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What effect does public and private capital have on income inequality? The case of the Latin America and Caribbean region

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Abstract

The effects that the Latin America and Caribbean capital stock (public and private) had on the income inequality levels of 18 countries from this region were analysed, over a period ranging from 1995 to 2017, recurring to an autoregressive distributed lag model in the form of an unrestricted error correction model. The results from the three models that were estimated (with the total capital stock, the public capital stock, and the private capital stock) pointed for the existence of an enhancing effect from the capital stock (public and private) on the income inequality of these countries in the short-run, suggesting that the investments were made in the already richer/wealthiest areas. In the long-run, the effects of capital stock on income inequality seem to vanish, probably due to the efforts to correct the previous detrimental effect. However, the lack of a statistically significant impact shows that, although the efforts, capital stock (public and private) still does not contribute to the income inequality reduction, meaning that these countries should improve/change the management and the selection criteria of their physical capital investments to be able to reduce their income gap.

Keywords: income inequality; public capital stock; private capital stock; Latin American and the Caribbean countries.

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Introduction

Despite the positive trend in the Latin America and the Caribbean (LAC) region's GDP growth - from 2000 to 2014, the LAC region had an average output growth of (3%) per year (OECD, 2016) - the region still suffers from a set of social-economic problems which enhance the gap between the LAC economies and the advanced (developed) ones. One of these "problems" is undoubtedly the high level of inequality that is frequently associated with this region (e.g., Gasparini and Lusting, 2010). Following the UN (2020) "World Social Report 2020", the LAC stands as one of the regions with the highest income inequality, jointly with Africa. Given this fact, it is not surprising that the progress of this region in terms of income inequality, and its subsequent effects on the region's economies, be often analysed (e.g., Santiago et al., 2019; De la Torre et al., 2017; and Delbianco, 2014).

Due to the increased attention that the income inequality subject has been receiving from international entities (e.g., Dabla-Norris et al., 2015; and OECD, 2011) and scholars (e.g., Piketty, 2014; and Stiglitz, 2012), nowadays, there is a general view that governments should seriously invest in measures focused on the decrease of their countries income gaps, not only for the improvement of the standards of living of their populations but also to promote the macroeconomic stability of their nations.

Among the various tools that governments could use to decrease income inequality (e.g., fiscal policy, minimum wages, interest rate controls), government spending is often considered an essential instrument to tackle income inequality (e.g., Anderson et al., 2017). Although most of the studies focus their analysis on the effects that the government spending on education, health, and social welfare have on income inequality (e.g., Martínez-Vazquez et al., 2012), there are other types of government spending whose effects on income inequality should be more intensively analysed (e.g., the public investment in infrastructure).

Following the IMF (2014), in the last three decades, the public capital stock[1] as a share of output has declined worldwide, enlarging the gap between developing and developed infrastructure levels. Indeed, according to Faruqee (2016), the lack of investment in infrastructures in the LAC region, and on its subsequent maintenance, has been compromising its competitiveness and, according to the general opinion, nowadays, the LAC region suffers from an "infrastructure gap" which, if nothing is done, can be harmful to the economic sustainability and development of the LAC countries (e.g., Lardé and Sánchez, 2014; and Perrotti and Sánchez, 2011).

Following these previous statements, it is easy to perceive why it is essential to study the relationship between these two variables (capital stock and income inequality) in the LAC and why we chose this region as our study sample. In our view, due to the region's high inequality levels and to its "infrastructure gap", it becomes mandatory to understand how these two problems are related so that, in the future, the investment that the region urgently needs can also be channelled to mitigate its income inequality levels. This issue is significant given that, following previous reports, the failure to invest in infrastructure in LAC can be particularly harmful to the poorest strata of the population and prevent the region from joining the group of upper-income countries (e.g., Cavallo et al., 2020; and Cavallo and Powell, 2019).

To our advantage, we should also refer that with the release of the "Investment and Capital Stock Dataset" by the IMF (2017)[2], data on public and private capital stocks became available for a large number of countries and years, thus allowing to extend the analyses focused on these

1 As it is known, capital stock represents the available physical capital of an economy at a given moment, and it is accounted by the value of new investments minus the depreciation. The public component of capital stock, i.e., public capital stock, can be directly related to the government's investment on economic and social public infrastructures.

2 The public and private capital stock data was constructed based on the Kamps (2006) and Gupta et al. (2014) methodology according to the perpetual inventory method (PIM). Moreover, we should stress that the public-private partnership (PPP) capital stock has a considerable lack of data, and that it why we did not include this variable in the analysis.

variables to a vast number of countries and regions. Given its availability, the private capital stock should also be included in the analysis to compare the effects of both types of capital stock on the LAC income inequality.

The central question of this study will then be the following: Is the LAC capital stock (public and private) contributing to reducing the region's income inequality? To answer this question, the impact of public and private capital stock on income inequality will be examined using a dataset comprising 18 countries from the LAC region in the period from 1995 to 2017, using an Autoregressive Distributed Lag (ARDL) model in the form of an Unrestricted Error Correction Model (UECM) to decompose the effects of the variables into their short- and long-run components.

This investigation can be considered innovative and contribute to this branch of literature for the following reasons: **(a)** it focuses on the LAC region and investigates a group of countries not previously considered in similar research efforts. The LAC region is one of interest because of the lack of studies that directly address these issues in the region and, mainly, because its political, social, and economic specificities turn the analysis of this relationship necessary to the construction of suitable future development strategies; **(b)** it uses ARDL in the form of a UECM as a general model, being one of the first assessments of the impact of public and private capital stock on income inequality; **(c)** it analyse if political and economic shocks influence the results; and **(d)** it tries to explain, in a complete way, how the variables interact with each other.

Moreover, this investigation becomes essential because, as we previously explained, it is necessary to know more about the effect of public and private capital stock on income inequality to **(a)** contribute to enlarge the scarce literature that approaches this topic; and **(b)** to help the LAC policymakers on the development of appropriate policies to reduce the region's income inequality levels and support the development of this same region.

Finally, this study is organised as follows: **Section 2** presents the literature review; **Section 3** describes the data and methodology; **Section 4** presents the empirical results and their respective discussion, and **Section 5** presents the conclusions and policy implications from this analysis.

Literature Review

Regarding the literature that addresses the effects of the public capital stock on income inequality, we should stress that there is a scarcity of literature that directly addresses these two subjects, with most of the public capital literature being focused on the relationship between this variable and economic growth (e.g., Jong et al., 2018; and Romp and De Haan, 2007). However, let us consider the public capital stock as a form of government spending (i.e., public investment) or a variable that mostly represents the public infrastructure provision. The number of studies from which we can draw information significantly increases, allowing us to shed some light on the relationship between these two variables.

Overall, public investment is a valuable tool to struggle against inequality. The outcomes of most studies show that the increases in public investment levels can lead to an equal distribution of income (e.g., Bom and Goti, 2018; and Furceri and Li, 2017). Although, as in the case of the relationship between public investment and growth, the magnitude of this effect can be influenced by several factors as, for example, the countries investment efficiency, the way that they finance their public investment, and their degree of economic slack (IMF, 2014).

Still, we know that it can take several forms on public investment. One of these forms is the government's investment in physical capital, such as roads, railways, bridges, schools, hospitals, sanitation and water systems, telecommunications, and energy systems. If we look at the literature focused on the effects of public infrastructure, and of infrastructure in general, on income inequality, the overall conclusion seems to be similar to the one from the public investment-income inequality relationship: infrastructure development tends to reduce income inequality (e.g., Calderón and Servén, 2014) for a valuable review of the literature on the effects of infrastructure development on income distribution and growth). However, some authors found opposite effects (e.g., Turnovsky, 2015; Chatterjee and Turnovsky, 2012; Khandker and Koolwal, 2007; and Artadi and Sala-i-Martin, 2003).

The major problem with the literature devoted to this relationship is the lack of knowledge regarding the channels through which these effects act. Still, if we review the literature, some authors have presented explanations regarding the possible channels by which infrastructure can affect income distribution.

As an example, various authors have stated that the investment in infrastructure can decrease income inequality by the fact that these investments can be a vital help to link the poorest/rural areas to the richer areas where there is a more thriving economic activity, reducing the production and transportation costs, facilitating the information flows, and increasing the access to further productive opportunities (e.g., Calderón and Servén, 2014; Calderón and Servén, 2004; Calderón and Chong, 2004; Estache, 2003; and Lopez, 2003). Although Lopez (2003) also states that if the infrastructure investment is canalised to the already rich/developed areas, it can enhance inequality.

Literature has also pointed out the positive effects of increased physical and social infrastructure investment on human capital, which, subsequently, positively affects productivity, earnings, and social welfare (e.g., Calderón and Servén, 2014; and Agenor and Moreno-Dodson, 2006).

Additionally, according to Pi and Zhou (2012), an increased supply of public infrastructure raises the marginal productivity of skilled and unskilled labour, consequently raising their earnings. Thus, if the sector which is more intensive in public infrastructure services is the one that uses unskilled labour, the skilled-unskilled wage inequality will be reduced due to the capital shift from the skilled to the unskilled sector. This situation happens because this shift will lead to a decline in the wage rate of skilled labour and an increase in unskilled labour. Although, if the more intensive sector in public infrastructure uses skilled labour, the effect will be the opposite.

