Inequality and economic growth in Latin*

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Abstract

Latin America is the region that bears the highest rates of inequality in the world. Deininger and Squire (1996) showed that Latin American countries achieved only minor reductions in inequality between 1960 and 1990. On the other hand, East Asian countries, recurrently cited in recent literature on this issue, have significantly narrowed the gap in income inequality, while achieving sustained economic growth. These facts have triggered a renewed discussion on the relationship between income inequality and economic growth. According to the above literature, income inequality could have an adverse effect on countries' growth rates. The main authors who spouse this line of thinking are Persson and Tebellini (1994), Alesina and Rodrik (1994), Perotti (1996), Bénabou (1996), and Deininger and Squire (1996, 1998). More recently, however, articles were published that questioned the evidence presented previously. Representatives of this new point of view, namely Li and Zou (1998), Barro (1999), Deininger and Olinto (2000) and Forbes (2000), believe that the relation between these variables can be positive, i.e., income inequality can indeed foster economic growth.

Using this literature as a starting point, this article seeks to evaluate the relation between income inequality and economic growth in Latin America, based on a 13-country panel, from 1970 to 1995. After briefly reviewing the above articles, this study estimates the per capita GDP and growth rate equations, based on the neoclassical approach for economic growth. It also estimates the Kuznets curve for this sample of countries. Econometric results are in line with recent work conducted in this area – particularly Li and Zou (1998) and Forbes (2000) – and confirm the positive relation between inequality and growth, and also support Kuznets hypothesis.

Key words: Income inequality, economic growth, Kuznets curve, Latin America.

JEL Classification: O15, O40.

1 Introduction

Latin America is the region that bears the highest rates of inequality in the world. Deininger and Squire statistics (1996), shown in table 1, attest that Latin American countries consistently had the highest rates of inequality between 1960 and 1990. While most other regions – notably East Asian countries – managed to significantly reduce inequality indicators from 1970 to 1990, income inequality remained high in Latin America.

The huge income inequality is associated to education distribution in the region, according to the Interamerican Development Bank – IDB (1998)[1]. The richest inhabitants of each country are also the most educated, since they have opportunity to graduate from high school and enter universities. In Latin America, education distribution follows the same pattern of income distribution. Income differences can largely be explained by education differences, as

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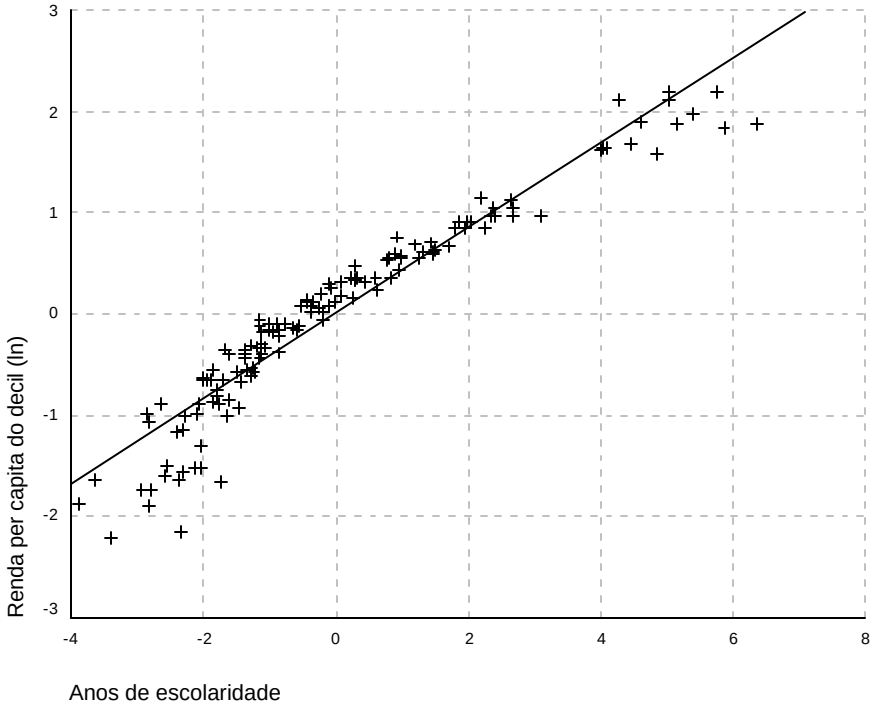
illustrated by graph 1 below. Estimates based on IDB data (1998)[2], which consider the participation in the product according to deciles in income distribution and average education of each group, for a set of 14 economies in the mid 90s, indicate that a typical Latin American citizen can increase his or her annual income by an average of 12%, for each additional year of schooling. Since a wide gap in education exists, income inequality is an inevitable consequence.

Table 1 Gini index according to regions, 1960 to 1990

Region	1960	1970	1980	1990
Latin America and Caribbean	53.2	49.1	49.7	49.3
Sub-Saharan Africa	49.9	48.2	43.5	46.9
Middle East and North Africa	41.4	41.9	40.4	38.0
East Asia and Pacific	37.4	39.9	38.7	38.1
South Asia	36.2	33.9	35.0	31.9
Industrialized and Developing Countries	35.0	34.8	33.2	33.7
East Europe	25.1	24.6	25.0	28.9

Source: Deininger and Squire (1996).

Graph 1 Income and education according to income distribution deciles, Latin America, mid 90s.



Source: own calculations based on IDB statistics (1998).

[1] Asset distribution, as well as land distribution, are decisive factors in explaining inequality. See IDB (1998).

[2] These estimates consider a panel with 10 observations (income-distribution deciles) for each of the 14 economies. In addition to the average schooling variable, employed in the regression to help explain the average income in each social group, in each country – income distribution decile – this article used dummies representing the nation and each of the deciles. The resulting equation is equivalent to a simplified version of the Mincer equation, widely used in Labor Economics studies. The regression, which showed that income semi-elasticity in relation to education was of 0.12%, presented an adjusted R^2 of 99%, with a DW of 2.027 and lack of residual heterocedasticity.

According to Birdsall et al (1995), education was the main variable behind the sustained growth enjoyed by East Asian countries. Public policies aimed at the expansion of the education basis improved education distribution among inhabitants of these countries, consequently affecting productivity and narrowing income inequality. Thus, policies ensured that the fruit of growth could be distributed, fostering subsequent growth.

