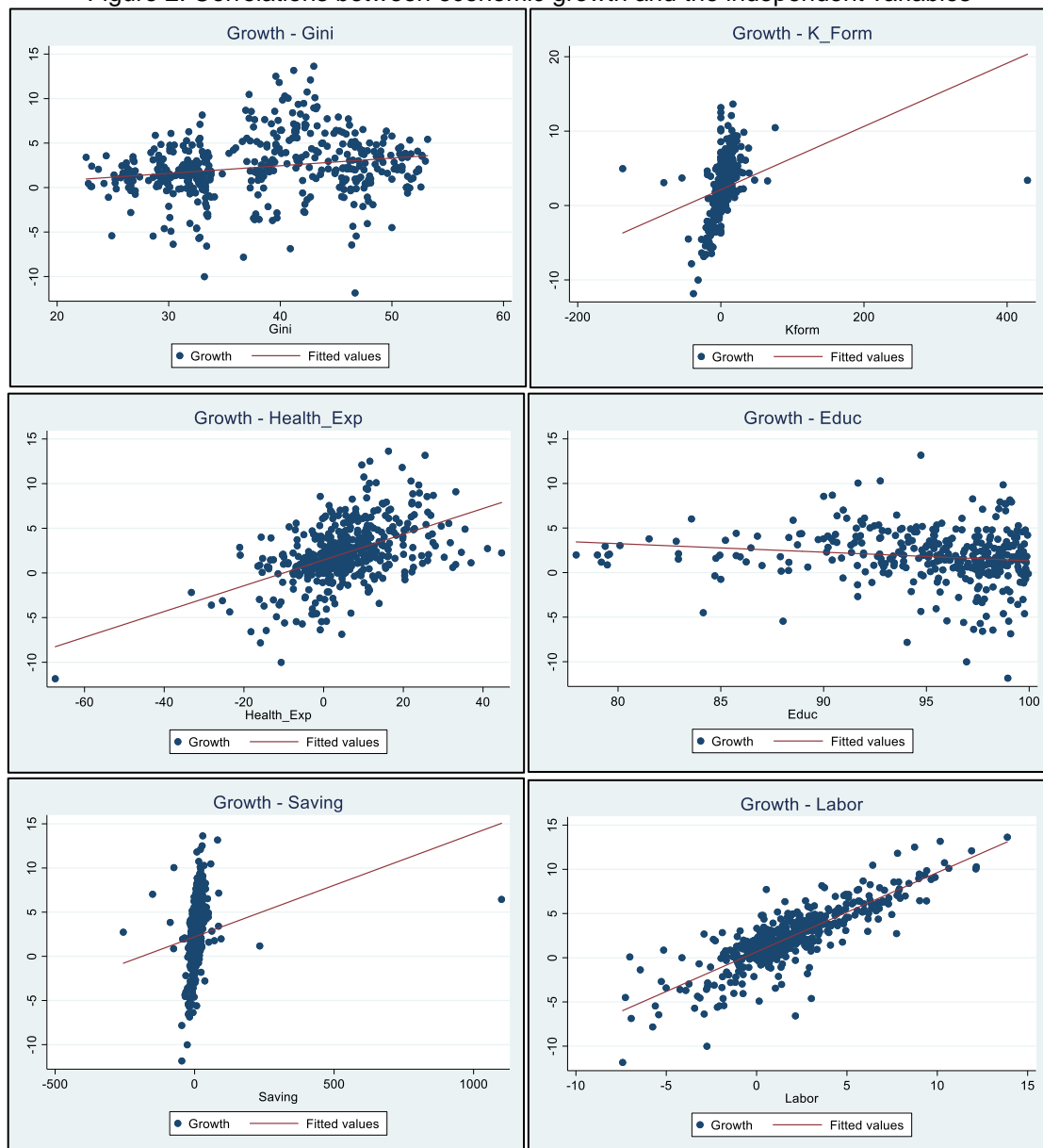
As we can see in the table, for the data sample considered it is not violated the assumption of non-perfect correlation between the variables. Nevertheless, we can observe higher and lower degrees, and positive and negative degrees of correlation in the variables in which is represented the economic relation of them.

