Three Empirical Essays on Concentration of Resources and Economic Growth

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Three Empirical Essays on Concentration of Resources and Economic Growth

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"Be curious. Read widely. Try new things.

What people call intelligence just boils down to curiosity."

(Aaron Swartz)

Preface and acknowledgements:

This PhD thesis is the fruit of several papers on different topics of economics, mainly in the areas of economic geography and economic development, which have constituted my research project as PhD student in the Faculty of Economics and Business at the University of Barcelona. It is academic in vein, but it has a great deal of personal background behind. I cannot express how important and rewarding it is for me to accomplish this goal. The outcome reflects not only my efforts but, in some way or another, the contribution of many people I have had the privilege to meet during the last years as PhD student as well as before.

As a postgraduate student of the UB during the last 5 years I have benefited in great deal from input and feedback from several excellent professors and classmates. I want to start by thanking Alex Esteller, Germà Bel and Elisabet Viladecans and all the Ubeconomics team, as well as Joan-Ramon Borell and all the professors I had in the Master in Economics. I also want to thank Ramón Alemany and everyone at the Department of Econometrics, Statistics and Spanish Economy of the UB. As PhD research fellow at the AQR-IREA research group of the UB, I could not have completed this thesis without all the help and support from all the members of the group (Jordi, Raúl, Quique and everyone else). Among them, I owe everything to Vicente Royuela. Vicente has been an extraordinary PhD supervisor for me and has given me more than I could have asked for, not only as a director but also as the extraordinary person he also is. Mil, mil y mil gracias Vicente!

The research carried out and the thesis itself has been possible thanks to the support of the Generalitat de Catalunya through the FI-scholarship that was granted to me during these 3 years. I am very grateful for this.

I also want to thank the referees and the commission following this thesis for their time and work.

Aiming at brevity, I do not want to forget all those I have shared great moments with during this time as PhD student. Daily work would not have been the same without Ernest, Sandra, Esther, Erika, Celia, Alicia, Karen, Ana, Arelli and of course my office partner Paula. I have also had the privilege to meet amazing people in the RSAI 2011 and ERSA 2012 Summer Schools, and I am very happy to have them as colleagues and friends.

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The papers in this thesis have been presented in several workshops and seminars as well as national and international congresses, where I have got valuable feedback for improving my work, and where I have also met great researchers. I want to acknowledge their contributions.

Along the papers presented in this thesis, I have also worked in parallel papers in topics of my interest. Although these papers are not fully reflected here, this thesis has benefited significantly from the research carried out in them. In this line I want to specially thank two of my co-authors, Gemmá Cairó and José María Larrú, for their patience and help and the opportunity to let me work with them.

I also want to remember friends and those who supported me in other universities where I had the privilege to study before; old friends in Universidad de Los Andes in Bogotá, in the University of Reading in the UK, in Universidad Autònoma de Barcelona (UAB), and in the CIDOB. In particular I want to express my gratitude here to Joaquim Novella, an excellent person I had the privilege to have as director of my research on *Poverty Persistence in Colombia*, as student of the Master in Development Studies of the CIDOB.

In a more personal vein, I want to thank Niki, who is with economics and tennis, my passion in life (I do not want to make a ranking here though). Niki, you mean the world to me and there would be no thesis or anything

without you. I need not to stress my gratitude and love to my parents and my family. Likewise to my friends back in Colombia, in Barcelona and Spain, in England and abroad. It means a great deal to me to have you as friends (even when distance sometimes does not allow me to spend as much time with you as I would like).

Let me finish by apologizing for any mistake and limitation of this thesis. I hope you enjoy it (which ever part you read, or all of it if you dare) and find the discussions in it interesting. As a thesis in social science, these discussions are never closed and my modest aim is just to contribute to them based on the applied economics research I have performed during this time.

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Chapter 1. Introduction

"Once one starts to think about them, it is hard to think about anything else."

(Lucas, Robert. 1988. 'On the Mechanics of Economic Development')

1.1. Context and motivation: Increasing agglomeration and rising inequalities

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 inequalities. Both traits are given between countries, but increasingly within them. With respect to geographic concentration, today we live in an increasingly urban world, with a rapid growth of large agglomerations worldwide. In fact, according to World Bank's data, while in 1960 almost 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, in 2050 around two thirds of the world population will be living in cities, with 1 out of 2 urban inhabitants living in cities of more than 1 million inhabitants. Furthermore, among the million plus cities, the megacities of at least 10 million inhabitants will experience the largest percentage increase (urban concentration).[1] With respect to inequalities, global income inequality has reached its highest historical levels. According to Milanovic (2012), using data on household surveys, individual global inequality has increased from a Gini index of 68.4 in 1998 to 70.7 in 2005. According to his results, while most of global income differences today still depend on international

[1] For more on urban trends see World Urbanisation Prospects (2011 Revision).

location,[2] the recent increases in global inequality are largely due to increases in inequality within countries.[3]

These trends have attracted substantial research. During the last decades there has been a growing interest for the study of the role of spatial issues on economic development, both at a regional as well as national level. These issues have been particularly approached from the fields of Economic Geography, Urban Economics, and Regional Science. One particular aspect that has attracted special attention is the role of agglomeration economies on economic growth and their effect on spatial disparities. Similarly, in the fields of Economic Development there is renewed interest in the relationships between inequalities and economic growth, as well as in possible factors influencing such relationship as a relevant aspect of the process of development.[4] In this line, relevant research has been undertaken from both a theoretical and empirical perspective. Nevertheless, there is still much we do not know about the interrelations and effects of both phenomena, increasing geographical concentration of economic activity and raising inequalities, in the process of economic growth.

Increasing agglomeration and rising inequalities are of course not independent from each other. The UN Habitat's State of the World's Cities 2008/2009 Report has found that disparities within cities and between cities and regions within the same country are growing. Additionally, the report finds that despite the fact that economic growth is often accompanied by rising inequalities, in cities that have high levels of inequality, economic growth is reduced. As cities grow and inequalities within them increase, "informal settlements" or slums also tend grow. According to UN-Habitat, approximately 1 billion people (1 in every 7 people on the planet) live in urban

[2] Milanovic (2011) reported that 51% of global inequality was due to "class" in the 19th century, while today this percentage is about 15%, with the other 85% relating to location.

[3] Milanovic explains three concepts of inequality: 1) between nations, 2) between nations weighing by population, and 3) between individuals regardless of where they live (that is taking into account also inequality within nations). Milanovic (2012) reports information about the three concepts. Briefly, inequality under concept 2 has declined since 1980, mainly due to the economic success of China and India. Inequality under concept 1 grew between 1980 and 2000 to then decline. Inequality under concept 3 has steadily risen due to increasing inequality within countries.