Literature on income inequality and economic growth published in the 90s considers East Asian countries classic examples, since they achieved considerable growth and narrowed their income gaps. This fact triggered renewed discussions regarding the relation between income inequality and economic growth and rekindled discussion on the Kuznets hypothesis – an inverted-U-shaped relation between per capita income and its distribution. According to this literature, income inequality could negatively affect a country's growth rates. The main studies that spouse this line of thinking are the following: Persson and Tabellini (1994), Perotti (1993), Alesina and Rodrik (1994), Bénabou (1996), Clarke (1995), Alesina and Perotti (1994), and Panizza (1998). More recently, however, another set of articles questioned the findings of the first line of studies. Li and Zou (1998), Barro (1999), Deininger and Olinto (2000), and Forbes (2000), discuss, based on new empirical evidence, if in fact inequality has negative impact on the rate of economic growth. These authors, unlike the previous ones, found a positive relation, meaning that income inequality can indeed benefit growth.

This article aims to evaluate the relation between income inequality and economic growth in Latin America, considering the period between 1970 and 1995. To do so, this article is divided into three sections, in addition to this introduction. The first summarizes recent work published on this issue, pointing out theoretical aspects and explanations for this set of studies. The second presents a series of regressions, which evaluate the relation between inequality and growth in Latin America, based on the neoclassical economic growth theory and on the Kuznets curve specifications. The third briefly discusses this article's findings and how they fit into the recent literature on the subject.

2 A review of the literature on inequality and economic growth

In the 90s much work was produced focusing the growth area, particularly regarding distribution issues. The resumption of the inequality theme was fueled mainly by the performance of Asian countries in the last three decades[3]. As pointed out by the 1993 World Bank Report:

[3] Please see World Bank Report (1993), which seeks to identify the determinants behind the exceptional Asian growth.

> "Some countries in East Asia sustained per capita GDP growth rates of 4-5 percent over four decades, with massive improvements in living standards and in health and education for poor people and for everyone else" (World Bank Report, 2000, p. 35)

These facts motivated several researchers to evaluate whether the reduction in income inequality was a decisive factor in that region's economic performance. A pioneering study evaluating the relation between inequality and growth was that of Persson and Tabellini (1994). The authors created a theoretical model, which related income inequality and growth using political mechanisms. Generally speaking, societies with wide income gaps do not protect property rights and do not allow full appropriation of returns on investments. Such facts choke capital accumulation and consequently economic growth. This first article was followed by a series of studies on this subject, summarized by Bénabou (1996), which compiles 23 theoretical and empirical works on inequality, economic growth and investment[4]. Among the chief conclusions of the works summarized by Bénabou (1996) are the following:

> "[...] a one standard deviation decrease in inequality raises the annual growth rate of GDP per capita by .5 to .8 percentage points." (p. 2)
> "[...] In any case, enrollments in and stocks of secondary education have a substantial negative correlation with inequality, and in some of the theories discussed below the link between income distribution and growth arises precisely through human capital investment."(p.3)

To ease exposition and analysis of the models relating inequality and growth, the studies were classified according to the key mechanism pointed out by the authors. Much work, such as that of Barro (1999), Rodríguez (2000), Deininger and Olinto (2000), Ferreira (1999), and Perotti (1996), aim at such classification[5]. The most comprehensive is that developed by Deininger and Olinto (2000), which states that there are three main lines of work: (i) models of political economics; (ii) models of imperfections in the credit market and indivisible investments; and (iii) models of social unrest and economic efficiency. Below are the main works in each area. At the end, there are some other studies not fitting this classification.

2.1 Political economics models

The works in this first group[6] can be further divided into two categories: the first was inspired by Meltzer and Richard (1981) and the second resulted from flaws in the empirical

[4] No empirical works are analyzed in this section, although some of those works will form the comparison basis for the empirical tests results developed in this article. For a summary of the works, see Bénabou (1996) and Durlauf and Quah (1998).
[5] Please see the summary of the approaches suggested by Aghion et al (1999).
[6] Alesina and Perotti (1994) prepared a list of the main works relating democracy and economic growth. See Panizza (1998),Alesina and Rodrik (1994), Bertola (1993), Perotti (1993), and Persson and Tabellini (1994).

evaluation performed by the first one. Essentially, this work is grounded on the notion of the redistributive role of the State. Governments tax income, according to the proportional taxation principle, and then redistribute the proceeds in egalitarian form. Given that taxation is decided by the median voter, if the income of this particular economic agent is below the population's average income, he or she will decide to raise taxes and consequently redistribute the income earned by these taxes. Therefore, if inequality is measured as the distance between the median voter and the mean voter, high inequality will lead to greater taxation, which will affect investment decisions. Taxation and redistribution are considered distortive policies that jeopardize economic efficiency. That is the reasoning behind greater inequality having a negative effect on growth[7].

Persson and Tabellini (1994) argue that in societies where distributive conflicts are significant, political decisions can restrain private appropriation of the results of individual effort, which in turn discourages productive investment and reduces growth. The authors adopted the superposed generations model, in which individuals born in each period are economic and political agents (voters). In this model, majority-driven redistribution policies would bring a negative relation between inequality and income. However, after testing the mechanisms that should link inequality to growth, for a sample comprised of only OECD nations, it was found that inequality only affects investment in democracies and no significant relation was found between income redistribution and growth. The results fail to confirm the relation between inequality and growth, through income redistribution. The authors also point out that empirical results are not as robust when controlled by regional variables and different political regimes.

Alesina and Rodrik (1994) also establish a relation between income distribution and growth occurring through distributive policies. The key point is that individuals differ in the relative endowment of productive factors – capital and work. Growth is determined by accumulation of physical capital, which in turn is determined by individual saving decisions. Government services are financed by taxes on work. Since individuals have different endowments, preference for different taxation levels will fluctuate among them. For an individual, the lower the share of his or her income originating from capital, relative to labor income, the greater the tax rate for such individual, consequently reducing the savings rate and in turn economic growth. In this model, different from that of Persson and Tebellini (1994), taxes play more than a redistributive role: they are used for the production of public assets, necessary for private pro-

[7] According to Lee and Roemer (1998), these models use the distance between median and mean voter. For these models, in place of inequality it would be more appropriate to use a measure of skewness, which does not always reflect inequality.

duction. Capital also has a broader role, since it includes all assets, such as physical, human and technological capital. The core point of the empirical analysis is that the authors, considering the initial income level and human capital, found a negative relation between income distribution, given by the Gini index, and growth. In other regressions the authors used a dummy for democracy, in order to identify the distinct relation between inequality and income for different political regimes. They also tested the formulation for land distribution (Gini-land) and concluded that countries that underwent agrarian reform after the war enjoyed higher growth than those that did not. The examples provided are those of Asian countries, compared to Latin American ones.