The table shows a positive correlation between economic growth and the income inequality. This may be due data used, which we mentioned in the literature review section. The works which use a cross-sectional data are more likeable to find a negative relationship, while the ones which emphasize in time-series data find the opposite result (Banerjee and Duflo, 2003). Despite this, later we will check if the causality is the same way, as well as the significance.

Contrary of what we expected, the primary education enrolment rare is negatively correlated with economic growth. This is very strange because this issue is often important for development and economic growth in the long-term. It may be due to the quality of education, often related with developing countries: if the education quality is low because of lack of resources, it can limit the development of knowledge and abilities required for growth, even if there is a high enrolment. The rest of the variables have the expected relationship with economic growth, acting in a positive way.

To finish this section, in figure 2 we can observe in a more visual way the relationship between the economic growth and the rest of the variables. The correlation corresponds to the adjusted regression lines.

Figure 2. Correlations between economic growth and the independent variables



Source: Own elaboration from Stata graphics

4.3 ECONOMETRIC MODEL

We have created a model, motivated by the previous literature, where the income inequality is linked as an influencing factor in GDP per capita growth, used as a proxy for economic growth in countries. There are also included the rest of the variables as explanatory variables of economic growth. With the purpose to study these relationships, the model specification is the following:

$$\begin{aligned} Growth_{i,t} = & \beta_0 + \beta_1 Gini_{i,t} + \beta_2 K_form_{i,t} + \beta_3 Health_Exp_{i,t} + \beta_4 Educ_{i,t} + \\ & \beta_5 Saving_{i,t} + \beta_6 Labor_{i,t} + \alpha_i + \varepsilon_{i,t} \\ & i = 1, 2, \dots, 25 \quad t = 2000, 2001, \dots, 2019 \end{aligned}$$

Where:

- *Growth* represents the annual percentage GDP per capita growth of each country.
- *Gini* represents the income inequality measured by the Gini coefficient.
- *K_form* is the Gross Capital Formation per capita growth rate (%)
- *Health_Exp* represents the current health expenditure per capita growth rate (%)
- *Educ* represents the primary school enrolment (% net)
- *Saving* represents the gross domestic savings per capita growth rate (%)
- *Labor* is the GDP per person employed growth rate (%)
- α_i represents a binary variable for each individual entity which considers the no observable factors (omitted variables which may be correlated with the explicative variables) which vary among each individual and they do not change across time (fixed effects)
- $\varepsilon_{i,t}$ represents the error term of the estimation and captures the unobserved effects that have an influence on the dependent variable (economic growth)

4.4 EMPIRICAL RESULTS

With the aim of study which is the impact of the previous variables on the economic growth, we have estimated the econometric model in two different methods: Fixed effects and Individual and Temporary effects. Then, we will decide which is the most optimal method using some statistical test. We have not included the Random Effects estimation, as we are using a macro data panel, so we will never select this option because the variability of the Random Effects is quite low, making difficult to get a precise estimate of the parameters.

1. Estimation by Fixed Effects

By estimating with this method, we take into account the omitted variables which affect the explicative variables, vary between individuals, and do not change across time. We incorporate heterogeneity to the model, which is the following:

$$\begin{aligned} Growth_{i,t} = & \beta_0 + \beta_1 Gini_{i,t} + \beta_2 K_form_{i,t} + \beta_3 Health_exp_{i,t} + \beta_4 Educ_{i,t} \\ & + \beta_5 Saving_{i,t} + \beta_6 Labor_{i,t} + \alpha_i + v_{i,t} \end{aligned}$$

We have used the statistical software Stata to estimate the model. As we can see in table A.2, we have a problem of heteroscedasticity. For checking this, we have used a Wald test for fixed effects, which evaluates the heteroscedasticity of the model. The null hypothesis of this test proposes homoscedasticity in the model. The results in the table give us a p-value equal to 0, which means we reject the previous null hypothesis, assuming we have heteroscedasticity. So, we take this into account when we estimate the model. The results are displayed on table 4:

Table 4. Estimation by Fixed Effects.