[4] The renewed interest for distributional issues can also be appreciated in the recent and increasing claims considering rising inequalities as a fundamental factor of recent growth patterns, as well as a central causal factor of the current economic crisis.

slums. Growing at high rates (higher than 4.5 per cent per annum in Sub-Saharan Africa) slums are expected to host 2 billion inhabitants by 2030.

The co-evolution of both trends, agglomeration and inequalities, poses a great challenge for both developed and especially for developing countries and raises relevant questions regarding spatial and distributional issues in the process of sustainable economic development. In this context, increasing agglomeration and rising inequalities bring to the forefront the need for relevant policy design. Improving our understanding of both trends, their interrelations and their effects on economic development, arises as a relevant motivation for empirical research.

This thesis seeks to study interactions between economic geography, socio-economic variables, and economic development processes. The aim is to analyse differentiated patterns of economic growth considering socio-economic dynamics associated with the stage of development and paying special attention to spatial issues. In particular, the thesis focuses on inequalities and geographic concentration of population and economic activity within countries (urbanization and urban concentration) and on their relationship with long-run economic growth.

1.2. Agglomeration and inequalities in the process of development: A brief theoretical background

Classical theories of economic development describe the process of development as a process of structural change (Lewis 1954). In these theories economic growth, at least in early stages of development, is fuelled by rural-urban migration and the transformation of an economy from an agricultural-based economy, performing under decreasing or constant returns to scale, to an industrial-based one, performing under increasing returns (mainly associated with urban activities and the positive externalities that proximity generates). This process of structural change is associated with geographical concentration of economic activity - mainly urbanisation and urban concentration (Williamson 1965 and Henderson 2003) as well as with increasing inequalities (Kuznets 1955), and with possibilities of high unemployment in the urban sector (Todaro 1969).

But the evolution of the geographical concentration of economic activity as well as of inequality is more complex than in classical models. There are several forces at play associated with these evolutions, which are not always associated with economic growth. In this line, we have to consider benefits as well as costs in terms of economic efficiency (economic growth) associated with both spatial concentration of economic activity at country level (urbanisation and urban concentration) and personal concentration (inequality).

In what refers to inequality, classical theories describe the relationship between inequality and capital accumulation necessary for growth, especially at early stages of development - and in particular in the presence of capital markets imperfections. But modern theories highlight the mechanisms for inequality to have a negative effect on economic growth - in short related to lower human capital accumulation, distortive policies, social unrest and conflict, lower aggregate demand, and higher fertility rates.[5]

In what refers to geographical concentration of economic activity, there is an extensive theoretical and empirical literature on the benefits of agglomeration. The argument, in a nutshell, resides in the fact that geographical proximity allows for positive externalities, as knowledge spillovers, which increase productivity and therefore allow for higher growth. But agglomeration has its associated growth-deterring congestion costs (traditionally, high rents, high transport costs and pollution), which also have to be taken into account.[6]

Parallel benefits and costs imply relevant trade-offs and non-linearities in the analysis of the relationship between inequality and economic growth, on the one hand, and between agglomeration and economic growth, on the other. Furthermore, the fact that inequality and agglomeration interact with each other also needs to be considered. On the one side, the benefits form agglomeration depend on some degree of inequality; a certain degree of inequality intensifies the growth-enhancing incentives and agglomeration economies of urban areas - in particular due to better labour market matching

[5] The different theories about the relationship between inequality and economic growth, as well as the empirical evidence, are reviewed in chapter 3.
[6] The theory and evidence about the benefits and cost from geographic concentration of economic activity is reviewed in chapter 4.

and specialisation (Fallah and Partridge 2007). But, on the other side, high inequality also weakens social cohesion, and this weakening may hamper agglomeration economies associated with human interaction - knowledge spillovers and human capital complementarities. Likewise, the above also implies that policies aiming at shaping (not necessarily detering) the evolution of inequalities, and the evolution of the geographic concentration of economic activity, have the potential to significantly enhance long-run economic growth and development, but should take into account these non-linearities and interactions.

1.3. Research hypothesis:

As described, both increasing geographical concentration of economic activity and rising inequalities are associated with the process of economic development. Both trends can therefore be considered as the two-pronged expression (personal and spatial) of concentration of resources within countries associated with the process of economic development, but also subject to congestion. As such, both trends should to be analysed together in their relationship with long-run economic growth.

It is expected that the growth-enhancing benefits and growth-deterring costs of agglomeration and inequality depend on each other. In particular, congestion costs can be considered in broad terms, considering traditional congestion (rents, transports costs and pollution), but also considering congestion due to deficient urban environments as well as social congestion, related to segregation, marginalisation, loss of trust and even social unrest and conflict. In this line concentration under high levels of inequality is expected to lead to costs outweighing the benefits of agglomeration.

In a similar way, it is expected that the degree and form of urban concentration as well as that of inequalities (and not just their levels) crucially determine their role on long-run economic growth. If that is the case, a more in-depth study of the dynamics behind these processes - inequalities, urbanisation and urban concentration - should be essential in the analysis of long-run economic growth, as well as in policy design aimed at shaping the evolution of the concentration of resources.

In what refers to inequalities, a fundamental issue might be to pay attention to different mechanisms of inequality that may influence economic growth in either a positive or negative way and that may change from country to country.

In what refers to urban concentration, the quality of the urban environment emerges as a key topic to consider. In particular, it is expected that investments to upgrade the urban environment might have not just direct positive effects on the quality of life of urban inhabitants, but also important growth-enhancing effects associated with the benefits of agglomeration. In other words, the extents to which agglomeration economies and congestion costs develop are expected to depend on the quality of the urban infrastructure.

1.4. Basic approach and methodology:

This is a thesis in applied economics. In this line, the research carried out has been mainly based on the descriptive and econometric analysis of economic data. However, and in order to properly perform this analysis and interpret its results, devoted attention has been paid to the study of the economic theory behind the main topics of the thesis. The research has mostly relied on cross-country analysis. Hence, the common units of analysis are individual countries and most of the variables in the analysis (as those related to inequality and agglomeration) are measured at country level. Nevertheless, the analysis also includes variables at city level (as those related to the urban environment in chapter 4), and most of the research questions can be extended towards more disaggregated level of analysis (as relevant lines of further research and as discussed in the last chapter).

The central and common variable to be explained throughout the thesis is national long-run economic growth. Thus, the analysis carried out mostly relies on the estimation of econometric models of economic growth. Both cross-section and panel data are used covering a time span between 1960 and 2010 (sample size depending on the specific analysis performed). The specific data used in each analysis is described in the corresponding chapter.