Alesina and Perotti (1994) underline the need to precisely define the notion of democracy. According to the authors, a democracy can be defined as a nation with free, periodical and multiparty elections, or a society that provides enough civil liberties to its population. In the empirical analysis, they explore the well-known Gastill civil-liberties index. The results do not show a relation between democracy and growth, which can be justified by the difficulty of classifying regimes, due to the diversity found in the group of non-democratic nations, as opposed to the relative similarity found in the group of democratic ones. Nonetheless, Barro (1991) argues that civil liberties have a beneficial effect on a country's economic performance.[8]

Deininger and Squire (1998) also tested the influence of different political regimes, dividing the sample of countries into democracies and non-democracies[9]. The authors found unique results: initial inequality affects only the growth of non-democratic nations. However, according to the theory, inequality should also affect the growth of democratic ones.[10]

One work that drifts slightly away from this article's line of study, but points towards a direction opposite to the empirical results found hitherto, is that of Rodrik (2000). The author covers the type of institutions that allow better economic performance[11]. Rodrik questions the frail results on the role of democracies in economic performance. According to this author, participatory political regimes lead to growth of higher quality – more egalitarian. Econometric results are partly explained because countries recording the highest growth rates in the last decades are authoritarian. On the other hand, the author finds that growth rate variance is smaller in countries with greater political participation. Moreover, in democracies and in nations with

[8] Regarding political regimes and growth, see also Durham (1999).
[9] Countries with a Gastill index of civil liberties below 2 were considered democratic.
[10] Similar results were also found by Clarke (1995) and Alesina and Rodrik (1994).
[11] Chong and Calderon (2000) also study the role of the quality of the institutions in economic performance. They have found a non-linear relation between the quality of the institutions and income inequality, represented by the Gini index, and conclude that this quality has positive effects on growth.

participatory institutions, the response to adverse shocks comes faster. This happens because this type of adjustments require the management of social conflicts and democracies are natural breeding grounds for institutions prepared to arbitrate such conflicts. This is precisely why South Korea and Thailand, nations whose regimes allow greater political participation, better managed the financial crises they met, unlike Indonesia, a country whose regime curbs political participation. The author also identifies a significant relation between the extension of political participation and wages, not disregarding differences in productivity, income level and other growth determinants.

Rodríguez (2000) argues that no satisfactory empirical evidence exists regarding the fact that inequality is associated to income redistribution or that redistribution is associated to lower growth rates[12]. The Meltzer and Richard model (1981), according to Rodríguez (2000), considers that the vote for income redistribution occurs in a democratic political environment[13]. Therefore, this model would not be suited to describing the economic growth and the expansion of inequalities in non-democratic regimes.

The second category of studies in this first group[14] aims at filling the blanks left by the first category. To do so, it considers a more complex interaction between income distribution and growth. Most of this work finds a positive correlation between fiscal policy variables and growth and, under certain conditions, unequal societies can present lower growth According to Panizza (1998), in spite of the model's structure being similar to that suggested by Persson and Tabellini (1994) as well as Alesina and Rodrik (1994), the negative relation between growth and inequality is identified in a different form.[15]

2.2 Models with imperfections in the investment and capital market

Models with imperfections in the investment and capital market comprise the second group of studies. Generally speaking, in societies will ill-distributed income, the possibilities for investment in physical and human capital are smaller. The reduction in economic growth is caused by more limited investment, which in turn is brought by imperfections in the asset market. This literature is based on the work of Loury (1981), who believes that credit restrictions

[12] Bénabou (2000) blends a theory of inequality and social contract to solve some issues in the aforementioned literature. According to the author, among the group of industrialized democratic nations, those more unequal tend to distribute less. In this aspect, the author compares the United States with Western Europe, and East Asian countries with Latin American ones. In spite of other differences, both Europe and Latin America are unequal societies.
[13] For other comments, see Rodríguez (2000) pp 4-5, Perotti (1994) and Alesina and Rodrik (1994).
[14] Acemoglu and Robinson (1996), Bourguinon and Verdier (1996) and Bénabou (1996)
[15] Bourguinhon and Verdier (2000) give the political mechanism an endogenous quality, meaning that political participation will depend on the citizens' education level. In an imperfect credit-market environment, only an educated elite will have political clout.

prevent the poor from reaching an efficient investment amount, which demands a minimum sum to run a business. Galor and Zeira (1993) as well as Aghion and Bolton (1997) underscore the problem of minimum scale, or size of project. In the opinion of Ferreira (1999), p.11:

> "[…] this could be a school or college fee; it could be the price of the smallest viable plot of land in an agricultural community; or the permit to operate a stall in a market. Wherever you look, the argument goes, you can find people who would be engaged in a more productive activity, had they only had the minimum initial "investment" required to enter it."

Deininger and Olinto (2000) state that this group of studies relate the initial wealth distribution to growth, based on credit-market imperfections: only entrepreneurs with considerable personal wealth are able to finance their projects. Because of scarce credit availability, creditors need guarantees to provide loans. Considering that investments are indivisible, i.e., there are high fixed costs per project, wealth distribution will determine how many people can finance their projects[16]. Investments in education or accumulation of human capital are examples of this rationale, particularly when no other forms of financing are available. Thus, according to Deininger and Olinto (2000), p.7:

> "In the presence of financial market imperfections, countries with different distribution of wealth (and initial wealth level) will follow different growth paths and may converge to different steady states"

This argument can be used to better understand the endurance, along many generations, of income inequality, particularly in Latin American countries, where wealth inequality would block accumulation of human capital, leading to a relative scarcity of skilled labor.[17]

Bénabou (1996) presents a model that includes imperfect-market and political economics models. This author's model springs from the idea that the income of the decisive voter is above that of the median voter. Under these circumstances, if inequality is too blatant, the cost of a redistribution for individuals with higher economic and political power will increase. Under this perspective, the higher the inequality the smaller the chance to have a income redistribution policy. Economic growth would be negatively impacted by inequality since, given credit-market imperfections, asset allocation would not be as efficient as that found in a more egalitarian society, where the poor would have a chance to invest in productive activities. Incomplete asset markets coupled with liquidity restrictions would in this particular case be positive for

[16] Aghion and Bolton (1997).
[17] See Birdsall et al (1995) regarding this aspect.

growth. In the Rodríguez model (1999b), high inequality shifts assets to rent-seeking activities and to the securing of political favors[18], which choke productive activities.

