REVISTA DE ESTUDIOS REGIONALES

I.S.S.N.: 0213-7585

2ª EPOCA Mayo-Agosto 2024

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UNIVERSIDADES DE ANDALUCÍA

REVISTA DE ESTUDIOS REGIONALES Nº 130, I.S.S.N.: 0213-7585 (2024), PP. 293-337

Income inequality and its impact on economic growth: An analisis for latina-merican countries and chilean regions

Desigualdad del ingreso y su impacto en el crecimiento: Un análisis para países latinoa-mericanos y las regiones chilenas

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Recibido, Agosto de 2021; Versión final aceptada, Enero de 2023

KEYWORDS: Income inequality; Economic growth; Initial income; Development; Regional inequality.

PALABRAS CLAVE: Desigualdad del ingreso; Crecimiento económico; Ingreso inicial; Desarrollo; Desigualdad regional.

JEL Code: D63, O47, R10.

ABSTRACT

This paper attempts to answer the questions: what is the effect of income inequality on economic growth? Is the inequality-growth relationship different for the Chilean regions than for the Latin American countries? An econometric analysis is proposed, estimating growth based on inequality, initial income, and other control variables. Four different inequality measures show that in Latin American countries the level of development mitigates the negative impact of inequality on growth. On the other hand, the results for the Chilean regions show an inverted U-shaped relationship between inequality and growth. However, the regional effect is positive on average.

RESUMEN

Este trabajo busca responder a las preguntas ¿cuál es el efecto de la desigualdad del ingreso sobre el crecimiento económico? y ¿es diferente la relación desigualdad-crecimiento para Chile que para el conjunto de países latinoamericanos? Se propone un análisis econométrico, estimando el crecimiento en función de la desigualdad, el ingreso inicial, y otras variables de control. Utilizando cuatro medidas diferentes de desigualdad, se muestra que a nivel de países latinoamericanos el impacto negativo de la desigualdad sobre el crecimiento se ve atenuado por el nivel de desarrollo. Por su parte, los resultados de las regiones chilenas evidencian una relación en forma de U invertida entre la desigualdad y el crecimiento, sin embargo, el efecto regional es, en promedio, positivo.

1. INTRODUCCIÓN

The literature proposes different channels through which inequality positively and negatively affects economic and development growth. For this reason, economists have not been able to reach a consensus about the inequality-growth relationship, and clarifying this empirical relationship remains of great scientific interest. Authors such as Alesina and Rodrik (1994), Alesina and Perotti (1996), Royuela *et al.* (2019) conclude that territories with more significant inequalities tend to show less economic growth. On the other hand, authors such as Kaldor (1955), Li and Zou (1998), and Forbes (2000), consider that higher inequality rates at the beginning of an assessed period foster higher growth rates in the long or mid-run. Finally, more contemporary authors such as Barro (2000), Benhabib (2003), Balcilar, Gupta, Ma and Makena (2021) find a more complex and not necessarily linear relationship between these variables, which in some cases results in an inverted U shape.

This paper focuses on Latin America (LA) and particularly on one of the countries of the region, Chile. Central to this paper are the questions: what is the effect of inequality on economic growth? Is the inequality-growth relationship different for the Chilean regions than for the Latin American countries? The main contribution of this paper is to provide new empirical evidence that explains the inequality-growth relationship by adopting a regional perspective and using extensive econometric analysis. The empirical evidence on this topic is inconclusive, as shown in the literature. Empirical work (as well as regional work) focusing on LA is scarce, as shown in the following section, mainly due to the difficulty of finding systematic, quality data at this administrative level. To the best of our knowledge, there is only one regional work in Latin America, which is based in the Federate States of Mexico (Ríos 2003).

In Latin America, characterized by high levels of inequality and lower levels of development, the relationship between inequality and growth is a topic of high relevance. According to Niembro (2018), globalization is closely associated with growing inequality and regional disparities in developing countries in Latin America, Asia, Africa, and Eastern Europe. According to OECD *et al.* (2019), the Gini coefficient for the region is 46.2, 9.7 points higher than for the OECD countries. According to Bourguignon (2001), as cited in Lustig *et al.* (2002), since countries' idiosyncratic factors are relevant to explaining the relationship between growth and inequality, microdata at a country level should be preferred for regions, states, and other territorial entities). As stated by Mahapatra *et al.* (2019, pp. 64) “even small differences in these growth rates, when cumulated over a long period, have resulted in a substantial impact on the people’s living standards.” These studies have prompted a second analysis across the regions of a specific country, namely Chile, as this country presents particular characteristics within the Latin America region. Chile has relatively good outcomes in economic growth (one of the most developed countries in LA) but also has persistent inequality (Mieres, 2020b) and one of the highest Gini coefficients in the world[1]. In the past few years, inequality in Chile has been one of the most debated topics in the country. In fact, as a result of continous protests, mainly the “Estallido Social” (social upheaval) in 2019, and the demands for a juster and more equitable country, Chile is undergoing a process to change the current Constitution. This study is the first to analyze the impact of inequality on economic growth in the Chilean regions, and it could become a good instrument for implementing new public policies, an opportunity that presents itself when the country is undergoing structural changes[2]. As Mahapatra *et al.* (2019, pp. 64) state, this type of analysis is essential to “formulate appropriate policies and bring about required institutional changes to spread the benefits of growth processes across regions.”

The main secondary source for the analysis of the LA countries is the Central Bank. The selected countries have a Gini index available for all the analyzed years resulting in a data panel for 14 countries in the period 1990-2015. For the Chilean case, the 15 regions of the country are analyzed[3] in the period 1990-2017, where the primary source for secondary data is the survey Caracterización Socioeconómica Nacional (CASEN survey [National Socio-economic Characterization Survey] (details in section 4).

This paper performs an econometric analysis that builds mainly on the methodology used by Forbes (2000), Ríos (2003), and Royuela *et al.*

1 According to the World Bank (2018), Chile ranks 26th out of 156 countries.

2 Roura (2021) states that the pre-constitutional debate (1976-78, in the case of Spain) and the writing and approval of the new Constitution pushed “regional” matters to the forefront of the country’s concerns. This situation is currently replicable in Chile, hence the relevance of focusing new research on smaller territorial units in the country, in this case, regions.

3 Currently, 17 regions. In this case, it was necessary to work with 15 for which data are available since 1990.

(2019), who use panel data and estimate growth based on initial inequality, initial income, and other control variables. Models are presented in a multi-equational form (Martín-Guzman 1988) using OLS, Fixed Effects (FE), and Random Effects (RE). Considering that the FE model provides a robust estimator for the short run[4], the preferred modeel in this work is FE (Baltagi and Griffin 1984, Pirotte 2003). To test the robustness of the results, and in line with previous works, the possible endogeneity problem caused by the two-way causality between inequality and economic growth can be solved by using Instrumental Variables (IV) and IV estimations as a generalized method of moments (GMM) problem. Other time horizons are also assessed. This thorough analysis is also a relevant contribution to the empiric analysis of the inequality-growth relationship in the Latin American region.

LA countries' and Chilean regions' analyzes confirm the importance of the initial level of development in the inequality-growth relationship. For the LA countries, the estimated coefficient of initial inequality is negative and statistically significant, while the nonlinearity of the relationship is rejected in most specifications. That is, inequality is detrimental to growth. For Chilean regions, a non-linear relationship is found. Growth rises at first as we move away from full equality but then falls as inequality rises further.

This paper is organized as follows: Section 2 displays the empirical results obtained by the main authors in this field to contextualize the inequality-growth relationship. Section 3 explains the work methodology. Section 4 presents the data and sources used, as well as a descriptive analysis of the data from LA and Chile. Section 5 conducts an empirical analysis applied to Latin American countries (1990-2015) and the regions of Chile (1990-2017) and shows the main results obtained. Finally, conclusions and limitations are presented.

2. RELATING INEQUALITY AND GROWTH

Central to this paper is the question: what is the effect of inequality on economic growth? This causal relationship had not been studied until the early 90s; nevertheless, the literature on this topic has grown over the past

4 And other characteristics of this type of model that are further discussed in section 5.

few years. The empirical literature has not reached a consensus about the sign of this relationship. It is worth noting that there are positive and negative forces that simultaneously play in a given economy (as empirically shown by Castells-Quintana and Royuela [2017][5]) and for this reason, there is no single answer to the question about the inequality-growth relationship, as will be seen in this review of the literature.

The most relevant authors who have analyzed this relationship, and have devoted their efforts to the negative effect of inequalities on growth, are economists such as Perotti (1993, 1994), who describes the impact of credit constraints on countries with more significant income inequalities. In this line, the works of Alesina and Rodrik (1994) and Persson and Tabellini (1994) are noteworthy as they relate inequality and growth through the political economy channel. Results show a negative correlation between inequality and growth. In 1996, Perotti concluded that more egalitarian societies have low *fertility rates* and high levels of *schooling investment*, and both situations are reflected in higher growth rates (see Barro [2000] and De La Croix and Doepke [2003]). Equally, Deininger and Squire (1998) conclude that *level of schooling* is the primary channel through which inequality affects growth[6].

Likewise, Perotti (1996) points out that more unequal countries tend to be politically and socially unstable, and, as a consequence, growth is reduced (Alesina and Perotti [1996] present the same result.). Rodrik (1999), who also considers the channel of social conflict and the institutions' quality, concludes that inequality is harmful to growth because it restrains the social expenditure needed to make adjustments in the presence of conflicts or "clashes" that slow down growth.

Ostry *et a*l. (2014, 2018) utilize a global database to assess the relationship among three variables (redistribution, inequality, and growth) in the mid and long run. In both cases, they conclude that inequality is a robust and powerful determinant of the pace of growth, consistent with the results obtained in 2011 establishing that inequality is detrimental to growth (Ostry

5 The authors show that there are positive and negative forces that play simultaneously in the long-term inequality-growth relationship. These authors state that negative forces are capable of explaining 80% of the total effect, and this negative influence is significant for developing countries.

6 The authors conclude that there is a strong negative relationship between initial inequality and long-run growth. In addition, the authors conclude that inequality in land ownership reduces the growth of the poor, but not of the rich.

and Berg, 2011). The most recent work in this area suggests that the effect of inequality (and redistribution) on growth is mainly transmitted through other channels because the inequality coefficient decreases and loses significance in explaining growth when they include variables such as *human capital* (schooling and life expectancy), *fertility* and *political climate* in their model.

Royuela, Veneri and Ramos (2019) conduct a regional study that includes over 200 regions from 15 OECD countries. They conclude that the effect of inequality on growth has been negative since the Great Recession. Also, they prove that inequality is more detrimental to areas with large and medium-sized cities. Inequality between regions may be due to several factors, mainly differences in resources and demographic conditions, less smooth mobility of goods and services, the concentration of regional economic activities, and others (Sukmaadi and Marhaeni, 2021). In contrast, other authors such as Kaldor, Forbes, Li and Zou suggest that the inequality-growth relationship is positive. Kaldor (1995), building on the Keynesian model, hypothesizes that people with higher incomes have a greater tendency to save than people with lower incomes. Therefore, more unequal countries would tend to show higher capital accumulation rates and, consequently, grow faster than more egalitarian countries.

Theoretically and empirically, Li and Zou (1998) analyze this relationship. Theoretically, they propose a positive relationship between inequality and growth through public consumption. Empirically, they aim to contradict the results achieved by Alesina and Rodrik (1994) using a more significant and improved database. The result shows a positive and significant relationship, in most cases, between inequality and growth. Forbes (2000) obtains the same results in the short and mid-run by using a global panel study, with the caveat that this relationship does not apply to extremely poor countries[7]. Like most of the authors mentioned above, Forbes (2000) uses initial levels of *income*, *investment*, and *female and male education* as explanatory variables to estimate the model.