Different estimation techniques suitable for cross-county growth regressions are studied and implemented (from Ordinary Least Squares -OLS,

to Fixed Effects -FE, Control Function Approach -CFA, panel Fixed Effects Instrumental Variables -FE-IV, and Generalised Method of Moments estimation techniques -GMM and SystemGMM). These different estimation techniques are compared looking in each specific analysis for the most appropriate one depending on the data structure, the variables used and the research question under analysis.

Finally, as focused on aspects of the process of development, findings from each analysis performed are discussed not just from a pure academic perspective (and the potential contribution to the literature) but also in the light of the related policy debate.

1.5. An overview of the thesis: structure and main findings

The thesis is structured in three core chapters, aside from this introductory chapter and a concluding one. The three core chapters also follow a chronological order with respect to the research performed. Thus, while chapter 2 takes a more broad perspective of the three key variables of analysis, inequalities, agglomeration and growth, the subsequent chapters (3 and 4) take a closer look at specific relationships. Each chapter reflects related papers fruit of the research undertaken during these last years. The papers have been revised and synthesized to avoid repetition and for simplicity of the thesis. These papers are accessible in their published form (either as scientific articles or as working papers).[7]

In **chapter 2** the idea of inequality and geographical concentration of economic activity as the two-pronged expression (personal and spatial) of concentration of resources within countries and associated with the process of

[7] The first two core chapters combine two papers each, while the third core chapter (chapter 4) reflects just one. Three additional research papers not formally included in this thesis were valuable in the development of some of the ideas expanded throughout the thesis. In the first of these papers the central role of increasing inequalities, not just as a consequence but also as an intrinsic determinant of the crisis itself, was examined: "Dimensions of the current systemic crisis" (with Gemma Cairo-i-Cespedes). In a second paper the determinants of the evolution of income inequality, focusing on Latin American countries, were studied: 'Does aid reduce inequality? Evidence for Latin America,' (with José María Larrú, and available in the *European Journal of Development Research*). Finally, in a third paper, a possible role for international migrations in urbanisation processes was also studied: 'International migrations and urbanisation: 1960-2010,' (with Vicente Royuela, and available in the *International Journal of Global Environmental Issues*)

economic development is addressed. The chapter analyses both the theory and the data on the evolution of the geographical concentration of economic activity and of inequalities. The analysis is first descriptive, focussing on correlation analysis, and then econometric, assessing the effects of agglomeration and inequality at country level on long-run economic growth.

The analysis performed highlights the relevance of studying both trends, increasing geographic concentration of economic activity and raising income inequalities, together. As a main finding and contribution of the chapter, results suggest that the net benefits of agglomeration at country level - urbanisation and urban concentration - depend not only on the level of income, as the literature has highlighted, but also on its distribution; growth-enhancing effects of increasing agglomeration are only found when the distribution of income remains relatively egalitarian. By contrast, results point towards a negative effect from agglomeration when concentration of resources goes too far: in rich countries with unequal distribution of income.

Chapter 3 focuses on income inequality. The chapter empirically analyses the different mechanisms for income inequality to influence long-run economic growth in the process of economic development.

The main finding of the analysis carried out is the evidence of two parallel and significant effects of inequality (one positive and one negative) on economic growth. The contribution of the analysis is twofold. By using several variables - that can be related to the different transmission channels - one contribution is to decompose the variance of inequality using a system of recursive equations to provide empirical evidence on these two parallel effects (something to the best of my knowledge not done before in the literature). A second contribution is the use of a Control Function Approach (CFA) in the empirical analysis of the relationship between inequality and growth, and in particular to assess the weight of the different channels between inequality and growth.

The chapter includes an extension focusing on the link between unemployment and increasing inequalities. This extension is partly motivated by the current crisis of employment in countries like Spain, with unemployment rates above 25%.[8] Hence, an additional contribution of

[8] Although the deep and long economic crisis is not the focus of this thesis, its dramatic effects on economic growth, income distribution and employment worldwide, especially

chapter 3 is the finding of a negative and significant effect of high and persistent unemployment, when associated with worsening income distribution, on long-run economic growth.

Chapter 4 focuses on agglomeration at country level. The analysis puts close emphasis on differences across countries and world regions in the relationship between urban concentration and economic growth, paying special attention to differences based on levels of economic development but also to differences in the urban environment (focusing on urban infrastructures).

Results from chapter 4 suggest that while increasing urban concentration has been positively associated with growth in Asian countries, the opposite has been true for Sub-Saharan African (SSA) countries. The main contribution of the chapter is to show that the negative effects from concentration found in SSA seem associated with the severe lack of adequate basic infrastructure in the urban areas of the region, rather than to other region-specific characteristics (as the degree of ethnic fractionalisation or the institutional framework) as suggested by previous papers. The results suggest that, as in the rest of the developing world, improvements in urban infrastructure (in particular access to basic services) can also unleash agglomeration economies while helping to control congestion costs in Sub-Sahara African countries.

Main findings from all chapters are analysed conjunctly to derive a central conclusion and relevant policy implications in the concluding chapter of the thesis (**chapter 5**). Some lines for further research are also discussed.

Each chapter includes different annexes describing the data sets used, supplementary descriptive statistics and sensitivity analysis. Additionally, three methodological appendices are also included in the thesis. The first one briefly describes how standard cross-country regressions are specified from neoclassical growth theory (appendix 1). The second one briefly discusses issues regarding the estimation of dynamic panel models of economic growth (appendix 2). The final one presents a formal proof on how one can adjust for simultaneity bias using FE-IV estimations and residual variation (appendix 3).

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intense in Spain, are closely related to the topics of the thesis and could not be ignored throughout the research carried out during these years.

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Chapter 2: Concentration of resources in the process of development [9]

2.1. Introduction

2.1.1. Context and Motivation:

As described in the introduction of this thesis, world trends over the last few decades point to two clear traits in economic growth: increasing geographic concentration of population and economic activity and rising inequalities within countries. As these two global trends are recognised we can revisit their mutual relationships.