Regarding the Bénabou (1996) model, Deininger and Olinto (2000) argue that if tax revenues were not used in consumption, but rather in productive activities or public assets – such as infrastructure, law and order, citizen protection, property rights assurance and other expenditures that can not be financed any other way – the impact of inequality on voters would be harder to predict[19]. The use of taxes will depend on the nature of the externality involved, opening the way for many forms of equilibrium[20], as well as for changes in inequality with the intent to avoid revolutions and social disorder (Acemoglu and Robinson, 1998). Moreover, Deiniger and Olinto (2000) point out that voters are less nearsighted as it is generally believed.

2.3 Models of economic efficiency and social instability

The third group of researchers works with the hypothesis that a politically unstable environment has negative effects on investments and therefore lowers growth. The core hypothesis is that a society with wide income gaps, where political power is likewise concentrated in a small elite, fuels the discontent of the population. This situation prompts the population to change the situation through "non-legal" means: disturbances, uprising and predatory activities. An unstable environment also produces sub-optimum investments, consequently lowering growth. Moreover, people involved in this type of activity could be engaged in productive efforts. Among the works that support this hypothesis are the following: Alesina and Perotti (1993, 1994 e 1996), Alesina at alli (1992), Perotti (1994, 1996), and Bénabou (1996).

Alesina and Perotti (1994) provide a list of the articles studying the relation between growth, inequality and political instability. They point out that the relation between political instability and growth faces two hurdles: the precise definition of political instability and endogeneity, i.e., the effect of growth on political instability. Social researchers gauge political instability in two ways. The first is an index comprised of variables such as the number of protests, murders and revolutions[21]. The second seeks to identify changes in government and estimates the probability of changes of positions and political parties in the executive branch of governments[22]. Thus, the higher this probability the greater is political instability. Another

[18] On the effects of corruption over growth, see Mauro (1995). In this work, it is assumed that not only institutions affect growth, but economic variables affect institutions. It finds meaningful results that corruption has a negative effect on investment. It uses a "bureaucracy efficiency" index to measure the quality of the institutions.
[19] On this subject, see also Bertola (1993), Cooper (1998), Saint-Paul and Verdier (1994).
[20] See Bourguignon and Verdier (1998).
[21] Works that have used this measure are: Venieris and Gupta (1986), Barro (1991), Gupta (1990), Mauro (1993), Olzer and Tabellini (1991), and Venieris and Sperling (1989).
[22] Edwards and Tabellini (1991), Londregan and Poole (1992) and Cukierman, Edwards and Tabellini (1992).

work, Alesina and Perotti (1996), provides an explanation for political instability. To the possibility of changes in the executive branch, they added the odds of constitutional changes, by way of electoral processes or illegal methods, such as a coup d'état. For a sample of 71 countries, for the period between 1960 and 1985, it is found that the most unequal societies are politically unstable and that such instability has negative effects on growth.[23]

According to Alesina and Perotti (1994) and (1996), poorer countries are also politically more unstable. They are unstable because they grow less and they grow less because they are unstable. Moreover, growth is not influenced solely by the political regime; political instability is of even greater importance. Transitions from dictatorship to democracy, which are associated to such instability[24], usually occur during periods of low economic growth. Most of the empirical work in this area has found a positive relation between inequality and instability – Perotti (1996) being one example. Those who have tested the relation between instability and growth have also stated that an environment of greater instability will reduce investment and growth.

According to Ferreira (1999), some researchers point out the relation between unequal societies and high rates of crime, which raises the cost of opportunity to live in such locations. Much is spent on protection and insurance, thereby reducing the amounts that could be spent on productive activities. This means that income inequality could be directly associated to the production of "public bads" (as opposed to public goods) – violence, criminality and crimes against property rights, factors which affect growth, whether directly or indirectly. Fay (1993), quoted in Alesina and Perotti (1994), states that in societies with ill-distributed income, the number of individuals who perform illegal activities, which threaten property rights, is greater.

2.4 Other approaches

There is a last set of works that does not fit the previous ones discussed but suggests a relation between income inequality, fertility and education. In this case, investment in human capital is affected by the fertility rate, which in turn is affected by income distribution. Works such as that of Becker (1988), Barro and Becker (1988), Becker, Murphy and Tamura (1991), and Perotti (1996) show that fertility rate is associated to better income distribution, greater investment in human capital and higher economic growth. This relation is also evaluated in an environment of credit-market imperfections, where restrictions prevent the poor from investing in the accumulation of human capital.

[23] Barro (1991) uses the frequency of coups d'état and the number of political assassinations to support the idea that political variables have a negative effect on growth.

[24] According to the authors, a transition from dictatorship to democracy demands a settlement of the conflicts between different political groups.

The work of Lee and Roemer (1998) blends elements of the first and second groups of studies. It combines the political economics approach with the imperfect credit markets hypothesis. According to the authors, the relation between income inequality and economic growth is more complex than expressed by the conventional political economics models, i.e., those following the formulation of Meltzer and Richard (1981). In the model suggested by Lee and Roemer (1998), the marginal consumption propensity of the poor is less than that of the richer. Income inequality affects private investments in two different ways: the first occurs through taxation on investment, which is the political effect; the second, called the "threshold effect", mirrors the result of a minimum scale of investment. According to this last effect, inequality has a positive correlation with private investment, for any tax rate. Therefore, no negative relation between income inequality and private investment is found, since there are multiple points of equilibrium, as in Galor and Zeira (1993).

Lastly, Barro (1999) and Rodríguez (2000) highlight the models whose relation between inequality and growth is positive. Income inequality would concentrate wealth in the hands of those able to save, the richer. Thus, more inequality would create the necessary assets for investment and economic growth.

3 Inequality and growth in Latin America – 1970 to 1995

This section aims to evaluate, using econometric exercises, the possible impact of income inequality on the level of product and on the economic growth rate in Latin American economies from 1970 to 1995. It also aims to estimate the Kuznets curve for this sample of countries, i.e., if economic growth during that period imposed some behavior pattern to income inequality. Before commenting the primary data and the econometric methodology employed in the analysis, it is important to describe the specifications of the product per worker, economic growth and Kuznets equations used in this article.