(1)	
VARIABLES	Growth
Gini	0.0538 (0.0599)
K_Form	0.00843 (0.0112)
Health_Exp	0.0418*** (0.0112)

Educ	-0.0425 (0.0706)
Saving	0.0166** (0.00709)
Labor	0.730*** (0.0805)
Constant	2.480 (7.626)
Observations	345
Number of i	24
R-squared	0.632

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This model shows that only three variables are statistically significant on explaining economic growth. These variables are current health expenditure, GDP per person employed (both significant at a 99% confidence level, which means that have a p-value lower than 0.01) and gross domestic savings (significant at a 95% confidence level, p-value<0.05). The rest of the variables are not statistically significant in this method, not even at a significance level of 10%. So, our main variable of interest, income inequality, does not have much relevance on economic growth. The R-squared of the regression has a value of 0.632. This means that, in this estimation, the explicative variables explain the variation in the dependent variable (economic growth) in a 63.2%, a high value.

If we analyse the model results, the inequality has a positive impact on GDP per capita growth. An increase of 1 point in the Gini coefficient would lead to an increase in the GDP per capita growth rate of 0.0538 units, *ceteris paribus*. However, this is not statistically significant, so we cannot prove our first hypothesis.

It also has a positive impact the gross capital formation growth rate, but again, it is not significant. The changes in growth rate are explained in this model by the health expenditure per capita, the GDP per person employed and the gross domestic savings, all of them expressed in growth rates. For example, if health expenditure increases in one percentage point, economic growth rate is affected by an increasing of 0.0418 units, *ceteris paribus*. Or if the change is in the GDP per person employed, growth increases in 0.73 units, if the rest of the variables remain constant. With these results, we cannot validate either the second and third hypotheses.

On contrast, the only negative effect on economic growth is caused by the primary enrolment rate, which is quite confusing, because this variable usually has a positive effect for an economy. An increase of 1 unit on this rate implies a GDP per capita growth of -0.0425 units, *ceteris paribus*, but this change is not statistically significant, so we would not pay much attention to it. With this result we cannot prove the hypothesis two of this work.

In addition, we have tested the significance of the individual effects, to make sure if it is correct to include them in the model. In order to prove it, we can have a look at the Table A.3 in the Annex. This table shows the result of the joint significance test, using the command *testparm* in Stata. The F-test for individual effects has the null hypothesis of joint non-significance. As the p-value associated to the statistic $F(24, 360) = 11.69$ is 0, we can reject the null hypothesis. Thus, fixed effects must be included when making the model.

2. Estimation by Individual and Temporary Fixed Effects

In this estimation, we include in the model time effects as binary variables. They took the value 1 for the period we are referring to and 0 in the rest periods. This way, these temporary dummies will cover events that will be common to all countries and occur in a particular moment in time, as the 2008 crisis.

$$Growth_{i,t} = \beta_0 + \beta_1 Gini + \beta_2 K_form_{i,t} + \beta_3 Health_exp_{i,t} + \beta_4 Educ_{i,t} + \beta_5 Saving_{i,t} + \beta_6 Labor_{i,t} + \alpha_i + \eta_t + v_{i,t}$$

So, in this model, we have incorporated a new constant that capture these time effects, η_t . The year 2000 is not included due to is used as the base year, being part of the constant coefficient. We will some there are missing years, because if there are some values missing for certain years in the variables, those years are excluded due to the lack of information. This does not imply that the years are not relevant, it is the fact they cannot be interpreted.

Like the previous model, we have regressed it robust to heteroscedasticity. The results of the estimation are shown on table 5:

Table 5. Estimation by individual and temporary Fixed Effects.

(1)	
VARIABLES	Growth
Gini	0.0978 (0.0698)
Kform	0.00794 (0.00854)
Health_Exp	0.0542*** (0.0142)
Educ	-0.0371 (0.0718)
Saving	0.0151* (0.00738)
Labor	0.628*** (0.0872)
2002.t	-0.524 (0.364)
2003.t	-1.154 (0.709)
2004.t	-0.0762 (0.641)
2005.t	0.0894 (0.578)
2006.t	0.719 (0.496)
2007.t	0.262 (0.550)
2008.t	-0.802 (0.596)
2009.t	-2.390*** (0.751)
2010.t	-0.438 (0.688)
2011.t	-0.713 (0.765)
2012.t	-0.504 (0.726)
2013.t	-0.697 (0.753)
2014.t	-0.112 (0.472)
2015.t	0.936 (0.565)
2016.t	-0.160 (0.603)
2017.t	0.194 (0.575)
2018.t	-1.000