Easterly and Servén (2003) stressed that due to pressures associated with fiscal consolidation, many countries have increasingly reduced their public investment in infrastructure, leading to insufficient infrastructure provision. They also referred that even with the increased participation from the private sector, the provision remained insufficient, negatively affecting the countries' growth and equity. This issue can be the case of the LAC countries that, due to the debt crisis of the 1980s, have seen their public investment levels being progressively reduced in the following decades. Even today, the levels of public investment in these countries remain relatively low, raising several concerns about the potential adverse effects of this gap on the region's development (e.g., Castellani et al., 2019).

Regarding the private capital, we should start by referring that the private sector has massive participation in infrastructure provision in many countries, with governments often opting for the privatisation of determined infrastructure sectors. This situation can produce several different effects on income distribution.

Starting with the "employment effects", Estache et al. (2002) state that after privatisation, the formerly public companies usually become profitable, mainly due to the downsizing strategy which the new private providers usually follow. The effect of the downsizing on income distribution depends on the number of lower-income workers in the infrastructure sector and the compensation to the workers laid off during the downsizing process. Benitez et al. (2001) imply that if the new private investment in infrastructures fosters growth and new jobs, the downsizing process in the public infrastructure sector (i.e. fewer jobs in the public sector) can be compensated creation of jobs in other sectors.

Apart from these effects, increased private participation can also eradicate subsidies to infrastructure provision and generate additional public revenues from privatisation. Moreover, if these fiscal resources are used to improve the quality and efficiency of public services, they can reduce income inequality (Estache et al., 2000).

Finally, following Estache et al. (2002), the privatisation of infrastructure services can also lead to the creation of barriers in the access and affordability of these services by the poor due to market effects (e.g., the elimination of subsidies may lead to higher prices; private providers will probably charge more significant connection fees than public providers, and the private initiative may be unwilling to invest in the most poorer/undeveloped areas). These facts can lead to infrastructure services becoming too expensive for lower-income groups, thus increasing the gap between the poor and the rich.

The previous idea follows Ferreira (1995), who pointed out that the credit constraint faced by the poor eventually inhibits them from using the private substitutes for infrastructure. In contrast, the rich can complement the public infrastructure provision with private alternatives. Although, as it is stressed by Calderón and Servén (2014), there are several cases where the access by the poor was improved by the privatisation of infrastructure services, with the outcome being extremely dependent on the design of the reforms of the infrastructure sector involving private participation.

Concerning the econometric approach of the past studies, most of the authors used panel data methods and estimators capable of dealing with potential endogeneity problems to inquire about the effects of infrastructure development on income inequality (e.g., Seneviratne and Yan Sun, 2013; Calderón and Servén, 2004; and Calderón and Chong, 2004). This endogeneity problem arises from the fact that "*income inequality could prevent the poor from accessing infrastructure services, while at the same time inadequate infrastructure may worsen income inequality*" (e.g., Seneviratne and Yan Sun, 2013, p. 9). To tackle this problem, in this study, we used the already mentioned ARDL in the form of a UECM, a technique that addresses the endogeneity problem, and which has several advantages (see **Section 3**) when compared with the simple pooled OLS that some previous authors used (e.g., Seneviratne and Yan Sun, 2013). Furthermore, following Calderón and Servén (2004), the generalised method of moments (GMM) could also be an option for the estimation. However, since we have T > N, the GMM may lead to some estimation problems (e.g., Asteriou et al., 2021) that can be avoided using the ARDL.

Data and Methodology

To accomplish the goals of this investigation, we collected annual data from 1995 to 2017 for a panel of 18 LAC countries, namely: **Argentina**, **Bolivia, Brazil**, **Chile**, **Colombia**, **Costa Rica**, **Dominican Republic**, **Ecuador**, **El Salvador**, **Guatemala**, **Honduras**, **Mexico**, **Nicaragua**, **Panama**, **Paraguay**, **Peru**, **Uruguay**, and **Venezuela** – both countries and time horizon were chosen according to the data availability. The name, definition, and sources, of the raw variables are displayed in **Table 1**.

Table 1. Variable's description

Variable	Definition	Source
INEQ	Gini index	Standardised World Income Inequality Database (SWIID)
KPUB	General government capital stock (current cost), in billions of national currency	Investment and Capital Stock Dataset (IMF)
KPRIV	Private capital stock (current cost), in billions of national currency	Investment and Capital Stock Dataset (IMF)
K	Capital stock (current cost), in billions of national currency	Authors own calculations
Y	Gross domestic product (current prices), in billions of national currency	Investment and Capital Stock Dataset (IMF)
HDI	Human development index	Human Development Reports (UNDP)
TRD	Trade (% of GDP)	World Development Indicators (WB)
TR	Tax revenue (% GDP)	CEPALSTAT
UNP	Unemployment, total (% of the total labour force)	World Development Indicators (WB)
CPI	Annual consumer prices indices general level (Base Index 2010=100)	CEPALSTAT

The dependent variable will be represented by the Gini index of disposable income (INEQ), collected from the "Standardized World Income Inequality Database" (SWIID), which will be the measure of income inequality. The values of this index range from (0%) to (100%), with (0%) representing perfect equality and (100%) representing maximum inequality. The option for the "Standardised World Income Inequality Database" (SWIID) was mainly due to the amount of available data that this database had when compared with alternative sources (e.g., CEPALSTAT, World Development Indicators). In contrast, the option to use the Gini index of disposable income rather than market income was since the first one is related to the income after taxes and transfers, thus being closer to individuals' value for spending and saving. For more information about the construction of this variable, see Solt (2019).

Concerning the interest variables of our models, they will be (1) capital stock (K) in **Model I**; (2) general government capital stock or public capital stock (KPUB) in **Model II**; and (3) private capital stock (KPRIV) in **Model III**. The variable capital stock (K) is the sum of both types of capital, public (KPUB) and private (KPRIV). The public capital stock (KPUB) and the private capital stock (KPRIV) were both retrieved from the "Investment and Capital Stock Dataset" (IMF, 2017). It is important to stress that the variable consumer prices indices (CPI) – retrieved from the CEPALSTAT - was used to transform the variables capital stock (K), public capital stock (KPUB), private capital stock (KPRIV), and gross domestic product (Y) into their real values (or constant values), i.e., adjust the variables to the effects of price changes, and that the capital stock (K), the public capital stock (KPUB), and the private capital stock (KPRIV), were then transformed into percentages of the GDP.

The remaining variables, i.e., the control variables, are commonly used in income inequality regressions. Nevertheless, again, one warns that, among the full range of variables that could be used, the control variables chosen were those for which a considerable amount of data was available. These variables were: (1) gross domestic product (Y) from the IMF "Investment and Capital Stock Dataset"; (2) human development index (HDI) from the United Nations "Human Development Reports"; (3) trade-in percentage of the gross domestic product (TRD) from the World Bank "World Development Indicators"; (4) tax revenue in the percentage of the gross domestic product (TR) from the CEPALSTAT; and (5) unemployment rate in percentage of the total labour force (UNP) from the World Bank "World Development Indicators".

Still, much theoretical and empirical evidence on the control variables makes us believe that all these variables can influence income inequality. First, regarding the Gross Domestic Product (Y), we can say that the relationship between this variable and income inequality has aroused the interest of researchers for several decades, with the nexus between growth and income inequality being the subject of many past and present studies (e.g., Yang and Greaney, 2017; and Rubin and Segal, 2015). As an example, Tsounta and Osueke (2014) found that, after policy measures, economic growth was the main reason for the decrease in Latin America (LA) income inequality.

Concerning the human development index (HDI), we should stress that most authors focused their investigations on the effects of education on income inequality (e.g., Coady and Dizioli, 2018). However, as most of the education variables have some problems as the lack of data, we decided to use the HDI, which, in addition to taking education into account, also incorporates data related to population health and standard of living. Theyson and Heller (2015), for example, investigated the relationship between development, proxied by HDI, and income inequality and found that human development could have different effects on income inequality, depending on the development stage of the countries.

Concerning trade (TRD), the vast literature that addresses its relationship with income inequality has found mixed results (e.g., Cerdeiro and Komaromi, 2017; Urata and Narjoko, 2017; and Meschi and Vivarelli, 2009). Although, Cerdeiro and Komaromi (2017), who developed a study to be included in an IMF report on trade integration in the LAC, found that trade tends to reduce income inequality.

When it comes to tax revenue (TR), a wide range of studies focused on the effects of tax policies on income inequality (e.g., Martorano, 2018; Balseven and Tugcu, 2017; Gómez-Sabaíni et al., 2016; and Zolt and Bird, 2005). As it could be expected, the literature on this theme is composed of several studies applied to the LAC region, where high inequality levels have been affecting these economies in the last decades (e.g., Bustillo et al., 2018). Following Balseven and Tugcu (2017) results, tax revenue has, indeed, contributed to decreasing income inequality in developing economies. However, regarding the sample of this study, Martorano (2018) finds that the low levels of tax revenue from the LA countries are an obstacle to promoting equality in this region.