The interaction between agglomeration and inequalities, in fact, centre a current policy debate. On the one hand, the World Development Report 2009 supports the argument of spatially unbalanced growth; indeed, economic growth is seldom balanced. Economic development is uneven across space and, as such, will lead to geographical disparities in income, especially in developing countries. Moreover, according to the Report, interventions to reduce spatial disparities can be highly inefficient in terms of national growth

[9] The content of this chapter is associated with two scientific articles: 'Are increasing urbanisation and inequalities symptoms of growth?' (Forthcoming in *Applied Spatial Analysis and Policy*) and 'Agglomeration, Inequality and Economic Growth' (*Annals of Regional Science* 52(2): 343-366 (2014)). Both papers have been presented in several national and international conferences and peer-reviewed. The first article was presented at the International Workshop on the Wealth of Nations the Wealth of Cities (Naples-Italy, September 2012). The second one was presented at the AQR-IREA Seminars-2011, at the Encuentros de Economía Aplicada (Coruña-Spain, June 2012), at several Regional Science Association International (RSAI) conferences (the 9th World Congress, 52nd European Congress and the 59th Annual North American Meetings) and at the Sixth World Bank Urban Research and Knowledge Symposium (Barcelona-Spain, October 2012).

performance. Nevertheless, the same Report points out that "the question is whether growing concentrations of humanity will increase prosperity, or produce congestion and squalor" (World Bank 2009, p. 3). On the other hand, it has been contested that economic growth does not need to depend exclusively on increasing agglomeration driven by urban concentration: "mega-urban regions are not the only possible growth pattern" (Barca et al. 2012, p.141) ... "context and institutions do matter when we consider economic geography" (Barca et al. 2012, p. 144).[10] In fact, that the process of urbanisation - and the increasing inequality associated with it - can be modified by social and institutional factors has already been considered in the literature; the displacement of people and resources from rural to urban areas can be motivated by "pathological non-economic factors", such as war, ethnic conflict and bright lights, rather than by agglomeration economies and higher productivity (Kim 2008). Additionally, increasing levels of urban concentration might not necessarily be associated with economic development; sooner or later, they can lead to significant congestion diseconomies. In developing countries, "where institutions are insufficiently developed, it may well be the case that urban expansion is the only realistic option for overcoming institutional problems and promoting growth and development" (Barca et al. 2012, p. 141). But in developed countries, where institutions are relatively good, economic growth can be based on a different urban system.[11] In fact, as Duranton and Puga (2000) argue, what matters is the efficiency of the overall "system of cities" and "there appears to be a need for both large and diversified cities and smaller and more specialized cities". In this line, the OECD 2009 Report also highlights the idea that growth opportunities are both significant in large urban areas as well as in smaller more peripheral agglomerations.

This debate makes clear the need of a more segregated analysis of the relationship between the process of urban concentration and economic growth, taking into account the inequalities associated with both processes, and differentiating among countries at different stages of development.

[10] Many authors have extensively defended the fundamental role of institutions for long-run growth. Robinson et al. (2005) relate institutions, along with a series of others factors, to "some degree of equality of opportunity in society".

[11] Barca et al. (2012) analyse the case of Europe where, they explain, economic growth is given in small to medium-sized cities.

2.1.2. Aim and Contribution:

The main aim and contribution of this chapter is therefore to analyse the association between economic growth, inequality and geographical concentration of economic activity (urbanisation and urban concentration), taking into account the countries' level of development, and in light of the policy debate just described. The chapter develops the idea of inequality and geographical concentration of economic activity as the two-pronged expression (personal and spatial) of concentration of resources within countries and associated with the process of economic development. Measures of vertical income inequality capture concentration of resources and wealth among individuals, while measures of urbanisation capture geographical concentration of economic activity. Given that concentration of wealth and resources is subject to positive and negative externalities and synergies, we expect both income inequality and geographical concentration of economic activity to be associated with benefits from agglomeration of productive resources, which are positive for economic growth, but also to give rise to possibilities of congestion, which are harmful to growth.

2.1.3. Main findings:

The analysis carried out indeed highlights the relevance of studying both trends, increasing geographic concentration of economic activity and increasing income inequalities, together. As a main finding, the results suggest that the net benefits of agglomeration at country level - urbanization and urban concentration - depend not only on the level of income (proxy for the stage of development) but also on its distribution. In particular, results point towards a positive impact of agglomeration for countries at early stage of development and where income distribution has not deteriorated too much. By contrast, results point towards a negative effect from agglomeration - interpreted as due to congestion - when concentration of resources goes too far; in rich countries with unequal distribution of income.

2.1.4. Structure:

In section 2 I briefly review theory and evidence on the positive role of concentration of resources at the early stages of economic development, as well as on the potential costs when concentration of resources goes to far. Section 3 analyses the evolution of inequality, geographical concentration of economic activity, and economic growth, describing the major trends over the period 1970-2007 for a panel of 51 countries. In section 4 the effects of agglomeration and inequality at country level on long-run economic growth are assessed relying on econometric analysis using dynamic panel data techniques. From both, the descriptive and econometric analysis, conclusions and policy implications are derived in section 5.

2.2. Theory and Literature: Urbanisation, inequality and economic growth

Concentration of resources, good at early stages of development:

The works from Simon Kuznets (1955) and W. Arthur Lewis (1954) postulate that income inequality tends to increase in the early stages of development and then fall once a certain average income is attained, in what is known as the Kuznets inverted-U curve. These models assume perfect labour mobility and a time-constant ratio of the mean incomes between urban and rural areas, while income distribution is presumed to be more uneven in urban than in rural areas. The consequence from these models is that economic growth is likely to be associated with increasing urbanisation and income inequality in the short and medium term. But as income increases and a country develops (and becomes more urbanised), inequalities are expected to decrease in the long term.[12] Likewise, Williamson (1965) found that regional

[12] The mean income differential between the agricultural sector and the urban sector, and the progressive migration from the first to the second, is sufficient to give the inverted-U relationship between urbanisation and inequality (Robinson 1976; Knight 1976; Fields 1979). On the other hand, increasing inequality can also be explained by income differentials within the urban sector, where a higher variance is expected. But as urbanisation proceeds inequality is expected to decrease: the exodus from agriculture raises rural wages and lowers willingness to migrate at risk of urban underemployment. However, if conditions are dramatically different between the urban and rural areas, incentives to migrate are going to be very high. Dramatic differences between conditions in rural areas and expected income in urban areas help to explain the rapid rise of urban slums that is characteristic of the developing world

inequalities also follow an inverted-U curve according to the general level of country economic development. Subsequently, Henderson (1974) introduced urbanisation issues in the analysis, showing that the relationship between urban concentration and per capita income also follows an inverted-U pattern.

Thus, inequality and urbanisation, at least in the early stages of development, would be associated with economic growth; they represent capital accumulation and the transformation from a rural to an urban society, in which productivity is much higher. For developing countries the central fact of economic development is rapid capital accumulation (Lewis 1954). And Lewis himself interprets capital accumulation at both the individual and the spatial level. At the individual level that means that the distribution of incomes is altered in favour of the saving class, while at the spatial level that capital and new ideas are not thinly diffused throughout the economy, but highly concentrated at a number of points from which they spread outwards.

In fact, there is empirical evidence for the benefits of concentration of resources. At the individual level, there is evidence of a positive relationship between inequality and growth, at least in the short run: "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, p. 869). At the spatial level we can also find empirical evidence supporting the benefits of urbanisation (Henderson 2003; Brülhart and Sbergami 2009) and urban concentration (Duranton and Puga 2004; Rosenthal and Strange 2004) for growth, especially in developing countries (Bertinelli and Strobl 2007; World Bank 2009). Urbanisation takes place as people and resources are reallocated from agricultural activities to industrial activities - in which value added is higher. Thus, urbanisation represents spatial concentration of production factors necessary for growth, and this concentration itself reinforces labour´s reallocation towards larger urban areas (Ross 2000).

