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"Agglomeration, Inequality and Economic Growth: Cross-section and panel data analysis"

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Abstract

The effects of inequality on economic growth depend on several factors. On one hand, they depend on the time horizon considered, on the initial level of income and on its initial distribution. But, on the other hand, as growth and inequality are also uneven across space, it also seems relevant to wonder how the effects of inequality on growth are related to the geographic agglomeration of economic activity. By introducing measures of urban concentration, this work analyzes how the effects of income inequality on economic growth depend not only on the level of development, and on the initial distribution of income, but are also affected by the process of concentration of economic activity at the urban level. By setting different econometric specifications, short from long-run effects are distinguished to then differentiate the effects of changes from the effects of levels of inequality. Results suggest that while inequality is a limiting factor for long-run growth, especially for low-income countries -consistent with previous literature-, increasing inequality, when associated with increasing concentration of economic activity at the urban level, is likely to enhance growth in the short and medium-run in those low-income countries.

JEL classification: O1, O4, R1
Keywords**:** Agglomeration, Urban concentration, Inequality, Growth

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I. Introduction

Do countries with higher unequal distribution of income tend to grow more or does inequality reduce economic growth? A large list of studies has analyzed the relationship between income inequality and economic growth considering different channels through which the first can affect the second. But, does higher inequality have the same effects on economic growth on the short than in the long-run? Are those effects the same in more developed countries than in less? Finally, are those effects the same in initially more equal than unequal countries? These are three questions that have been usually addressed separately by the related literature. This fact, in conjunction with the use of different theoretical backgrounds, data, sample and econometric methodology, can lead to results that may, a priori, be contradictory. Some works show a positive effect of inequality on growth while others a negative one. However, the mix results can be better understood and, at least to some extent, conciliated if we acknowledge that the effects of inequality on growth depend on several factors. On one hand, the effects depend on the time horizon, on the initial level of income and on its initial distribution, as mentioned. But, on the other hand, growth and inequality are also uneven across space. It then also seems relevant to wonder how the effects of inequality on growth are related to the geographic agglomeration of economic activity. In this work, by setting different econometric specifications, we try to distinguish short from long-run effects. We also try to distinguish the effects of *changes* on inequality from the effects of *levels* of inequality. We use, as a measure for development, per capita income -as has been done in previous works- and measures of agglomeration -as they seem to have not only an impact on growth but also on the relationship between income distribution and growth. In this way, we analyze how the effects of inequality on economic growth depend on the level of development, and on initial distribution of income, as well as on geographic agglomeration.

This paper is organized as follows: the rest of this section reviews some of the main empirical works. In first place, the effects of inequality on economic growth are reviewed (section I.1). In second place we focus on the effects of urbanization (as proxy for agglomeration) on economic growth (section I.2). Finally, we review the relationship between urbanization and income inequality (section I.3). Section II sets the empirical model to follow and analyzes the data, section III presents the estimations and results for the effects of inequality and agglomeration levels on economic growth, while section IV analyses the effects of *changes* of inequality and agglomeration. Finally, section IV concludes.

1. The effects of income inequality on economic growth:

The modern economic study of the relation between income inequality and economic growth dates back to Simon Kuznets, who in 1955 showed that income inequality tends to increase first and then decrease with the level of income. This famous economic phenomenon has been called the "Kuznets inverted-U". It implies that economic growth in poor countries is likely to come with increasing inequality, at least in the short and medium term. However, in the second half of the XXth century the economic performance of different countries seems to show that low initial levels of inequality enhance higher and sustained long-run growth.[1] High inequality, when intense and persistent, can become a serious limit for economic growth. In fact, many developing countries today face low per capita income along with high inequality and disappointing growth performance. In most cases, very high levels of inequality are very likely playing a limiting factor for economic development.

There are different theoretical channels through which income distribution may influence economic growth. Two main positions can be distinguished: on one side, some authors argue that an unequal distribution of income fosters economic growth. A moderate degree of income inequality, their analysis goes, allows for some sectors to save and invest, especially relevant when investment indivisibilities are important. Also, inequality generates incentives for capital accumulation (in a broad sense -physical and human-) and for innovation, and therefore higher growth is achieved. On the other hand, other authors argue the contrary; that inequality represents a limiting factor for growth. Several reasons are given: 1) high inequality reduces productivity of certain assets -especially land- and generates redistributive pressure which reduces economic growth, 2) in the presence of credit-market imperfections, higher inequality reduces average investment, especially in human capital, and can increase macroeconomic volatility, 3) it also implies a higher share of population with low purchasing power, which, given that the poor tend to demand local products, reduces aggregate demand, 4) higher inequality also implies higher socio-political instability and risk of violent conflict, and 5) higher inequality is also related to higher fertility rates, which in turns reduces growth (Barro 2000). It is important to notice that the factors that support a positive relation between inequality and economic growth are more likely to act in the short-run, while the factors that support a negative relationship are more likely to act in the long-run. But each of these factors will very possibly have a different explanatory power depending on the type of country; in particular depending on its level of development and

[1] In particular, the high growth performance of East Asian countries that had relatively low levels of inequality has been compared to the rather weak performance of Latin-American countries that had persistent high level of inequality.

on its initial income distribution. In particular, persistent inequality, especially in less developed countries, implies high incidence of extreme poverty which itself limits economic growth.

Focusing on the empirical evidence we can start by distinguishing time horizon differentials. Many are the authors that have focused on the long-run effects of income inequality on economic growth using cross-section analysis in a Barro-type model of economic growth (Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Clarke, 1995; Perotti, 1996; and Easterly, 2007)[2]. Their results coincide on finding evidence that income inequality has a negative and significant effect on subsequent economic growth and independent of the measure used and robust to possible data quality problems. A&R and P&T argue that this negative effect is the result of redistributive pressures. Interestingly, A&R´s results also indicate that countries that perform land reforms, which significantly improve wealth -as well as income- distribution, grow faster. Easterly differentiates between *market inequality* and *structural inequality*; theoretically, while the first one relates more to the short-run and can have positive effects on growth, the second one relates to the long-run and is unambiguously bad for subsequent development. However, Easterly, using factor endowment differentials across countries -in particular the exogenous suitability of land for wheat versus sugarcane-, empirically focuses only on long-run-structural inequality.

Since 1996, given higher data availability (thanks to Deininger and Squire[3]), some authors have analyzed the effects of inequality on growth using panel, instead of cross-country, data. Panel data can be more puzzling but also more enriching; its analysis allows differentiating short from long-run effects and controlling for time-invariant omitted variables. Focusing on how a change in inequality within a given country is related to economic growth within that country we can measure short-run effects. Results in this line indicate that “in the short and medium term, an increase in a country’s level of income inequality has a significant positive relationship with subsequent economic growth” [Forbes (2000)]. Banerjee and Duflo (2003), furthermore, emphasize that it is changes in inequality, and not inequality levels, what we should look at.

As already mentioned, the effects of inequality on growth are also likely to differ between countries given the level of development (Partridge, 1997; Barro, 2000). This level is usually understood as level of per capita GDP. Barro (2000) uses panel data and follows his

[2] Alesina and Rodrik model include income and land (as a proxy for wealth) distribution variables along with control variables for initial level of income and primary school enrolment ratio, taking 1960-1985 and 1970-1985 time horizons. Clarke´s work estimates accumulated annual average growth of per capita GDP for 1970 to 1988 using as independent variables different inequality measures and controlling for initial p.c. GDP, primary and secondary enrollment rates lagged ten years, the average number of revolutions and coups per year between 1970 and 1985, the deviation of the price level for investment in 1970 from the sample mean and the average government spending of GDP between 1970 and 1988.
[3] Deininger and Squire have compiled a data set on inequality measures for 108 countries.