Concerning the unemployment rate (UNP), extensive literature addresses the relationship between this macroeconomic indicator and income inequality (e.g., Sheng, 2011; Helpman et al., 2010; Cysne, 2009; and Mocan, 1999). The overall conclusion is that the unemployment rate has an augmenting effect on income inequality. Furthermore, following Gasparini and Lusting (2010), unemployment could have contributed to rising inequality in Argentina due to its indirect effect on wages. Finally, Hacibedel et al. (2019) conclude that policies to support employment are an essential tool for reducing inequality in emerging market countries and low-income countries, with its regressions showing that increases in unemployment tend to boost inequality, regardless of whether the countries are facing a "good" or "bad" economic conjuncture.

Regarding the empirical analysis, we can refer to the panel autoregressive distributed lag (PARDL) model in the form of an unrestricted error correction model (UECM). First, this model allows us to identify the explanatory variables' short- and long-run impacts on the dependent variable. Second, it deals appropriately with cointegration. Third, it allows the inclusion of I(0), I(1), and fractionally integrated variables in the exact estimation. Fourth, it is robust when there are signals of endogeneity. Finally, it gives consistent results with a small/moderate number of observations.

The equations (1), (2), and (3) represent the basic forms of the ARDL specifications of our three models, with the variables in natural logarithms (with the prefix "L"). In **Model I**, capital stock (K) is the interest variable; in **Model II**, the general government capital stock (KPUB) is the interest variable and, finally, in **Model III**, private capital stock (KPRIV) is the interest variable.

$$LINEQ_{it} = \alpha_{1i} + \beta_{1i1}LINEQ_{it-1} + \beta_{1i2}LK_{it} + \beta_{1i3}LK_{it-1} + \beta_{1i4}LY_{it} + \beta_{1i5}LY_{it-1}$$
$$\beta_{1i6}LHDI_{it} + \beta_{1i7}LHDI_{it-1} + \beta_{1i8}LTRD_{it} + \beta_{1i9}LTRD_{it-1} + \beta_{1i10}LTR_{it} + \beta_{1i11}LTR_{it-1} +$$
$$\beta_{1i12}LUNP_{it} + \beta_{1i13}LUNP_{it-1} + \varepsilon_{1it} \quad (1)$$

$$LINEQ_{it} =$$
$$\alpha_{2i} + \beta_{2i1}LINEQ_{it-1} + \beta_{2i2}LKPUB_{it} + \beta_{2i3}LKPUB_{it-1} + \beta_{2i4}LY_{it} + \beta_{2i5}LY_{it-1} + \beta_{2i6}LHDI_{it} + \beta_{2i7}LHDI_{it-1} +$$
$$\beta_{2i8}LTRD_{it} + \beta_{2i9}LTRD_{it-1} + \beta_{2i10}LTR_{it} + \beta_{2i11}LTR_{it-1} + \beta_{2i12}LUNP_{it} + \beta_{2i13}LUNP_{it-1} + \varepsilon_{2it} \quad (2)$$

$$LINEQ_{it} =$$
$$\alpha_{3i} + \beta_{3i1}LINEQ_{it-1} + \beta_{3i2}LKPRIV_{it} + \beta_{3i3}LKPRIV_{it-1} + \beta_{3i4}LY_{it} + \beta_{3i5}LY_{it-1} + \beta_{3i6}LHDI_{it} + \beta_{3i7}LHDI_{it-1} +$$
$$\beta_{3i8}LTRD_{it} + \beta_{3i9}LTRD_{it-1} + \beta_{3i10}LTR_{it} + \beta_{3i11}LTR_{it-1} + \beta_{3i12}LUNP_{it} + \beta_{3i13}LUNP_{it-1} + \varepsilon_{3it} \quad (3)$$

According to Tang (2003), the equations (1), (2), and (3), which represent the general ARDL models, can be simply reparametrised to obtain the dynamic general UECM form of the ARDL models and to obtain the dynamic relations between the variables (i.e., to decompose the dynamic relationships of the variables into their short- and long-run components). In this sense, the reparameterisation of the equations (1), (2), and (3) gives origin to the corresponding UECM versions represented in the equations (4), (5), and (6), as follows:

$$DLINEQ_{it} =$$
$$\alpha_{4i} + \beta_{4i1}DLK_{it} + \beta_{4i2}DLY_{it} + \beta_{4i3}DLHDI_{it} + \beta_{4i4}DLTRD_{it} + \beta_{4i5}DLTR_{it} + \beta_{4i6}DLUNP_{it} + \gamma_{4i1}LINEQ_{it-1} +$$
$$\gamma_{4i2}LK_{it-1} + \gamma_{4i3}LY_{it-1} + \gamma_{4i4}LHDI_{it-1} + \gamma_{4i5}LTRD_{it-1} + \gamma_{4i6}LTR_{it-1} + \gamma_{4i7}LUNP_{it-1} + \varepsilon_{4it}. \quad (4)$$

$$DLINEQ_{it} =$$
$$\alpha_{5i} + \beta_{5i1}DLKPUB_{it} + \beta_{5i2}DLY_{it} + \beta_{5i3}DLHDI_{it} + \beta_{5i4}DLTRD_{it} + \beta_{5i5}DLTR_{it} + \beta_{5i6}DLUNP_{it} +$$
$$\gamma_{5i1}LINEQ_{it-1} + \gamma_{5i2}LKPUB_{it-1} + \gamma_{5i3}LY_{it-1} + \gamma_{5i4}LHDI_{it-1} + \gamma_{5i5}LTRD_{it-1} + \gamma_{5i6}LTR_{it-1} + \gamma_{5i7}LUNP_{it-1} +$$
$$\varepsilon_{5it}. \quad (5)$$

$$DLINEQ_{it} =$$
$$\alpha_{6i} + \beta_{6i1}DLKPRIV_{it} + \beta_{6i2}DLY_{it} + \beta_{6i3}DLHDI_{it} + \beta_{6i4}DLTRD_{it} + \beta_{6i5}DLTR_{it} + \beta_{6i6}DLUNP_{it} +$$
$$\gamma_{6i1}LINEQ_{it-1} + \gamma_{6i2}LKPRIV_{it-1} + \gamma_{6i3}LY_{it-1} + \gamma_{6i4}LHDI_{it-1} + \gamma_{6i5}LTRD_{it-1} + \gamma_{6i6}LTR_{it-1} + \gamma_{6i7}LUNP_{it-1} +$$
$$\varepsilon_{6it}. \quad (6)$$

In equations (4), (5), and (6), the α_i represents the intercept, while β_{ik} and γ_{im} represent the short-run and long-run parameters, respectively, with k = 1, …, 6 and m = 1, …, 7. The ε_{it} denotes the error term. The variables are represented in natural logarithms (with the prefix "L") and first differences (with the prefix "D"). In the UECM versions of the models, the error correction mechanism (ECM) term is represented by the coefficient of the dependent variable (LINEQ), lagged once.

To choose a suitable estimator for the three models, there is a need to conduct a series of preliminary tests and specification tests before the estimation. To understand the characteristics of our series and cross-sections, we applied the following preliminary tests: (1) the correlation matrix; (2) the variance inflation factor (VIF); (3) the cross-sectional dependence test (Pesaran, 2004); and (4) the second-generation unit root test (CIPS) (Pesaran, 2007).

Starting with the correlation matrices and variance inflation factors, from **Table A1** (in the Appendix), we see that both collinearity and multicollinearity are far from being a concern to the estimations of the three models, given the low correlation and VIF (and Mean VIF) values. In the case of the VIF's test, the values are lower than the typically assumed benchmarks: 10 in the case of the VIF values and 6 in the mean VIF values.

In **Table 2**, we can see the descriptive statistics of the variables in natural logarithms and first differences and the results from the cross-sectional dependence test. Before the analysis of the outcomes from the cross-sectional dependence test, we should stress that the variables INEQ, K, KPUB, KPRIV, Y, and TRD, have fewer observations because there is a lack of observations for the Gini index of disposable income (INEQ) in the cases of the Dominican Republic in 2017, of Guatemala in 2015, 2016, and 2017, of Mexico in 2017, of Nicaragua in 2015, 2016, and 2017, and of Venezuela in 2016 and 2017. In addition, Venezuela also has a shortage of data for the capital stock (K), public capital stock (KPUB), and private capital stock (KPRIV) in 2016 and 2017, and for trade-in percentage of the gross domestic product (TRD) in 2015, 2016, and 2017. Despite these facts, the statistical software **STATA 17** still assumes the panel as a "strongly balanced" one, given that the lack of data only occurs at the end of the series. This outcome led us to continue carrying out the analysis without significant concerns.

