Concentration of resources and economic development: An empirical overview[*]

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Abstract. This paper summarizes the main results and contributions from my Ph.D. dissertation on the concentration of resources and economic development. Its empirical analysis, summarised here, focuses on two major world trends in modern economic development: increasing agglomeration and rising inequalities. The impact of both trends on long-run economic growth is studied, and results are discussed in light of relevant policy debates.

Key words: concentration, inequality, agglomeration, growth, development

JEL classification: O1, O4, R1

1 Introduction

World trends over the last few decades point to two clear traits in economic growth: increasing geographic concentration of economic activity (i.e. agglomeration) and rising inequality within countries. The co-evolution of both trends is a great challenge for sustainable economic development. Inevitably, these realities attracted, and continue to attract substantial research to understand and address these phenomena. Nonetheless, important gaps remain. This paper seeks to summarize the main results and contributions from my Ph.D. dissertation, where trends of agglomeration and inequality, and their impact on long-run economic growth were studied.[1]

1.1 Increasing agglomeration and rising inequalities

Urbanisation is increasing globally, resulting in ever-larger agglomerations. The World Bank's data shows that while in 1960 nearly one-third of the world population lived in cities, in 2010 this figure was above 50% and was steadily growing by 1% every three years. At this rate, by 2050 nearly two-thirds of the world's population will be living in cities, with one out of two urban inhabitants living in cities of more than 1 million inhabitants. Furthermore, among the "million plus" cities, those megacities with at least ten million inhabitants will experience the largest percentage increase. Along with record changes

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    [1]The whole thesis is available online. http://www.tdx.cat/handle/10803/289344

in urbanization, income inequality has reached historically high levels. According to Milanovic (2012), using data on household surveys, individual global inequality increased from a Gini index of 68.4 in 1998 to 70.7 in 2005. According to his results, while most differences in global income still depend on location, the recent increases in global inequality are largely attributable to increases in inequality within countries.

Increasing agglomeration and rising inequalities are not independent of each other, nor are they neutral in the process of development. The UN Habitat's State of the World's Cities 2008/2009 Report found that disparities within cities, and between cities and regions within the same country are growing. Additionally, the report finds that despite the notion that economic growth is often accompanied by rising inequalities (see also Ravallion 2009), cities with high levels of inequality generally experience reduced economic growth. As cities grow and intra-urban inequalities increase, 'informal settlements' or slums also tend to grow. According to UN-Habitat, approximately one billion people – one in every seven people on the planet – live in urban slums. Growing at high rates (e.g. higher than 4.5 per cent per annum in Sub-Saharan Africa), slums are expected to host two billion inhabitants by 2030.

2   Concentration of resources and economic development, a brief literature review

Agglomeration and inequality represent the spatial and social dimensions, respectively, of the concentration of resources that occurs as countries develop. The former is related to the geographical concentration of economic activity and the population; and the latter to the concentration of income and wealth across individuals. Classical theories of economic development describe the process of development as one of structural change associated with a concentration of resources (Lewis 1954, Kaldor 1961). These theories describe economic growth in the early stages of development as fueled by rural-urban migration and an economic transformation from agricultural-based activities, performing under decreasing or constant returns to scale, to industrial-based ones, performing under increasing returns resultant from the positive externalities of proximity. This process of structural change is associated with the geographical concentration of economic activity and the population (Williamson 1965, Hansen 1990, Henderson 2003), increased inequalities (Kuznets 1955), and possibilities for high urban unemployment (Todaro 1969), which can lead to a rise in slums (Rauch 1993). The evolution of the geographical concentration of economic activity and of inequality however, is more complex than in classical models. Furthermore, the factors involved in this evolution are not always associated with economic growth. Geographical concentration can be driven by the exhaustion of resources in the rural sector, deteriorating climatic conditions, or conflict. Income inequality can be the outcome of a particular set of endowments, deficient institutions, and/or a lack of equal opportunities. And there exist benefits as well as costs – in terms of economic efficiency – that are associated with both spatial and social concentration. Current trends in these two dimensions of concentration, and the trade-off between their respective benefits and costs, have attracted substantial research in recent years.