"Determinants of Growth" model (1991, 1997) in which he introduces variables for inequality[4]. He examines the effects of inequality on growth through the effects of the former on the fertility rate. Results give a negative correlation between initial inequality and subsequent growth. Gini coefficient is permitted to interact with the level of GDP (in log) showing that inequality is negatively correlated with growth in low income countries -per capita GDP below $2070 (1985 US dollars)- but positively correlated in high income countries.

Finally, the effects of income inequality on growth are also likely to depend on the initial levels of inequality. Chen (2003), using cross-section analysis, finds an inverted-U relationship between inequality and long-run economic growth; the effect of inequality on growth is positive when initial inequality is low and negative when initial inequality is high. Therefore, for very equal countries, inequality increases can foster economic growth, while a country with a large initial income inequality can increase economic growth by achieving more equal distribution of income. In fact, the level of inequality that maximizes growth corresponds to a Gini coefficient of 0.37. [5]

To sum up, literature results tend to suggest that income inequality is positively correlated with subsequent economic growth in the short-run but negatively correlated in the long-run. In parallel, inequality seems to be more harmful in low-income than in high-income countries. Additionally, higher inequality is more likely to foster growth in initially equal countries than in initially unequal ones.

2. The effects of urbanization on subsequent economic growth:

Economic history tells us that urbanization, industrialization and economic development -through higher economic growth- tend to be parallel processes. Economic growth tends indeed to increase urbanization in almost any country. But a relevant question is whether and when geographic agglomeration of economic activity, which can be related to urbanization, fosters subsequent economic growth. The issue is a critical and current area of research in urban economics and economic geography. In fact, the World Development Report of 2009 highlights that "the concentration of economic production as countries develop is manifest in urbanization ... but the question is whether concentration (and therefore urbanization) will increase prosperity"

[4] The independent variables used are the initial level of p. c. GDP (in log), its square, the period average share of government consumption to real GDP, the period average share of investment to real GDP, the period average rate of inflation, the period average fertility rate (in log), the period average growth rate of terms of trade, the initial level of year of schooling, rule of law index, a democracy index and its square. His panel is composed by data for 10 year periods from 1965 to 1995.

[5] Chen estimates growth including initial values of GDP, capital inputs (physical and human), institutional and policy's variable, and regional dummies. His sample includes data for 43 countries for 1970-1992.

[WDR 2009, pg 3]. Theory and evidence point towards a positive effect of agglomeration on economic growth. Some works have focused on urbanization measures to show a growth-enhancing effect on countries´ income in the long-run (Henderson, 2003; Brülhart and Sbergami, 2009). However, the effect is likely to be complex and dependent on several factors. Firstly, the growth-enhancing effect of urbanization depends on the level of development; geographical concentration of economic activity favors growth in early stages of development -thanks to economies of agglomeration[6]- but retards it in later stages -mainly due to diseconomies of congestion- (Williamson, 1965). Brülhart and Sbergami suggest a critical level of per capita GDP of US $10.000 (in 2006 prices) from which higher urbanization becomes detrimental for growth. Secondly, the growth-enhancing effect of urbanization also depends on the way urbanization takes place (Bloom et al., 2008)[7]. Finally, the degree of urban concentration may be more important than urbanization per se; the growth-enhancing effects of urbanization, related to scale and agglomeration economies, and particularly in developing countries, become significant for large urban agglomerations, rather than for small ones (Duranton and Puga, 2004; Rosenthal and Strange, 2004; Berinelli and Strobl, 2007).

Hence, given that both inequality and urbanization affect subsequent economic growth, what can be said about the relationship and interaction between these two?

3. The relationship between urbanization and income inequality:

The same evidence that supports the idea that urbanization can promote economic growth, at least in early stages of development, implies that there is a trade-off between economic growth and equal distribution of income, at least in spatial terms. As the already mentioned Brülhart and Sbergami argue, poor countries face a dilemma between lower inter-regional equality and higher economic growth. In fact, the relationship between development and income inequality described by Kuznet is highly related to urbanization processes; economic growth in its initial stages requires higher urbanization that accompanies industrialization (Lewis 1954). This process leads

[6] As Brülhart and Sbergami note, different spatial scales imply different mechanisms at work and, therefore, may yield different results. For small spatial scale, there are positive spillovers associated with clustering activities (mainly knowledge spillovers) and agglomeration may have a positive impact on economic growth even, at probably more importantly, in more developed countries. Their results, however, relate to a higher spatial scale associated with urbanization, where the agglomeration impact relates to reduction of transaction costs and higher integration of markets.

[7] When urbanization takes place as a result of forced displacement of people from the rural areas -due to violence and social conflict, natural catastrophes and lack of opportunities-, urbanization takes place in a non-planned way and is, therefore, more likely to retard economic growth. Bloom et al, (2008) compare industrialization-driven urbanization in Asia, likely to enhance economic growth, with urbanization due to population pressure and conflict in Africa, most likely detrimental for growth. Regarding Latin-American, the lack of proper urban planning is also evident in some countries (Angotti, 1996).

to increasing inequality, as higher incomes are perceived in urban areas -characterized by increasing returns to scale activities and higher labor productivity- compared to rural areas. Both, higher inequality and higher urbanization favor the concentration of production factors necessary for growth, and this concentration itself reinforces labor´s reallocation from the rural towards the urban areas (Ross, 2000). In later stages of development, however, urbanization is related to lower inequality as the concentration of people in the cities raises rural salaries and reduces income differentials. The WDR 2009 goes in line with the argument; *economic growth is seldom balanced.* Economic development is uneven across space and, therefore, will bring geographical disparities in income, especially in developing countries. Moreover, interventions to reduce spatial disparities can be highly inefficient in terms of national growth performance. Hence, low-income countries that experience sustained economic growth will very likely experience rapid urbanization and higher inequality -the three phenomenons reinforcing each other.

Given that inequality, urbanization and growth go hand to hand, the key element is the relation of forces between the three processes, at least as countries develop. When increasing inequality is given simultaneously in a context of increasing concentration of economic activity at the urban level, the process can be beneficial for growth. If inequality, on the other hand, becomes too high and persistent but the country remains poor and suburbanized, then higher inequality is clearly expected to be detrimental for long-run growth. In this case, urbanization can be a tool for both higher long-run growth and lower inequality. Once countries develop, the effects of both, inequality and urbanization, depend on existing levels; high urbanization can become detrimental for growth (due to congestion) and high inequality will only be beneficial as long as income distribution does not deteriorate substantially.

II. The Standard versus the Internal Model

1. Determinants of Growth

Sala-i-Martin (1997, 2004) using cross-section regressions, and Barro (1991, 1997, 2000, and 2003) using panel data, are probably the two authors that have studied in most depth the determinants of economic growth. Sala-i-Marti et al. (2004) explore 67 possible explanatory variables for long-run growth over 1960-1996 and find 18 that are significantly related to it. Results show that differences across countries in long-run growth of per capita GDP can be well explained using initial levels of per capita GDP -the neoclassical idea of conditional convergence- and variables for natural resource endowments, physical and human capital accumulation,

macroeconomic stability, and productive specialization (it is found a negative and significant effect of the fraction of primary exports in total exports). Barro (2003) also supports conditional convergence "given initial levels of human capital and values for other variables that reflect policies, institutions, and national characteristics". Following these works and in order to analyze the impacts of inequality on subsequent economic growth, we set an econometric model of growth that controls for conditional convergence, levels of human capital and investment. This setting is common in the reviewed empirical work on inequality and growth (A&R, 1994; Perotti, 1996: Forbes, 2000). Along with measures of initial income inequality, we introduce measures of agglomeration to study its effects on economic growth and how it influences the effects of inequality on growth. We consider, to measure agglomeration, initial urbanization measures, geographic concentration indices (geographical concentration of population) and population density -following Brülhart and Sbergami (2009).