Table 2. Descriptive statistics and cross-sectional dependence test

Variables	**Descriptive statistics**					**Cross-sectional dependence test**		
	Obs.	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**CD-test**	**Corr.**	**Abs. (corr.)**
LINEQ	404	3.8300	0.0888	3.5807	3.9722	38.21***	0.660	0.813
LK	412	5.4820	0.2396	4.9834	6.7567	6.03***	0.105	0.443
LKPUB	412	4.1555	0.5827	3.0219	6.2561	6.94***	0.121	0.501
LKPRIV	412	5.1201	0.2259	4.4146	5.8248	5.21***	0.091	0.464
LY	412	7.1069	2.8219	2.5355	13.4472	46.79***	0.808	0.868
LHDI	414	-0.3746	0.1064	-0.6792	-0.1708	56.73***	0.979	0.979
LTRD	411	4.0617	0.4563	2.7496	5.1162	15.54***	0.264	0.462
LTR	414	2.5375	0.2502	1.7138	3.0958	27.21***	0.460	0.523
LUNP	414	1.7724	0.4911	0.6966	3.0214	14.48***	0.248	0.467
DLINEQ	386	-0.0051	0.0095	-0.0376	0.0219	17.69***	0.310	0.369
DLK	394	0.0000	0.0735	-0.2488	0.8455	11.40***	0.200	0.277
DLKPUB	394	-0.0043	0.0757	-0.2454	0.8520	8.66***	0.151	0.266
DLKPRIV	394	0.0024	0.0743	-0.2536	0.8357	12.51***	0.220	0.277
DLY	394	0.0327	0.0778	-0.7740	0.2635	16.82***	0.295	0.315
DLHDI	396	0.0072	0.0058	-0.0117	0.0429	6.51***	0.115	0.220
DLTRD	393	0.0027	0.0946	-0.3371	0.6475	20.87***	0.363	0.377
DLTR	396	0.0111	0.0805	-0.7910	0.2923	6.04***	0.104	0.207
DLUNP	396	-0.0085	0.1302	-0.4742	0.4783	11.38***	0.199	0.247

Notes: The CD test (Pesaran, 2004) has N (0,1) distribution under the H0: cross-section independence; *** denotes statistical significance at (1%) level.

Regarding the cross-sectional dependence test, as we can observe in **Table 2**, the results endorse the presence of cross-sectional dependence in all the variables, either in natural logarithms or in first differences. It suggests interdependence between variables across countries, maybe due to the mutual shocks that our countries share. With this result, we realise that we must deal with this phenomenon in the estimation, or else, incorrect inferences may be produced (e.g., Eberhardt and Teal, 2011).

Given the previous statement, we conducted the 2nd generation unit root test. More precisely, the cross-sectionally augmented IPS (CIPS) test, to access the order of integration of the variables. The reason to not use panel unit root tests of 1st generation, as the LLC (Levin et al., 2002), the ADF-Fisher (Maddala and Wu, 1999), and the ADF-Choi (Choi, 2001), is because these tests are not suitable to deal with variables with cross-sectional dependence. The results of the CIPS test are displayed in **Table 3**.

Table 3. Panel Unit Root test (CIPS)

	CIPS (Zt-bar)	
	without trend	With trend
LINEQ	-0.232	-1.774**
LK	2.187	2.870
LKPUB	1.417	1.090
LKPRIV	3.586	3.638
LY	1.402	1.218
LHDI	-0.503	1.136
LTRD	-0.946	0.601
LTR	-1.042	0.022
LUNP	0.182	1.710
DLINEQ	-3.439***	-1.741**
DLK	-3.441***	-1.968**
DLKPUB	-3.362***	-1.729**
DLKPRIV	-3.004***	-2.142**
DLY	-5.570***	-4.414***
DLHDI	-5.152***	-3.649***
DLTRD	-4.883***	-3.218***
DLTR	-6.688***	-5.486***
DLUNP	-3.558***	-0.897

Notes: ***,** denote statistical significance at (1%) and (5%) levels, respectively; Pesaran (2007) Panel Unit Root Test (CIPS) assumes that cross-sectional dependence is in the form of a single unobserved common factor and H0: series is I(1).

The outcomes from the CIPS test seem to indicate that all variables in natural logarithms are I(1), i.e., they are integrated of order one, and that they are all stationary in first differences, except DLUNP with the trend[3].

3 Given to this issue, we will not use a time trend in our models.

After the performance of the preliminary tests and the subsequent analysis of their results, the next step will be the computation of a battery of specifications tests which will help us select a suitable estimator.

Results and Discussion

As previously mentioned, before estimating the models, we need to test for the presence of several effects and phenomena that can lead to misleading conclusions if not considered.

The specification tests which were conducted were the following: (1) the Hausman test (Hausman, 1978) to confront the random effects (RE) and fixed effects (FE) models; (2) the Hausman test (Hausman, 1978) to confront the mean group (MG), the pooled mean group (PMG), and the pooled estimators; (3) the modified Wald test (Greene, 2002); (4) the Pesaran test of cross-sectional independence (Pesaran, 2004); and the Wooldridge test (Wooldridge, 2002).

Table 4. Hausman test (FE vs. RE)

	Model I	**Model II**	**Model III**
	FE vs. RE	**FE vs. RE**	**FE vs. RE**
Hausman test	Chi2(13) = 82.87***	Chi2(13) = 86.39***	Chi2(13) = 81.90***
Hausman test (with *sigmamore*)	Chi2(13) = 75.22***	Chi2(13) = 81.81***	Chi2(13) = 73.37***
Hausman test (with *sigmaless*)	Chi2(13) = 91.04***	Chi2(13) = 101.29***	Chi2(13) = 88.26***

Notes: *** denotes significance at (1%) level; H0: difference in coefficients not systematic.

In **Table 4**, we exhibit the results from the Hausman test between the random effects (RE) and fixed effects (FE) models. This test will allow us to know if the countries individual effects must be considered. The test's null hypothesis is that the difference in coefficients is not systematic, or random effects (RE) are the most suitable specification. As the null hypothesis is rejected for all specifications (with the standard specification and with the *sigmamore* and *sigmaless* options), the conclusion is that the fixed effects (FE) are the most suitable specification, i.e., we should account for the individual effects. The conclusion is the same for all three models. As in the standard specification, "*the covariance matrix has not been positively defined*", we used both the *sigmamore* and *sigmaless* options to correct this situation. This issue can also be seen as a robustness test to the standard Hausman test result.

The next estimation step was to confront the mean group (MG), the pooled mean group (PMG), and the pooled estimators to test the parameters' slope heterogeneity. In other words, we want to inquire about the homogeneity/heterogeneity of the panel. For a more profound discussion on the mean group (MG) and pooled mean group (PMG) estimators, see Pesaran et al. (1999). Finally, in **Table 5**, we display the results from the Hausman test between these estimators.

The results of the Hausman tests indicate the pooled estimator as the preferable one for all models. This result suggests that the panel is homogeneous, meaning that these countries can be treated as a group. Therefore, the estimation can proceed with the fixed effects (FE) specification rather than with the mean group (MG) and pooled mean group (PMG) specifications. Moreover, it is essential to stress that the null hypotheses of these Hausman tests are that the difference in coefficients is not systematic or that: (1) the pooled mean group (PMG) is the most suitable (when MG vs PMG); (2) Pooled is the most suitable (when PMG vs Pooled, and MG vs Pooled). Finally, it is also important to stress the fact that the negative "Chi2" values can be interpreted "*as strong evidence that we cannot reject the null hypothesis*" (see "Hausman specification test" from the Stata Manual, p.8[4]).

Table 5. Hausman test (MG vs PMG vs Pooled)

	Model I	**Model II**	**Model III**
Hausman test	**MG vs. PMG**	**MG vs. PMG**	**MG vs. PMG**
	Chi2(13) = -58.61	Chi2(13) = 60.14***	Chi2(13) = 31.81***
	PMG vs Pooled	**PMG vs Pooled**	**PMG vs Pooled**
	Chi2(13) = 0.19	Chi2(13) = 7.39	Chi2(13) = 0.75
	MG vs Pooled	**MG vs Pooled**	**MG vs Pooled**
	Chi2(13) = -7.76	Chi2(13) = 15.54	Chi2(13) = -1.14

Notes: *** denotes statistically significant at (1%); H_0: difference in coefficients not systematic.

In **Table 6**, the outcomes from the remaining specification tests are presented. These are the modified Wald test, to test for group-wise heteroscedasticity, the Pesaran test of cross-sectional independence[5], to test for contemporaneous correlation among cross-sections, and the Wooldridge test, to test for the presence of serial correlation[6]. The null hypotheses of these tests are, respectively, sigma(i)^2= sigma^2 (or no group-wise heteroscedasticity), residuals are not correlated (or no contemporaneous correlation), and no first-order autocorrelation (or no serial correlation).

Table 6. Specification tests

	Model I	**Model II**	**Model III**
	Statistics	**Statistics**	**Statistics**
Modified Wald test	Chi2 (18) = 141.08***	Chi2 (18) = 144.96***	Chi2 (18) = 139.46***
Pesaran's test	2.939***	3.051***	2.868***
Wooldridge test	F(1, 17) = 19.286***	F(1, 17) = 19.482***	F(1, 17) = 19.193***

Notes: *** denotes statistical significance at (1%) level; H_0 of Modified Wald test: sigma(i)^2= sigma^2 for all I; H_0 of Pesaran's test: residuals are not correlated; H_0 of Wooldridge test: no first-order autocorrelation.