A new relationship between inequality and growth is presented by authors such as Barro (2000), Benhabib (2003), Banerjee and Duflo (2003), Castells-Quintana and Royuela (2017), and Balcilar *et al.* (2021), who opt

7 The author notes that results might not not apply to extremely poor countries because of the limited data availability and, therefore, low presence of extremely poor countries in the study.

for a more complex and not necessarily linear relationship between these variables. The study conducted by Barro (2000) shows a small general relationship between inequality (measured by income share) and growth rate[8]. The author concludes that higher inequality rates reduce the growth rates of poorer countries, but the effect is the opposite for wealthy countries. Lin *et al.* (2009) obtain the same results, which are robust when assessed in the short and long run.

Benhabib's (2003) theoretical political economy model aims to prove that a high level of inequality is detrimental to growth as it motivates rent-seeking, appropriation, and excessive interference from the government, while a modest level of inequality could lead to higher growth rates as productivity differences are leveraged. To this effect, the author suggests a somewhat non-linear relationship with the shape of an inverted U (see also Chen [2003] for long-run empirical evidence). Banerjee and Duflo (2003) present a model where net changes in inequality, in any direction, cause a decrease in growth rates. These authors employ the same control variables used by Perotti (1996) and Barro (2000) but separately. The result, in both cases, is a non-linear relationship. Following this line, Balcilar *et al.* (2021) conclude that inequality positively impacts growth up to a threshold of average Gini coefficient of 35.92, beyond which it negatively impacts growth. Similarly, Aktas and Iyidogan (2022) conclude that, for a panel of 60 developed and developing countries, when inequality reaches high levels is detrimental to growth, that is that equality can lead to growth when it is low, especially in developing economies.

In a recent paper, Dorofeev (2022) concludes that in countries with low-income inequality rates, an increase in inequality has a positive effect on growth and contrarywise (see also Grigoli and Robles [2017]). Also, their results suggest that inequality is more detrimental to growth in countries with low incomes. In this line, Brueckner and Lederman (2018) had previously stated that the inequality-growth relationship depends on the initial income of a territory, a result suggested by Deininger and Squire (1998) and Barro (2000). Brueckner and Lederman (2018) conclude that inequality has a negative effect on growth in high-income countries, while the contrary occurs in low-income countries. However, one caveat is that these authors measure

8 Also, the author finds a relationship between inequality and investment rate.

the variables growth and inequality in the same period; therefore, causality cannot be observed.

In Latin America, the literature on this matter is scarce. Unlike most studies focusing on a group of developed and developing countries, Ríos (2003) estimates a regional panel study across the thirty-two Federate States of Mexico. This author concludes that in the short run, under different combinations of inequality and control variables (such as *average schooling*, *life expectancy*, and *social instability index*, among others), there is a negative, robust, and significant effect of initial inequality rates on the economic growth of the Mexican States..

Bengoa and Sánchez-Robles (2004) utilize a representative sample of Latin American economies (1975-1995). The study shows that countries with a very high or very low inequality level experience a lower growth rate, while those with a higher proportion of an intermediate level of inequality experience more significant growth in the analyzed period. Following this line, Delbianco *et al.* (2014) analyze a set of twenty Latin American and Caribbean countries (1980-2010) and conclude that the inequality-growth relationship depends on the initial income level of the countries. In general, inequality is detrimental to growth; however, when the *income of the wealthiest ten percent* is used as a measure of inequality (instead of the Gini), results show that this variable positively relates to growth in countries with high incomes. As Lin *et al.* (2009), these authors suggest redistributive policies for low-income countries.

As observed in this section, although there is extensive literature studying the impact of inequality on growth (see summary in Appendix A), empirical work studying the inequality-growth relationship in LA is scarce. The same occurs at the regional level within a country, where the works of Ríos (2003) and Royuela *et al.* (2019) stand out. From the existing empirical literature, a possible conclusion is that not only initial levels of income and inequality are essential for growth, and growth rates could reflect a complex interplay between these two variables and show a non-linear relationship between inequality and growth. Therefore, a dynamic setup is necessary to address the relationship between inequality and growth. In this context, this study is the first to analyze the impact of inequality on economic growth in the Chilean regions.

3. SPECIFICATION AND ESTIMATION METHODS

Considering that few Latin American countries have a large amount of available data and that the number of regions within a country is usually low, it is best to present the models in a multi-equational form (Martín-Guzman 1988). For this reason, and building mainly on the methodology used by Forbes (2000), Ríos (2003), and Royuela *et al*. (2019), a panel data analysis is performed, and growth is estimated based on initial inequality, initial income, and other control variables.

This paper does not aim to find all the variables that potentially influence growth but rather to find good relationships between certain macroeconomic variables that focus on inequality. The econometric model is built on the variables that most researchers use (mainly Alesina and Rodrik [1994], Forbes [2000], Ríos [2003], Bengoa and Sánchez-Robles [2004], and Royuela *et al.* [2019]) and taking in account the best correlations between the available variables and *GDP per capita yearly average growth rate* (the dependent variable). For robustness reasons, inequality within regions and countries is calculated using various annual indicators related to the disposable income of individuals or households. The general model is then expressed as follows:

$$\triangle y_{i,t} = \alpha + \beta_1 y_{i,t-1} + \beta_2 INEQ_{i,t-1} + BX_{i,t-1} + \varepsilon_{i,t} \tag{1}$$

Where:

$\triangle y_{i,t}$ = GDP per capita yearly average growth rate of country/region i during period t.

α = constant term.

β_i = coefficient of explanatory variable j.

$y_{i,t-1}$ = GDP per capita of country/region i at the beginning of period t (end of the period t-1).

$INEQ_{i,t-1}$ = inequality of country/region i at the beginning of the period t (end of the period t-1).

B = vector of coefficients of control variables.

$X_{i,t-1}$ = vector of control variables in country/region i at the beginning of the period t (end of the period t-1).

$\varepsilon_{i,t}$ = error term in country/region i at period t.

This model assumes that the intercept $\alpha\alpha$ of the regressions is the same for each transversal unity. The individuality of each country/region can be modeled using the Fixed Effects model. This model assumes that the differences between different regions are constant (or fixed); thus, each intercept must be estimated. A way to allow the intercept to vary for each region is the technique of the "differential intersection dichotomous variables" (Aparicio and Márquez 2005, Wooldrige 2010) expressed in the following formula:

$$\triangle y_{i,t} = v_i + \beta_1 y_{i,t-1} + \beta_2 INEQ_{i,t-1} + BX_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

In this equation, $v_i v_i$ is a vector of dichotomous variables for each region. A restricted *F-test* is performed for the above equationsto find which model is the most efficient, this one or OLS..

Another way to model each country or region's "particular" character is using the Random Effects model, which assumes that each transversal unity has a different intercept with a mean value a and an aleatory deviation of this mean value u_i. The Random Effects model is expressed as follows:

$$\triangle y_{i,t} = \alpha + \beta_1 y_{i,t-1} + \beta_2 INEQ_{i,t-1} + BX_{i,t-1} + u_i + \varepsilon_{i,t} \quad (3)$$

Estimations were derived by using robust standard errors. The cluster()[9] option in Stata makes it possible to estimate despite heteroscedasticity and autocorrelation problems. The contemporaneous correlation assumptions are met. The Ramsey-Reset test for omitted variables is applied in each equation.

In line with previous works, the possible endogeneity problem caused by the two-way causality between the variables inequality and economic growth must be considered. As Forbes (2000, pp. 873) indicates "by focusing on stock variables measured at the start of the periods, rather than flow variables measured throughout the periods, any endogeneity should be reduced (although it could still be a potential problem)." Therefore, to address the possibility that one of the regressors in the model correlates to the error term in the regression[10], instrumental variables (IV or 2LSL [Two-Stage least

9 Cluster(country/región). Residual clustering by territory.

10 In this context, an OLS estimation could generate biased and inconsistent estimates, while the IV method allows obtaining consistent parameter estimates (Moral & Pérez López, 2019).

squares]) and instrumental variables estimations as a generalized method of moments problem (IV-GMM) are used. As stated by Moral and Pérez López (2019, pp 122), "IV estimators can be used not only to solve endogeneity problems but also to handle other situations such as mismeasurements in regressors (errors in variables)."

When models with IV are used, the multivariate Sanderson-Windmeijer F test of excluded instruments is included for individual endogenous regressors, and the Underidentification test is aplied under the null hypothesis that the equation is underidentified. The Sargan-Hansen test is applied to contrast the overidentification of the instruments. The Durbin-Wu-Hausman test is performed to detect if the regressor presenting "endogeneity problems" can be considered as entirely exogenous (Moral & Pérez López, 2019). The null hypothesis is that the regressor is exogenous; therefore, the usual estimation method can be applied. The results in both analyses, Latin American countries, and Chilean regions, show that with a high p-value, the null hypothesis cannot be rejected; therefore, the instrumental variables method is unnecessary.

Finally, although this paper aims to analyze short-run effects, the model is replicated for more extended periods, dividing them into two subperiods instead of five subperiods. For Latin America, the period 1990-2015 is divided into 1990-2005 and 2005-2015; and for the regions of Chile, the period 1990-2017 is divided into 1990-2003 and 2003-2017. Although consistent, these results must be regarded with caution due to the low number of observations in the long run.

4. DATA SETS

This section presents the primary data and sources used, as well as some descriptive analysis, presenting Latin America first and then the regional data set.

4.1. Latin American countries

Appendix B displays data sources and descriptive statistics and Appendix H, the definitions of the used variables. A database with fourteen LA countries is built. According to the available data, the estimated period is 1990-2015, which has been divided into five equally-long periods (t=1: 1990-1995; t=2: 1995-2000; t=3: 2000-2005; t=4: 2005-2010 y t=5: 2010-2015)[11]. Forbes (2000) states that this technique reduces yearly serial correlation from economic cycles. This dataset considers all the Latin American countries that have available Gini indexes for all the analyzed years. The Gini index is the best known and most widely used measure of inequality in inequality studies, "Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution" (World Bank, 2018).

Three other measures of income inequality are also used: *20:20 ratio*, *20:80 ratio,* and *10:40 ratio* or *Palma index*[12]. These indicators compare the participation (percentage) in the country's income of the upper part of the distribution versus the participation of the lower part; that is, the lower income population (see details in Appendix E). With these considerations, a dataset of seventy *Gini indexes*, sixty seven *20:20* and *20:80 ratios*, and sixty six *Palma indexes* is obtained (see Table 1). In each case, the income inequality indicator of the given year is considered, or by default, the observed measure from the closest year in the five-year span ending in the stated year[13]. The World Bank (2018) is the primary source from where the *Gini index* is obtained, and Deininger and Squire (1996) is the complementary source for some missing data. The World Bank (2018, 2020) is the source for the rest of the income inequality indicators.

The dependent variable in this analysis is the GDP per capita yearly average growth rate (%), calculated using the GDP per capita purchasing power parity based (PPP) provided by the World Bank for the 14 countries. Graph 1 presents the relationship between the *GDP per capita yearly average growth rate* of each period and the *initial income inequality* for LA countries. The correlation is negative for the four different measures of inequality. There are no indications of a non-linear relationship. Possible outliers are noted

11 Each period is assigned an observed value of the *GDP per capita growth rate* and a value of the different predictive and control variables at the beginning of the period. For instance, for the second period (1995-2000), the variable *inequality* and the other initial explanatory variables correspond to 1995 and the corresponding growth rate is the annual average rate calculated for 1995-2000.

12 Based on the work of the Chilean economist Gabriel Palma.

13 For instance, for the year 1990, the available Gini for that year is used; if the Gini is unavailable, the observation is taken from the closest year to 1990 in the period 1986-1990.