2. Data

As all the authors that have approached the subject notice, inequality data is scare and of doubtful quality. Moreover, inequality can be measured with different indicators (Gini coefficient, Theil index, quartiles share, etc). The main and most complete dataset on Gini coefficients comes from the World Income Inequality Database (WIID-WIDER). However, different Gini coefficient primary sources use different raw data to construct the Gini. Besides quality, there are three factors to take into account: 1) the object of measure -that can be gross income, net income, expenditure or consumption-, 2) the unit of measure -individual, family or household-, and, 3) the coverage of data -urban, rural or all-. According to Knowles (2001) it is best to use net income, expenditure or consumption, as the explanations of the effects of inequality on growth relate to income distribution after redistribution has taken place. Data on Gini coefficients based on expenditure or consumption is scarce, moreover in developing countries. Therefore, data based on net (or disposable) income should be preferred, that measures household or family income and with total population coverage.

Given this variety of data, some authors adjust data to try to solve for significant differences, while others prefer to use unadjusted data. Clarke (1995) finds that the correlation between inequality and growth is not fragile despite data concerns. He uses unadjusted data, pre and post tax (choosing pre-tax data when available and household data if possible), for his cross-section analysis. To account for measurement errors, he uses a two-stage least-squares instrumenting for the inequality measures and conducts sensitivity analysis. Barro (2000) also uses unadjusted data, but he uses dummies to control for differences in the method of measure for the Gini.

However, more recent empirical work (i.e.: Gruen and Klasen 2008) worry about the use of unadjusted data. For the analysis done in this work, given the complexity of the data problem and acknowledging recent concerns about the use of inequality data in previous literature, we follow Gruen and Klasen and use the coefficients they use[8]. These come from the WIID database, are adjusted for different possible object of measure, and relate to households or families and for the entire population.

We use *growth*, as our dependent variable, which reflects accumulated annual average per capita GDP growth rate, with data from Summers and Heston (Penn World Table -PWT-). As independent variables we use *log_pcgdp* -the initial level of per capita GDP (in log)-, *pi* -the initial price of investment-, *schooling* -the initial level of years of schooling-, *inequality* -the initial level of Gini coefficient- and a measure for a*gglomeration*. To measure agglomeration we try *urb* -the initial rate of urbanization. To capture the degree of urban concentration, we also try *urb_1m* -the initial population in agglomerations of more than 1 million as % of total population-, from the WB, *geo_conc* -the geographic concentration of population-, from Collier 2009, and *density* -average population by squared km- also from the WB. Apart from the Gini coefficients, all data come from the PWT and the World Bank Development Indicators database. (A table with the variables used and their sources is annexed).

Our sample includes 51 countries with data for 1970-2007, taking data from 1970 for the regressors to explain growth between 1970 and 2007 in the cross-section and data for 1970, 1980, 1990 and 2000 to explain growth in each subsequent decade in the panel. The selected countries are those for which reliable data for all the variables used here have been found (a list of the countries considered is annexed)[9]. The sample, although relatively small, includes major countries from all different world regions, is bigger than most previous works´ samples and gives enough information for the purpose of the work[10]. Table 1 shows descriptive statistics for main variables. Table 2 shows descriptive statistics by period for growth, inequality and urbanization measures.

[8] Some missing values for Gruen´s Gini coefficients have been filled taking tends: Bolivia 1980 y 2000, Ecuador 1980, Egypt 1980, Honduras 1980, Korea 1980, Nepal 1990, Peru 1980 South Africa 1980, Tanzania 1980 and Zambia 1990.

[9] For missing values of inflation we take closest value (7 observations out of 204). For missing values of trade we also take closest values (4 observations out of 204). For missing values of years of schooling for Madagascar and Nigeria we use "IIASA/VID Projection: Mean years of schooling, age 15+, total".

[10] Sample includes: 11countries form Latin-America & the Caribbean, 2 from North-America, 10 from Africa, 13 from Asia, 1 from Oceania and 14 from Europe.

Table 1: Descriptive statistics:

		Std. Dev.				
	Mean	Overall	Between	Within	Maximum	Minimum
GROWTH	2.3020	2.1835	1.4753	1.6197	10.4990	-4.4309
LOG_PCGDP	3.7779	0.4709	0.4560	0.1299	4.6209	2.7500
SCHOOLING	6.2272	2.8526	2.5928	1.2306	13.0221	0.5000
PI	70.9360	40.1247	32.7336	23.5444	19.0652	315.6483
INEQUALITY	44.8642	9.5423	8.6704	4.1219	66.6000	23.5000
URB	51.7960	23.0178	22.3927	5.9829	100.0000	4.0000
URB_1M	20.3945	16.4260	16.3776	2.3565	100.0000	0.0000

The variance of each variable can decomposed into *between* variance, which reflects the variance between countries, and *within* variance, which reflects the variance over time within countries. While the variation of growth can be explained by both, the between (cross-section) and within (over time) variation, in approximately equal parts, the variation of inequality and of urbanization are more attributable to cross-section differences between countries.

Table2: Descriptive statistics categorized by period: growth, inequality and urbanization:

	GROWTH		INEQUALITY		URB		URB_1M	
PERIOD	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1970-1980	2.8529	2.1039	44.1078	9.3767	44.9392	23.1845	18.2170	15.4573
1980-1990	1.5401	2.2013	43.5863	9.0657	49.9482	22.9439	19.9734	16.0837
1990-2000	1.8462	1.9251	44.6255	10.1899	54.2259	22.4594	21.2248	17.1051
2000-2007	2.9690	2.1937	47.1373	9.3895	58.0706	22.0244	22.1646	17.2142
All	2.3020	2.1835	44.8642	9.5423	51.7960	23.0178	20.3949	16.4260

Table 3 gives us the correlations between the variables for the whole 204 observations (cross-section correlations, including only one observation by country, are annexed). Initial inequality is significantly and negatively correlated with subsequent economic growth, but insignificant when we control for time and country effects (adjusted data). Inequality is also significantly and negatively correlated with income and urbanization. Urbanization and per capita GDP are highly and positively correlated. Finally, urbanization does not seem to be significantly correlated with economic growth according to the raw data, but significantly and negatively correlated after fixing time and country effects, which would support the idea of diseconomies of congestion.

Overall, we can say that developed, urbanized countries display lower inequality levels and that the negative correlation between inequality and growth seems to depend on time and country effects.

Table 3: Global correlations and correlations controlling for spatial and time fixed effects, of all variables with growth, inequality and urbanization:

	GROWTH		INEQUALITY		URB		URB_1M	
	raw data	adjusted data	raw data	adjusted data	raw data	adjusted data	raw data	adjusted data
GROWTH	1.000	1.000						
INEQUALITY	**-0.203**	0.032	1.000	1.000				
URB	0.025	**-0.154**	**-0.273**	**-0.160**	1.000	1.000		
URB_1M	0.117	**-0.136**	-0.028	-0.039	**0.636**	**0.612**	1.000	1.000
LOG_PCGDP	0.034	**-0.409**	**-0.396**	0.008	**0.875**	**0.159**	**0.494**	**0.127**
SCHOOLING	0.115	0.033	**-0.329**	-0.083	**0.751**	**0.314**	**0.432**	**0.316**
PI	**-0.323**	**-0.255**	-0.084	-0.116	0.115	0.017	0.029	0.001

Note: Bold values indicate significance at 5% level.