On the one hand there is a growing interest for studying the role of spatial issues on economic development, both at a regional as well as national level. These issues are approached from the fields of economic geography and urban economics. One particular aspect that has attracted special attention is the effect of agglomeration economies on economic growth and their effect on spatial disparities, for which an extensive theoretical and empirical literature already exists.[2] Benefits from agglomeration are expected, as geographical proximity allows for positive externalities (i.e. from knowledge spillovers), which increase productivity and therefore allow for higher growth. But costs are also

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[2]See for instance Brülhart, Sbergami (2009) as a recent analysis of the effects of agglomeration at the national level. Duranton, Puga (2004) and Rosenthal, Strange (2004) provide a good theoretical survey on micro-foundations of agglomeration economies, and an extensive review of the empirical evidence. Spence et al. (2009) provide a comprehensive review linking the literature on agglomeration economies with the literature on urbanisation and growth.

expected from mechanisms such as growth-deterring congestion, which results in high rents, high transport costs and increased pollution.

On the other hand, in the field of economic development there is renewed interest in the relationship between inequalities and economic growth as a relevant aspect of the development process. While classical theories describe the positive relationship between inequality and capital accumulation as necessary for growth, especially at the early stages of development and in particular in the presence of capital markets' imperfections, modern theories highlight the mechanisms through which inequality negatively affects economic growth. These are, broadly, related to lower human capital accumulation, distortive and extractive economic policies, social unrest and conflict, lower aggregate demand and higher fertility rates.[3]

3   Methodology and data

The research synthesized in this paper relies on neoclassical models of economic growth to estimate cross-country regressions of long-run economic growth, using cross-section, and dynamic and static panel data models. The results presented here rely on estimations techniques using instrumental variables in order to identify causal effects: They include System GMM, Two Stage Residual Inclusion, and panel Fixed Effects-Instrumental Variables.[4] The majority of the data is at the national level, with some measured at the urban or city level, always with the aim of cross-country comparisons. The time span under analysis covers 1960 to 2010, with variations in range depending on the specific estimation. The dependent variable is long-run economic growth, measured over 5, 10 or 37 years, depending on the question under analysis and the robustness of the results. The key independent variables are income inequality and various measures for agglomeration, both of which are measured at the national level.

The analysis carried out is divided into three main empirical studies. The first takes a broader perspective incorporating the evolution of the three key variables under study – inequalities, agglomeration and economic growth. The second focuses on the inequality-growth relationship. The third looks at the effect of urban concentration on economic growth. The next section presents the primary findings of each of these studies.

4   Main results

4.1   Concentration of resources and economic development

The first empirical analysis[5] studies the joint impact of increasing urbanisation, urban concentration, and inequality on economic growth, from both a descriptive and an econometric analysis for a sample of 51 countries around the world using panel data from 1970 to 2007. Growth is regressed on several controls, agglomeration, and inequality measures. Variations in magnitude and changes over time, as well as the interaction between the two, are included:

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\begin{aligned}
y_{it} = {} & \alpha(y_{i,t-1}) + \beta_1(A_{i,t-1}) + \beta_2(I_{i,t-1}) + \beta_3(\Delta A_{i,t-1}) + \beta_4(\Delta I_{i,t-1}) + \\
& \beta_5(\Delta A_{i,t-1})(\Delta I_{i,t-1}) + (\mathbf{X})\gamma + u_{i,t}
\end{aligned} \tag{1}
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Table 1 presents the main results under System GMM in which urbanisation rates of cities of more than one million inhabitants are used as a proxy for agglomeration at the national level. In sum, the results show a negative effect of inequality and a positive effect

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[3]See for instance Marrero, Rodriguez (2013) for a recent empirical analysis of the inequality-growth relationship. Ehrhart (2009), Galor (2009), and Neves, Silva (2013), provide good reviews of different theories about the relationship between inequality and economic growth, as well as the empirical evidence on this relationship.

[4]Detailed descriptions of each technique used are provided in each chapter as well as in methodological appendices of the thesis. All variables definitions, sources, and descriptive statistics, can also be found in the tables and annexes of the thesis.