	(0.850)
Constant	0.723
	(7.756)
Observations	345
Number of i	24
<u>R-squared</u>	<u>0.697</u>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

If we focus on the temporary fixed effects, we note that most of them have a negative effect on economic growth. The year after the recession, 2009, is the only significant one, an expected and intuitive result. This indicates that GDP per capita growth rate is 2.39 units lower than the base year (2000) in the 25 countries considered for the sample, *ceteris paribus*. A positive coefficient, for instance in the year 2015 (which is the higher positive value), means that in that year, economic growth rate was 0.936 units higher than in the base year.

Then, if we compare the results of this new estimation with the previous one, which did not include time effects, we note the same effect of the variables. The signs have not changed, and the same variables are significant, with a small difference in gross domestic savings, which has now seen his significance reduced, at a 10% confidence level. So, the hypotheses 2 and 3 cannot be validated.

The variable that interests us, inequality, remains with a positive effect on economic growth, but again it is not significant. Now the R-squared has a higher value, being 0.697, which means that this model explains better the changes on the dependent variable, given the independent variables. Concretely, they form the 69.7% of the change in GDP per capita growth rate. Again, our first hypothesis cannot be proved.

We can see that some temporary effects are significant and some other are not. Like we have done before, we test the joint significant test for the time effects to prove they have to be included in the model. We have used the same command in Stata as before (*testparm*). Table A.4 shows the results.

The statistic $F(19, 24)=39.48$ with a p-value of 0 indicates us that we have to reject the null hypothesis of joint non-significance of the time effects. Thus, temporary fixed effects must be included in the model.

4.5 OECD VS NO OECD

In some studies of the relationship between economic growth and inequality, the authors chose to distinguish between developed and developing countries due to the difference of data available among them. These countries usually have different socio-economic context: developed countries tend to have higher incomes, better levels of human development, more stable political systems or a more advanced infrastructure in comparison to developing countries.

What is more, they also differ in the economic structure. Developed countries often have more diversified economies, oriented towards services, whereas developing countries could rely more on agriculture, manufacturer industry or exportations of raw materials. They could be in different phases on the Kuznets (1956) curve of inequality which is mentioned in the literature review above, so these differences may affect the relationship between inequality and growth in the different types of countries.

In order to see how the effect of the inequality in growth is more precisely, we have separated the countries of our sample between if they form part of the OECD (Organisation for Economic Co-operation and Development) or not. Is often known as the "rich countries club", and since 2017, the members conform the 42.8% of the global GDP.

In our sample, the countries who are part of the OECD are the following: Australia, Belgium, Canada, Chile, Denmark, France, Germany, Greece, Italia, Korea, Mexico, Spain, and the United States. We have done another regression, by fixed and temporary effects, including only these countries. The results are shown on table 6:

Table 6. OECD countries estimation.

(1)	
VARIABLES	Growth
Gini	-0.110 (0.126)
K_Form	0.201*** (0.0238)
Health_Exp	0.0337 (0.0363)
Educ	-0.00785 (0.0579)
Saving	-0.00294 (0.0217)
Labor	0.426*** (0.0948)
2002.t	-0.317 (0.474)
2003.t	-1.687*** (0.477)
2004.t	-0.442 (0.465)
2005.t	-0.178 (0.343)
2006.t	-0.652* (0.315)
2007.t	-0.678** (0.286)
2008.t	-1.453*** (0.387)
2009.t	-1.406** (0.518)
2010.t	-1.240** (0.489)
2011.t	-0.975** (0.362)
2012.t	-0.693 (0.457)
2013.t	-1.173** (0.428)
2014.t	-0.715 (0.455)
2015.t	-0.296 (0.608)
2016.t	-0.512 (0.403)
2017.t	-0.483 (0.558)
Constant	5.596

(5.806)

Observations	176
Number of i	12
R-squared	0.850
<hr/>	
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

In this new model it can be seen some small differences with respect to the previous estimation. Now, inequality has the opposite effect on economic growth; the coefficient has become negative. This can be explained due to the fact they are in a later stage of growth, so more inequality does not benefit the economy. Nevertheless, it is not statistically significant, so we cannot determine that it is a decisive factor with respect of economic growth.