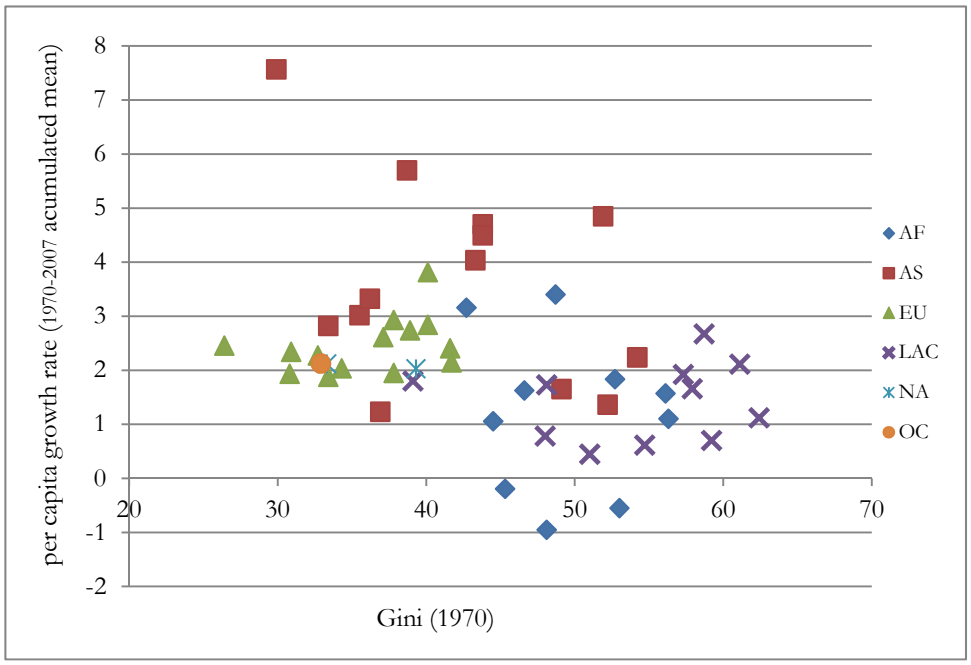
Adjusted data is obtained eliminating time and country effects

Included observations: 204

Inequality and growth:

Figure 1 shows the correlation graph between initial inequality (1970) and accumulated annual average growth (1970-2007). It can be observed that countries with initial high inequality -Gini above 45- presented low, or even negative, subsequent economic growth -generally lower than 2%- (countries like Madagascar, Morocco, Peru, Honduras or Nepal), while countries with initial low inequality presented higher subsequent economic growth (countries like China, South Korea, Ireland and Egypt). Annex shows overall variation, between (cross-country) and within variation (over time), for the full panel data sample.

Figure 1: Correlation graph inequality and growth



Note: AF=Africa, AS=Asia, EU=Europe, LAC=Latin America and Caribbean, NA=North America, OC=Oceania (Australia).

Differentiating on the level of GDP, among the initially low-GDP countries, those with an initial Gini coefficient lower than the sample mean tended to grow more than those with initial Gini higher than the sample mean. In fact, 11 out of 13 of the low-GDP countries that grew less than the median rate where initially unequal. Only 5 low-GDP and initially unequal countries grew above the median (Malaysia, Panama, Thailand, Tunisia and Turkey). Interestingly, the first three are countries highly dependent on international trade[11]. Among the high-GDP countries, only one (Hong Kong) out of 8 of the initially unequal ones, and again a country highly dependent on international trade, grew above the median growth rate.

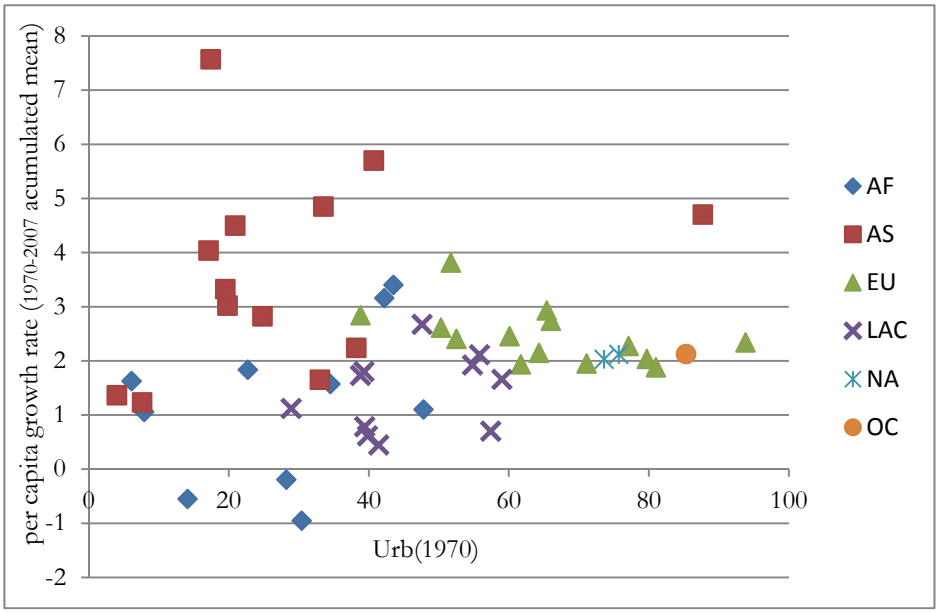
Urbanization and growth:

The correlation between *initial* urbanization rates and subsequent accumulated growth is positive but minimum. However, growth performance appears to differ more among countries with low levels of urbanization than among countries with high levels; countries with urbanization rates higher than 60% had very similar growth performance always above 1.5%(normally between 2 and 3%), in contrast with countries with low urbanization rates. Moreover, looking by continents, there is a clearer positive correlation between higher urbanization in 1970 -when urbanization rates were still low- and higher growth. Europe -with higher urbanization rates- was the exception.

[11] These countries could clearly be defined by a system of "Unequal Development" (Samir Amin); their economy is markedly split between a highly efficient and highly remunerated international sector and a lagged and poorly remunerated domestic sector.

As before, Annex shows overall variation, between variation and within variation, for the full sample.

Figure 2: Correlation graph urbanization and growth



Note: AF=Africa, AS=Asia, EU=Europe, LAC=Latin America and Caribbean, NA=North America, OC=Oceania (Australia).

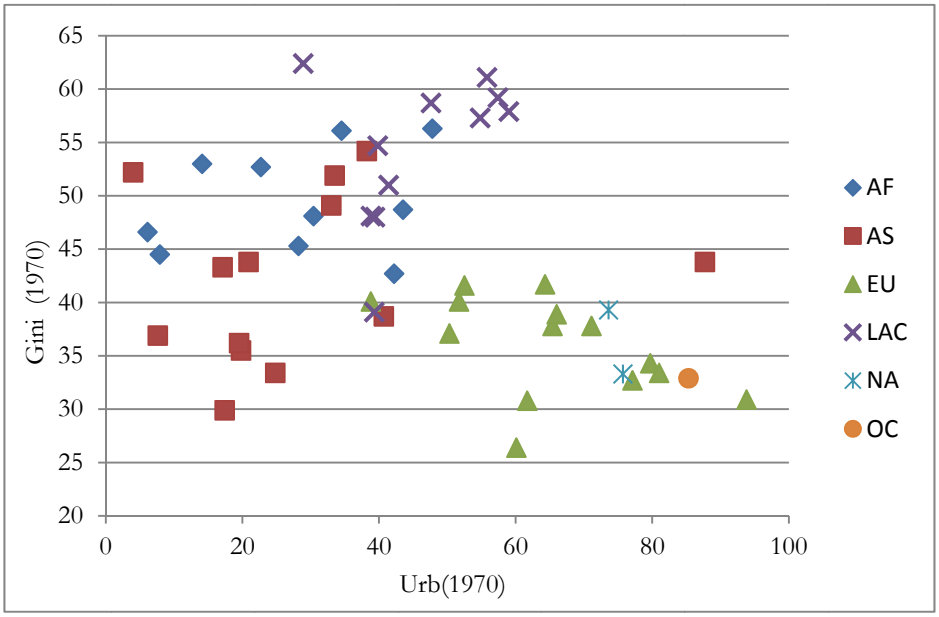
Urbanization and inequality:

We already know the correlation between initial levels of urbanization and initial levels of inequality, despite significantly negative, is low (-0.27). However, as figure 3.a shows, there are different patterns between continents. In Asia, characterized by being quite rural in 1970, higher urbanization is actually correlated with higher Gini. In Europe, characterized by being quite urbanized in 1970, the correlation is the opposite. Latin-American countries present values of urbanization around 50% (close to the full sample mean) but values of inequality significantly higher. In fact, excluding the 4 biggest Latin-American countries the sample correlation between urbanization and inequality becomes quite stronger (coefficient of -0.43)[12]. Figure 3.b compares initial urbanization this time with the long-run evolution of inequality. It shows that countries that performed best in terms of income distribution improvements where those with higher initial urbanization, given that they were not already highly urbanized in 1970 (a U-shape pattern

[12] The countries are Brazil, Colombia, Mexico and Peru, characterized for high and persistent inequality levels -Gini over 55- and for urbanization rates higher than 50%. In these countries rapid urbanization has taken place in the second half of the twentieth century, not just as a result of the natural process of industrialization and economic growth but also as a consequence of rural violence and displacement. Millions of people have been moved into the cities with no proper planning of infrastructure or proper opportunities for them.