[5]For an extended analysis and discussion of the results presented in this subsection see Castells-Quintana, Royuela (2014a), Castells-Quintana, Royuela (2015)

Table 1: System GMM estimations of equation (1)

Dependent Variable: LOG_PCGDP(t)	1	2	3
LOG_PCGDP(t-1)	0.8614***	0.8474***	0.9109***
I(t-1)	-0.0148***	-0.012***	-0.0105***
A(t-1)	0.0052**	0.0034**	0.0028
ΔA*GDP_LOW	0.0284*		
ΔA*GDP_HIGH	-0.0196**		
ΔI*GDP_LOW	0.0037		
ΔI*GDP_HIGH	0.0013		
Δ A*GINI_LOW		0.0202***	
ΔA*GINI_HIGH		-0.0201	
ΔI*GINI_LOW		0.0006	
ΔI*GINI_HIGH		0.0075	
ΔA*GDP_LOW*GINI_LOW			0.0519***
ΔA*GDP_HIGH*GINI_LOW			-0.002
ΔA*GDP_LOW*GINI_HIGH			0.004
ΔA*GDP_HIGH*GINI_HIGH			-0.0389**
ΔI*GDP_LOW*GINI_LOW			0.0046
ΔI*GDP_HIGH*GINI_LOW			-0.0019
ΔI*GDP_LOW*GINI_HIGH			0.0004
ΔI*GDP_HIGH*GINI_HIGH			0.0063
ΔI*ΔA*GDP_LOW*GINI_LOW			
ΔI*ΔA*GDP_HIGH*GINI_LOW			
ΔI*ΔA*GDP_LOW*GINI_HIGH			
ΔI*ΔA*GDP_HIGH*GINI_HIGH			
CONSTANT	1.8217***	1.7893***	1.2472***
CONTROLS	YES	YES	YES
Obs.	153	153	153
AR1 p-value	0.039	0.082	0.11
J stat p-value	0.199	0.199	0.245

Note: Estimation by System GMM using variables lagged 2 and 3 periods as instruments. Δ represents change between t-2 and t-1. Period dummies in all estimations are not shown. Standard errors clustered by continent. Significance levels: ***1%, **5%, * 10%.

of agglomeration on economic growth when both variables are considered by magnitude. With regards to the variables considered in temporal changes, results suggest that the net benefits of agglomeration at the national level not only depend on income levels, as previously highlighted in the literature, but also on its distribution. The positive effects on economic growth from agglomeration are only found when income distribution is relatively equal. By contrast, in rich countries with a highly unequal distribution of income, results suggest a negative effect from agglomeration.[6]

4.2 Income inequality and long-run economic growth

The second empirical analysis[7] focuses on income inequality, and the different mechanisms through which it can affect economic growth. A model of long-run economic growth is estimated using cross-sectional data, and considering initial levels of income inequality,

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[6]AR1 and Hansen tests for validity of instruments are reported in Table 1. Due to the shortness of the panel and the use of variables in changes, AR2 tests can only be computed as robustness checks from estimations similar than those presented but omitting the variables in changes (in order to gain an extra time period). Key results for the rest of the variables do not change and serial correlation does not appear to be a problem. Correlation analysis for the key variables reveals substantial explanatory power for lagged differences to explain levels and for lagged levels to explain first differences.

[7]For an extended analysis and discussion of the results presented in this subsection see Castells-Quintana, Royuela (2014b)

measured with adjusted Gini coefficients, along several controls:

$$growth_i = c + X_i\Gamma + \beta I_{i0} + u_{1i} \qquad (2)$$

This empirical approach uses a Control Function Approach (CFA) to deconstruct the variance in levels of inequality. Several variables are used to identify the different transmission mechanisms between inequality and growth. For instance, geographical variables associated with the evolution of institutions (e.g. the proportion of land suitable for wheat compared to that suitable for sugar) are used to identify the effects of inequality on growth through institutional development. The model is estimated by Two-Stage-Residual-Inclusion (2SRI). In the first stage, inequality is estimated with regards to the variables associated with each transmission channel under analysis. From this, estimations residuals are obtained. In the second stage, growth is regressed on inequality measures and estimated residuals from the first stage.