TABLE 1

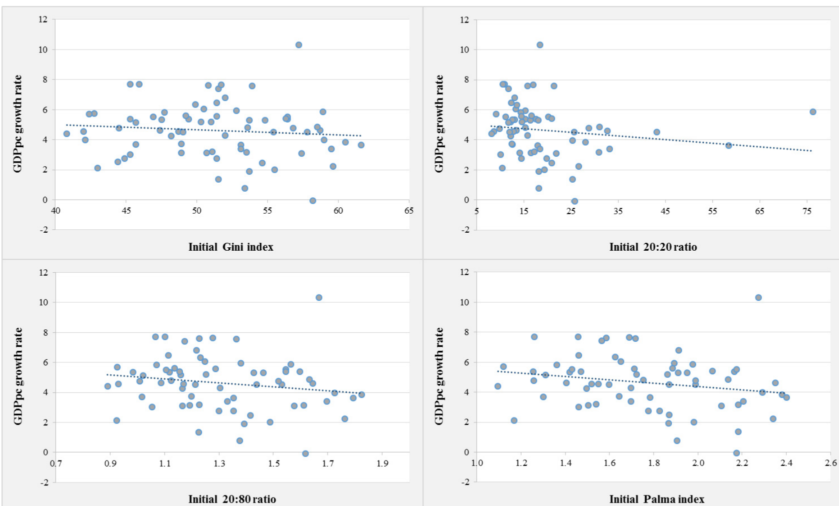
INEQUALITY INDEXES FOR LATIN AMERICA BY COUNTRY AND YEAR

	Gini index					20:20 ratio					20:80 ratio					Palma index				
Country	1990	1995	2000	2005	2010	1990	1995	2000	2005	2010	1990	1995	2000	2005	2010	1990	1995	2000	2005	2010
Argentina	45.3	48.9	51.1	47.7	43.0	10.92	14.16	17.22	14.36	10.43	1.10	1.16	1.23	1.07	0.92	1.46	1.50	1.54	1.36	1.17
Bolivia	42.0	53.5	61.6	58.5	49.2	8.61	30.85	58.36	31.00	16.63	0.93	1.61	1.79	1.63	1.14	1.55	2.18	2.40	2.14	1.88
Brazil	60.5	59.6	59.0	56.3	53.7	28.09	26.58	25.32	20.93	18.19	1.82	1.76	1.72	1.54	1.39	2.38	2.34	2.29	2.06	1.87
Chile	57.2	56.4	52.8	51.5	49.0	18.38	17.57	15.26	11.74	11.91	1.67	1.60	1.38	1.17	1.21	2.28	2.17	1.89	1.57	1.60
Colombia	53.6	51.5	58.7	53.7	54.8	15.32	25.33	32.74	16.33	18.00	1.13	1.23	1.65	1.43	1.46	1.75	2.18	2.35	1.91	1.95
Costa Rica	45.3	45.7	47.4	47.5	48.2	13.05	12.60	13.36	12.57	12.23	0.98	1.02	1.09	1.12	1.16	1.25	1.30	1.41	1.42	1.50
Dominican Rep.	50.5	51.4	52.0	49.9	46.9	13.21	12.26	15.72	13.46	11.17	1.25	1.11	1.30	1.23	1.11	1.65	1.46	1.70	1.63	1.43
Ecuador	50.7	53.4	56.4	53.1	48.7	16.48	18.09	20.23	17.97	12.83	1.19	1.38	1.54	1.35	1.17		1.91	2.18	1.78	1.52
Honduras	57.4	55.5	55.4	59.5	53.1	21.86	19.29	25.65	33.11	18.42	1.58	1.49	1.44	1.70	1.33	2.11	1.98	1.87	2.21	1.70
Mexico	52.0	50.3	51.4	48.9	45.3	13.07	12.20	14.49	12.39	10.06	1.22	1.16	1.30	1.20	1.05	1.91	1.86	1.83	1.64	1.46
Panama	58.9	57.8	56.8	53.9	51.7	76.25	43.21	28.71	21.37	17.00	1.56	1.53	1.52	1.36	1.28	1.98	1.99	1.99	1.72	1.69
Paraguay	40.8	58.2	54.6	51.4	51.0	8.12	25.75	20.93	14.44	14.63	0.89	1.62	1.42	1.29	1.25	1.10	2.17	1.87	1.71	1.72
Peru	42.8	44.9	49.4	50.8	45.7		19.83	15.31	15.74	11.74		1.35	1.16	1.23	1.02		1.78	1.47	1.58	1.31
Uruguay	42.4	42.1	44.4	45.9	44.5	9.08			10.53	9.84	0.93			1.07	1.01	1.12			1.26	1.26

Source: Author's own based on World Bank Data (2018) and removed from the sample considering the standard deviation of the residuals. Discarded observations due to the presence of extreme values are Chile, 1990; and Paraguay, 1995.

GRAPH 1

INITIAL INEQUALITY AND GDP PER CAPITA GROWTH RATE CORRELATION. LATIN AMERICAN COUNTRIES, 1990-2015 (AUTHOR'S OWN ELABORATION)



Source: Author's own.

4.2. Chilean regions

A relevant contribution of this work is the presentation of a comprehensive regional database (ver Mieres Brevis [2020a, 2020b]) where the primary source for secondary data is the survey Caracterización Socioeconómica Nacional (CASEN survey [National Socio-economic Characterization Survey], a collection of data that provides information on household socioeconomic characteristics). Also, the author calculates regional data, such as *GDP per capita,* the *Gini index* (2013-2015), and other measures of income inequality. In order to obtain a more extensive and comparable database of the GDP per capita, the author uses the *method of the variation rate* (Correa *et al.*

2002)[14]. In particular, regional per capita GDP at constant prices of different series is used and taken to the year 2013. In this way, the author obtains a single dataset with base year 2013. Also, unavailable data is drawn from different official institutions, especially Instituto Nacional de Estadísticas (INE [National Office of Statistics])[15].

Table 2 illustrates the inequality indicators by region. The *Gini index* is calculated following the methodology formerly used by the Ministerio de Desarrollo Social (Ministry of Social Development). This methodolgy uses an index based on autonomous household income per capita.

Appendix C presents the descriptive statistics and data sources for the main regional variables that are used in the analysis (variables at the beginning of each period, except *education growth*) and lists the sources from where each variable is drawn (see definitions in Appendix I). A panel data from year 1990 to 2017 is divided into five different periods (t=1: 1990-1996; t=2: 1996-2003; t=3: 2003-2009; t=4: 2009-2013 and t=5: 2013-2017). Therefore, it is possible to study five periods of economic growth for each region. This method allows for a dataset with sixty-nine observations and fifteen regions.

Graph 2 presents the short-run relationship between the *GDP per capita yearly average growth rate* and the *initial income inequality* over the period 1990-2017. The correlation between the *Gini index* and the *GDP per capita growth rate* is positive. However, a possible quadratic relationship is observed when the other three measures of inequality are used. The inference is that initially, the GDP per capita grows along with inequality, but at some point, greater levels of inequality are associated with lower growth rates.

The control variables used in this section are not the same used in the Latin America analysis. This choice is not a prior one but a decision made considering data availability. In Chile, it is still difficult to find complete, quality data at a regional level for the studied period hence the best proxies for the variables used in the comparative analysis of the countries are used, as will be seen in the next section.

14 The Central Bank of Chile uses and recommends this method.

15 Recollection of data was difficult, especially when data for the long run was required. The author wants to acknowledge the different institutions that provided information through the Portal de Transparencia del Estado.

TABLE 2
INEQUALITY INDEXES FOR CHILE BY REGION AND YEAR.

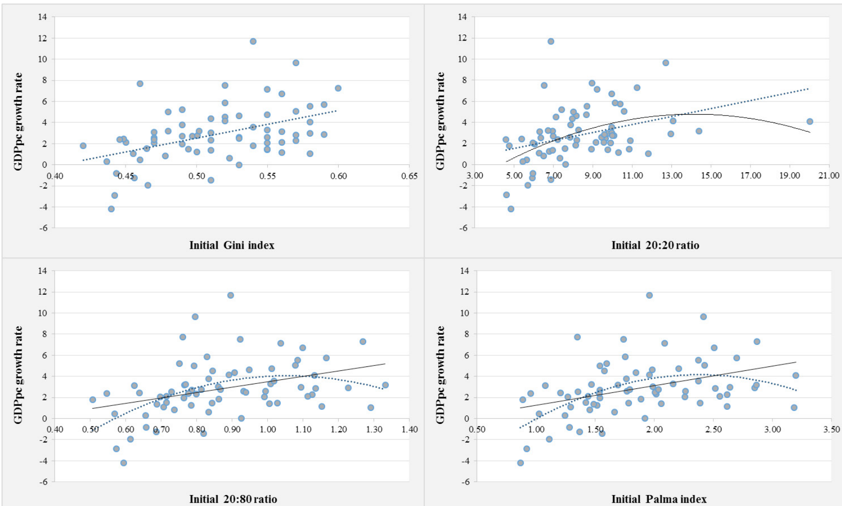
Region	1990	1996	2003	2009	2013	1990	1996	2003	2009	2013	1990	1996	2003	2009	2013	1990	1996	2003	2009	2013
Arica y Parinacota				45.00	44.57				9.17	4.59				0.71	0.55				1.44	0.95
Tarapacá	55.00	51.00	49.00	44.00	45.62	9.21	8.19	6.05	4.84	5.93	1.04	0.80	0.76	0.59	0.69	2.09	2.02	1.54	0.87	1.37
Antofagasta	52.00	48.00	46.00	42.00	46.55	6.53	6.96	5.65	4.75	5.70	0.92	0.77	0.57	0.51	0.61	1.74	1.69	1.03	0.89	1.11
Atacama	54.00	58.00	47.00	46.00	44.20	6.87	11.82	6.29	8.96	4.62	0.90	1.29	0.62	0.76	0.57	1.96	3.18	1.08	1.35	0.92
Coquimbo	55.00	53.00	56.00	48.00	44.35	8.66	7.86	9.55	8.01	5.95	1.01	0.93	1.11	0.79	0.66	2.21	1.77	2.55	1.54	1.28
Valparaíso	53.00	50.00	47.00	49.00	47.80	8.17	6.80	5.97	7.86	6.51	0.95	0.79	0.70	0.83	0.74	1.98	1.52	1.27	1.77	1.45
Metropolitana	56.00	56.00	57.00	57.00	52.32	9.96	10.31	9.60	10.59	7.32	1.10	1.15	1.14	1.08	0.83	2.51	2.62	2.52	2.43	1.66
O'Higgins	51.00	53.00	47.00	47.00	43.67	7.95	9.64	6.36	7.20	5.44	0.91	0.94	0.73	0.78	0.66	1.85	2.01	1.35	1.53	1.25
Maule	60.00	55.00	54.00	54.00	45.54	11.25	9.46	8.13	9.97	6.28	1.27	0.99	0.86	1.02	0.71	2.87	2.26	1.89	2.38	1.29
Biobío	58.00	57.00	55.00	51.00	46.48	9.75	10.91	9.89	9.96	7.58	1.09	1.13	0.99	0.86	0.72	2.64	2.61	2.26	1.99	1.42
La Araucanía	59.00	55.00	59.00	58.00	49.71	10.38	9.76	12.95	20.03	10.06	1.17	1.01	1.23	1.13	0.87	2.70	2.06	2.85	3.20	2.03
Los Ríos				52.00	49.44				13.09	8.92				0.89	0.84				1.96	1.78
Los Lagos	58.00	55.00	55.00	52.00	50.04	8.70	8.28	10.85	10.12	9.98	1.09	1.01	1.03	0.83	0.81	2.37	2.16	2.39	1.75	1.79
Aysén	52.00	49.00	56.00	57.00	50.17	7.12	7.42	14.40	12.71	6.73	0.85	0.75	1.33	0.80	0.77	1.58	1.60	2.87	2.42	1.47
Magallanes	53.00	49.00	51.00	51.00	44.84	7.63	7.00	6.87	6.95	5.40	0.93	0.79	0.82	0.69	0.64	1.92	1.54	1.56	1.49	1.21

*Gini index in Chile goes from 0 to 1. The data format has been changed to match the format used for the countries' study (0-100).