Given the results displayed in **Table 6**, we see that all null hypotheses are rejected at the (1%) level for all models, meaning that heteroscedasticity, contemporaneous correlation, and first-order autocorrelation are all present in **Model I**, **Model II**, and **Model III**. To deal with the presence of these phenomena (heteroskedasticity, contemporaneous correlation, first-order autocorrelation, and cross-sectional dependence), we decided to use the Driscoll and Kraay (1998) estimator to perform the analysis of the three models, given that it produces standard errors robust to the disturbances being cross-sectionally dependent, heteroskedastic, and autocorrelated. In **Table 7**, the results from the estimation of **Model I**, **Model II**, and **Model III** with the DK-FE estimator are presented[7].

4 Available at: https://www.stata.com/manuals13/rhausman.pdf

5 The Frees' test of cross-sectional independence (Frees, 2004, 1995), and the Friedman's test of cross-sectional independence (Friedman, 1937) were also computed, with both tests corroborating the result from the Pesaran test of cross-sectional independence (Pesaran, 2004).

6 The Breusch–Pagan LM test of independence (Breusch and Pagan, 1980) was also computed, although, as the correlation matrix of residuals was singular, it was not able to produce any outcome. The command *xtcsd* (which includes the Pesaran, Free's, and Friedman tests of cross-sectional independence) is seen as an alternative in these cases.

7 Following Jeffery Wooldridge's "Introductory Econometrics: A Modern Approach" (Wooldridge, 2003), with annual data,

Table 7. Estimation results

Dependent Variable: **DLINEQ**	**Model I**	**Model II**	**Model III**
Constant	0.3781***	0.3749***	0.3804***
DLK	0.0186**	-	-
DLKPUB	-	0.0146**	-
DLKPRIV	-	-	0.0205**
DLY	-0.0114**	-0.0137***	-0.0105*
DLHDI	0.0542	0.0546	0.0514
DLTRD	-0.0003	-0.0005	-0.0002
DLTR	-0.0034	-0.0039	-0.0029
DLUNP	0.0090**	0.0089***	0.0090**
LINEQ (-1)	-0.0880***	-0.0869***	-0.0874***
LK (-1)	-0.0002	-	-
LKPUB (-1)	-	0.0012	-
LKPRIV (-1)	-	-	-0.0013
LY (-1)	-0.0025*	-0.0029**	-0.0025*
LHDI (-1)	-0.0688***	-0.0653***	-0.0676***
LTRD (-1)	-0.0089***	-0.0090***	-0.0088***
LTR (-1)	-0.0138***	-0.0142***	-0.0138***
LUNP (-1)	0.0102***	0.0095***	0.0105***
Diagnostic statistics			
N	385	385	385
R^2	0.3562	0.3525	0.3599
F	F(13, 21) = 91.68***	F(13, 21) = 63.56***	F(13, 21) = 109.37***

Notes: ***, **, and * denote statistical significance at (1%), (5%), and (10%) level, respectively.

Before we proceed, we should first clarify that the long-run elasticities are not shown in **Table 7** because they had to be calculated by applying a ratio between the long-run coefficients of the variables and the LINEQ coefficient lagged once. Then we had to multiply this ratio by −1. **Table 8** displays long-run elasticities, short-run impacts, and the adjustment speed of the estimated three models.

the number of lags is typically small (1 or 2 lags). To not to lose degrees of freedom, we opted for the use of a number of lags equal to the frequency of the dataset (i.e., one lag).

Table 8. Elasticities, short-run impacts, and adjustment speed

Dependent Variable: **DLINEQ**	**Model I**	**Model II**	**Model III**
Short-run impacts			
DLK	0.0186**	-	-
DLKPUB	-	0.01455**	-
DLKPRIV	-	-	0.0205**
DLY	-0.0114**	-0.0137***	-0.0105*
DLHDI	0.0542	0.0546	0.0514
DLTRD	-0.0003	-0.0005	-0.0002
DLTR	-0.0034	-0.0039	-0.0029
DLUNP	0.0090**	0.0089***	0.0089**
Long-run (computed) elasticities			
LK (-1)	-0.0025	-	-
LKPUB (-1)	-	0.0143	-
LKPRIV (-1)	-	-	-0.0144
LY (-1)	-0.0286**	-0.0337**	-0.0284*
LHDI (-1)	-0.7824***	-0.7505***	-0.7730***
LTRD (-1)	-0.1009***	-0.1031***	-0.1006***
LTR (-1)	-0.1573***	-0.1638***	-0.1574***
LUNP (-1)	0.1160***	0.1091***	0.1199***
Speed of adjustment			
ECM	-0.0880***	-0.0870***	-0.0874***

Notes: ***, ** and * denote statistical significance at (1%), (5%) and (10%) levels, respectively; the ECM denotes the coefficient of the variable LINEQ lagged once.

Following the rule of parsimony, after the first estimations, we decided to remove from the models the variables that did not produce any statistically significant coefficients in the short- and long-run. Thus, we removed the variables human development index (HDI), trade (TRD) and tax revenue (TR) from the short-run in all the three models, and the variables capital stock (K), public capital stock (KPUB), and private capital stock (KPRIV), from the long-run in **Model I, Model II**, and **Model III**, respectively. Now, we can replace the specifications from the equations (4), (5), and (6) for:

$$DLINEQ_{it} = \alpha_{7i} + \beta_{7i1}DLK_{it} + \beta_{7i2}DLY_{it} + \beta_{7i3}DLUNP_{it} + \gamma_{7i1}LINEQ_{it-1} + \gamma_{7i2}LY_{it-1} + \gamma_{7i3}LHDI_{it-1} + \gamma_{7i4}LTRD_{it-1} + \gamma_{7i5}LTR_{it-1} + \gamma_{7i6}LUNP_{it-1} + \varepsilon_{7it}. \tag{7}$$

$$DLINEQ_{it} = \alpha_{8i} + \beta_{8i1}DLKPUB_{it} + \beta_{8i2}DLY_{it} + \beta_{8i3}DLUNP_{it} + \gamma_{8i1}LINEQ_{it-1} + \gamma_{8i2}LY_{it-1} + \gamma_{8i3}LHDI_{it-1} + \gamma_{8i4}LTRD_{it-1} + \gamma_{8i5}LTR_{it-1} + \gamma_{8i6}LUNP_{it-1} + \varepsilon_{8it}. \tag{8}$$

$$DLINEQ_{it} = \alpha_{9i} + \beta_{9i1}DLKPRIV_{it} + \beta_{9i2}DLY_{it} + \beta_{9i3}DLUNP_{it} + \gamma_{9i1}LINEQ_{it-1} + \gamma_{9i2}LY_{it-1} + \gamma_{9i3}LHDI_{it-1} + \gamma_{9i4}LTRD_{it-1} + \gamma_{9i5}LTR_{it-1} + \gamma_{9i6}LUNP_{it-1} + \varepsilon_{9it}. \quad (9)$$

The equations (7), (8), and (9) stand for the most parsimonious specifications that we have reached. All specification tests were redone to ensure that all assumptions remained the same (e.g., **Table A2**, **Table A3**, and **Table A4**, in the Appendix). The results from the parsimonious versions of **Model I**, **Model II**, and **Model III** can be seen below in **Table 9**.

Table 9. Estimation results (parsimonious)

Dependent Variable: **DLINEQ**	**Model I**	**Model II**	**Model III**
Constant	0.3693***	0.3690***	0.3705***
DLK	0.0148***	-	-
DLKPUB	-	0.0118***	-
DLKPRIV	-	-	0.0168***
DLY	-0.0113***	-0.0132***	-0.0102***
DLUNP	0.0096***	0.0098***	0.0095***
LINEQ (-1)	-0.0877***	-0.0870***	-0.0882***
LY (-1)	-0.0021*	-0.0023**	-0.0020*
LHDI (-1)	-0.0739***	-0.0730***	-0.0736***
LTRD (-1)	-0.0091***	-0.0093***	-0.0090***
LTR (-1)	-0.0126***	-0.0123***	-0.0128***
LUNP (-1)	0.0102***	0.0099***	0.0103***
Diagnostic statistics			
N	386	386	386
R^2	0.3542	0.3510	0.3572
F	F(9, 21) = 42.80***	F(9, 21) = 39.12***	F(9, 21) = 46.77***

Notes: ***, **, and * denote statistical significance at (1%), (5%), and (10%) level, respectively.

As we can see from the outcomes of **Tables 7** and **9**, the results from the non-parsimonious and parsimonious models are very similar, with minor differences in the coefficient values and on the statistical significances of some of the variables.

Regarding the results from **Model I**, we can see that, in the short run, the variables capital stock (K), gross domestic product (Y), and unemployment rate (UNP) all have a statistically significant effect on income inequality (INEQ). Although, while the Gross Domestic Product (Y) seems to contribute to reducing the LAC countries income inequality (INEQ) in the short run, the variables capital stock (K) and unemployment rate (UNP) seem to present an inverse effect, with both variables showing signals of having an enhancing effect on these countries income inequality (INEQ). Additionally, it can be observed that, in the short-run, the main driver of income inequality (INEQ) is, indeed, the variable capital stock (K).