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help to explain the rapid rise of urban slums that is characteristic of the developing world (Rauch 1993), and hence high levels of urban concentration and of both urban-rural inequality and intra-urban inequality. In any case, urban slums are also related to a lack of response from the supply side and not an inevitable consequence of urbanisation (something that will be addressed in chapter 4 of the thesis).

When concentration of resources goes too far:

The strength of the benefits of agglomeration economies for growth - either from concentration of resources at individual or at geographical level - seems to have a limit (as the non-linearities above-described suggest). In fact, the relationship between inequality and growth, and between urbanisation and growth, is complex and dependent on several factors.

Previous literature on inequality suggests that its effects on economic growth indeed depend on initial conditions. Some degree of inequality is growth-enhancing at early stages of development but can be growth-deterring at later stages (Galor and Moav 2004). Furthermore, increases in inequality harm growth when initial income distribution is already unequal (Chen 2003). For poor countries high inequality seems indeed to be particularly harmful in the long run (Partridge 1997; Barro 2000). In fact, most empirical work on inequality and subsequent long-run growth reports a negative effect (Alesina and Rodrik 1994; Persson and Tabellini 1994; Clarke 1995; Perotti 1996; Easterly 2007; Kanbur and Spence 2010).[13]

Regarding urbanisation measures, the literature suggests that the effects of urbanisation on growth also depend on income levels (Henderson 2003; Brülhart and Sbergami 2009).[14] In fact, it has been suggested that while geographical concentration of economic activity is likely to enhance growth in early stages of development, it can slow it down in later stages due to congestion diseconomies - the so-called Williamson hypothesis (Williamson 1965). Brülhart and Sbergami found a critical level of per capita GDP of US $10.000 (in 2006 prices) above which higher urbanisation becomes detrimental

[13] As with the possibility of a positive effect, there are also several channels that would predict a negative effect of inequality on growth. Positive and negative effects from inequality, and the transmission channels associated with these effects, are precisely the focus of chapter 3, where this literature is reviewed in more detail. Briefly, the negative channels predicting a negative effect of inequality are the following: 1) socio-political instability and the risk of violent conflict, 2) redistributive pressures, 3) credit-market imperfections, reducing capital accumulation and increasing macroeconomic volatility, 4) lower aggregate demand, and 5) higher fertility rates.

[14] As Brülhart and Sbergami note, different spatial scales imply different mechanisms at work and, therefore, may yield different results. At small spatial scales, there are positive spillovers associated with clustering activities (mainly knowledge spillovers) and agglomeration may have a positive impact on economic growth, and probably stronger in more developed countries. Their results, as the analysis carried out here, refer to the larger spatial scale that is associated with urbanization, at which the agglomeration impact may relate to a reduction of transaction costs and higher integration of markets.

to growth. In addition, we expect that the effects of urban concentration on economic growth also depend on initial levels of concentration, both in terms of urbanisation (as in Bertinelli and Back 2004) and in terms of income distribution (our hypothesis).[15]

2.3. Data and descriptive analysis

Describing the database:

The empirical analysis performed in this chapter is based on cross-country panel data. The main variables of interest are inequality, geographic concentration of economic activity, and economic growth, all at country level. Variables are compiled from different sources: a table with all the variables used and their sources is annexed - Table A.2.1. The sample includes 51 countries with data for the period 1970 to 2007. The panel is constructed taking the data for 1970, 1980, 1990 and 2000 to explain the growth in each subsequent decade.[16] The countries selected are those for which reliable data for all the variables used here has been found. A list of the countries considered is also annexed - Table A.2.2. The sample, although relatively small, includes major countries from all the world's regions. Moreover, it is comparatively larger than samples used in most previous studies on inequality and provides sufficient information to meet our purposes.[17]

For economic growth cumulative annual average per capita GDP growth rates are considered, constructed with data from Summers and Heston's database, using real GDP chain data. For income inequality Gruen and Klasen's (2008) coefficients are used, which are from the WIID-WIDER database, adjusted for the different possible objects of measurement, and related to household or family and for the entire population, allowing us to address concerns about international comparability of inequality data. Other authors (e.g. Atkinson and Brandolini 2010) have previously used these

[15] The theory and evidence on the trade off between the benefits and the costs from urban concentration will be reviewed in more detail in chapter 4.

[16] Aggregating growth rates over ten years is common in the long-run literature using panel data. Higher frequency inequality data are extremely scarce and, for periods smaller than ten years, the within country variation in income inequality is very low, while the variation in growth may be too large (Barro 2000).

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

adjusted coefficients.[18] To measure geographic concentration of population and economic activity at country level, urbanisation measures are considered (following Brülhart and Sbergami 2009): the initial rate of urbanisation (URB) and the initial rate of population in agglomerations of more than 1 million as a proportion of the total population (UC), which captures urban concentration. The difference between these two variables has also been considered reflecting the percentage of population living in small and medium-size cities (URB_SMC). Data for urbanisation measures comes from the World Bank (World Development Indicators). When working with these data one has to be aware that the definition of urban areas for each country depends on national statistical offices, as there is no consistent and universally accepted standard for distinguishing urban from rural areas. For robustness we consider other measures for geographic concentration.[19]

Both the *levels* as well as the evolution of the key variables over time (i.e. the variables in *changes*) are considered. As it has been discussed before, the processes of increasing inequality as well as that of increasing agglomeration (geographic concentration of resources) are as relevant as the levels of inequality and agglomeration.[20]

Several other variables are also considered as controls. These include initial levels of price of investment (PI) and initial levels of years of schooling

[18] The main and most complete dataset on Gini coefficients is the World Income Inequality Database (WIID-WIDER). In addition to quality, there are three other important items in the construction of Gini coefficients that should be considered when using these coefficients to study interactions between inequality and economic growth: 1) the object of measure -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 are scarce, particularly in developing countries. Therefore, data based on net (or disposable) income, measuring household or family income and total population coverage should be preferred. We filled some missing values for Gini coefficients based on trends and/or interpolations: Bolivia 1980 and 2000, Ecuador 1980, Egypt 1980, Honduras 1980, Korea 1980, Nepal 1990, Peru 1980 South Africa 1980, Tanzania 1980 and Zambia 1990.

[19] We consider the share of population concentrated in the largest city (PRIMACY), as well as two other variables employed in the related literature, the geographical concentration of population (GEO_CONC) and the average population per square km (DENSITY) (see Table A.2.1).