The main results are presented in Table 2. OLS results yield a negative but non-significant effect of inequality on economic growth (column 1); while under 2SRI, the coefficient for inequality does become significant. Moreover, results show two significant associations between inequality and growth – one negative and one positive. Variables associated with the domestic market and with institutional development appear as the relevant mechanisms to control for in order to disentangle these two opposing effects. The extended results are presented in my dissertation.[8]

Table 2: Two opposing effects of inequality

Dependent variable: growth	1	2
	OLS	2SRI
Inequality	-0.015	-0.038**
s.e.	*-0.014*	*0.019*
Resid		0.083**
s.e.		*0.04*
CONSTANT	10.077***	11.330***
CONTROLS	YES	YES
Observations	51	51
R^2	0.672	0.706
K-P p-value		0.028
Hansen p-value		0.368

Excluded instruments (column 2): death, assassp2, wardrum, Q3, logGDP-1970, pop-growth, mortality, family, wheat-sugar, troppop, mount

Notes: Estimations using bootstrap standard errors (1,000 repetitions). *p<0.10, **p<0.05, ***p<0.01. K-P is the Kleibergen-Paap LM statistic, which tests for the null hypothesis that the matrix of the reduced-form coefficients in the first-stage regression is under-identified. The Hansen J statistic tests the null hypothesis of instrument validity under the assumption of heteroscedasticity.

4.3   Urban concentration, infrastructure, and economic growth

The third and final empirical analysis[9] focuses on the relationship between urban concentration and economic growth. The analysis tries to explain regional differences in the urban concentration-growth relationship. In particular, it seeks to explain a previously identified negative effect of concentration on economic growth in Sub Saharan Africa (Brückner 2012). It does so by means of differences in urban environments across countries. For that goal, a model of long-run economic growth (over 5 year periods) is estimated

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[8]The relevance and validity of the approach is tested in different ways. For relevance, F statistics and the Partial-R^2 were analysed in the first regression. Under-identification tests were also performed. These are reported in Table 2 along with tests of over-identifying restrictions.

[9]For a deeper analysis and discussion of the results presented in this subsection see Castells-Quintana (2015)

for up to 200 countries using panel data from 1960 to 2010, where the effect of urban concentration is let to vary depending on the level of urban infrastructures:

$$\Delta y_i = \beta(\log y_{i,0}) + \psi X_{i,0} + \lambda_1 UC_{i,0} + \lambda_2 G_{i,0} UC_{i,0} + \pi Z_{1i,0} + \epsilon_i \qquad (3)$$

Table 3 shows results under System GMM estimations. The results presented are for urban primacy, measured as the percentage of the urban population living in the largest city, as well as access to basic services, measured as the percentage of urban population having access to improved sanitation facilities. While column 1 shows a significant effect of urban concentration, UC, for the world sample, column 2 shows a significant differential and negative effect for Latin America and the Caribbean, and Sub Saharan Africa. However, these differential negative effects seem to be accounted for when an interaction between concentration and urban infrastructure is introduced (columns 3). As it can be seen, the interaction term for Latin America and the Caribbean, as well as that for Sub Saharan Africa become insignificant, while the interaction with urban infrastructure yields highly significant coefficients. As columns 4 and 5 show, infrastructures' significance is robust to several controls and non-linearities previously identified in the literature, and holds if only developing countries are considered.