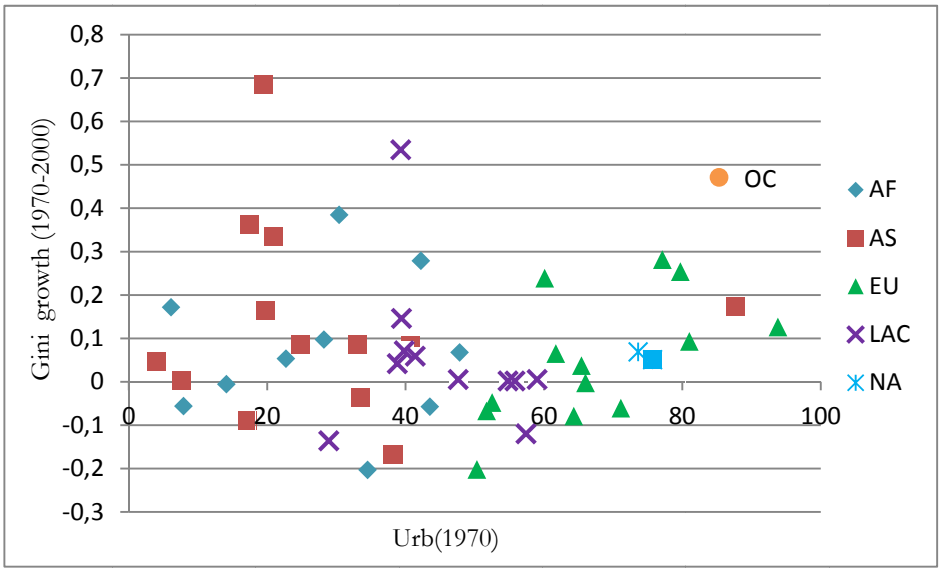
between initial urbanization and income distribution evolution). (Annex shows overall variation, between variation and within variation).

Figure 3.a: Correlation graph urbanization (1970) and inequality (1970)



Note: AF=Africa, AS=Asia, EU=Europe, LAC=Latin America and Caribbean, NA=North America, OC=Oceania (Australia).

Figure 3.b: Correlation graph urbanization (1970) and inequality growth (1970-2000)



Note: AF=Africa, AS=Asia, EU=Europe, LAC=Latin America and Caribbean, NA=North America, OC=Oceania (Australia).

Focusing on poor countries, and relating urbanization and inequality with subsequent economic growth, we find that those classified as unequal and suburbanized in 1970 (a total of 14 countries where higher inequality did not mean higher urbanization), only 3 (Malaysia, Thailand and Turkey) experienced high long-run growth rates between 1970 and 2007. In the other 11 countries subsequent economic growth was low. By contrast, looking only at poor countries that experienced high growth (a total of 12), 10 were either classified as equal or as urbanized already in 1970; only Malaysia and Thailand, again, experienced high subsequent growth being initially unequal and suburbanized by 1970.

Therefore, from the relationships we have examined so far with our data, we can say: 1) developed, urbanized countries tend to display lower inequality levels, 2) both, urbanization patterns and inequality levels seem to somehow influence subsequent economic growth, and 3) urbanization and inequality are, to some extent, interdependent processes of economic development. Econometric analysis can help us to better understand how these relationships work.

III. Estimation and results

Given that we want to distinguish short from long-run effects, we estimate both cross-section and panel regressions. Our starting point will be the use of explanatory variables measured at the beginning of the period to avoid reverse causality and reduce possible endogeneity concerns.[13] Cross-section regressions of accumulated growth rates over initial values of explanatory variables capture how persistent cross-sectional differences in inequality affect long-run growth rates, therefore measuring the long-run effects of initial inequality on subsequent economic growth. Panel Random Effects (RE) should yield similar results when most of the variation is cross-sectional -as is the case with Gini coefficients-. On the other hand, Panel Fixed Effects (FE) estimators capture how time-series changes in inequality within a country affect changes in its growth rate over time. Given that the coefficient only reflect within-country time-series variation, they can be interpreted as short-run effects. [Partridge 2005].

Our cross-section takes into account the whole 1970-2007 period, while the panel splits the period in four sub-periods: 1970-1979, 1980-1989, 1990-1999 and 2000-2007.[14] Cross-section

[13] Later on we will look at the possibility of endogeneity of the used regressors.
[14] Other authors (Barro, 2000; Forbes, 2000) also use ten years periods. As they note, first, higher frequency data for inequality is very scarce, and second, for less than ten years the within countries variability of income inequality is very low.

estimations are made by OLS with robust standard errors. For the panel, we first estimate regressions with random effects (RE). This allows us to control for unobserved country specific effects but also retaining cross-sectional differences, important in our analysis given that the variance of our variables of analysis (inequality and agglomeration) is mainly cross-sectional.[15] We then estimate regressions with fixed effects (FE). FE allows us to control for time-invariant country specific effects and considers only within variation. Therefore, as mentioned before, FE gives us short and medium-term effects. In both, RE and FE, period dummies are used to control time, allowing us to focus on changes over countries, instead than on whole sample time trends.[16] Estimations are made by GLS with robust standard errors.[17]

Three different models are specified to assess the theoretical analysis presented in section I:

Model 1: $growth = c + \alpha(y_{i0}) + \beta 1(A_{i0}) + \beta 2(I_{i0}) + \gamma 1(X) + u_i$

Model 2: $growth = c + \alpha(y_{i0}) + \beta 1(A_{i0}) + \beta 2(I_{i0}) + \beta 3(I_{i0}y_{i0}) + \gamma 1(X) + u_i$

Model 3: $growth = c + \alpha(y_{i0}) + \beta 1(A_{i0}) + \beta 2(I_{i0}) + \beta 3(I_{i0}A_{i0}) + \gamma 1(X) + u_i$

The models include all different variables separately, where (y_{i0}) is initial per capita GDP, (A_{i0}) is agglomeration, (I_{i0}) is inequality and (X) all the controls -model 1-. Model 2 also analyzes conjunct effects on growth of inequality and level of development (using per capita GDP). Finally, model 3 analyses conjunct effects of inequality this time with agglomeration.

[15] As Forbes notes, the major drawback of RE is that it can be inconsistent if there is correlation between the country-specific effects and the other regressors.
[16] Barro (2000) introduces time fixed effects instead. He also chooses cross-section random effects, instead of fixed, to avoid cross-sectional information loss and, therefore, focusing on long-run effects.
[17] An additional problematic (for all our panel estimations) is the inclusion of initial income as a regresor -dynamic model bias-. GMM could correct these problems, but eliminating one observation (of four) by country. Partridge (2005) makes the same argument and indicates that the use of GMM does not change main results in most of the related works.

1. Cross-section results:

Table 4 reports the results for the cross-country estimations for the 3 models.