In the remaining models, **Model II** and **Model III**, when we decompose capital stock in its public and private dimensions (KPUB and KPRIV, respectively), the results seem to point for similar inferences. However, comparing both models, we realise that the enhancing effect from private capital stock (KPRIV) on income inequality (INEQ) is higher than the one from public capital stock (KPUB).

On to the long-run analysis, **Tables 7** and **9** does not give us the long-run elasticities because they had to be calculated. **Table 10** displays the long-run elasticities, the short-run impacts, and the adjustment speed of the three models.

Table 10. Elasticities, short-run impacts, and adjustment speed (parsimonious)

Dependent Variable: **DLINEQ**	**Model I**	**Model II**	**Model III**
Short-run impacts			
DLK	0.0148***	-	-
DLKPUB	-	0.0118***	-
DLKPRIV	-	-	0.0168***
DLY	-0.0113***	-0.0132***	-0.0102***
DLUNP	0.0096***	0.0098***	0.0095***
Long-run (computed) elasticities			
LY (-1)	-0.0241**	-0.0270**	-0.0231**
LHDI (-1)	-0.8423***	-0.8397***	-0.8350***
LTRD (-1)	-0.1039***	-0.1067***	-0.1020***
LTR (-1)	-0.1436***	-0.1416***	-0.1448***
LUNP (-1)	0.1158***	0.1141***	0.1165***
Speed of adjustment			
ECM	-0.0877***	-0.0870***	-0.0882***

Notes: *** and ** denote statistical significance at (1%) and (5%) levels, respectively; the ECM denotes the coefficient of the variable LINEQ lagged once.

The results from **Table 10** show that, in the long run, the gross domestic product (Y), the human development index (HDI), trade (TRD), and tax revenue (TR) all contribute to decreasing the income inequality (INEQ) in these countries (in all models). Among these variables, the human development index (HDI) seems to be the one that contributes the most to reducing income inequality (INEQ). In contrast, the unemployment rate (UNP) is the only one of these variables that promote income inequality (INEQ). Although the unemployment rate (UNP) has a similar effect in the short- and long-run, we see that its effect is more significant in the long-run.

One aspect that should also be emphasised is the absence of a statistically significant effect from capital stock (K) on income inequality (INEQ) in the long run. This outcome also occurs in the case of **Model II** and **Model III**, with the public (KPUB) and private (KPRIV) dimensions of capital stock. Because of this reason, and as it was already stressed, these variables were not included in the most parsimonious models.

Regarding the error correction mechanism (ECM) terms from the three models, represented by the variable LINEQ, lagged once, we see that they are all negative and statistically significant at the (1%) level. This result can signify the presence of cointegration/long-memory in the variables. Finally, the magnitude of the ECM coefficients indicates that the speed at which the dependent variable returns to equilibrium after variations in the independent variables is relatively low/moderate for all the estimated models, i.e., when the models are faced with shocks, they require a considerable amount of time to return to equilibrium.

When researchers analyse regions as the LAC region, they should not ignore the possible existence of several political and economic shocks, which could influence the results from their estimations and lead to inaccurate conclusions. Given this presumption, to test the robustness of the previous results and conclusions, a set of dummy variables were added to the three models to control for the shocks that may have affected these countries' income inequality levels in several ways.

The method consists of identifying the events that may have produced peaks/breaks of significant magnitude in the income inequality of these sample countries, followed by a residual's analysis which will allow us to confirm the existence of such shocks. Finally, we incorporate dummies in the regressions to correct the identified shocks (peaks/breaks) (e.g., Santiago et al., 2020; and Fuinhas et al., 2017). The dummies added to deal with the detected outliers were BRA2016; GTM2013; GTM2014; PRY2004; URY2010; URY2011; and URY2012.

- BRA2016: Corrects the peak observed in Brazil in 2016. This peak could be explained by the effects of the Brazilian crisis, which started in mid-2014, with the deceleration of the Chinese economy and the fall in commodity prices and culminated with the impeachment of Dilma Rousseff in 2016. This unfavourable situation negatively affected Brazilian macroeconomic stability, namely, income inequality, with the rise in unemployment and the decline in real wages.

- GTM2013 and GTM2014: Correct the breaks observed in Guatemala in 2013 and 2014, respectively. These breaks could be probably linked with the tax reforms adopted in 2012 by the Guatemalan government to improve its revenues and public social spending, which increased the progressivity of the country tax system[8].

- PRY2004: Corrects the break observed in Paraguay in 2004. This break could be possibly connected with the fact that, after some years of decline and stagnation, Paraguay registered a recovery in 2003 and 2004 (in part due to high commodity prices). At the same time, in 2003, the Paraguayan government also introduced a set of welfare programs that, combined with the country's economic recuperation, could have influenced its income inequality levels in a great deal.

- URY2010, URY2011, and URY2012: Correct the breaks observed in Uruguay in 2010, 2011, and 2012. These breaks could be linked with the election of José Mujica as President of Uruguay in 2010. Although income inequality began to fall around 2007 when José Mujica rose to power, one of his most giant flags was the fight against inequalities and wealth concentration. The measures were taken under his presidency, for example, the rise in the minimum wage and the expansion of social spending, have undoubtedly affected Uruguay's income gap.

8 However, between 2006 and 2014, income inequality has showed a decreasing trend in Guatemala, primarily "*due to a fall in the incomes of the rich rather than to a rise in the incomes of the poor*" (Sanchez et al., 2016, p. 24)

Table 11. Estimation results (parsimonious corrected for shocks)

Dependent Variable: **DLINEQ**	**Model I**	**Model II**	**Model III**
Constant	0.3506***	0.3503***	0.3520***
DLK	0.0126***	-	-
DLKPUB	-	0.0094**	-
DLKPRIV	-	-	0.0145***
DLY	-0.0107***	-0.0126***	-0.0097***
DLUNP	0.0070***	0.0071***	0.0069**
LINEQ (-1)	-0.0777***	-0.0771***	-0.0783***
LY (-1)	-0.0028**	-0.0030**	-0.0027**
LHDI (-1)	-0.0617***	-0.0609***	-0.0616***
LTRD (-1)	-0.0088***	-0.0090***	-0.0087***
LTR (-1)	-0.0147***	-0.0144***	-0.0149***
LUNP (-1)	0.0070***	0.0067***	0.0071***
BRA2016	0.0261***	0.0261***	0.0260***
GTM2013	-0.0215***	-0.0214***	-0.0216***
GTM2014	-0.0210***	-0.0209***	-0.0210***
PRY2004	-0.0207***	-0.0206***	-0.0207***
URY2010	-0.0260***	-0.0265***	-0.0257***
URY2011	-0.0305***	-0.0306***	-0.0303***
URY2012	-0.0344***	-0.0343***	-0.0344***
Diagnostic statistics			
N	386	386	386
R^2	0.4874	0.4845	0.4898
F	F(16, 21) = 470.25***	F(16, 21) = 490.76***	F(16, 21) = 473.34***

Notes: *** and ** denote statistical significance at (1%), and (5%) level, respectively.

The results of **Model I**, **Model II**, and **Model III**, with the correction of shocks, are shown in **Table 11**. With the inclusion of dummies, we see that, in the short run, the results remain similar to the ones from the models without the correction of shocks (**Table 7**), with only a few differences in the coefficients (which seem to be smaller). Thus, we can say that the previous inferences remain identical.

Regarding the dummy variables, the outcomes of **Table 11** indicate that the coefficients from all the dummies introduced in the models are statistically significant at (1%) level, thus proving the suitability of their inclusion.

As in the previous case, the long-run elasticities had to be calculated. **Table 12** displays the long-run elasticities, the short-run impacts, and the adjustment speed of the three models corrected for shocks.

Table 12. Elasticities, short-run impacts, and adjustment speed (parsimonious corrected for shocks)

Dependent Variable: **DLINEQ**	**Model I**	**Model II**	**Model III**
Short-run impacts			
DLK	0.0126***	-	-
DLKPUB	-	0.0094**	-
DLKPRIV	-	-	0.0145***
DLY	-0.0107***	-0.0126***	-0.0097***
DLUNP	0.0070***	0.0071***	0.0069**
Long-run (computed) elasticities			
LY (-1)	-0.0358**	-0.0390***	-0.0347**
LHDI (-1)	-0.7940***	-0.7899***	-0.7868***
LTRD (-1)	-0.1137***	-0.1169***	-0.1115***
LTR (-1)	-0.1891***	-0.1865***	-0.1901***
LUNP (-1)	0.0896***	0.0875***	0.0906***
Speed of adjustment			
ECM	-0.0777***	-0.0771***	-0.0783***

Notes: *** and ** denote statistical significance at (1%) and (5%) levels, respectively; the ECM denotes the coefficient of the variable LINEQ lagged once.