In addition, the gross domestic savings and the health expenditure have lost their significance, they no longer determine the economic growth. In this sample, the gross capital formation has become an important variable, going significant at a 99% confidence level, implying that inversion plays an important role in developed economies. It has a positive effect for growth; if the growth rate of the capital formation increases in 1 unit, the growth increases in 0.201 points, *ceteris paribus*.

The GDP per person employed remains as previously: significant at a 99% confidence level and having a positive effect for economic growth. If its growth rate increases in 1 point, growth is increased in 0.426 units, *ceteris paribus*. The change is lower than before. The rest of the explanatory variables have not a significant effect. Once again, our hypothesis cannot be fully proved.

If we focus on the temporary dummies, we can note some years that are really significant, especially the crisis' years. This is due to the crisis affected mostly developed countries in a direct way; its origin was in the United States, and it was later spread to Europe. So, clearly, we have to take into consideration this negative shock which affected economic growth, making it slower. It is curious that every year shown has a negative coefficient, so the growth has been slower than the base year (2000) in all this period.

After having analysed the OECD countries sample, now we focus our attention to the estimation of the rest of the countries which are not considered developed yet; they are mostly in the middle-income group. The results are shown in table 7:

Table 7. Non-OECD countries estimation.

(1)	
VARIABLES	Growth
Gini	0.157 (0.0864)
K_Form	0.00323 (0.00551)
Health_Exp	0.0555*** (0.0127)
Educ	-0.126 (0.116)
Saving	0.00512 (0.00669)
Labor	0.645*** (0.125)
2002.t	-0.871 (0.681)
2003.t	-0.318 (1.754)
2004.t	0.703 (1.646)
2005.t	0.0451 (1.443)
2006.t	0.903 (1.361)
2007.t	0.676 (1.272)
2008.t	0.0351 (1.378)
2009.t	-1.160 (1.373)
2010.t	0.462 (1.531)
2011.t	0.0598 (1.651)
2012.t	0.418 (1.652)
2013.t	0.162 (1.821)
2014.t	0.413 (1.218)
2015.t	1.229 (1.337)
2016.t	-0.307 (1.499)
2017.t	0.573 (1.448)

2018.t	-0.731 (1.532)
Constant	5.586 (11.13)
Observations	144
Number of i	10
R-squared	0.725

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In this new estimation, we can note some differences with respect to the developed countries. First of all, the inequality, our variable of interest, has the opposite effect; now, for this group of countries, it affects positively to economic growth. But again, it is not significant.

As the previous models, the GDP per person employed it is also significant at a 99% confidence level and has a higher coefficient than for the OECD countries; the productivity in less developed countries is more important than in developed ones, so with a higher productivity, they will encourage a higher economic growth.

Now, the health expenditure is significant at a 99% confidence level too. The inversion in human capital for these countries is extremely essential; if they cannot achieve a health standard, the economy will never growth. The unhealthy people are less productive than the healthy, basically they may not attend work if they cannot barely move from their bed, or they have contagious diseases. The rest of the independent variables are not significant, so one of the main focuses to achieve growth in these countries is a raise in the productivity of their workers.

Lastly, temporary effects are not significant in this sample, not even the crisis and post-crisis years. This is because, as we stated before, the crisis affected mostly to developed economies, it does not affect in a direct way to the developing countries.

5. CONCLUSIONS

The effect of inequality in economic growth is an issue of great concern among the economist in the recent decades; but it seems that no consensus can be reached. Numerous studies have been published and they reach different results of the effect that inequality has on growth.

Inequality can negatively affect economic growth, because it contributes to political instability, it exacerbates financial markets imperfections, it alters the savings and investment decisions, or it can cause fertility rates gaps which affect human capital development. All of these consequences are harmful for the economy.

But at the same time, it can also interact positively with the economic growth, acting as an impulsive factor. If you let people choose, they will vote for equity in all the world, so all the people will earn the same amount of money. If this happens, people will not have incentives to invest, work hard, or learn new abilities. So, a certain degree of inequality is necessary for people to innovate and work.