Table 4: Cross-section regressions

Dependent Variable: GROWTH

	model 1			model 2			model 3		
Variable	Coeff.	Std. Err.		Coeff.	Std. Err.		Coeff.	Std. Err.	
LOG_PCGDP	-2.2487	(0.7769)	**	-7.8068	(1.9987)	**	-2.2422	(0.6969)	**
SCHOOLING	0.1844	(0.1472)		0.2163	(0.1367)		0.2006	(0.1345)	
PI	-0.0156	(0.0060)	*	-0.0111	(0.0053)		-0.0141	(0.0051)	*
URB_1M	0.0330	(0.0106)	**	0.0261	(0.0115)	*	-0.1058	(0.0221)	***
INEQUALITY	-0.0649	(0.0113)	***	-0.5706	(0.1505)	**	-0.1232	(0.0275)	**
INE*LOG_PCGDP				0.1418	(0.0451)	**			
INE*URB_1M							0.0032	(0.0007)	***
CONSTANT	12.7946	(2.2238)	***	32.4447	(6.8052)	***	15.1491	(1.2967)	***
R-sqd		0.363			0.434			0.411	
Adj R-sqd		0.292			0.357			0.331	

Method: Least Squares
Included observations: 51
Robust standard errors clustered by continent
Asterisks indicate significance: *** 1%, **5% and * 10%

All variables have the expected sign in all models. Results are consistent with conditional convergence; initial per capita GDP has a negative and significant coefficient, while higher human capital levels and lower initial price of investment increase long-run growth. Regarding agglomeration, every one of the variables considered in model 1 (*urb, urb_1m, primacy, density and dis_pop*) shows a positive effect. Urbanization (using either urb or urb_1m), in particular, is significantly positive. We report results for *urb_1m*, which reflects urban concentration. Regarding inequality, model 1 shows, as mentioned authors have found, a negative and significant effect on subsequent long-run economic growth. Model 2 replicates the findings of Partridge (1997) and Barro (2000) that the effect of inequality is likely to depend on the level of development (initial level of per capita GDP). Model 3 suggests that the effects of inequality depend on the level of urban concentration (significant coefficient for the interaction term).

Table 5 shows how economic growth changes given an increase in inequality for different values of urban concentration (model 3) and for different values of per capita GDP (model 2). It can be seen that higher inequality reduces growth, but the effect diminishes as urban concentration or as per capita GDP are higher. Actually, the effect of inequality on growth becomes positive in richer countries, in line with Barro (2000).

Table 5: Net effect of inequality on growth evaluated at different stages of development: cross-section

Model 2	LOG_PCGDP		
	Q(1/4)=3.332	Median=3.593	Q(3/4)=4.073
d(GROWTH)/d(INE) =	-0.0982	-0.0612	0.0069
Model 3	URBAN CONCENTRATION (URB_1M)		
	Q(1/4)=7.68%	Median=16.26%	Q(3/4)=25.98%
d(GROWTH)/d(INE) =	-0.0983	-0.0705	-0.0391

2. Panel (RE) results:

As in the cross-country analysis, we follow three different estimations (models 1, 2 and 3) for the panel analysis. Table 6 shows results for these different estimations using cross-section random effects.

The results reflect cross-sectional differences among countries, as well as variations over time within countries. They, therefore, show again long-run effects. As with the cross-section, all explicative variables have the expected sign. Results of model 1 are consistent with the results of the cross-section analysis; inequality reduces subsequent long-run growth. However, once we introduce the interaction terms, either inequality (in model 2) or urban concentration (in model 3) is no longer significant. In contrast to the cross-section analysis, in RE initial countries´ situations in 1980, 1990 and 2000 are also considered. It is possible that the more recent processes of economic growth show different patterns. Additionally, the fact that the interactions of inequality with income (model 2) and with urban concentration (model 3) are non significant may be due to the fact that the important long-run conjunct effects of this interaction exceed time intervals over ten years (our time reference for the panel analysis). Additional research on this aspect arises as interesting point for further research.

Table 6: Panel estimations with period dummies and cross-section random effects

Dependent Variable: GROWTH									
	model 1			model 2			model 3		
Variable	Coeff.	Std. Err.		Coeff.	Std. Err.		Coeff.	Std. Err.	
LOG_PCGDP	-2.1409	(0.3453)	***	-0.3724	(0.0174)		-2.1145	(0.3345)	***
SCHOOLING	0.2501	(0.0564)	***	0.2108	(0.0009)	**	0.244	(0.0530)	***
PI	-0.0169	(0.0042)	***	-0.0175	(0.0001)	***	-0.0169	(0.0043)	***
URB_1M	0.0246	(0.0095)	***	0.0283	(0.0001)	**	0.0375	(0.0288)	
INEQUALITY	-0.0555	(0.0151)	***	0.0838	(0.0014)		-0.0508	(0.0234)	**
INE*LOG_PCGDP				-0.0392	(0.0004)				
INE*URB_1M							-0.0003	(0.0007)	
CONSTANT	12.5088	(1.4880)	***	6.331	(5.7046)		12.2263	(1.8122)	***
R-sqd between		0.260			0.229			0.258	

Method: GLS with period fixed and country random effects
Included observations: 204
Robust standard errors clustered by continent
Asterisks indicate significance: ***1%, **5% and *10%

3. Panel (FE) results:

We again perform three different estimations. Table 7 reports the results for the different estimations this time using cross-section fixed effects.[18]

The results reflect variations over time within countries controlling for country specific effects. This gives us an idea of short-run effects of the explicative variables on economic growth. Regarding inequality, its effect again seems to be dependent on urban concentration (model 3). However, this time, in contrast with the cross-section analysis, the coefficients have opposite signs. This suggests that the effects of inequality on growth are not only dependent on urban concentration patterns, but different, actually opposite, in the long than in the short-run, as suggested by Forbes (2000).

[18] Instrumental Variables estimation has also been performed for model 1 using lag values of the regressors, lag values of infant mortality and lag values of GDP per capita squared (these last two variables having significant explanatory power for Gini coefficients) as instruments. A Hausman test does not reject the null hypothesis of no systematic difference in coefficients between the GLS and the IV estimations.

T able 7: Panel estimations with period dummies and cross-section fixed effects.

Dependent Variable: GROWTH									
	model 1			model 2			model 3		
Variable	Coeff.	Std. Err.		Coeff.	Std. Err.		Coeff.	Std. Err.	
LOG_PCGDP	-6.717	(2.6261)	*	-0.9696	(2.8766)		-6.7992	(2.5613)	*
SCHOOLING	0.1876	(0.1211)		0.1405	(0.1193)		0.1584	(0.1290)	
PI	-0.0172	(0.0026)	***	-0.016	(0.0026)	***	-0.0168	(0.0026)	***
URB_1M	-0.0854	(0.0523)		-0.0762	(0.0444)		-0.0153	(0.0400)	
INEQUALITY	0.003	(0.0175)		0.4558	(0.2351)		0.0237	(0.0194)	
INE*LOG_PCGDP				-0.1292	(0.0627)				
INE*URB_1M							-0.0013	(0.0005)	**
CONSTANT	28.899	(10.1913)	**	8.5704	(11.4338)		28.1705	(9.6837)	**
R-sqd within		0.351			0.381			0.355	

Method: GLS with period and country fixed effects
Included observations:
204
Robust standard errors clustered by continent
Asterisks indicate significance: *** 1%, ** 5% and * 10%

As in table 5, table 8 shows how economic growth changes given an increase in inequality for different values of initial urbanization, but this time in the short-run. It can be seen that higher inequality can be beneficial for countries at initial stages of development (low urban concentration), but no for countries with high urban concentration. The urban concentration threshold seems to be somewhere close to 20%, the sample median.