As in the short-run, the long-run outcomes stay similar to the ones without the correction of shocks, with some minor changes in the values of the coefficients and on the significance of the effect from the gross domestic product (Y) in **Model II** (from (5%) to (1%) level). The signals of the coefficients remain the same with the gross domestic product (Y), the human development index (HDI), trade (TRD), and tax revenue (TR), still showing to decrease income inequality (INEQ), and with the unemployment rate (UNP) still appearing to promote income inequality (INEQ).

The ECM terms of the three models continue to be all negative and statistically significant at the (1%) level, although they all suffer a decrease in their magnitude. This result means that with the inclusion of dummies, the adjustment speed of the three models becomes slightly slower.

Overall, we can conclude that, although the inclusion of dummies has proved to be adequate, the results do not differ much when the shocks are corrected, with the outcomes and inferences from the first set of models, i.e., without dummies, remaining accurate.

Discussing the main results of this analysis, we can start by referring that economic growth seems to be a tool to reduce income inequality, the variable gross domestic product (Y) shown to have had a depressing effect on income inequality (INEQ) both in the short-run and long-run. This result suggests these countries governments are combining their growth-enhancing policies with measures focused on promoting a more equitable society. In our view, these governments should continue to follow this trend. This result seems to be in line with past studies, for example, the one from Tsounta and Osueke (2014), who used a sample like ours.

Conversely to economic growth, the unemployment rate (UNP) showed an augmenting effect on these countries income inequality (INEQ) levels, both in the short- and long-run. This result means that to tackle income inequality, LAC governments should concentrate some of their efforts on developing, for example, policies to encourage job creation and measures that grant enlarged job opportunities for all. As in the previous case, this result is also accordant with past literature findings (e.g., Hacibedel et al., 2019).

Regarding the variables that have only demonstrated statistically significant effects, in the long run, we can start with the human development index (HDI), which showed to reduce the income inequality (INEQ) levels of the countries from our sample. This result traduces the general view that policies aimed at improving populations' standard of living, such as government investment in education and health, contribute to an equal society (e.g., Martínez-Vazquez et al., 2012).

In the same line, the tax revenue (TR) also showed to have had a negative impact on income inequality (INEQ) (i.e., decreased income inequality), which means that taxation is having a redistributive effect in these countries. However, as most of these countries have low tax revenues (e.g., Martorano, 2018), improving their tax schemes (e.g., more progressive taxation) could be essential to obtain higher revenues. This result also seems to be validated by some previous literature (e.g., Martorano, 2018; and Balseven and Tugcu, 2017).

Now, concerning the effects of trade (TRD) on the income inequality (INEQ) of the LAC countries, while the literature has found mixed results, our outcomes seem to support the view that trade has a reducing effect on income inequality (e.g., Cerdeiro and Komaromi, 2017). Therefore, we suggest that these countries should continue their integration process, given the positive effects that this can have on their economic output (e.g., Santiago et al., 2020), at the same time as they continue to develop policies aimed at extending the gains from trade to the general population.

Finally, answering our central question, we see that the effects from total capital stock (K), public capital stock (KPUB), and private capital stock (KPRIV) on income inequality (INEQ) were all positive and statistically significant, i.e., all these variables seem to have contributed to the deterioration of the income distribution in these countries in the short-run. However, we should mention that, in the long run, none of these variables showed to have a statistically significant effect on income inequality (INEQ).

These findings reveal some worrying aspects regarding the physical capital investments in these countries. First, regarding the enhancing effect that the total capital stock (K), the public capital stock (KPUB), and the private capital stock (KPRIV) demonstrated on income inequality (INEQ) in the short-run, we can say that this result is probably linked with the fact that the public and private investment in physical capital (e.g., roads, railways, bridges, schools, hospitals, sanitation and water systems, telecommunications and energy systems, public transportation, and among others) is being made in the already rich/wealthiest areas, where there is evidence of a particular economic dynamism, rather than being channelled to the poorest/undeveloped areas (e.g., Lopez, 2003). Some authors have already acknowledged this issue in their investigations and warned about the LAC's need to invest more in the region's rural and undeveloped areas (e.g., Brushett and John-Abraham, 2006; Fay et al.,2017; and Pérez, 2020).

Concerning the effect of the private capital stock (KPRIV) on income inequality (INEQ), we should also account for the fact that the private interest is majorly driven by profit and, therefore, it is natural that (in the absence of government incentives) they invest in areas where higher profits are guaranteed (generally in the most developed areas). In addition to this, we must also consider the possible barriers that the private control of, for example, energy, infrastructure, and transport services, can generate to the poorest groups of the population. Usually, private enterprises charge higher prices for their services than public enterprises, which could reduce the access and affordability of these services by the most disadvantaged strata of the population. These additional assumptions can probably help to explain why the magnitude of the effect of private capital (KPRIV) on income inequality (INEQ) is greater than the one from the public capital (KPUB).

Regarding the lack of a statistically significant effect from the total capital stock (K), the public capital stock (KPUB), and the private capital stock (KPRIV) on income inequality (INEQ) in the long-run, one should state that this is probably linked with the fact that over time, governments try to correct the harmful short-run effect with increased investment in the undeveloped/ rural areas or with the creation of incentives to the private sector to invest in these same areas (IFAD, 2016). However, even with the suppression of the negative effect, it seems that the investment levels and/or the investment strategies which were followed were not yet capable of inducing a reducing effect from the total capital stock (K), the public capital stock (KPUB), and the private capital stock (KPRIV) on income inequality (INEQ).

Looking at some of the data available in the World Bank, we see that although the progress in some fields, for example, in the electricity coverage[9] (in 1995, only (62.9%) of the rural population of the LAC had access to electricity, which contrasts with the value from 2017, where this percentage achieved the (91%)), some socio-economic indicators continue to point the rural areas of this region as the areas where people need to struggle more to get out of poverty. According to the LAC Equity Lab and the World Bank's $1.90-a-day (2011 PPP prices) International Poverty Line for the LAC aggregate, we see that while in the region's rural areas, the poverty rate in 2017 was (16,2%), in urban areas, this same rate was of only (1%).

All these results were held either in the non-parsimonious or in the parsimonious models, and when we corrected the three models for the presence of outliers, we included dummy variables, thus confirming the robustness of the results. In the following section (**Section 5**), we will present the conclusions and policy implications drawn from the outcomes of this analysis.

Conclusions and Policy Implications

In this study, we tried to uncover the effects that the Latin American and Caribbean capital stock has had on the income inequality levels of 18 countries of the region between 1995 and 2017. In our analysis, three models were built: **Model I** with capital stock (K) as the interest variable, **Model II** with the general government capital stock (KPUB) as the interest variable and, finally, **Model III** with private capital stock (KPRIV) as the interest variable. The econometric analysis was based on the use of the autoregressive distributed lag (ARDL) model in the form of an unrestricted error correction model (UECM), primarily because it allows identifying the short- and long-run impacts of the explanatory variables on the dependent variable, and it is robust when there are signals of endogeneity. In addition, the Driscoll and Kraay estimator with fixed effects was used to analyse the three models, and it produces standard errors robust to the disturbances being cross-sectionally dependent, heteroskedastic, and autocorrelated.

The results from our three models (non-parsimonious and parsimonious) indicate that, in the short-run, the gross domestic product (Y) seems to contribute to reducing these countries income inequality (INEQ). In contrast, the variables capital stock (K) and unemployment rate (UNP) seem to raise their income inequality (INEQ) levels. In **Model II** and **Model III**, when we decompose capital stock in its public and private dimensions (KPUB and KPRIV, respectively), the results seem to point for a similar inference, with both types of capital presenting an enhancing effect on income inequality. In the long-run, we see that the gross domestic product (Y), the human development index (HDI), trade (TRD), and tax revenue (TR) all contribute to

9 Information based on the values from the variables "Access to electricity, rural (% of rural population)" (EG.ELC.ACCS.RU.ZS) and "Access to electricity, urban (% of urban population)" (EG.ELC.ACCS.UR.ZS) from the World Development Indicators Database from the World Bank for the LAC aggregate.

decreasing these countries income inequality (INEQ). At the same time, the unemployment rate (UNP) is the only variable that seems to promote it.

Moreover, we should mention that none of the capital stock variables (K, KPUB, and KPRIV) showed a statistically significant effect on income inequality (INEQ) in the long-run. Thus, once again, **Model II** and **Model III** outcomes are similar to those from **Model I**. Finally, when we corrected the three models for the presence of outliers, the conclusions remained identical, a fact which confirms the robustness of the results.

According to these outcomes, it seems that the Latin American and Caribbean governments should rethink their public investment strategies, given that it seems that the investment was being made mainly in the regions where there was already a certain level of development/richness, forgetting the areas where the investment in physical capital is essential, i.e., in the poorest/undeveloped areas. Even with the efforts to correct this situation, the investment is still not producing the desired effect, i.e., it does not seem to contribute to the income inequality decrease. Thus, if no changes are made in this field, the cohesion of these countries will continue to be threatened due to the increase in their income distribution gap. In this sense, the region's governments should improve the management and the selection criteria of the public investments to develop the poorest/rural areas, linking them to the richer areas where there is a more thriving economic activity and, thus, increasing income convergence. Although, given the low degree of economic slack that many of these countries face, it could also be important that these governments try to create incentives so that the private initiative invest in these areas as, otherwise, this is unlikely to happen. Still, the private initiative should be intensively examined/discussed by the public entities to grant that it does not neglect the low-income lawyers of the population.