3.1 Theoretical specifications

The specifications for the equations for per capita product and its growth followed the tradition of the Solow model with human capital. The starting point was an aggregated production function, of the Cobb-Douglas type, where the product of each country (Y) is determined by the stocks of physical capital (K), of human capital (H) and of knowledge (A). In this equation, the stock of human capital in an economy is defined as the work adjusted to its productivity (h), which is an increasing function of labor education (u).

$$Y = K^{\alpha} \cdot (A \cdot H)^{1-\alpha} \tag{1}$$

where $0 < \alpha < 1$, $H = h \cdot L$ e $h = e^{\phi \cdot u}$.

Based on this equation, the Gini variable is introduced, as an element that adjusts the productivity of the factors, as suggested by Hall and Jones (1996, 1999), Jones (2000), and Garcia et al (1999) for institutional-type variables – equation (2), where $G = e^{Gini}$. The aim of this procedure is to capture the effect of inequality on economic efficiency, as suggested by the theoretical approaches discussed in the previous section.

$$Y = G^{\gamma} \cdot \left[K^{\alpha} \cdot (A \cdot H)^{1-\alpha} \right] \tag{2}$$

From equation (2), the specification for the product per effective-human capital unit is derived, i.e., the production function in its reduced form, where $\tilde{y} = Y/A \cdot H$, $\tilde{k} = K/A \cdot H$ e $H = L \cdot e^{\phi \cdot u}$:

$$\tilde{y} = G^{\gamma} \cdot \tilde{k}^{\alpha} \tag{3}$$

Solow's (1956) capital accumulation equation – also expressed in its reduced form – gives us the conditions for the steady state of the economy. In this equation, s_k denotes the savings rate, n the demographic growth rate, g the technological innovation rate, and d the depreciation rate.

$$\dot{\tilde{k}} = s_k . \tilde{y} - (n + g + d) . \tilde{k} \tag{4}$$

In the steady-state equilibrium, the variation of the capital stock per unit of effective-human capital is null, which allows us to calculate the value of the capital stock per unit of equilibrium effective-human capital, $\tilde{k}^*$. This value is determined by equation (5). And, by substituting the value of $\tilde{k}^*$ in the reduced-form production function, the value of the product per unit of effective-human capital in steady state is obtained, indicated by $\tilde{y}^*$ and defined by expression (6).

$$\tilde{k}^* = \left(\frac{s_k}{n + g + d} \right)^{\alpha/1-\alpha} \tag{5}$$

$$\tilde{y}^* = G^{\gamma} \cdot \left(\frac{s_k}{n + g + d} \right)^{\alpha/1-\alpha} \tag{6}$$

By defining y^* as the product per worker in steady state, equation (7) is obtained. And, by linearizing this expression, using the natural logarithm, expression (8) is obtained, which defines, in theoretical terms, the product per worker:

$$y^* = G^{\gamma} \cdot \left(\frac{s_k}{n+g+d} \right)^{\alpha/1-\alpha} .A.e^{\phi u} \tag{7}$$

$$\ln y^* = \gamma \cdot Gini + \frac{\alpha}{1-\alpha} . \ln s_k - \frac{\alpha}{1-\alpha} . \ln (n+g+d) + \ln A + \phi.u \tag{8}$$

Assuming the hypotheses of Mankiw, Romer and Weil (1992) regarding knowledge, it is assumed that $A_t = A_0.e^{gt}$ and that $\ln A_{(0)} = a + \varepsilon$ – where a is a technological constant and ε, is a specific random shock in the economy. Assuming, by simplification, that $t = 0$, the empirical specification to be estimated is obtained, given by equation (9).

$$\ln y^* = a + \gamma \cdot Gini + \frac{\alpha}{1-\alpha} . \ln s_k - \frac{\alpha}{1-\alpha} . \ln (n+g+d) + \phi.u + \varepsilon \tag{9}$$

In equation (9) it is expected that γ be a negative parameter, which would be indicating that a greater level of inequality, as measured by the Gini income index, would lead the economy to economic efficiency losses. The higher this coefficient, the greater the impact of inequality on the economy.

Based on equation (9), and assuming that economies drift towards a steady state, it is possible to deduce in the traditional form the growth equation for the product per worker in this economy. In addition to the variables which determine the product per worker in steady state, in the equation that calculates the growth rate, the initial income level per worker emerges as an explanatory variable.

$$\begin{aligned} \ln y_t - \ln y_{t-1} = a + \left(1 - e^{-\beta T}\right) \cdot \ln y_{t-1} + \gamma \cdot Gini + \frac{\left(1 - e^{-\beta T}\right)\alpha}{1-\alpha} \cdot \ln s_k - \\ - \frac{\left(1 - e^{-\beta T}\right)\alpha}{1-\alpha} \cdot \ln (n+g+d) + \left(1 - e^{-\beta T}\right)\phi \cdot u + \varepsilon \end{aligned} \tag{10}$$

Lastly, the Kuznets equation took into consideration the alternate specifications (11) and (12), which were inspired by previous works, such as those of Deininger and Squire (1998) and Barro (1999):

$$Gini = \delta_0 + \delta_1 \cdot \ln (Y/L) + \delta_2 \cdot (\ln (Y/L))^2 + \delta_3 \cdot u + \varepsilon \tag{11}$$

$$Gini = \delta_0' + \delta_1' \cdot (\ln y_t - \ln y_{t-1}) + \delta_2' \cdot u + \varepsilon' \tag{12}$$

3.2 Data bases and econometric methodology

Initially, the sample included 17 countries, studied in the period from 1970 to 1995, separated into five-year periods, i.e., five time observations for each country: 1970, 1975, 1980, 1985, 1990 e 1995. Following a first evaluation, however, some countries, namely Ecuador, Guatemala, Honduras and Paraguay, were excluded from the estimation, since they suffered

from lack of information for some years and inequality data presented problems that frustrated temporal comparison for these economies. Consequently, the 102 observations were reduced to 78, meaning 13 countries analyzed at six points in time. Income distribution was measured by the Gini index and the main source of information was the data bank provided by Deiniger and Squire (1996). Inequality data employed are presented in table 2.