[20] In fact, some authors argue that it is the *change* in inequality, not only the *level* of inequality, which matters (Adelman and Robinson 1989; Chen 2003; Banerjee and Duflo 2003).

(SCHOOLING), along the initial levels of per capita GDP in logs (LOG_PCGDP).

Table 2.1 shows the descriptive statistics for our main variables. The variance of each variable can be broken down into *between* variance, reflecting the variance between countries, and *within* variance, reflecting the variance over time within countries. The variance in the variables related to levels tends to be most obviously attributable to cross-sectional differences between countries. If we examine the variables related to changes, however, both the between (cross-section) and within (over time) variances are more balanced. Table 2.2 shows the descriptive statistics by period for GROWTH, INEQUALITY, URB and UC. INEQUALITY, URB and UC, all present increasing trends over time.

Table 2.1: 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
UC	20.3945	16.4260	16.3776	2.3565	100.0000	0.0000
ΔINEQUALITY	1.0098	6.1005	2.4285	5.6032	19.9000	-22.2000
ΔURB	4.3771	3.5829	2.7819	2.2803	17.1000	-4.6000
ΔUC	1.3159	1.9985	1.4792	1.3546	10.8242	-6.6017

Included observations: 204 for variables in levels, 153 for variables in changes.

Table 2.2: Descriptive statistics categorized by period: growth, inequality and urbanisation:

	GROWTH		INEQUALITY		URB		UC	
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

Correlation analysis: Long-term associations

To begin with, the association between the levels of inequality, urbanisation measures and economic development (i.e. income levels) across countries is analysed.

Inequality and development: Figures 2.1a and 2.1b display scatterplots of real GDP and the Gini Index in 1970 and 2000, respectively. A non-linear relationship that can be likened to the Kuznets curve was observed for 1970. It is reasonable to assume that poorer countries will increase their inequality as they develop, but that this inequality will subsequently decrease.

Urbanisation and development: Figs. 2.2a to 2.2f show again that, as countries develop, they experience an increase in the urbanisation rate at a diminishing return. This is expected because urbanisation rate is a truncated variable. When looking at the relationship between economic development and urban concentration in cities of more than 1 million, and in small- and medium-sized cities (cities between the urbanisation threshold and 1 million), we observe that most developed and developing countries had similar proportions of the population living in cities of more than one million inhabitants, while developed countries displayed a larger proportion of people living in small- and medium-sized cities.

Inequality and urbanisation (Figs. 2.3a-2.3f): while there was no relationship at the international level in large cities, urbanisation in small- and medium-sized cities was *negatively* related both with the level and the variance of the Gini index, i.e. countries with a large proportion of people living in small- and medium-sized cities had lower inequalities than countries with a large proportion of their population living in big cities.

Figure 2.1: Association between Real GDP per capita and Inequality

a. 1970 **b. 2000**

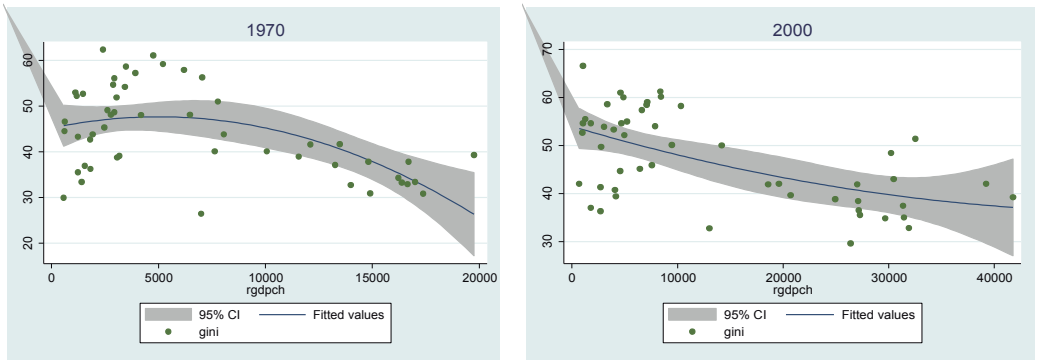
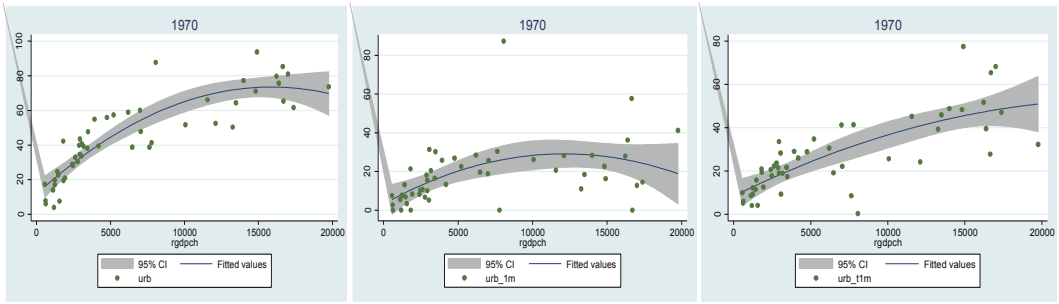


Figure 2.2: Association between Real GDP per capita and Urbanisation

a. 1970. Urbanisation **b. 1970. Urbanisation 1 Million** **c. 1970. Urb. SMC**



d. 2000. Urbanisation **e. 2000. Urbanisation 1 Million** **f. 2000. Urb. SMC**

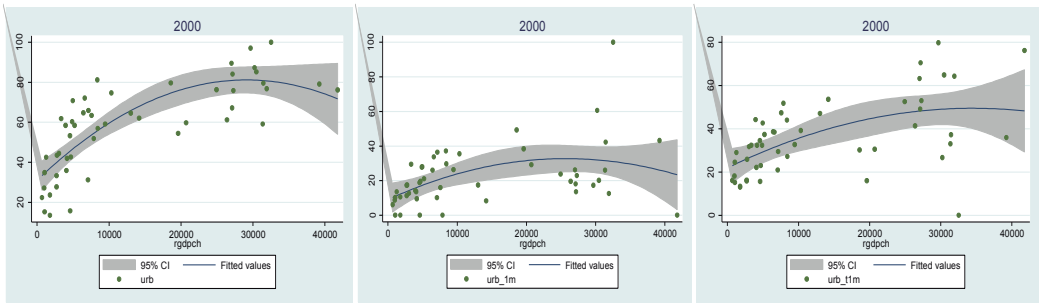
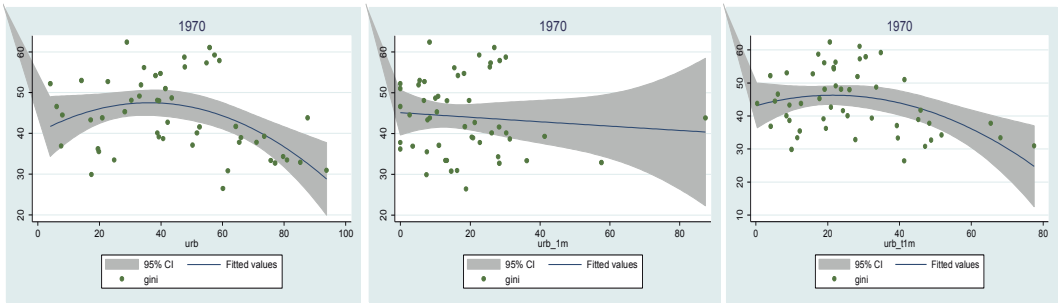