Source: Author's own based on CASEN Sourvey Data.

GRAPH 2

INITIAL INEQUALITY AND GDP PER CAPITA GROWTH RATE CORRELATION. REGIONS OF CHILE, 1990-2017 (AUTHOR'S OWN ELABORATION)



Source: Author's own.

5. EMPIRICAL ANALYSES

This section aims to provide an empirical answer to the questions: What is the inequality's effect on economic growth? Is the inequality-growth relationship different for the chilean regions than for LA countries? Latin American countries will be analyzed first, and then Chile's particular case.

5.1. Estimation results: Latin American countries

This section's estimations utilize different variables correlating with the *GDP per capita growth rate*. Table 3 shows the results of estimating the different equations for the fourteen countries set. Four different measures of inequality are used: *Gini index, 20:20 ratio, 20:80 ratio,* and *Palma index* (10:40 ratio). In most cases, the estimated coefficient of inequality is negative and significant regardless of the estimation method or the inequality variable.

Whether using OLS, Fixed Effects (FE), or Random Effects (RE), findings show that *inequality* is detrimental to *GDP per capita growth* (see OLS and RE estimations in Appendix D)[16]. In addition, the variable *inequality squared* is incorporated as an explanatory variable to check out for a possible quadratic relationship, but it is found non-significant. So, there is no significant evidence of a non-linear relationship, as could be inferred from Graph 1.

Following Brueckner and Lederman (2018), equations V to VIII include the interaction between the *initial level of inequality* and *GDP per capita* (in logs), being this coefficient significant except when the *20:20 ratio* is used. The inference is that the relationship between *inequality* and *growth rate of GDP per capita,* in general, will depend on the countries' initial level of economic development. By introducing this new variable, the *Gini,* the *20:80 ratio,* and the *Palma index* become significant at 99%, 90%, and 95% confidence levels, respectively, and the negative sign is mantained. This better model especification allows rejecting the hypothesis that the country's dichotomous variables are equal to zero. Furthermore, the Robust Hausman Specification Test was applied (Kaiser 2014)[17], which showed that the FE model is more efficient than the RE model. Additionally, the FE methodology is typically used in social sciences when studying the causality problem; consequently, considering the nature of the data and the possible endogeneity of inequality, the FE model is preferred (Firebaugh *et al.* 2013, Moral and Pérez López 2019). Moreover, the FE model provides a robust estimator for the short run (Baltagi and Griffin 1984, Pirotte 2003).

The results of models V to VIII show that the coefficient of the combined variable is positive; consequently, the higher the level of development, the less detrimental inequality is to growth. Model V (the preferred model) can be taken as an example to obtain the marginal effect of inequality, An increase of one point in the *Gini index* (ceteris paribus) in countries with a

16 The restrictive F test indicates that we cannot reject the null hypothesis of complete homogeneity in equations I to IV; this means that the OLS model must be preferred (Aparicio and Márquez 2005, Moral and Pérez López 2019). However, the F statistic is not much higher than 0.05, and significant individual effects of each country are observed; consequentlyhe models FE and RE are chosen for display.

17 "This command implements a (cluster-)robust version of the Hausman specification test using a bootstrap procedure. For example, this test can be used to compare random effects (RE) vs. fixed effects (FE) models in the case where the RE-GLS estimator is not fully efficient due to heteroscedasticity or serial correlation".

high *LN(GDPpc),* like Argentina in 2010 (9.82), would result in an increase of 0.48% in the *growth rate of GDP per capita* (similar to the result for the Chilean case). Conversely, if a low *Ln(GDPpc)* is considered, such as that of Honduras in 1990 (7.63), an increase of one point in the *Gini index* results in a decrease of 0.13% of the *growth rate of GDP per capita*[18].

TABLE 3
DEPENDENT VARIABLE: GDP PC GROWTH RATE. LATIN AMERICAN COUNTRIES, 1990-2015

	I FE	II FE	III FE	IV FE	V FE	VI FE	VII FE	VIII FE
Variable	**Gini**	**20:20 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**Gini**	**20:20 ratio**	**20:80 ratio**	**Palma Index (10:40)**
LN(GDPp.c.)	-7.092***	-7.561***	-7.399***	-7.166***	-19.982***	-6.880**	-13.184***	-15.501***
	(2.157)	(2.231)	(2.273)	(2.320)	(3.818)	(2.802)	(4.080)	(4.227)
Inequality	**0.0419**	**-0.037***	**-0.822**	**0.416**	**-2.224***	**0.468**	**-40.907***	**-42.340****
	(0.053)	**(0.017)**	**(1.090)**	**(0.988)**	**(0.561)**	**(0.587)**	**(23.151)**	**(17.573)**
Inequality*GDP					0.275***	-0.061	4.89714*	5.113**
					(0.068)	(0.071)	(2.813)	(2.115)
Sec. Female schooling	0.257	-0.228	-0.152	0.176	0.014	-0.240	-0.241	-0.190
	(1.109)	(1.356)	(1.416)	(1.198)	(0.951)	(1.449)	(1.185)	(0.980)
LE	0.139	0.141	0.095	0.133	0.194	0.149	0.142	0.035
	(0.183)	(0.212)	(0.213)	(0.194)	(0.179)	(0.215)	(0.189)	(0.178)
Fertility rate	1.339	0.882	1.154	1.317	2.283**	0.571	2.190**	2.811**
	(1.004)	(0.983)	(1.045)	(1.098)	(0.874)	(1.098)	(0.970)	(1.002)
Export(%GDP)	0.065	0.031	0.045	0.056	0.075*	0.029	0.065	0.075
	(0.038)	(0.043)	(0.047)	(0.043)	(0.037)	(0.044)	(0.049)	(0.043)
1995-2000	-0.151	-0.037	0.133	-0.206	-0.075	-0.090	0.207	0.362
	(1.001)	(0.942)	(1.045)	(1.154)	(0.821)	(0.982)	(0.878)	(0.888)
2000-2005	1.723	2.280	2.468	1.957	1.634	2.171	2.562	3.028*
	(1.832)	(1.807)	(1.893)	(2.085)	(1.479)	(1.907)	(1.541)	(1.592)
2005-2010	4.508*	4.933*	5.242**	4.687	4.626**	4.698*	5.732**	6.699**
	2.321	(2.310)	(2.421)	(2.652)	(1.861)	(2.486)	(2.018)	(2.238)
2010-2015	5.632	5.825	6.241*	5.753	6.336**	5.472	7.313**	8,652**
	(3.276)	(3.309)	(3.409)	3.708	(2.686)	(3.577)	(2.889)	(3.236)
R2	**0.511**	**0.524**	**0.542**	**0.488**	**0.599**	**0.530**	**0.542**	**0.590**
R2_a	**0.425**	**0.436**	**0.448**	**0.392**	**0.520**	**0.433**	**0.448**	**0.504**
Test Ramsey-Reset	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**
N	**68**	**65**	**65**	**64**	**68**	**65**	**65**	**64**

Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. Estimations were derived by using robust standard errors. The cluster() option in Stata makes it possible to estimate in spite of heteroscedasticity and autocorrelation problems. The contemporaneous correlation assumptions are met. The Ramsey-Reset test is applied for omitted variables. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are differences between time periods, hence there are fixed effects over time.

Source: Author's own.

18 It is observed that from a GDP pc of US$3,262, the inequality (Gini) tends to be less detrimental to countries' growth.

All the models include *secondary female schooling*[19]*,* showing that countries with higher female educational levels tend to grow faster. The effect is positive and significant, except in FE models, which could be indicative of a significant long-run effect of *secondary female schooling* on *economic growth* (Baltagi and Griffin 1984, Pirotte 2003)[20]. Furthermore, this variable is positive and highly correlated with the development level (at 99% of confidence) and, consequently, with the variable *inequality*GDP per capita* interaction. The models also include the variable *life expectancy (LE)*. As known, health is deeply connected to inequality (see, for example, Mieres Brevis [2020a]); hence it is not always significant in the inequality-growth relationship[21]. In the FE models, *LE* has the expected sign. The coefficient is negative and significant in OLS and RE models for the variable *total fertility rate*. In FE models, the coefficient changes sign, probably for the same reasons mentioned for the variable *secondary female schooling*[22]. As in Barro (2000), the positive effect of economic openness is controlled through the variable *exports,* wich is positive in all specifications[23].

The results show that there are time-fixed effects for the Latin American countries. The temporal variable reflects the situation in LA in the nineties, a decade of reactivation and poverty reduction (see, for example, Ocampo [2004]). However, as reported by this author, the Asian crisis caused significant instability across LA countries, reflecting the economic vulnerability of a territory still undergoing profound structural transformation. The downturn of the region from the year 1997 on reflected the effects of this international crisis. This condition can explain the results obtained (growth over the period 1995-2000 is significatively lower than during the base period [1990-1995]).

19 Although not present in the table, the equation was estimated with two other measures of education: *human capital index* and *average schooling*. Both variables are significant in explaining economic growth. When *secondary female schooling* is used, the equation presents a higher R^2 R^2.

20 These studies show that the OLS and RE models offer good estimators of the long-run effects, while the FE model provides robust short-term effects.

21 The results show that regions with higher *LE* tend to grow less (in RE models); the interpretation of this result is not evident since higher life expectancy is positively related to both current and long-run income. The sign seems to be influenced by an extreme value corresponding to Bolivia in 2010-2015. Bolivia has the second highest growth in the last period but with the lowest LE.

22 Another possible influence is the last period (2010-2015), where a positive correlation is observed between the *TFR* and the *GDP per capita growth rate*.

23 The variable *natural resource exports* was also tested; the results showed a negative and significant coefficient in several equations, but it was not more efficient than the used variable.

In line with previous works, the possible endogeneity problem caused by the two-way causality between inequality and economic growth can be solved by using instrumental variables (IV) and instrumental variables estimations as a generalized method of moments (IV-GMM) problem (see Table 4)[24]. Both estimation methods show very similar results for the inequality-growth relationship and demonstrate the robustness of the estimation results in Table 3, mainly a negative direct effect of inequality on growth and a positive effect of the combined variable (always significant except for the *20:20 ratio*).

Agriculture (% of GDP), *population,* and *political rights*[25] are the instruments used for the variables *income inequality* and *inequality*GDP per capita*. The two first variables positively correlate with *inequality*; that is, countries with higher population and a high percentage of agricultural production tend to be more unequal (this statement is consistent with the results obtained by Castells-Quintana *et al.* [2015]).

The results show that inequality negatively affects growth in each equation and is significant in all cases except when using the *20:20 ratio*[26]. I*nequality*GDP per capita* has a positive and significant effect (except when using the *20:20 ratio)*. The *20:80 ratio* is the most significant inequality variable at 99% confidence level.

The underidentification and overidentification (Sargan-Hansen) tests show that the instruments satisfy the requirements as instrumental variables; that is, there are no problems with weak or irrelevant instruments (except for the *20:20 ratio*)[27]. The Durbin-Wu-Hausman test is performed to detect if the regressor that presents "endogeneity problems" can be considered as entirely exogenous (Moral & Pérez López, 2019). The results show that with a high p-value, the null hypothesis cannot be rejected; therefore, the instrumental variables method is not required. Nevertheless, IV estimations

24 Whether the models OLS and GMM are the best estimators in the long run is a matter of debate. (Forbes, 2000; Royuela et al., 2019). Consequently, Fixed Effects is used in each case in VI. Regardless of the latter, tables 3 and 5 display similar results, proving the robustness of the results.