In respect with the empirical studies, the ones reviewed in this paper reach different conclusions. This seems to follow a trend, as Banerjee and Duflo (2003) state: *Those studies which emphasize cross-sectional data find a negative relationship between inequality and growth, while those who use time-series variability, find the opposite result.*

In this paper we have found that, for the whole sample of 25 developed and developing countries, inequality has a positive sign for economic growth. This result matches with what we have stated in the previous paragraph, as we have used a panel data for the variables. Nevertheless, this relationship is not statistically significant, so we cannot validate our first hypothesis, not even that it really affects growth. In this model the growth is explained by the growth rates of health expenditure, gross domestic saving, and GDP per person employed.

Then, in order to achieve a more accurate estimation of the relationship between inequality and growth, we have divided the sample according to if the country is member of the OECD or not. So, for the developed countries, we have seen that inequality has a negative effect for the economic growth, an expected result. But again, it is not statistically significant, so we cannot say that it really affects economic growth.

Finally, for those developing countries of the sample, we find the opposite effect: inequality acts as a positive factor for economic growth. This is maybe, as stated before, they need innovation and hard work to achieve a higher productivity. However, as we have been seeing throughout the paper, this time also is not statistically significant, and growth is explained by other variables.

In any of the previous estimates we can fully validate our three hypotheses: The first one stated a negative impact of inequality to growth, but in any case this variable is statistically significant. The second hypothesis was about the positive impact the human capital has on economic growth: the primary enrolment ratio is never significant, and in fact has a negative relationship. Lastly, our third hypothesis said that saving and gross capital formation is positively correlated with growth. We have proved that in any case both variables are statistically significant together.

Over the studies made over the last decades no consensus has reached, and this work does not find solid results to affirm which is the relationship between inequality and growth. The publication made by the OECD (*In it together, why less inequality benefits all*, 2015) seems to end the debate stating that inequality is harmful for economic growth undoubtedly. Nevertheless, more investigations are needed to reach a more precise conclusion, with more data availability and a more precise measurement of inequality.

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ANNEX

Country	Average Gini 2000-2019
Argentina	41,39
Australia	32,43
Belgium	26,58
Brazil	48,915
Canada	31,535
Chile	47,495
China	41,79
Colombia	49,99
Cyprus	29,715
Denmark	24,705
Ecuador	45,93
France	29,825
Georgia	40,28
Germany	28,46
Greece	32,63
Honduras	49,515
India	44,135
Indonesia	44,9
Italia	33,275
Korea	32,26
Singapore	39,295
Mexico	45,855
Russia	35,565
Spain	31,97
UU.EE.	38,005

Table 8. Average of the Gini Coefficient for each country 2000-2019.

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (25) = 2610.39
Prob>chi2 = 0.0000
```

Table 9. Wald test for heteroscedasticity.

```
. testparm i.i

( 1)  2.i = 0
( 2)  3.i = 0
( 3)  4.i = 0
( 4)  5.i = 0
( 5)  6.i = 0
( 6)  7.i = 0
( 7)  8.i = 0
( 8)  9.i = 0
( 9) 10.i = 0
(10) 11.i = 0
(11) 12.i = 0
(12) 13.i = 0
(13) 14.i = 0
(14) 15.i = 0
(15) 16.i = 0
(16) 17.i = 0
(17) 18.i = 0
(18) 19.i = 0
(19) 20.i = 0
(20) 21.i = 0
(21) 22.i = 0
(22) 23.i = 0
(23) 24.i = 0
(24) 25.i = 0

      F( 24,   360) =   11.69
      Prob > F =    0.0000
```

Table 10. Fixed effects joint significance test.


```
. testparm i.t

( 1) 2001.t = 0
( 2) 2002.t = 0
( 3) 2003.t = 0
( 4) 2004.t = 0
( 5) 2005.t = 0
( 6) 2006.t = 0
( 7) 2007.t = 0
( 8) 2008.t = 0
( 9) 2009.t = 0
(10) 2010.t = 0
(11) 2011.t = 0
(12) 2012.t = 0
(13) 2013.t = 0
(14) 2014.t = 0
(15) 2015.t = 0
(16) 2016.t = 0
(17) 2017.t = 0
(18) 2018.t = 0
(19) 2019.t = 0

      F( 19,    24) =    39.48
      Prob > F =    0.0000
```

Table 11. Time effects joint significance test.