Table 2 Gini index for income distribution, Latin America, 1970 to 1995*

Country	Year					
	1970	1975	1980	1985	1990	1995
Argentina	0.394	0.366	0.410	0.400	0.431	0.463
Bolivia	0.530	0.525	0.520	0.516	0.486	0.530
Brazil	0.576	0.603	0.578	0.562	0.596	0.590
Chile	0.460	0.470	0.532	0.549	0.579	0.565
Colombia	0.520	0.520	0.545	0.512	0.513	0.571
Costa Rica	0.444	0.452	0.450	0.420	0.461	0.460
Dominican Rep.	0.455	0.450	0.441	0.433	0.505	0.487
Jamaica	0.479	0.511	0.504	0.498	0.484	0.445
Mexico	0.577	0.579	0.540	0.506	0.550	0.550
Peru	0.550	0.570	0.493	0.494	0.492	0.515
El Salvador	0.465	0.484	0.400	0.424	0.448	0.510
Uruguay	0.428	0.450	0.424	0.412	0.424	0.430
Venezuela	0.477	0.436	0.428	0.452	0.538	0.470

Note: (*) the data refer to the year closest to those shown in the table.

All other variables were built based on *World Development Indicators* (2000) data. The measure used as a proxy for human capital – average schooling – was obtained from Barro and Lee (1996) and updated with information supplied by the Interamerican Development Bank data bank. Due to the poor quality of the data relative to workforce occupation, it was preferable to employ the per capita product of these economies and its growth as dependent variables of equations (9) and (10), respectively, and as independent variables of equations (11) and (12).

It was also assumed that depreciation rate, d, is constant and the same for all countries comprising the sample, namely 3% per year. The technological innovation rate, g, is also constant and the same for all countries in the sample, by construction. The value assumed was 1.2% per year, as suggested by Piedrahita (1998), which considers that g is equal to the average per capita product growth rate in Latin America in the period from 1916 to 1989.

In estimating equations (9) to (12), the Ordinary Least Squares (OLS) method was employed, since it is assumed that explanatory variables are independent of specific country factors and also do not depend on residue. According to Mankiw, Romer and Weil (1992) there are three reasons that justify the independence hypothesis. In addition to this method, the Two-Stage Ordinary Least Squares method (2OLS) was also employed, to handle eventual simultaneity problems between equations (9) and (10), for product per worker and growth rate, and equations (11) and (12), which define the Gini index for the sample countries.

In both estimation procedures, dummy variables were used to capture the country's fixed effects. This procedure aims to capture the effects of the omitted variables, but which affect the per capita product. According to Forbes (2000), p. 5-6:

> "Since the dummy variables are significant, this indicates that region-specific factors affecting growth are not captured by the explanatory variables. Moreover, since the regional variables render the coefficient on inequality insignificant, this suggests that the coefficient on inequality may actually capture the effect of these omitted variables on growth, instead of the direct influence of inequality. Any sort of omitted variable bias can be a significant problem in a cross-country growth regression. If a variable that helps explain growth is correlated with any of the regressors and is not included in the regression, then coefficient estimates and standard errors will be biased. As discussed in the introduction, the direction of the bias is determined by the relationship between the omitted variable and the regressors and is difficult to sign *a priori*."

It is important to highlight that in most empirical work on inequality and economic growth, the inclusion of regional dummies – mainly for Latin America and Africa – renders the coefficient associated to the Gini non significant. Such result indicates that the omission of variables can jeopardize the estimates. Among works that have arrived at this result are the following: Persson and Tabellini (1994), Alesina and Perotti (1993), and Birdsall et al (1995). Barro (1999) uses dummies as inequality determinants and points out that they are important proxies for other variables not considered in the model[25].

Fixed-effect estimates are calculated based on differences intrinsic to each country. Panel estimations are divided into two groups: those with fixed effect and those with random effect. According to Ferreira and Rossi (1999) the use of fixed effects is justified by the simple fact that the sample size is small. In these cases, it is not necessary to attribute a random character to the intercept. And, according to Forbes (2000), the use of random effects would be necessary only if the specific effects of the country were not correlated with other explanatory variables of the model.

It is important to point out that the fixed effect of time on the estimations was not considered. First, because two important model variables have a well-established temporal tendency. It is the case of the average schooling of the work force, which grows along the 25 years analyzed for all countries, and of the Gini index, which had a similar temporal behavior for the set of 13 economies analyzed – please see table 2. In this case, what is left from the regression between the temporal dummies and the average schooling, for instance, is practically a random variable. This variable, which is employed in the regression between the per capita product and

[25] See also Banerjee and Duflo (2000).

average schooling, would not reflect the actual effort in training the labor force in the region. The second reason is associated to the very significance tests for the inclusion of these variables in the control. Statistics F, calculated to test the inclusion of time dummies in the models incorporating the fixed effect of the country, indicate that the fixed time effects do not contribute to increase the degree of fitness of the models. For this very reason, the time dummies were disregarded in this analysis.

3.3 Econometric results

Table 3 below shows the estimation results of equation (9), for the per capita product of Latin American economies. The first column exhibits Solow's model estimate, with neither human capital nor the Gini index. The second includes schooling, i.e., the effect of the accumulation of human capital. These two regressions form the comparison basis for the complete model, whose results are displayed in the third column. All models employ fixed effects for the countries, which significantly expand the adjusted R^2 of the models.

It is easy to see that all three models have quite high adjusted R^2 and that the sequential inclusion of the human capital and of the inequality index increases their value and reduces the values of the estimates' standard errors. The coefficient associated to savings has the expected signal and is a significant 1% in all three models. Values calculated for α in the models are quite close – 37.5%, 37.9% and 37.7%, respectively – which indicates that the inclusion of the human capital and of the inequality index does not interfere with the estimates of α. The fixed effect seems to correct the high share of physical capital found in the estimates without the fixed effect. It can be seen that the coefficient associated to the break-even investment is not significant, and it also displays a sign opposite to that expected, in models (2) and (3). This result can be attributed to the particular case of El Salvador, which has two observations outside the confidence interval (1970 and 1985) for the relation between per capita product and break-even investment rate. The human capital variable, when included in the second model, is quite significant at 10%, and displays the expected sign. The last model brings a coefficient associated to the Gini index, positive and significant at 5%, in spite of the schooling coefficient being significant at only 10%. The positive sign shows that for the sample of Latin American countries analyzed, higher concentration of income allows a greater per capita income.

The estimation of the growth equation, expression (10), followed the previous procedure: first, the convergence equation, without human capital, was estimated; then, average schooling was included; last, the inequality index was included. The results are shown in table 4. In the case of the equation for per capita product, when the country dummies were included,

there was a considerable improvement in the degree of fitness of the models. In the estimation of the growth rate, however, the improvement occurs in a small proportion: the adjusted R^2 of the new regressions remains low, between 27% and 37%, in spite of the significance of the country dummies.