25 Dummy variables are used, giving a value of 1 to countries with a score of 1 or 2 on political rights, and 0 on the rest.

26 The *20:20 ratio* is always negative and significant when the variable interaction is not incorporated. The importance of the initial GDP per capita in the inequality-growth relationship cannot be observed when this indicator is used.

27 For a better comparison between the models, the same instrumental variables are used, although in some cases the instruments are not the most efficient (as in equations XV and XVI). Other good instruments are *unemployment rate* and *percentage of rural population*.

and IV-GMM estimations support the results of Table 3 and help handle other situations like mismeasurements in regressors.

TABLE 4
DEPENDENT VARIABLE: GDP PC GROWTH RATE. INSTRUMENTAL VARIABLES AND IV-GMM MODELS. LATIN AMERICAN COUNTRIES, 1990-2015

	IX	X	XI	XII	XIII	XIV	XV	XVI
	IV	IV-GMM	IV	IV-GMM	IV	IV-GMM	IV	IV-GMM
Variable	**Gini**	**Gini**	**20:20 ratio**	**20:20 ratio**	**20:80 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**Palma Index (10:40)**
LN(GDP pc)	-27.627**	-27.873**	-11.562**	-10.416**	-20.725***	-20.607***	-20.039**	-18.793**
	(11.291)	(11.290)	(4.735)	(4.714)	(5.975)	(5.974)	(8.358)	(8.271)
Inequality	**-3.486****	**-3.410****	**-2.842**	**-1.522**	**-87.651*****	**-81.618****	**-67.288***	**-57.107***
	(1.671)	**(1.670)**	**(3.768)**	**(3.732)**	**(33.919)**	**(33.321)**	**(34.983)**	**(33.581)**
Inequality*GDP pc	0.456**	0.445**	0.333	0.163	11.649***	10.785***	8.658**	7.460*
	(0.204)	(0.204)	(0.475)	(0.470)	(4.221)	(4.122)	(4.180)	(4.018)
Sec. Female schooling	0.733	0.355	-0.528	-0.468	1.550	1.285	1.002	0.851
	(1.128)	(1.089)	(1.804)	(1.803)	(1.589)	(1.564)	(1.214)	(1.206)
LE	0.207	0.140	0.128	0.284	0.450**	0.303*	0.140	0.056
	(0.136)	(0.125)	(0.334)	(0.328)	(0.229)	(0.170)	(0.185)	(0.167)
TFR	3.458***	3.288***	2.037	0.456	4.865***	4.597***	4.587***	4.363***
	(1.030)	(1.021)	(4.673)	(4.632)	(1.150)	(1.115)	(1.389)	(1.372)
Export(%GDP)	0.108***	0.131***	0.0164	-0.0199	0.166***	0.175***	0.135***	0.145***
	(0.038)	(0.034)	(0.169)	(0.169)	(0.049)	(0.048)	(0.031)	(0.029)
S-W (Inequality)	**0.032**	**0.032**	**0.379**	**0.379**	**0.016**	**0.016**	**0.056**	**0.056**
S-W (Inequality*GDP)	**0.039**	**0.039**	**0.398**	**0.398**	**0.016**	**0.016**	**0.055**	**0.055**
Underidentification test	**0.042**	**0.042**	**0.616**	**0.616**	**0.196**	**0.196**	**0.038**	**0.038**
Sargan-Hansen	**0.197**	**0.197**	**0.011**	**0.011**	**0.342**	**0.342**	**0.058**	**0.058**
Robust Hausman test	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**0.993**	**1.000**	**0.998**
N	**68**	**68**	**65**	**65**	**65**	**65**	**64**	**64**
Instrumented	Inequality, Inequality*GDP	Inequality, Inequality*GDP	Inequality, Inequality*GDP	Inequality, Inequality*GDP	Inequality, Inequality*GDP	Inequality, Inequality*GDP	Inequality, Inequality*GDP	Inequality, Inequality*GDP
Excluded instruments	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)	Population, Political rights, Agriculture (% GDP)

Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. Estimations were derived by using robust standard errors. The cluster() option in Stata makes it possible to estimate in spite of heteroscedasticity and autocorrelation problems. The contemporaneous correlation assumptions are met. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are differences between time periods, hence there are fixed effects over time (not shown). Country fixed effects are used in all ecuations. The multivariate Sanderson-Windmeijer F test of excluded instruments is included for individual endogenous regressors and the Underidentification test is aplied under the null hypothesis that the equation is underidentified. The Sargan-Hansen test is applied to contrast overidentification of the instruments. The cluster-robust Hausman test (rhausman in Stata) allows testing the endogeneity of the regressors.

Source: Author's own.

Finally, the author conducts a brief analysis to ascertain if results still hold when considering more extended periods, in an attempt to better capture the long run effect of inequality on growth. However, due the low number of observations obtained the results must be regarded with caution. In this case, the time horizon 1990-2015 is divided into two subperiods: 1990-2005 and 2005-2015. Despite the limitation of the sample size, the results are consistent with those in Table 3 and 4, and there is a tendency: *income inequality* negatively affects growth, and the combined variable *inequality*GDP per capita* positively and significantly affects growth in the equations that use FE (except when using the *20:20 ratio*), see Appendix E.

Considering the results obtained by Ostry *et al.* (2014, 2018), greater equality can help sustain growth, and the evidence suggests that inequality can reduce the pace and length of growth. In the same line, Atkinson (2016, 29) paraphrases Christine Lagarde (Managing Director of the International Monetary Fund) who, in her speech at the annual IMF and World Bank meeting, stated that "recent IMF research tells us that less inequality is associated with greater macroeconomic stability and more sustainable growth."

5.2. Estimation results: Chilean regions

Section 5.1 showed that the effect of inequality on growth in Latin American countries could be negative or positive depending on the level of economic development. The positive and significant coefficient of the interaction variable *inequality*GDP per capita* allows us to infer that this effect could be positive for countries with higher incomes. For this reason, the case of Chile is analyzed in this section as it stands out not only as one of the most developed LA countries but also as one of the countries in the world with very high and persistent inequality[28].

Table 5 shows the estimation outcomes when FE and RE models are applied using different inequality measures The cluster-robust Hausman Test is applied, showing that the FE model is more efficient than the RE model regardless of the inequality measure used[29]. In contrast to the results for LA countries, as analyzed above, *inequality* has a positive effect on growth (non-significant for the *Gini index*), and the variable *inequality squared* becomes significant with a negative sign (again non-significant for the *Gini index*)[30].

28 By incorporating the variable *inequality*GDP pc* into the Chilean model, it is significant only when using the *20:20 ratio* revealing that inequality positively affects growth in regions with a higher level of development.

29 The results of the *F-test* show that all equations require the Fixed Effects model instead of the OLS model. When OLS is used, inequality is equally significant and keeps the sign. This also means less adjustment to the model than when FE or RE are used (see OLS estimates in Appendix G)

30 The incomes of the middle class usually represent about half of the gross national income, while the other half is divided between the very rich and the poor (Palma 2011). For this reason, it is more plausible to see the effect of income inequality on growth when disparities between these last two groups are compared.

Therefore, it would be correct to conclude that in the case of the Chilean regions' *inequality* shows an inverted U relationship with *GDP per capita growth*. The regions of Chile initially grow as they move away from perfect equality, but when inequality reaches a relatively high level, it becomes detrimental to growth[31]. Benhabib (2003) demonstrates that a modest level of inequality could lead to higher growth rates as productivity differences are leveraged. However, a high level of inequality is detrimental to growth as it motivates rent-seeking, appropriation, and excessive interference from the government.

The estimations show that the quadratic relationship remains even when the *initial GDP per capita* and the other proposed variables are controlled for. The *20:20 ratio*, the *20:80 ratio,* and the *Palma index* seem to be more efficient measures of inequality than the *Gini index* when estimating the model for short-run growth and inequality across the regions of Chile. For illustration purposes, consider the model with the best fit (model VII with an R^2 of 0.68): the regions of Chile tend to show lower growth rates when the *Palma index* is higher than 2.36 points. For instance, this value is observed in the region of Maule in 2009 (2.38 points), where the income share of the wealthiest 10% of households was 35.5%, 2.4 times the share of the poorest 40% of households. In contrast, regions with Palma coefficients below 2.36, such as Antofagasta, will show an inverse relationship between inequality and growth. On average, however, the effect of inequality on growth will be positive, regardless of the inequality indicator used. This result is consistent with the one obtained in the LA country study in Section 5.1, mainly that relatively higher developed countries in LA tend to show a positive effect of inequality on growth.

Consistent with the convergence result in Mieres Brevis' work (2020b), *initial GDP per capita* negatively affects a region's growth (non-significant in RE models); that is, when controlling for variables correlated with long-run income such as education and life expectancy, initially poorer regions tend to grow faster than initially wealthier ones. The effect of initial income on growth tends to be non-significant when using RE models (long-run effect).

The results show that an increase in average years of schooling (*education growth*)[32] has a positive and significant effect on growth (for all model

31 These results are consistent with those obtained by Chen (2003), Benhabib (2003), and Grigoli and Robles (2017).

32 This variable is used because it is more significant than other variables that are also correlated with *GDP pc growth*, as *initial schooling* or *secondary female schooling*.

specifications except model IV). On the other hand, the effect of the *tertiary sector*[33] is positive and significant in all cases (except model VIII). *Life expectancy* is positive in all the estimations and significant at 95% in the FE models (except model I). The models study the effect of *global fertility rate (GFR)*[34] on growth. In the short run, regions with high global fertility rates tend to show higher average growth, but this effect changes in the long run (Appendix F).

TABLE 5
DEPENDENT VARIABLE: GDP PC GROWTH RATE. REGIONS OF CHILE, 1990-2017

	I	II	III	IV	V	VI	VII	VIII
	FE	RE	FE	RE	FE	RE	FE	RE
Variable	**Gini**	**Gini**	**20:20 ratio**	**20:20 ratio**	**20:80 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**Palma Index (10:40)**
LN(GDP pc)	-8.465***	-1.142	-9.238***	-0.842	-8.877***	-0.948	-8.183***	-0.850
	(2.690)	(0.808)	(2.537)	(0.733)	(2.177)	(0.703)	(2.338)	(0.784)
Inequality	**0.965**	**1.789**	**1.147****	**1.093*****	**35.331****	**29.914***	**9.775****	**10.433****
	(1.100)	**(1.669)**	**(0.468)**	**(0.422)**	**(15.769)**	**(15.701)**	**(4.314)**	**(4.287)**
Inequality^2	-0.008	-0.016	-0.039*	-0.038**	-17.612**	-14.828*	-2.068*	-2.259**
	(0.011)	(0.016)	(0.020)	(0.018)	(8.131)	(8.365)	(0.998)	(1.045)
Education growth	0.156**	0.094*	0.179**	0.117	0.119***	0.076*	0.153***	0.096**
	(0.059)	(0.054)	(0.061)	(0.074)	(0.036)	(0.046)	(0.043)	(0.047)
LE	0.563	0.227	0.568**	0.159	0.559**	0.185	0.606**	0.269
	(0.251)	(0.163)	(0.258)	(0.168)	(0.216)	(0.171)	(0.209)	(0.177)
GFR	3.527	4.582**	3.140	4.507**	2.908	4.488**	3.652*	5.016***
	(2.270)	(1.881)	(1.970)	(1.811)	(2.094)	(1.895)	(1.775)	(1.886)
Tertiary sector (%GDP)	0.117***	0.024*	0.094***	0.027**	0.091**	0.026*	0.090**	0.022
	(0.028)	(0.015)	(0.028)	(0.012)	(0.033)	(0.015)	(0.031)	(0.018)
R2	**0.630**	**0.399**	**0.664**	**0.420**	**0.660**	**0.402**	**0.680**	**0.443**
R2_a	**0.587**		**0.626**		**0.621**		**0.644**	
Test Ramsey-Reset	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**

N=69. Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. The robust() option in Stata makes it possible to estimate in spite of heteroscedasticity problems. The contemporaneous correlation and autocorrelation assumptions are met. The Ramsey-Reset test is applied for omitted variables. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are not differences between time periods, hence there are not fixed effects over time.