Figure 2.3: Association between Inequality and Urbanisation

a. 1970. Urbanisationb. 1970. Urbanisation 1 Million c. 1970. Urb. SMC



d. 2000. Urbanisation e. 2000. Urbanisation 1 Million f. 2000. Urb. SMC

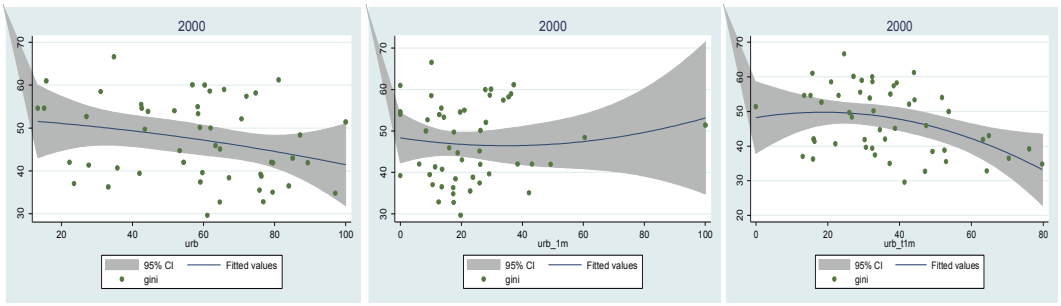


Table A.2.3 in the Annex displays the correlation coefficients between the key variables for each and all available years for the 51 countries considered. In order to find out if there were non-linearities, the sample is divided into two different subsets: higher and lower GDP per capita levels, and higher and lower inequality levels.[21] Together with the levels of urbanisation, inequality and development, the measure of economic growth during the subsequent decade is added. From these data the following stylised facts are highlighted:

- Higher levels of development - in terms of real GDP per capita - were associated with lower levels of inequality and higher levels of urbanisation. Over the years the relationship was stronger for inequality and weaker for urbanisation. Nevertheless, in less-developed countries, both higher inequality and higher urbanisation were positively associated with the process of development.

- The sign of the association between inequality and urbanisation also depended on the stage of development: higher urbanisation rates

[21] The full sample is divided using every period median of every variable.

(particularly in small- and medium-sized cities) were negatively associated with inequality in more developed countries, while they were positively associated in the less developed ones.

- While in developed countries urban concentration in large cities (more than one million inhabitants) was negatively associated with urbanisation in small and medium-sized cities, the association was positive in the less developed countries.

- A significant negative correlation between economic growth and the initial level of GDP only in the subsample of more equal countries (unconditional economic convergence).

Overall, the analysis finds non-linearities between all three variables (inequality, urbanisation and economic development), as suggested by the literature review. On the one hand, non-linearities between inequality and development were in line with the Kuznets inverted-U hypothesis (see, also, Partridge 1997, and Barro 2000). On the other hand, non-linearities were identified between urbanisation and development, in line with the Williamson hypothesis (similarly to Henderson 2003, and Brülhart and Sbergami 2009). However, the analysis also revealed non-linearities in the relationship between urbanisation and inequality; the correlation between inequality and urbanisation was positive for less-developed countries but negative for more developed ones.

Dynamic association:

An alternative and complementary approach is to inspect the relationships between the evolutions rather than the levels themselves of the considered variables.

From the literature review in section 2 we have seen that the sign of the association between the considered variables depended on both the initial level of economic development *and* on the initial level of income inequality. Thus, the sample of 51 countries is divided into four subsamples depending on level of economic development and inequality, i.e. high-high, high-low, low-high and low-low, respectively. By taking advantage of the panel structure of our database, the database is expanded serially by considering growth rates in 10-year intervals: 1970-80, 1980-90, 1990-2000. Table A.2.4 in the Annex shows

the correlations for every subsample, where every observation is of a country and period of time.

Growth in urbanisation rates and growth in inequality are found to have a positive association with economic growth only for these less developed and more equal countries. In other words: in less developed countries and with better income distribution there were increases in urbanisation and inequality that were associated with growth, in line with the first development phase of the Kuznets' and Lewis' models. In these countries urban growth is highly associated with both large cities and small and medium-sized cities. By contrast, for more developed countries or for countries with an unequal distribution of income, we do not see any significant positive correlation between growth in urbanisation or in inequality and economic growth. If any, the correlation with urban concentration is negative, although non-significant in our sample. Consequently, additional increases in the concentration of resources are apparently not associated with better economic outcomes in these countries.[22]

2.4. Econometric Analysis

2.4.1. Empirical Model

The descriptive analysis performed in section 3 suggests non-linear associations between concentration of resources and economic growth. In particular the analysis seems to suggest, in line with our argument, that increasing concentration of resources, in either of its two dimensions (inequality or urbanisation/urban concentration), is positively correlated with subsequent economic growth only when that concentration is not already too high (again in either of its two dimensions). This section analyses more deeply the effects of agglomeration and inequality at country level on log-run economic growth (beyond the simple associations done in the previous

[22] China, South Korea and Morocco (but also Bangladesh and Tanzania more recently) are examples of low-income, low-inequality countries where increasing inequality and urbanisation (as well as urban concentration) were associated with significantly high rates of economic growth. By contrast, Colombia, Peru and South Africa are examples of high-inequality, high-income countries where the opposite happened: increasing inequality and urban concentration associated with low economic growth.

section) and tests whether indeed these effects depend on initial levels of concentration of resources.