Table 3 Equation for per capita product, Latin America, 1970 to 1995*

	(1)	(2)	(3)
Constant	6.726	5.852	5.197
	(0.694)	(0.824)	(0.849)
Savings – $\ln s_k$	0.602	0.611	0.606
	(0.147)	(0.144)	(0.139)
Break-even investment – $\ln (n + g + d)$	-0.185	0.163	0.123
	(0.250)	(0.307)	(0.298)
Schooling – u		0.0596	0.0547
		(0.032)	(0.031)
Gini index – G			1.304
			(0.575)
Adjusted R^2	0.936	0.938	0.942
Standard error of the estimate	0.144	0.141	0.137
Durbin-Watson	1.298	1.289	1.481
White test – $n.R^2$	17.9	18.9	24.8
χ^2 - table (alpha=5%)	32.7	37.7	43.8
F- fixed effect	60.9	55.3	59.3
F- table (1%)	2.5	2.5	2.5
Degrees of freedom	63	62	61

Note: (*) numbers in parentheses are standard errors of the estimates.

Table 4 Equation for economic growth, Latin America, 1970 to 1995*

	(1)	(2)	(3)
Constant	4.074	3.882	2.582
	(1.089)	(1.106)	(1.115)
Initial per capita product – $\ln y_0$	-0.620	-0.661	-0.566
	(0.147)	(0.152)	(0.145)
Savings – $\ln s_k$	0.162	0.193	0.128
	(0.187)	(0.190)	(0.177)
Break-even investment – $\ln (n + g + d)$	0.344	0.512	0.435
	(0.270)	(0.318)	(0.296)
Schooling – u		0.036	0.021
		(0.036)	(0.033)
Gini index – G			1.563
			(0.526)
Adjusted R^2	0.276	0.276	0.377
Standard error of the estimate	0.121	0.121	0.113
Durbin-Watson	1.143	1.122	1.468
White test – $n.R^2$	23.2	13.1	32.8
χ^2 - table (alpha=5%)	42.6	43.7	43.8
F- fixed effect	2.8	2.8	2.7
F- table (1%)	2.6	2.6	2.6
Degrees of freedom	60	59	58

Note: (*) numbers in parentheses are standard errors of the estimates.

The coefficient associated to the initial product displays the expected sign and is significant, at 1%, for the three models analyzed. In regression (4), only the initial product is significant, at 1%, and has the expected sign. The inclusion of human capital, in model (5) slightly improves the significance of the variables, but not enough to made them significant, at least at 10%. In the last model, the coefficient associated to the Gini index is significant, at 5%, and has a positive sign, similarly to the per capita product regression – model (3). The coefficient of the initial product remains negative and significant, at 1%. The coefficient associated to schooling has a positive sign, but it is not significant, the same occurring with the break-even investment and the savings rate. These results allow us to state that income inequality has positively affected the rate of economic growth of the sample countries.

The estimation of the Kuznets curve of the sample countries followed two alternate formulations, expressed by equations (11) and (12). The results of the estimates are shown in table 5. The econometric models numbered (7) and (8) have a high degree of fitness: adjusted R^2 of 75% and 76%, respectively. In the case of model (7), the coefficients of the per capita product and its square display the expected sign and are significant, at 5%. Yet, schooling is not significant. In the case of regression (8), there is a positive relation between growth and inequality. Apparently, there is an inverted-U-shaped relation between the per capita product and income inequality in Latin American countries comprising this sample, similarly to the findings suggested by Kuznets. There is also evidence that growth concentrated income during that period.

Table 5 Kuznets equation, Latin America, 1970 to 1995*

	(7)**	(8)**
Constant	-3.438	0.553
	(1.811)	(0.027)
Per capita product – $\ln y$	0.969	
	(0.458)	
Per capita product square – $(\ln y)^2$	-0.058	
	(0.029)	
Average schooling – u	-0.002	0.006
	(0.005)	(0.007)
Rate of economic growth – $(\ln y_t - \ln y_{t-1})$		0.925
		(0.027)
Adjusted R^2	0.746	0.758
Standard error of the estimate	0.029	0.028
Durbin-Watson	1.896	1.828
White test – $n.R^2$	23.2	3.9
χ^2 - table (alpha=5%)	37.7	11.1
F- fixed effect	16.3	13.7
F- table (1%)	2.5	2.6
Degrees of freedom	60	61

Note: (*) numbers in parentheses are standard errors of the estimates; (**) without the 1970 observation of the Dominican Republic.

Lastly, a comments deserves making regarding simultaneity. In equation (10), the rate of growth was considered a function of inequality. In equation (12), inequality was supposed a function of growth, similarly to the Kuznets hypothesis. Considering that for all three cases the coefficients associated to these relations are significant, the doubt remains if there is not a simultaneity problem in determining inequality and rate of economic growth, which could be originating an estimation problem. For this reason, these equations were analyzed using the Two-Stage Ordinary Least Squares regression method. The results were quite satisfactory. In fact, some coefficients change considerably. The coefficient that relates per capita product with the Gini index in table 3 is reduced from 1.304 to 1.277, yet remains significant. The same occurs with the coefficient that relates per capita product growth rate with the Gini index, in table 4, which drops from 1.563 to 1.217. Table 5 coefficients, also undergo small changes, but remain significant and display the signal presented by the Ordinary Least Squares regression.

4 Final remarks

After a brief presentation of the results of this article, they should now be discussed in the light of the recent literature on the subject. First of all, an important aspect should be discussed: the econometric methodology employed in the investigation of the relation between inequality and growth. Until mid 1998, empirical works that tested the relation between the two variables used a transversal cut analysis e equations denominated Barro type equations by Panizza (1998). Temple (1999) classifies this type of equation as informal growth regressions, which would be a simplified version of the Mankiw, Romer and Weil (1992) model. In spite of the importance of the work of Barro (1991), the chief problem in this method lies in the fact that statistical significance of certain variables can simply disappear when a different group of explanatory variables is chosen.

According to empirical works that employ Barro's methodology, the relation between income inequality and economic growth is negative: ill distribution of income reduces the rates of growth of countries, as argued by most of the theoretical literature on the subject. However, some recent works, such as those of Li and Zou (1998), Barro ((1999), Deiniger and Olinto (2000) and Forbes (2000), question these results, arguing that they are not robust; much to the contrary, there is evidence that the relation between inequality and growth would be positive. Barro (1999) does not find a linear relation between the two variables, similarly to Deiniger and Squire (1998); these authors argue that inequality reduces growth for the poorer countries and increases it for the richer ones. Forbes (2000) and Li and Zou (1998) find a positive relation

between the variables. These recent works have in common the panel technique, unlike all previous works.