Source: Author's own.

As in the previous section, and considering a possible endogeneity problem in the model, an FE model with instrumental variables[35] is used for Table 6, showing that the main results displayed in Table 5 are robust. *Initial unem-*

33 Other sectoral variables were not significant. For instance, the *agricultural sector* negatively affected *GDP pc growth*, but this variable was not significant in the model.
34 In Chile, the GFR is used, which is equal to the TFR in the study of LA countries.
35 The same instrumental variables are used for a better comparison between the models, although in some cases the instruments are not the most efficient (as in equations IX and X). Another good instrument is, for example, *population.*

ployment rate, last quintile income, rural population concentration, academic offer, and *social public spending* are used to instrument *income inequality*. *Unemployment rate* has a positive and significant effect on inequality. Unemployment is usually concentrated in the quintiles with the lowest incomes, as confirmed by Jiménez and Ruedi (1998). Therefore, higher unemployment rates affect the incomes of the poorest quintile and increase inequalities.

Moreover, the higher income of the wealthiest 20% of the population is related to greater inequality (Mieres Brevis, 2020a). On the other hand, regions with a broader *offer of higher education* or more *social public spending* tend to be less unequal. *Rural population concentration* is positively correlated with all the measures of inequality[36].

The instruments do not show problems of under-identification (p-values under 0.05 in each case, except using the *Gini index*) or over-identification (Sargan-Hansen test). IV estimations are used as a generalized method of moments (GMM) to test for robustness,. The results are emphatic: there is a quadratic relationship between inequality and growth in Chile. The *20:80 ratio* is the most significant measure of inequality (at 99% of confidence level). *Education* and the other control variables maintain their sign and remain significant in most model specifications. The cluster-robust Hausman Test is applied. Results show that with a high p-value, the null hypothesis cannot be rejected; therefore, instrumental variables would not be required. However, both estimations IV and IV-GMM support the results of Table 6.

A final consideration is to determine if these results could be replicated under more extended periods, dividing the period into two parts instead of five, for example. Considering that there are few regions in Chile, the number of observations obtained is deficient, and the results are only indicative. A quadratic relationship between inequality and growth is not evident in this case. Although both variables *inequality* and *inequality squared* maintain their signs, they are not significant, but *inequality* on *GDP per capita growth* has a positive and highly significant effect (see Appendix F). The results also show that the *Gini index* is a better measure of inequality in the long run than in the short run. Model XVII shows that an increase of one standard deviation on the *Gini* would result in an increase in the *growth rate of GDP*

36 The variable inequality squared is not instrumented because the C test of orthogonality is run showing that this variable can be treated as exogenous (see Baum *et al.* [2003, 24]).

pc of 0.11%. As expected, the sign of *GFR* changes when considering more extended periods since regions with higher global fertility rates tend to have lower average growth rates[37].

TABLE 6
DEPENDENT VARIABLE: GDP PC GROWTH RATE. INSTRUMENTAL VARIABLES AND IV-GMM MODELS. REGIONS OF CHILE, 1990-2017

	IX	X	XI	XII	XIII	XIV	XV	XVI
	IV	IV-GMM	IV	IV-GMM	IV	IV-GMM	IV	IV-GMM
Variable	Gini	Gini	20:20 ratio	20:20 ratio	20:80 ratio	20:80 ratio	Palma Index (10:40)	Palma Index (10:40)
LN(GDP pc)	-7.383***	-9.497***	-9.207***	-10.616***	-8.887***	-10.848***	-8.159***	-10.424***
	(2.560)	(2.262)	(2.052)	(1.939)	(1.754)	(1.491)	(1.980)	(1.771)
Inequality	**7.163**	**8.524***	**1.294****	**0.832**	**34.901*****	**33.035*****	**9.947****	**7.340***
	(5.795)	**(4.747)**	**(0.639)**	**(0.589)**	**(11.775)**	**(10.709)**	**(4.241)**	**(3.841)**
Inequality^2	-0.068	-0.083*	-0.046*	-0.024	-17.391***	-17.777***	-2.108**	-1.688*
	(0.057)	(0.046)	(0.026)	(0.024)	(6.316)	(5.746)	(1.028)	(0.942)
Education growth	0.100	0.038	0.185***	0.108**	0.119**	0.068	0.153***	0.096*
	(0.088)	(0.070)	(0.060)	(0.051)	(0.056)	(0.050)	(0.057)	(0.053)
LE	0.656***	0.782***	0.582***	0.681***	0.559***	0.776***	0.607***	0.772***
	(0.204)	(0.190)	(0.169)	(0.164)	(0.175)	(0.149)	(0.161)	(0.150)
GFR	5.266**	7.445*	3.207*	4.572**	2.906	6.485***	3.665*	6.203***
	(2.583)	(2.299)	(1.911)	(1.769)	(2.370)	(1.754)	(2.015)	(1.785)
Tertiary sector (%GDP)	0.103**	0.083**	0.093**	0.104***	0.091***	0.117***	0.090**	0.111***
	(0.052)	(0.042)	(0.039)	(0.035)	(0.034)	(0.029)	(0.035)	(0.030)
Underidentification test	**0.358**	**0.358**	**0.041**	**0.041**	**0.002**	**0.002**	**0.007**	**0.007**
Sargan-Hansen	**0.354**	**0.354**	**0.118**	**0.118**	**0.162**	**0.162**	**0.064**	**0.064**
Robust Hausman test	**0.849**	**0.418**	**1.000**	**0.547**	**1.000**	**0.255**	**1.000**	**0.530**
Excluded instruments	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.	Unemployment rate, Academic offer, Social public spending, Last quintile, Rural pop.

N=69. Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. The model of Robust Fixed Effects makes it possible to estimate in spite of heteroscedasticity problems. The contemporaneous correlation and autocorrelation assumptions are met. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are not differences between time periods, hence there are not fixed effects over time. *Inequality* is the instrumented variable. The Underidentification test is aplied under the null hypothesis that the equation is underidentified. The Sargan-Hansen test is applied to contrast overidentification of the instruments. The cluster-robust Hausman test (rhausman in Stata) allows testing the endogeneity of the regressors.

Source: Author's own.

A question here is how to explain the positive part of the relationship between inequality and economic growth observed in Chile. A first possible hypothesis to answer this question is that variables that positively relate not

37 A result that is consistent with the findings of Perotti (1996), Barro (2000), and De La Croix and Doepke (2003). In XXI and XXII models, other control variables are used. *Inequality* is still significant with this new combination of variables

only to *inequality* but also to *GDP per capita growth rate* are not included in the model because of a paucity of disaggregated data available at a regional level. Besides, this behavior can be explained as the effect of progressive enrichment of that part of the population with the highest incomes; their better access to credit and investment fosters growth (Perotti 1994, 1996, Deininger and Squire 1998).

In line with the work of Bengoa and Sánchez-Robles (2004), additional estimations are performed including *inequality growth* (in absolute value) as an explanatory variable (see Appendix G). The results show that regions with higher growth in inequality (all measures) tend to grow more slowly (only the *20:20 ratio* and the *Palma index* are significant).

As mentioned in Section 2, different positive and negative forces play a simultaneous role in the inequality-growth relationship, and the result depends on the relative influence of each one of them. In the case of Chile, results suggest that the channels through which inequality positively affects growth are stronger at first. Nevertheless, as established in our short-run analysis, when inequality is too high, negative forces such as loss of life quality, poorer education, social unrest, and others, appear more significant than the positive ones. These results are a call to focus the political efforts on those factors that reduce inequality and, simultaneously, foster growth, such as investment in human capital. The data for Chile prove that inequality has a negative effect on education (results are not displayed). All the used measures of inequality demonstrate that regions with greater inequalities tend to have fewer *years of schooling* as well as lower *growth of education*. It is necessary to highlight this result since schooling is the primary channel through which inequality affects growth, as Deininger and Squire (1998) state.

6. CONCLUSIONS

According to the literature, there are different channels through which inequality affects growth. It is worth noting that a possible inference from the literature is that the initial development rate of the countries (GDP pc) plays an essential role in predicting economic growth, and this paper could support that assumption.

The empirical analysis of Latin American countries shows that countries with greater levels of inequality tend to present lower economic growth rates.

The *Gini index*, the *20:80 ratio*, and the *Palma index* appear to be the best proxies to measure inequality in LA. The analysis includes the interaction between the *inequality* indicator and the level of economic development (measured by *Ln[GDP per capita]*). As this coefficient is positive and significant, a possible inference is that the relationship between *inequality* and *growth* depends on the countries' initial level of development. Inequality tends to be less detrimental to growth in countries with higher levels of development. This assumption could support the results for Chile since it is the country with the highest GDP per capita in LA

The assesment of the Chilean regions allows concluding that *inequality* shows an inverted U relationship with *GDP per capita growth*. That is, growth rises at first as we move away from full equality but then fall as inequality rises further. The *20:20 ratio*, the *20:80 ratio*, and the *Palma index* prove to be more efficient measures of inequality than the *Gini* to estimate the short-run inequality-growth model for Chile. The positive part of this relationship can be explained as follows: 1) A higher initial income rate helps mitigate the negative effect of inequality, which is especially true when inequality is a consequence of an increment in the income share of the rich, and a group of people is endowed with the capacity to accumulate more human capital, start businesses, and innovate. This situation, in turn, fosters more significant growth. 2) Another possible inference is that the effect of redistribution is omitted.

Estimations with instrumental variables and IV estimations as a generalized method of moments (GMM) problem are used to test for the robustness of the results. Although the cluster-robust Hausman test shows no endogeneity problems and instrumental variables are not required, the results are maintained confirming that inequality negatively affects growth in Latin American countries and that there is a non-linear relationship in the case of Chile.

Finally, it is necessary to keep in mind that the relationship between inequality and growth is complex because many positive and negative forces play simultaneously, and the results vary depending on the strength of each particular force. Public policies should consider these forces and their effect on growth and favor those that simultaneously yield equality and more significant economic growth.

The main limitation of this work is the low number of observations. Equally, in the case of Chile, it is still complicated to find regional data for variables that are of great interest, variables that could be related to inequality and growth. Following the works of Castells-Quintana and Royuela (2017) and Ostry et al. (2018), it would be of interest to complete this line of research by separately identifying the positive and negative forces, redistribution included, that affect the inequality-growth relationship.