Table 8: Net effect of inequality on growth evaluated at different levels of urban concentration: FE

Model 3	URBAN CONCENTRATION (URB_1M)		
	Q(1/4)=10%	Median=18.13%	Q(3/4)=26.83%
d(GROWTH)/d(INE) =	1.0700	0.0131	-1.1179

IV. Changes in inequality and agglomeration, and growth

As noted in section 2, some authors argue that it is the *change* in inequality, rather than the level of inequality, what matters. To test this argument, and our own that urban concentration -as our measure for agglomeration- influences the effect of inequality on growth, we set a model considering *changes* in inequality as well as *changes* in urban concentration.[19]

Model 4: $$growth_{it,t+1} = c + \alpha(y_{it}) + \beta 1\left(\Delta I_{it-1,t}\right) + \beta 2\left(\Delta I_{it-1,t} * \Delta A_{it-1,t}\right) + \gamma(X_{it}) + u_i$$

Table 9 reports the results for fixed effects estimation of model 4. We first take the effects on the whole sample (estimation 4.a) and then we split the effects on high-GDP from those on low-GDP countries (model 4.b).

Table 9: Effects of changes in inequality on economic growth. Panel FE with period dummies.

Dependent Variable: GROWTH						
	model 4a			model 4b		
Variable	Coeff.	Std. Err.		Coeff.	Std. Err.	
LOG_PCGDP	-9.7213	(3.5925)	***	-9.9101	(3.5587)	***
SCHOOLING	0.2271	(0.3892)		0.2580	(0.3957)	
PI	-0.0130	(0.0076)	*	-0.0110	(0.0089)	
ΔINE	-0.0428	(0.0095)	***			
ΔINE*ΔURB_1M	0.0195	(0.0092)	**			
ΔINE*GDP_HIGH				-0.0624	(0.0264)	**
ΔINE*ΔURB_1M*GDP_HIGH				-0.0009	(0.0125)	
ΔINE*GDP_LOW				-0.0419	(0.0079)	***
ΔINE*ΔURB_1M*GDP_LOW				0.0377	(0.0080)	***
CONSTANT	37.8087	(14.9370)		38.1095	(14.9205)	**
Adj. R-sqd		0.540			0.545	
Akaike		3.905			3.900	

Method: GLS with period and country fixed effects
Included observations: 153
Robust standard errors clustered by continent
Asterix indicate significance: *** 1%, ** 5% and * 10%

Results show that the country´s growth of inequality in the previous ten years (between t-1 and t) has a negative and significant effect on economic growth in the subsequent ten years (t and t+1). However, when the growth of inequality interacts with growth in urban concentration, also in the previous ten years, the effect on economic growth can become positive (significant coefficient for the interaction term between inequality increases and urban concentration increases). In fact, on

[19] We also proved 2 different models: one including only the change of inequality and agglomeration separately, and one including both changes and its interaction. Our model (model 4) was the one with smaller Akaike and higher adjusted R-squared.

one hand, the net effect becomes positive in those low-GDP countries that experience higher growth in urban concentration. On the other, the net effect becomes even more negative in high-GDP countries that experience higher urban concentration. While in the case of low-GDP countries higher urban concentration favors agglomeration economies, in the case of high-GDP countries it is more likely to intensify congestion diseconomies.

Table 10 presents the net effect of the change in inequality for given values of change in urban concentration, for high-GDP and low-GDP countries.

Table 10: Net effect of changes on inequality on economic growth evaluated at different changes of urban concentration. FE estimation

	Δ URBAN CONCENTRATION (URB_1M)		
	Q(1/4)=0.0059	Median=1.031	Q(3/4)=2.243
High-GDP countries:			
d(GROWTH)/d(ΔINE) =	-0.0624	-0.0633	-0.0643
Low-GDP countries:			
d(GROWTH)/d(ΔINE) =	-0.0416	-0.0030	0.0426

The evolution of inequality is not the same in all countries. Time-invariant as well as time-variant factors are given as determinants of inequality in the literature. If we focus only at time-variant determinants, GDP per capita, its square, secondary schooling, openness ratio (Barro, 2000), higher share of subsidies in government expending and economy downturns (Odedokun and Round, 2001) are found to have significant explanatory power for within country variation of inequality.[20] However, and not considered by the cited authors, spatial redistribution of population and economic activity also helps us to explain within countries´ evolution of inequality, especially in early stages of development. We find that inequality is likely to be more beneficial for growth in countries with low, rather than in countries with high, urban concentration (results of section 3) precisely because the economic growth enhancing potential of urban concentration has not yet been exploited. Our results support the idea stated in part 1.3; *when increasing inequality is given simultaneously in a context of increasing concentration of economic activity at the urban level, the process is likely to be beneficial for growth in low income countries.*

[20] See Barro (2000) and Odedokun and Round (2001) as studies of the determinants of inequality. If we look only at time-variant determinants, Barro finds initial GDP per capita, its square, secondary schooling and openness ratio to have significant explanatory power for with-in country variation of inequality (secondary schooling having a negative effect on inequality while openness having a positive one). Odedokun and Round find that a higher share of subsidies in government expending significantly reduces inequality while economy downturns significantly increase it.

V. Conclusion

This paper has studied how the effects of income inequality on economic growth are affected by the process of concentration of economic activity at the urban level. By setting different econometric specifications, short and long-run effects of inequality have been distinguished. As suggested by previous literature, inequality seems to limit growth in the long-run while enhancing it in the short-run. Moreover, its effects depend on the countries´ level of development. In the long-run, inequality seems to worsen the conditioning factors necessary for sustained economic growth, especially at early stages of development. Empirical results show that among the poor countries those with higher and persistent inequality tend to have lower long-run growth rates. Rising inequality in low-income countries means persistently high levels of poverty. Persistent poverty, as mentioned, is a serious limit for growth. In the short-run, on the other hand, inequality seems to be associated to higher economic growth, especially in countries with low urban concentration. In fact, the results presented suggest that the possibilities for higher growth are associated to the potential growth-enhancing agglomeration economies that low-income countries can experience as economic activity concentrates at the urban level.

The policy implications for low-income countries are as follows. On one hand it has been argued that countries should pursue growth first and then, just when growth is secured, attend distributional aspects; the recurrently argued trade-off between efficiency and equity in economics. This acknowledges the empirical fact that growth is by nature, and at least in the short-run, uneven. This unevenness is crucially spatial too; associated to the geographic concentration of economic activity. On the other hand, however, it seems also quite clear that inequality becomes, sooner or later, a handicap for growth; developing countries that face high income inequalities are indeed also facing greater obstacles to achieve sustained long-run economic growth. Both facts together mean that while achieving higher economic growth may imply higher inequality due to higher geographic concentration of economic activity in the short-run, it also implies efforts for better income distribution in the long-run as a reinforcing, instead of confronting, objective to economic growth.

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ANNEX

Variables used:

Variable	Description	Source	Notes
Growth	Accumulated annual average per capita GDP growth rate	Constructed with data from Summers and Heston, using real GDP chain data (rgdpch)	
log_pcgdp	Per capita GDP (in log)	Constructed with data from Summers and Heston, using real GDP chain data (rgdpch)	
Pi	Price of investment	Constructed with data from Summers and Heston, using real GDP chain data (rgdpch)	
schooling	Mean years of schooling, age 15+, total	World Bank	Missing values for MDG and NGA filled using "IIASA/VID Projection"
inequality	Gini coefficient	Gruen and Klasen 2008	Missing values filled taking tends: BOL 1980 y 2000, ECU 1980, EGY 1980, HND 1980, KOR 1980, NPL 1990, PER 1980 ZAF 1980, TZA 1980 and ZMB 1990.
urb_1m	Population in agglomerations of more than one million as percentage of urban population.	World Bank	
Kg	Share of government consumption to real GDP	Summers and Heston	
inflation	Rate of inflation	World Bank	Missing values filled with closest values (7 observations out of 204)
years_open	Number of years the economy remained open between 1950 and 1994	World Bank	
mortality	Infant mortality rate, per 1000 live births	World Bank	Missing values for Hong Kong filled with those of China
life_exp	Life expectancy at birth, total years	World Bank	
Urb	Urban population as percentage of total population	World Bank	
geo_conc	Geographic concentration of population	Collier 2009	
Density	Average population by squared km of land.	World Bank	