This means that econometric technique could be affecting the results. Rodríguez (2000) suggests the following division of empirical works: transversal cut studies and panel studies. The second group is represented mainly by the works of Forbes (2000) and Li and Zou (1998), which re-estimate the models of Alesina and Rodrik (1994) and of Persson and Tabellini (1994), with a fixed country effect, and find a positive relation between growth and inequality. For these reasons, it is worthwhile to take a deeper look at the works of Li and Zou (1998) and of Forbes (2000).

The work of Li and Zou (1998) reexamines the model of Alesina and Rodrik (1994), using data supplied by Deininger and Squire (1996), and includes new variables, following the work of Levine and Renelt (1992)[26]. The results show that income inequality has a positive impact on growth. The basic growth equation includes initial per capita product for each period, the Gini index, and schooling, as well as country dummies and a democracy index. The coefficient for the initial per capita product is significant and has the expected sign, showing that those countries with the highest product in the previous period grew less. The schooling variable is significant only with the fixed effect and its coefficient has a negative signal. The coefficient associated to the democracy index is not significant in any of the models. On the other hand, the coefficient related to the Gini index is significant and positive for all models, even when estimated with random effects.

In order to confirm the panel results, Li and Zou (1998) used a transversal cut to estimate the models of Alesina and Rodrik (1994) and of Persson and Tabellini (1994). All other panel-estimated variables maintained their sign in the transversal cut. However, the Gini index coefficient goes from a positive sign to a negative sign. They conclude that:

> "On an empirical basis the relationship can be both positive and negative, depending on whether we allow enough variations in income inequality over time. When we extend the discussion in Alesina and Rodrik (1994) by considering the dynamic relationship between growth and income distribution, we can even find a very strong positive relationship between the two." (Li and Zou, 1998, p. 327).

The work of Forbes (2000) is essentially empirical and discusses the panel technique, its advantages and differences in regards to transversal-cut analysis. According to the author, the

[26] Li and Zou (1998), following the recommendations of Deininger and Squire (1996) adjust the sample when the Gini index is based on expenses. The authors, as well as Forbes (2000), have used averages for the Gini index. It resulted in a sample comprised of 215 observations and 46 countries. The sample includes the following Latin American countries: Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Honduras, Mexico, Panama and Venezuela.

negative impact of inequality on growth depends on exogenous factors, such as political institutions, development level and aggregated wealth. Moreover, many of these works arrive at multiple equilibrium points, at which, under certain initial conditions, inequality can have positive effect on growth.

In addition to theoretical problems, Forbes (2000) considers that most of the empirical works presented in the area are subject to methodological problems. First, they cannot be considered robust, considering that after the sensibility tests, the inequality coefficient becomes non-significant, particularly when regional dummies are included. Second, the problem of inequality measurement and the omission of variables can bias the estimation. Third, and according to Forbes the main problem, is that studies do not properly explain how changes in the level of a country's inequality are related to that country's growth. The technique employed by these studies shows the pattern of growth of the economies for a long period of time, usually 25 years. Thus, it can be said that only countries with lower inequality indexes have a growth pattern above those featuring very high initial levels. Thanks to the panel technique this problem is diminished because there are more observations per country.

The results submitted by Forbes (2000) show that the model's periodicity, the quality of the inequality data, and the estimation techniques play a decisive role in the results. For comparison purposes, the author follows the specification suggested by Perotti (1996) and tests various alternate models, in which periodicity, inequality and econometric technique are used in turns.

Generally speaking, the results found corroborate the conditional convergence hypothesis. Regarding the relation between growth and inequality, estimates suggested by Forbes (2000) show coefficients with positive signals and significant at 5%, no matter which econometric technique is employed. Furthermore, to ensure that empirical results found are not due solely to econometric technique, or to the five-year period, the author again tests the Perotti (1996) model, considering differences in the definition and quality of the variables. When corrected to the better-quality sample of Deininger and Squire (1996), considering the fixed country effect and five-year sub-periods, the relation between growth and inequality remains positive and significant. Forbes (2000) further tests the same model using different inequality data and longer growth periods, 25 years. The results are quite interesting: for periods of 25 years, the coefficients related to the Gini index presented a negative sign and were not significant. In testing the model for a sample with low-quality Gini indexes, for five-year periods, the estimated coefficients remain negative.

Therefore, these two works show that the technique used, the quality of the data and the growth period in question are determinant in explaining the relation between income inequality and economic growth. As seen, the empirical analysis undertaken in this article employed the panel methodology, better-quality data and five-year sub-periods. Perhaps these are the reasons for the consistency of the results presented in the previous section with those found by Li and Zou (1998) and Forbes (2000). From this perspective, it can be said that the results arrived at in this article are in line with those of recent works on the subject and confirm, for a smaller set of specific Latin American countries, the positive relation existing between inequality and growth and the Kuznets hypothesis.

Lastly, it might be worthwhile to ponder on the reasons why inequality benefits growth. This fact can be largely explained by the effects of capital productivity fluctuations. It is well known that an economy's interest rate falls as income level rises. Thus, growth leads to a drop in capital productivity and therefore discourages investment. Considering a poor and unequal economy, with low per capita income and salaries, but high interest rates, a wider inequality will be reflected in factor productivity, boosting remuneration of those who earn more (holders of physical and human capital) and reducing that of those who earn less (workers). The opposite is also possible: a change in the relative factor remuneration, benefiting physical and human capital, implies in deteriorating income distribution. Thus, these changes encourage accumulation of physical and human capital, which in the end reflects in higher steady-state income and rate of economic growth.

This article's empirical results, which were based on a sample of relatively poor countries with high inequality, fit this argument. The change in the relations between marginal factor productivity seems to have led to higher inequality, in spite of having increased investments, the stock of steady-state capital and the rate of economic growth. In fact, these dynamics were witnessed in Latin America during the period studied. Two recent works on the region's development pattern complement each other in this aspect. Bandeira (2000) argues that economic reforms implied in greater capital productivity and consequently higher investment, per capita income and growth. Morley (2000) shows that these reforms raised income inequality for the same sample of countries. In this particular aspect, this article supplies additional evidence to the above works and finds that in Latin American countries during the 70s, 80s and 90s inequality and growth walked hand-in-hand.

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