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8 APPENDIX

A. Empirical literature summary

Authors	Type of Study	Sample	Period	Inequality/Growth relationship
Alesina and Rodrik (1994)	Cross-sectional	70 developed and developing countries	1960-1985	(-) Income and land ownership inequality
Persson and Tabellini (1994)	Panel and cross-sectional	9 countries (8 Europeans and USA); 56 developed and developing countries	1830-1985; 1960-1985	(-)
Perotti (1996)	Cross-sectional	67 developed and developing countries	1960-1985 (or the last available year)	(-)
Alesina and Perotti (1996)	Cross-sectional	70 developed and developing countries	1960-1985	(-)
Deininger and Squire (1998)	Cross-sectional	Developed and developing countries (87 countries in first estimates)	1960-1992	(-) Land ownership inequality; not significant for income inequality
Li and Zou (1998)	Panel data	46 developed and developing countries	1960-1990	(+)
Rodrik (1999)	Cross-sectional	Developed and developing countries	1960-1989	(-)
Forbes (2000)	Panel data	45 developed and developing countries	1965-1995	(+) the results do not apply to very poor countries based on the limited availability
Barro (2000)	Panel data	Developed and developing countries	1965-1995	NON-LINEAR. (-) poor countries; (+) rich countries; (-) for the whole sample by not considering fertility in the model
Banerjee and Duflo (2003)	Panel data	45 developed and developing countries	1965-1990	NON LINEAR. Net changes in inequality, in any direction, cause a decrease on growth rates
Ríos (2003)	Panel data	32 Federated States of Mexico	1984-1999	(-)
Bengoa and Sánchez-Robles (2004)	Panel data	11 countries from Latin America and the Caribbean	1975-1995	NON LINEAR. Very high or very low inequality experienced a lower growth rate
Easterly (2007)	Cross-sectional	Developed and developing countries	1960-1998	Inequality (-) affects development through agricultural endowments
Lin et *al.* (2009)	Panel and cross-sectional	82 developed and developing countries	1965-2003	NON LINEAR. (-) poor countries; (+) rich countries
Delbianco (2014)	Panel data	20 countries from Latin America and the Caribbean	1980-2010	(-) the entire sample (income inequality); (+) rich countries (inequality measured through incomes of the wealthiest 10%)
Ostry et *al*. (2014; 2018)	Panel data	Developed and developing countries	1960-2010	(-)
Castells-Quintana and Royuela (2017)	Cross-sectional	Developed and developing countries	1970-2007	Differentiates between (+) and (-) forces
Royuela, Veneri and Ramos (2019)	Panel data	Regions of 15 OECD countries	2003-2013	(-)
Balcilar et al. (2021)	Panel data	63 countries	1991-2017	NON LINEAL. Positive relationship up to a Gini of 35.92
Dorofeev, M. L. (2022)	Panel data	39 countries	1980-2019	The correlation is more negative for countries with low income and more positive in countries with high income per capita (partial confirmation)

Source: Author's own.

B. Descriptive statistics, Latin American countries, 1990-2015.

Variable	Source		Mean	Std. Dev.	Min	Max	Obs.
GDP per capita growth rate (%)	Calculated from World Bank (2018)	overall	4.61	1.81	-0.07	10.32	N = 70
		between		1.05	3.29	6.72	n = 14
		within		1.50	1.03	8.22	T = 5
LN(GDP pc)	World Bank (2018)	overall	8.84	0.52	7.63	9.82	N = 70
		between		0.42	7.93	9.36	n = 14
		within		0.32	8.10	9.50	T = 5
Gini index	World Bank (2018); Deininger and Squire (1996)	overall	51.33	5.20	40.80	61.60	N = 70
		between		4.14	43.86	57.82	n = 14
		within		3.30	40.37	59.97	T = 5
20:20 ratio*	Calculated from World Bank (2018)	overall	18.99	11.08	8.12	76.25	N = 67
		between		7.62	9.82	37.31	n = 14
		within		8.26	-1.49	57.93	T-bar = 4.79
20:80 ratio*	Calculated from World Bank (2018)	overall	1.31	0.24	0.89	1.82	N = 67
		between		0.18	1.00	1.65	n = 14
		within		0.16	0.82	1.68	T-bar = 4.79
Palma index*	Calculated from World Bank (2020)	overall	1.76	0.34	1.10	2.40	N = 66
		between		0.29	1.21	2.19	n = 14
		within		0.21	1.14	2.22	T-bar = 4.71
Secondary female schooling	Barro and Lee (2013)	overall	2.08	0.60	0.87	3.67	N = 70
		between		0.51	1.12	3.12	n = 14
		within		0.33	1.43	2.94	T = 5
Life expectancy	World Bank (2018)	overall	71.79	4.50	55.11	78.73	N = 70
		between		4.06	60.72	77.29	n = 14
		within		2.16	66.18	77.48	T = 5
Total fertility rate (TFR)	World Bank (2018)	overall	2.91	0.75	1.81	5.14	N = 70
		between		0.61	2.17	4.05	n = 14
		within		0.45	1.75	4.02	T = 5
Exports (% of GDP)	World Bank (2018)	overall	31.03	15.98	7.53	70.04	N = 70
		between		15.52	10.38	64.18	n = 14
		within		5.32	20.30	44.14	T = 5

* Acording to the availability of data it was possible calculate this variable for all the countries, but not for each of the periods studied.

Source: Author's own.

C. Descriptive statistics, regions of Chile, 1990-2017.

Variable	Source		Mean	Std. Dev.	Min	Max	Obs.
GDP per cápita growth rate (%)	Calculation on data from Banco Central de Chile (Central Bank of Chile) and INE (National Office of Statistics).	overall	2,86	2,69	-4,21	11,69	N = 69
		between		1,06	1,01	5,15	n = 15
		within		2,47	-4,16	10,42	T-bar = 4.6
LN(GDP pc)	Calculation on data from Banco Central de Chile (Central Bank of Chile) and INE (National Office of Statistics).	overall	8,51	0,59	7,37	10,07	N = 69
		between		0,51	7,80	9,82	n = 15
		within		0,28	7,80	9,11	T-bar = 4.6
Gini index	Ministerio de Desarrollo Social (Ministry of Social Development). Some indexes have been calculated from CASEN Survey data.	overall	51,34	4,63	42,00	60,00	N = 69
		between		3,24	44,79	56,14	n = 15
		within		3,53	43,17	59,50	T-bar = 4.6
20:20 ratio	Calculated from CASEN Survey data.	overall	8,47	2,60	4,59	20,03	N = 69
		between		1,85	5,92	12,64	n = 15
		within		1,91	5,38	15,86	T-bar = 4.6
20:80 ratio	Calculated from CASEN Survey data.	overall	0,88	0,19	0,51	1,33	N = 69
		between		0,13	0,63	1,08	n = 15
		within		0,15	0,61	1,34	T-bar = 4.6
Palma index	Calculated from CASEN Survey data.	overall	1,86	0,57	0,87	3,20	N = 69
		between		0,39	1,20	2,57	n = 15
		within		0,44	1,02	3,35	T-bar = 4.6
Education growth	Calculated from CASEN Survey data.	overall	5,46	3,64	-3,21	14,61	N = 69
		between		1,52	1,31	7,70	n = 15
		within		3,45	-2,37	13,62	T-bar = 4.6
Life expectancy	INE (National Office of Statistics).	overall	75,31	4,01	66,36	80,62	N = 69
		between		1,50	73,82	78,84	n = 15
		within		3,82	67,61	80,40	T-bar = 4.6
Global fertility rate (GFR)	INE (National Office of Statistics).	overall	2,22	0,36	1,72	3,26	N = 69
		between		0,18	1,88	2,52	n = 15
		within		0,31	1,79	3,05	T-bar = 4.6
Tertiary sector (% of GDP)	Banco Central de Chile (Central Bank of Chile).	overall	48,83	14,25	20,28	79,09	N = 69
		between		13,50	23,81	74,48	n = 15
		within		6,33	36,09	61,49	T-bar = 4.6

Source: Author's own.

D. Latin America's additional estimates.

	I	II	III	IV	V	VI	VII	VIII
	OLS	OLS	OLS	OLS	RE	RE	RE	RE
Variable	**Gini**	**20:20 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**Gini**	**20:20 ratio**	**20:80 ratio**	**Palma Index (10:40)**
LN(GDP pc)	-1.093*	-1.080*	-1.259*	-1.105*	-1,093**	-1,080**	-1,259**	-1,105*
	(0.536)	(0.533)	(0.631)	(0.612)	(0.536)	(0.533)	(0.631)	(0.612)
Inequality	**-0.045***	**-0.034****	**-2.013*****	**-1.087***	**-0,045***	**-0,034****	**-2,013*****	**-1,087****
	(0.025)	**(0.014)**	**(0.581)**	**(0.534)**	**(0.025)**	**(0.014)**	**(0.581)**	**(0.534)**
Sec. Female schooling	1.172***	1.251***	1.148***	1.223***	1,172***	1,251***	1,148***	1,223***
	(0.186)	(0.254)	(0.197)	(0.188)	(0.186)	(0.254)	(0.197)	(0.188)
LE	-0.059	-0.082*	-0.097**	-0.076**	-0.059	-0,082**	-0,097***	-0,076*
	(0.043)	(0.042)	(0.036)	(0.043)	(0.043)	(0.042)	(0.036)	(0.043)
Fertility rate	-1.164**	-1.256**	-1.438**	-1.158**	-1,164**	-1,256***	-1,438***	-1.158
	(0.452)	(0.419)	(0.485)	(0.440)	(0.452)	(0.419)	(0.485)	(0.440)
Export(%GDP)	0.032***	0.037***	0.033***	0.028***	0,032***	0,037***	0,033***	0,028***
	(0.009)	(0.010)	(0.008)	(0.006)	(0.009)	(0.010)	(0.008)	(0.006)
1995-2000	-2.121***	-2.238***	-1.948***	-2.163***	-2,121***	-2,238***	-1,948***	-2,163***
	(0.393)	(0.406)	(0.429)	(0.522)	(0.393)	(0.406)	(0.429)	(0.522)
2000-2005	-1.654**	-1.634**	-1.340**	-1.560**	-1,654***	-1,634***	-1,340**	-1,560**
	(0.577)	(0.624)	(0.583)	(0.632)	(0.577)	(0.624)	(0.583)	(0.632)
2005-2010	-0.656	-0.907	-0.588	-0.767	-0.656	-0.907	-0.58784	-0.767
	(0.545)	(0.566)	(0.530)	(0.621)	0.545	(0.566)	(0.530)	(0.621)
2010-2015	-1.968**	-2.202***	-1.988**	-2.085**	-1,968***	-2,202***	-1,988***	-2,085***
	(0.671)	(0.707)	(0.679)	(0.721)	(0.671)	(0.707)	(0.679)	0.721
R2	**0.479**	**0.502**	**0.518**	**0.508**	**0.479**	**0.518**	**0.518**	**0.479**
R2_a	**0.387**	**0.410**	**0.428**	**0.416**				
Test Ramsey-Reset	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**
N	**68**	**65**	**65**	**64**	**68**	**65**	**65**	**64**

Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. Estimations were derived by using robust standard errors. The cluster() option in Stata makes it possible to estimate in spite of heterocedasticity and autocorrelation problems. The contemporaneous correlation assumptions are met. The Ramsey-Reset test is applied for omitted variables. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are differences between time periods, hence there are fixed effects over time.

Source: Author's own.