List of countries:

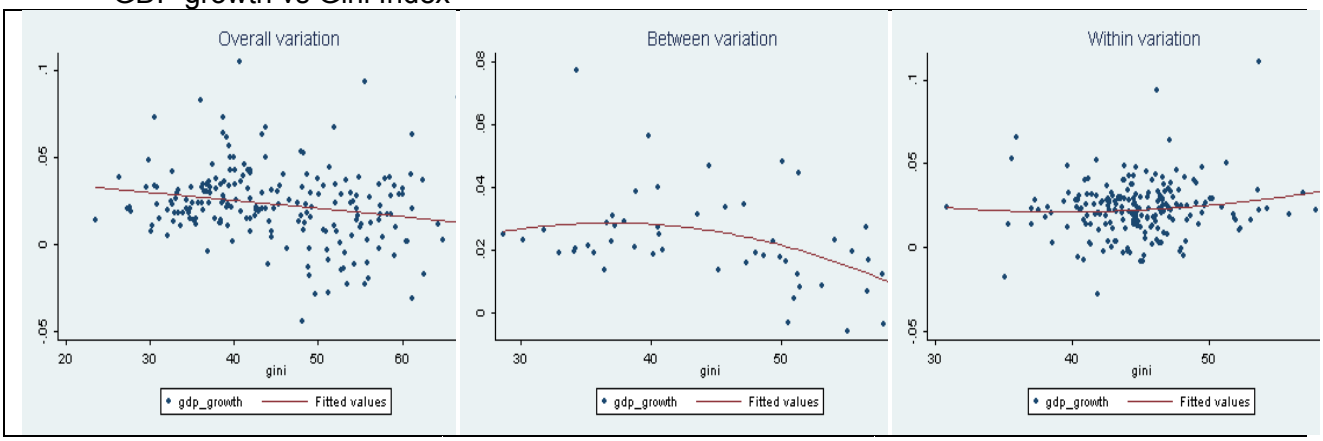
Country	isocode	Country	isocode	country	isocode
Australia	AUS	Honduras	HND	Norway	NOR
Bangladesh	BGD	Hong Kong	HKG	Pakistan	PAK
Belgium	BEL	Hungary	HUN	Panama	PAN
Bolivia	BOL	India	IND	Peru	PER
Brazil	BRA	Indonesia	IDN	Philippines	PHL
Canada	CAN	Ireland	IRL	Portugal	PRT
China	CHN	Italy	ITA	South Africa	ZAF
Colombia	COL	Jamaica	JAM	Spain	ESP
Costa Rica	CRI	Korea, Republic of	KOR	Sri Lanka	LKA
Cote d`Ivoire	CIV	Madagascar	MDG	Sweden	SWE
Denmark	DNK	Malawi	MWI	Tanzania	TZA
Ecuador	ECU	Malaysia	MYS	Thailand	THA
Egypt	EGY	Mexico	MEX	Tunisia	TUN
El Salvador	SLV	Morocco	MAR	Turkey	TUR
Finland	FIN	Nepal	NPL	United Kingdom	GBR
France	FRA	Netherlands	NLD	United States	USA
Greece	GRC	Nigeria	NGA	Zambia	ZMB

Cross-section correlations:

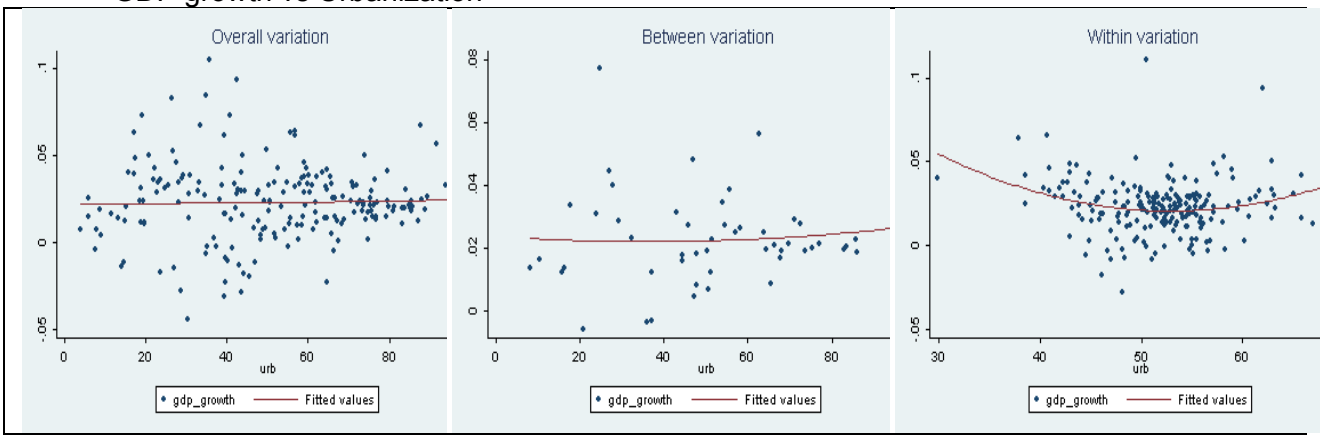
	GROWTH	INEQUALITY	URB	URBAN CONCENTRATION
GROWTH	1.000			
INEQUALITY	**-0.371**	1.000		
URBANIZATION	0.053	**-0.302**	1.000	
URBAN CONCENTRATION	**0.201**	-0.090	**0.667**	1.000
PCGDP	-0.070	**-0.301**	**0.900**	**0.503**
SCHOOLING	0.164	**-0.523**	**0.759**	**0.467**
PI	**-0.238**	-0.137	**0.256**	0.106

Included observations: 51

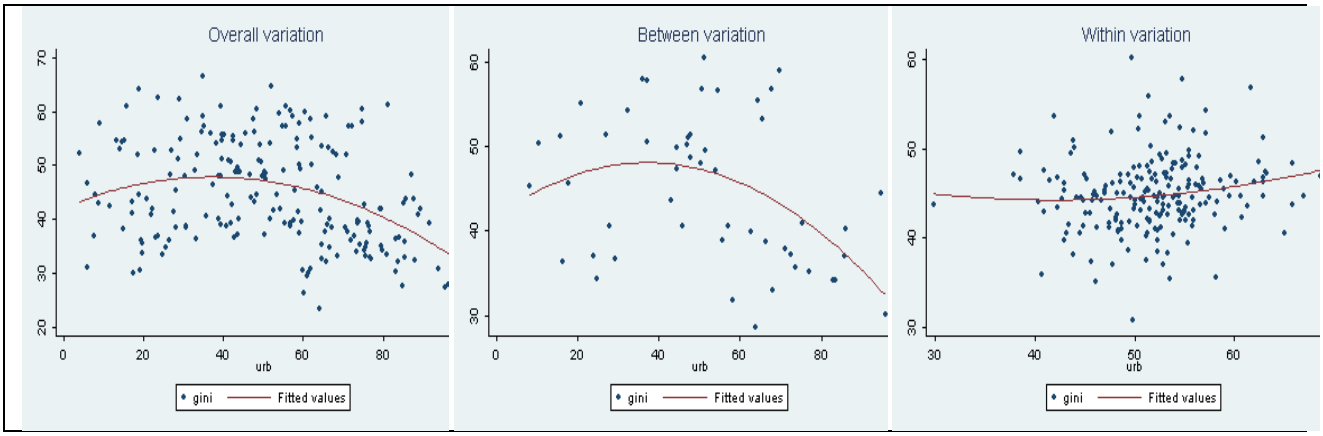
GDP growth vs Gini Index



GDP growth vs Urbanization



Gini vs Urbanization



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