For future research, we think that the inclusion of the public-private partnership (PPP) capital stock in a similar framework (which for now has a considerable lack of data) would be interesting. As it is known, the LAC region had considerable experience with PPP projects until the late 1990s (Vassallo, 2020), when there was a drawback on this type of investment (mainly due to the harmful effects from the poorly implemented PPP's). Nevertheless, given the need to reduce the regional infrastructure gap and, at the same time, to maintain a balanced public budget, the LAC countries returned to bet on this investment scheme. Following Michelitsch et al. (2017, p. 4), "*over the period 2006-2015 around 1,000 PPP projects were developed in LAC*", with the PPP investment in infrastructure passing from US$8 billion in 2005 to US$39 billion in 2015. Given the importance and the predominance of the PPPs in the LAC region, its effects on the regions' income inequality should also be analysed to see if this type of investment schemes. Moreover, it involves the collaboration between governments and private-sector companies, which can tackle one of the region's most worrying issues.

Moreover, given the problems usually associated with this region (e.g., corruption), including variables as policy uncertainty, country risk, or the quality of public sector management and institutions could also be of especial interest. As Gupta and Abed (2002) already stressed, corruption can have detrimental effects on government revenue and, thus, can reduce its productive spending. Ultimately, this means that the quality of public sector management and institutions is very important to grant that the public investment, like the one on infrastructure, is efficiently channelled to the most important projects (e.g., the ones centred on inequality reduction). Hence, it is not a surprise that some authors have already pointed out that better institutional quality leads to lower income inequality (e.g., Chong and Gradstein, 2011). Moreover, we should also say that, as Percoco (2014) states, better institutional quality, with lower corruption levels and better regulatory frameworks, can also be essential to foment the private investment, namely the private participation in PPP schemes. Consequently, this means that it could also be suitable to include this type of variable in future investigations to understand the effects they can produce on the LAC public (and private) investment and, subsequently, on the region's income inequality.

Finally, we think that, in the future, it would also be interesting to analyse the effect of capital stock on income inequality dividing the rural and urban subsamples of these countries. Unfortunately, although the Gini Index from the CEPALSTAT makes this division, it holds an unbearable number of blanks, which makes the use of such data unviable. Nevertheless, when data availability allows, it could be relevant to explore in a more detailed way the conclusion that, in the LAC, the investments were primarily made in the already richer/wealthiest areas, as the results from our analysis and the assumptions from other previous authors seem to indicate (e.g., Pérez, 2020; Fay et al., 2017; and Brushett and John-Abraham, 2006).

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Appendix

Table A1. Correlation matrices and VIF statistics

			Model I				
	LG	**LK**	**LY**	**LHDI**	**LTRD**	**LTR**	**LUNP**
LG	1.0000						
LK	0.0668	1.0000					
LY	0.0842	-0.1239	1.0000				
LHDI	-0.4848	-0.3087	0.3306	1.0000			
LTRD	0.0772	-0.0131	-0.2605	-0.2374	1.0000		
LTR	-0.3300	-0.1116	-0.0546	0.1739	0.0059	1.0000	
LUNP	-0.1554	0.1943	0.4369	0.3069	-0.4691	0.0228	1.0000
VIF		1.33	1.37	1.42	1.31	1.06	1.74
Mean VIF		1.37					
	DLG	**DLK**	**DLY**	**DLHDI**	**DLTRD**	**DLTR**	**DLUNP**
DLG	1.0000						
DLK	0.1476	1.0000					
DLY	-0.1873	-0.4421	1.0000				
DLHDI	0.0050	-0.2882	0.2392	1.0000			
DLTRD	0.0633	-0.0821	0.0702	0.0791	1.0000		
DLTR	0.0168	-0.0643	-0.0634	0.1182	0.2035	1.0000	
DLUNP	0.1913	0.2685	-0.2359	-0.1109	-0.2072	-0.1900	1.0000
VIF		1.48	1.37	1.11	1.08	1.11	1.22
Mean VIF		1.23					
			Model II				
	LG	**LKPUB**	**LY**	**LHDI**	**LTRD**	**LTR**	**LUNP**
LG	1.0000						
LKPUB	-0.1155	1.0000					
LY	0.0842	-0.2221	1.0000				
LHDI	-0.4848	-0.4016	0.3306	1.0000			
LTRD	0.0772	-0.0070	-0.2605	-0.2374	1.0000		
LTR	-0.3300	0.1344	-0.0546	0.1739	0.0059	1.0000	
LUNP	-0.1554	0.0848	0.4369	0.3069	-0.4691	0.0228	1.0000
VIF		1.42	1.38	1.57	1.32	1.10	1.64
Mean VIF		1.40					

Table A1 (continued). Correlation matrices and VIF statistics

	DLG	DLKPUB	DLY	DLHDI	DLTRD	DLTR	DLUNP
DLG	1.0000						
DLKPUB	0.1099	1.0000					
DLY	-0.1873	-0.4097	1.0000				
DLHDI	0.0050	-0.2932	0.2392	1.0000			
DLTRD	0.0633	-0.0653	0.0702	0.0791	1.0000		
DLTR	0.0168	-0.0503	-0.0634	0.1182	0.2035	1.0000	
DLUNP	0.1913	0.2520	-0.2359	-0.1109	-0.2072	-0.1900	1.0000
VIF		1.40	1.31	1.12	1.08	1.11	1.21
Mean VIF		1.20					
				Model III			
	LG	**LKPRIV**	**LY**	**LHDI**	**LTRD**	**LTR**	**LUNP**
LG	1.0000						
LKPRIV	0.3135	1.0000					
LY	0.0842	0.0527	1.0000				
LHDI	-0.4848	-0.1141	0.3306	1.0000			
LTRD	0.0772	-0.0033	-0.2605	-0.2374	1.0000		
LTR	-0.3300	-0.3703	-0.0546	0.1739	0.0059	1.0000	
LUNP	-0.1554	0.1173	0.4369	0.3069	-0.4691	0.0228	1.0000
VIF		1.24	1.33	1.24	1.31	1.24	1.56
Mean VIF		1.32					
	DLG	**DLKPRIV**	**DLY**	**DLHDI**	**DLTRD**	**DLTR**	**DLUNP**
DLG	1.0000						
DLKPRIV	0.1783	1.0000					
DLY	-0.1873	-0.4433	1.0000				
DLHDI	0.0050	-0.2772	0.2392	1.0000			
DLTRD	0.0633	-0.0842	0.0702	0.0791	1.0000		
DLTR	0.0168	-0.0767	-0.0634	0.1182	0.2035	1.0000	
DLUNP	0.1913	0.2677	-0.2359	-0.1109	-0.2072	-0.1900	1.0000
VIF		1.47	1.37	1.10	1.08	1.12	1.22
Mean VIF		1.23					

Table A2. Hausman test (FE vs. RE) (parsimonious)

	Model I	Model II	Model III
	FE vs. RE	**FE vs. RE**	**FE vs. RE**
Hausman test	Chi2(9) = 97.55***	Chi2(9) = 96.54***	Chi2(9) = 97.36***
Hausman test (with *sigmamore*)	Chi2(9) = 86.50***	Chi2(9) = 88.82***	Chi2(9) = 85.24***
Hausman test (with *sigmaless*)	Chi2(9) = 109.68***	Chi2(9) = 113.52***	Chi2(9) = 107.60***

Notes: *** denotes significance at (1%) level; H0: difference in coefficients not systematic.

Table A3. Hausman test MG vs PMG vs Pooled (parsimonious)

	Model I	Model II	Model III
Hausman test	**MG vs. PMG**	**MG vs. PMG**	**MG vs. PMG**
	Chi2(9) = -3.51	Chi2(9) = -3.66	Chi2(9) = 3.10
	PMG vs Pooled	**PMG vs. Pooled**	**PMG vs. Pooled**
	Chi2(9) = 2.38	Chi2(9) = 3.01	Chi2(9) = 3.35
	MG vs Pooled	**MG vs. Pooled**	**MG vs. Pooled**
	Chi2(9) = 20.49**	Chi2(9) = 35.59***	Chi2(9) = 14.91

Notes: *** denotes statistically significant at (1%); H0: difference in coefficients not systematic.

Table A4. Specification tests (parsimonious)

	Model I	Model II	Model III
	Statistics	Statistics	Statistics
Modified Wald test	Chi2 (18) = 145.37	Chi2 (18) = 144.97***	Chi2 (18) = 145.36***
Pesaran's test	2.863***	2.981***	2.798***
Wooldridge test	F(1, 17) = 19.483***	F(1, 17) = 19.484***	F(1, 17) = 19.484***

Notes: *** denotes statistical significance at (1%) level; H0 of Modified Wald test: sigma(i)^2= sigma^2 for all I; H0 of Pesaran's test: residuals are not correlated; H0 of Wooldridge test: no first-order autocorrelation.