E. Dependent variable: GDP pc growth rate. Latin American countries in the long run (1990-2005; 2005-2015).

	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV
	FE	RE	FE	RE	FE	RE	FE	RE
Variable	**Gini**	**Gini**	**20:20 ratio**	**20:20 ratio**	**20:80 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**Palma Index (10:40)**
LN(GDP pc)	-23.07**	-0.773	4.651**	-2.106	-9.283**	-1.410	-16.497***	-1.831
	(8.018)	(4.878)	(2.242)	(2.267)	(3.882)	(2.884)	(2.416)	(3.026)
Inequality	**-3.982****	**-0.003**	**0.027**	**-0.544**	**-97.085*****	**-3.882**	**-99.233*****	**-6.144**
	(1.443)	**(0.810)**	**(1.033)**	**(0.835)**	**(29.738)**	**(17.877)**	**(15.920)**	**(14.297)**
Inequality*GDP pc	0.501**	-0.002	-0.010	0.062	11.868***	0.416	12.571***	0.646
	(0.178)	(0.094)	(0.122)	(0.097)	(3.542)	(2.070)	(1.874)	(1.617)
Sec. Female schooling	0.173	1.243***	-4.661***	1.206***	-2.830	1.245***	1.563	1.235***
	(0.912)	(0.347)	(1.419)	(0.366)	(2.081)	(0.390)	(1.947)	(0.334)
LE	0.198	-0.014	0.101	0.028	0.323	0.003	0.257*	0.002
	(0.151)	(0.067)	(0.087)	(0.066)	(0.212)	(0.071)	(0.133)	(0.049)
TFR	1.983	-0.528	-0.824	-0.446	3.285**	-0.426	5.828***	-0.223
	(1.629)	(0.555)	(0.942)	(0.479)	(1.303)	(0.601)	(0.615)	(0.503)
Export(%GDP)	-0.009	0.021	-0.073	0.022	0.053	0.018	0.154***	0.018
	(0.064)	(0.015)	(0.051)	(0.016)	(0.040)	(0.017)	(0.017)	(0.014)
R2	**0.667**	**0.488**	**0.766**	**0.521**	**0.768**	**0.484**	**0.874**	**0.494**
R2_a	**0.537**		**0.670**		**0.673**		**0.819**	
Test Ramsey-Reset	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**
N	**26**	**26**	**25**	**25**	**25**	**25**	**24**	**24**

Dependent var: GDP per cápita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. Estimations were derived by using robust standard errors. The cluster() option in Stata makes it possible to estimate in spite of heteroscedasticity and autocorrelation problems. The contemporaneous correlation assumptions are met. The Ramsey-Reset test is applied for omitted variables. A cluster-robust Hausman test was applied (rhausman in Stata), which showed that for all equation the Fixed Effects model is more efficient than the Random Effects model (except using 20:20 ratio). The F test shows that OLS model is preferred in each case. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are not differences between time periods, hence there are not fixed effects over time.

Source: Author’s own.

F. Dependent variable: GDP pc growth rate. Regions of Chile in the long run (1990-2003; 2003-2017).

	XVII	XVIII	XIX	XX	XXI	XXII
	FE	FE	FE	FE	FE	FE
Variable	**Gini**	**20:20 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**Gini**	**20:80 ratio**
LN(GDP pc)	-0.990***	-1.030***	-0.970***	-1.077***	-0.638***	-0.651***
	(0.220)	(0.196)	(0.206)	(0.191)	(0.189)	(0.145)
Inequality	**0.028****	**0.032*****	**0.394*****	**0.143*****	**0.027*****	**0.042*****
	(0.007)	**(0.007)**	**(0.083)**	**(0.028)**	**(0.007)**	**(0.001)**
Education growth	0.017***	0.010**	0.013***	0.0160***	0.014***	0.011***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
LE	0.033**	0.022*	0.029**	0.030**		
	(0.014)	(0.010)	(0.012)	(0.012)		
GFR	-0.168	-0.170	-0.122	-0.187	-0.340***	-0.310***
	(0.248)	(0.227)	(0.230)	(0.224)	(0.098)	(0.085)
Tertiary sector (%GDP)	-0.001	0.001	0.001	0.000		
	(0.003)	(0.003)	(0.003)	(0.003)		
EAP growth					0.006***	0.007***
					(0.001)	(0.001)
Indigenous concentration					-0.004***	-0.005***
					(0.001)	(0.001)
R2	**0.961**	**0.951**	**0.958**	**0.955**	**0.973**	**0.981**
R2_a	**0.949**	**0.936**	**0.945**	**0.941**	**0.964**	**0.975**
Test Ramsey-Reset	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**

N=26. Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The model of Robust Fixed Effects makes it possible to estimate in spite of heteroscedasticity problems. The contemporaneous correlation and autocorrelation assumptions are met. An F test is applied to know the joint significance of the temporary variables in the model, the test shows that there are not differences between time periods, hence there are not fixed effects over time.The Ramsey-Reset test is applied for omitted variables.

Source: Author's own.

G. Chilean regions' additional estimates.

	I	II	III	IV	VII	VIII	IX	X
	OLS	**OLS**	**OLS**	**OLS**	**FE**	**FE**	**FE**	**FE**
Variable	**Gini**	**20:20 ratio**	**20:80 ratio**	**Palma Index (10:40)**	**20:20 ratio**	**20:20 ratio**	**Palma Index (10:40)**	**Palma Index (10:40)**
LN(GDP pc)	-1.094*	-0.754	-0.948	-0.776	-11.153***	-10.625***	-11.023***	-8.653**
	(0.637)	(0.649)	(0.657)	(0.632)	(2.441)	(2.530)	(2.249)	(3.042)
Inequality	1.749	1.107**	29.914**	9.906**		0.980**		9.375*
	(1.486)	(0.478)	(14.791)	(4.038)		(0.407)		(4.954)
Inequality^2	-0.015	-0.039**	-14.828*	-2.126**		-0.040**		-2.035*
	(0.014)	(0.018)	(7.688)	(0.929)		(0.018)		(1.060)
Inequality growth					-0.240**	-0.188**	-0.964*	-0.270
					(0.094)	(0.080)	(0.467)	(0.561)
Education growth	0.095	0.119*	0.076	0.100	0.156**	0.189**	0.189***	0.162***
	(0.074)	(0.069)	(0.071)	(0.071)	(0.060)	(0.069)	(0.053)	(0.047)
LE	0.222	0.154	0.185	0.258	0.486	0.575*	0.540*	0.605**
	(0.185)	(0.167)	(0.170)	(0.171)	(0.277)	(0.271)	(0.269)	(0.216)
GFR	4.511**	4.450**	4.488**	4.914***	1.430	2.140	2.136	3.400*
	(1.252)	(1.837)	(1.928)	(1.786)	(2.586)	(2.337)	(2.571)	(1.633)
Third sector (%GDP)	0.021	0.023	0.026	0.018	0.076**	0.074**	0.087**	0.085**
	(0.023)	(0.022)	(0.023)	(0.022)	(0.032)	(0.034)	(0.035)	(0.034)
R2	**0.400**	**0.421**	**0.402**	**0.444**	**0.643**	**0.676**	**0.622**	**0.681**
R2_a	**0.331**	**0.354**	**0.333**	**0.381**	**0.609**	**0.633**	**0.586**	**0.639**
Test Ramsey-Reset	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**	**Pass**

N=69. Dependent var: GDP per capita growth rate. Standard error in parentheses. *10% significance level. **5% significance level. ***1% significance level. The constant (not shown) is included in each model. The Robust models makes it possible to estimate in spite of heteroscedasticity problems. The contemporaneous correlation and autocorrelation assumptions are met. The Ramsey-Reset test is applied for omitted variables.

Source: Author's own.

H. Definitions of variables used in the analysis of LA countries.

Agriculture, value added (percent of GDP): "Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs". Retrieved from World Bank (2018).

Exports (percent of GDP): "Exports of goods and services represent the value of all goods and other market services provided to the rest of the world". Retrieved from World Bank (2018).

GDP per capita: "GDP per capita purchasing power parity based (PPP). GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products (…) Data are in current U.S. dollars". Retrieved from World Bank (2018).

GDP per capita growth rate: GDP per capita yearly average growth rate (%). Calculations based on World Bank data (2018).

Gini index: "Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution". "A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality". Retrieved from World Bank (2018).

Palma index: Income share by the highest ten percent divided by the income share of the lowest foury percent. Calculations based on World Bank data (2020).

Political rights: In order to measure the level of political rights, a country or territory is given a score that goes from one to seven, where one represents the highest level of liberty and seven the lowest. For instance, one means that the countries or territories "enjoy a wide range of political rights, including free and fair elections". Recovered from Freedom House (2018). To know each one of the levels, see the methodology section on Freedom House webpage.

Secondary female schooling: Average years of secondary schooling for women over age twenty-five. Retrieved from Barro and Lee (2010).

Total Fertility rate: "Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year". Retrieved from World Bank (2018).

Unemployment rate (percent of total labor force): "Unemployment refers to the share of the labor force that is without work but available for and seeking employment". Retrieved from World Bank (2020).

20:20 ratio: Income share by the highest twenty percent divided by the income share of the lowest twenty percent. Calculations based on World Bank data (2018).

20:80 ratio: Income share by the highest twenty percent divided by the income share of the lowest eighty percent. Calculations based on World Bank data (2018).

I. Definitions of variables used in the analysis of the regions of Chile.

Academic offer: Higher education vacancies for first year (per 1000 inhabitants). Retrieved from Consejo Nacional de Educación (National Council of Education) (2019).

Education growth: Growth rate of the average years of schooling of population over age fifteen. Calculated on CASEN Survey data.

GDP per capita growth rate: GDP per capita yearly average growth rate (%). Calculations based on Central Bank of Chile (2018).

GDP per capita: Gross Domestic Product per person. Based on data drawn from Banco Central de Chile (Central Bank of Chile) (2018). Calculated by the *method of the variation rate*. In particular, a regional GDP per capita at constant prices of different series are used and taken to the year 2013. In this way a single database with base year 2013 is obtained.

Gini index: The Gini index is a statistic that ranges from 0 to 1, where 0 corresponds to perfect equality (everyone has the same income) and 1 corresponds to perfect inequality (one person has all the income and the others none). The index is based on autonomous household income per capita. Calculated by the author on CASEN Survey data (years 2013 and 2015).

Global fertility rate: "Global fertility rate (GFR) is the average number of children that would be born to a woman within a hypothetical women cohort that would have children during their reproductive life according to the fertility rates by age (ages 15 to 49) in a given period of study, and were not exposed to mortality risks from the moment of birth to the end of their reproductivity life" (INE [National Statistics Office], 2018) (translated from Spanish). Retrieved from INE on Portal Transparencia Chile.

Last quintile income: Average household autonomous income of the twenty percent of the population with the highest income. Calculated on CASEN Survey data.

Life expectancy at birth: Average number of life expectancy at the time of birth. Data retrieved from INE as presented on Portal Transparencia Chile.

Palma index: Inequality index that shows the relationship between the income of 10% of the households with the highest incomes and the income of the 40% of the households with the lowest incomes. It is based on the work of Gabriel Palma, a Chilean economist who found that the incomes of the middle class usually represent about half of gross national income, while the other half is divided between the richest 10% and the poorest 40%, but the proportion of these two groups varies considerably. Calculated on CASEN Survey data.

Rural population concentration: Rural population refers to people living in rural areas. Rural population concentration is calculated as the total rural population of a region over the total rural population of the country. Calculated on CASEN Survey data.

Tertiary sector (%GDP): Contribution to the regional GDP from the following sectors: commerce, restaurants and hospitality industry, transportation, information and telecommunications, financial and business services, housing and real estate services, personal services and public administration. Calculations on data drawn from Banco Central de Chile (Central Bank of Chile) (2018).

Social public spending: In Chile, Public Social Spending of the Central Government is understood as the sum of the following functional expenditure items, which are defined according to the IMF's "Manual of Public Statistics 2001": Protection of the Environment, Housing and Community Services, Health, Recreational Activities, Education and Social Protection. Retrieved from Subsecretaria de Desarrollo Social (Under-secretariat of Social Development) (2018).

Unemployment rate: "Percentage of unemployed population (people who have worked before, and people who are searching for a job for the first time) over age 15 in the labor force or economically active population" (Ministerio de Desarrollo Social [Ministry of Social Development]) (translated from Spanish). Retrieved from INE and CASEN Survey (2003 and 2006).

20:20 ratio: Inequality index that shows the relationship between the income of the twenty percent of the households with the highest incomes and the income of the twenty percent of the households with the lowest incomes. Calculated on CASEN Survey data.

20:80 ratio: Inequality index that shows the relationship between the income of the twenty percent of the households with the highest incomes and the income of the eighty percent of the households with the lowest incomes. Calculated on CASEN Survey data.