Finally, results also hold if we consider only the Sub Saharan Africa sample, and use only external instruments. Exogenous variation given by rainfall data is used for identification, and data on light intensity at night is used as a proxy for income.[10] Results under Fixed Effects-Instrumental Variables confirm the role of urban infrastructure in the urban concentration-economic growth relationship. The results are available in my dissertation.[11]

5   Concluding remarks and policy implications

This paper briefly presents the main results and contributions form my Ph.D. dissertation and highlights how distributional issues associated with the concentration of resources are not only associated with the process of economic development, but also represent important determinants of long-term economic growth. The spatial and social dimensions of the concentration of resources have been considered: agglomeration and inequality, respectively. In particular, three different contributions to the literature are presented. The first relates to the agglomeration literature and shows that growth-enhancing benefits from agglomeration at the national level are only found in countries with low levels of income inequality. For high-income countries with unequal distribution of income, the evidence points towards growth-deterring congestion costs from increasing agglomeration. The second contribution relates to the inequality-growth literature. The results presented show two-opposing effects of inequality in a single growth model, linking them to the different transmission channels for inequality to affect growth. Finally, the last set of results contributes to the urban concentration-growth literature by providing evidence on the relevance of the urban environment. Urban infrastructure, in particular access to basic services for developing countries, is found to be fundamental to balance benefits and costs that stem from concentration in large cities.

Relevant policy implications arise. In particular, the results obtained allow us to contextualise the discussion on concentration at the national level. The desirability of concentration seems to depend not only on the level of development but also on income distribution, as well as in the physical aspects of the urban environment. Regarding the level of development, in the case of low-income countries there appears to be a

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[10]According to some authors (i.e., Henderson et al. 2012), traditional income data for Sub Saharan Africa is unreliable and can lead to measurement error bias.

[11]The identification strategy relies on two steps. In the first step, the effect of growth on urban concentration and on urban infrastructure is identified using rainfall as an instrument for growth. From these estimations residuals are obtained: Resid(UC) and Resid(G). These residuals have been "purged" from the reverse effect of growth. In the second step, the effect of urban concentration and the role of infrastructure is identified using these residuals. Standard tests were performed and support the relevance and validity of rainfall and rainfall squared as instrument for growth in the first step, and the relevance and validity of the residual variation in primacy and sanitation (once the reverse causality from growth has been removed) as instruments for actual primacy and sanitation in the second step.

Table 3: Estimations of equation (3): World and Developing samples

	1	2	3	4	5
Sample: Dependent variable:	World growth	World growth	World growth	Developing growth	Developing growth
UC	0.0054* (0.0032)	0.0049* (0.0027)	-0.0396*** (0.0139)	0.1152 (0.0729)	
UC*LAC		-0.0040*** (0.0012)	0.0031 (0.0032)		
UC*SSA		-0.0070** (0.003)	0.014 (0.0122)		
sanitation			0.0005 (0.0132)	-0.008 (0.0089)	-0.0137 (0.0112)
UC*sanitation			0.0004*** (0.0001)	0.0004** (0.0002)	0.0005** (0.0002)
UC*ln(rgdpch)				-0.0360** (0.0177)	-0.0354** (0.0134)
UC*(ln(rgdpch))2				0.0021* (0.0011)	0.0018** (0.0009)
UC*region					YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	1204	1204	500	356	356
No. of countries	137	137	131	94	94
AR1 test p-value	0.004	0.002	0.135	0.029	0.043
AR2 test p-value	0.437	0.552	0.353	0.863	0.711
Hansen test p-value	0.047	0.338	0.156	0.325	0.272

conflict between efficiency and equity, at least in the short term, given that increased urban concentration seems desirable for growth but may involve greater inequalities (in line with the World Bank 2009, World Development Report). Indeed, as the analysed data suggests, low-income countries that experienced high rates of economic growth also experienced rapid urbanisation and urban concentration as well as increasing inequalities. For high-income countries, by contrast, a more balanced urban system, in which small and medium-sized cities play a key role, seems more desirable than high urban concentration (in line with Barca et al. 2012). In terms of distribution, for both high- and low-income countries, the fact that the benefits derived from agglomeration depend on income inequality highlights the importance of socio-economic and institutional factors in the debate on urban concentration. Finally, in respects to the urban environment, the analysis confirms recent concerns about urban informal settlements (i.e. slums), which represent poverty traps rather than a transitory state in the process of structural change and economic development. Expansion in access to public services arises as one key policy in this regard.

In sum, the set of results presented highlights rising inequalities, urban congestion, and deficient urban environments as great challenges for sustained and sustainable development that policy makers, especially in developing countries, should take into account and properly address.

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