The starting point is a neoclassical growth model, which controls for conditional convergence, levels of human capital and investment.[23] Other time-invariant country characteristics can be controlled for using panel data techniques. This approach is common in empirical studies of inequality and growth (Alesina and Rodrik 1994; Perotti 1996; Forbes 2000).[24] Along with measures for initial income inequality, measures of geographical agglomeration of economic activity at country level are considered, thus expecting to capture both dimensions of concentration of resources. In addition to the effects of levels of inequality and agglomeration, the effects of increases in these variables (country´s growth of inequality and of agglomeration, both in the previous ten years) and interaction terms between both processes are also considered. The econometric specification in dynamic panel data terms is represented by equation 2.1:

$$y_{it} = \alpha(y_{i,t-1}) + \beta 1(A_{i,t-1}) + \beta 2(I_{i,t-1}) + \beta 3(\Delta A_{i,t-1}) + \beta 4(\Delta I_{i,t-1}) + \beta 5(\Delta A_{i,t-1})(\Delta I_{i,t-1}) + (\boldsymbol{X})\gamma + u_{i,t} \quad (2.1)$$

[23] See the methodological appendix 1 for an explanation of how to derive this common econometric setting from neoclassical economic growth theory. Regarding determinants of growth, Sala-i-Martin et al. (2004), using cross-section regressions, and Barro (2000, 2003), using panel data, have both conducted in-depth analyses. Sala-i-Martin et al. (2004) explore 67 possible explanatory variables for long-run growth between 1960 and 1996 and find 18 that are significantly related to it. These results show that cross-country differences in long-run growth in per capita GDP are well explained using initial levels of per capita GDP - the neoclassical idea of conditional convergence - and variables of natural resource endowments, physical and human capital accumulation, macroeconomic stability, and productive specialisation (a negative and significant effect being found for 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."

[24] Alesina and Rodrik use cross-section data and 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. As control variables, Perotti includes the initial level of income, the initial average years of secondary schooling in the male and female population (MSE and FSE) and the initial PPP value of investment deflator relative to the U.S. Forbes also adopts Perotti's specification but uses panel data. Other authors include additional control variables. Clarke's cross-section study, for instance, includes the initial level of income, primary and secondary enrolment 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 as percentage of GDP between 1970 and 1988. His time horizon is 1970 to 1988.

where $(y_{i,t-1})$ is initial per capita GDP, $(A_{i,t-1})$ is initial agglomeration at country level, $(I_{i,t-1})$ is initial income inequality, Δ represents previous 10 years growth of the corresponding variable, $(\mathbf{X})$ all the controls and $u_{i,t}$ a composite error term that includes an unobserved country-specific effect, a time-specific effect and an stochastic error term.[25]

2.4.2. Estimations and Results

One should be aware of several econometric concerns when estimating dynamic panel data models of economic growth, specially when estimations rely on a short panel where the lagged dependent variable is highly persistent and the between sample variance large compared to the within sample variance (as is the case here). The methodological appendix 2 discuses main concerns with estimations of dynamic panel data models, as equation (2.1), as well as estimation techniques to address these concerns. Accordingly, Model 1 is estimated by System-GMM (Blundell and Bond 1998).[26] As suggested by our theoretical framework and by the descriptive analysis of the data, a relevant issue is the possibility of nonlinearities or parameter heterogeneity (difficult to empirically identify and to deal with when one is constrained by the amount of observations as in cross-country analysis). Following Durlauf et al. (2005), interactions are introduced and heterogeneous effects by groups of countries are allowed, as a natural solution.[27]

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[25] Rather than including lagged levels and first differences, an alternative, but intrinsically equivalent, specification would be to include contemporaneous levels and lagged levels, as in Brülhart and Mathys (2008) estimating agglomeration effects on labour productivity for European regions. We choose the specification detailed in model 1 for consistency with traditional econometric settings of cross-country economic growth models in which right-hand-side variables are not introduced contemporaneously. In this regard, our specification is closer to Brülhart and Sbergami (2009).

[26] System-GMM estimation techniques have already been used in the two fields in which the present research focuses: in the study of the effects of inequality on economic growth, in works such as Voitchovsky (2005), and in the study of the effects of agglomeration on economic growth, in Brülhart and Sbergami (2009). Both papers present a good practical explanation and discussion of the advantages of System-GMM estimators in short dynamic panels with highly persistent variables.

[27] An additional concern worth noticing with GMM estimations of the effect of inequality on economic growth, according to Banerjee and Duflo (2003), is that for inequality we need to be aware that the use of lagged levels to instrument for first differences is likely to be biased. This happens because, while low levels of inequality are not significantly correlated with

Tables 2.3 and 2.4 report results for 7 different specifications (in Table 2.3 we used UC as measure for agglomeration, while in Table 2.4 we used URB).[28] The staring specification considers the two variables reflecting increasing inequality and increasing agglomeration - the variables in changes - (results in column 1). An interaction term between the two variables is then added (column 2). Specification 3 only introduces the interaction term. To account for nonlinearities, and according to Partridge (1997) and Barro (2000), it is important to distinguish whether the country has a low or high income; specification 4 categorizes each country relative to each period median (GPD_LOW and GDP_HIGH, respectively). According to Chen (2003) the effect of increasing inequality depends on initial levels of inequality; specification 5 distinguishes between initially equal and unequal countries (GINI_LOW and GINI_HIGH, respectively and again using each period median). Specification 6 mixes both criteria; thus, it segregates the effects between four groups of countries depending on a country's initial conditions (i.e., whether its initial levels of inequality and income are low or high). Specification 7 considers both processes - increasing inequality and increasing agglomeration - interacting with each other and again for the different inequality and income levels. All seven specifications were made by System-GMM using two-step estimation, Windmeijer's (2005) finite sample robust error correction and limiting the lag depth of the instruments as possible to avoid instrument proliferation.

The results (Table 2.3) are consistent with previous literature. Controls have the expected sign and are always significant. Likewise, while inequality is

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increases in inequality, high levels of inequality are significantly correlated with decreases, which are positively correlated with economic growth. As there are usually more decreases than increases in their dataset, the coefficient for the effect of inequality on economic growth is positively biased when estimating by traditional GMM. In that case, using Sys-GMM, rather than traditional GMM, has an additional advantage of compensating the mentioned bias. Furthermore, in our sample there are actually more increases - 86 - than decreases - 67, and both are common in countries with initially high as in countries with initially low levels of inequality.

[28] We report ar1 and Hansen tests for validity of instruments in the results tables. Due to the shortness of our 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. As for evidence regarding the strength of our instrument set, as Bazzi and Clemens (2013) highlight, there is yet no reliable and straightforward test for Sys-GMM estimations. However, an analysis of correlations for our key variables reveals substantial explanatory power for lagged differences to explain levels and for lagged levels to explain first differences.

associated with lower growth, urban concentration is associated with higher growth. Furthermore, our results also highlight two main points. First, regarding growth in agglomeration - measured as the within country's change in UC - there seems to be a significant effect, but which varies with the level of development, as in Brülhart and Sbergami (2009). Thus, there is a positive association in the early stages of development (low income), but becoming negative thereafter (specification 4). However, the significance of the positive association disappears not only when income levels are high, but also when inequality levels are high (specification 5). Moreover, it is only when both these levels are low that increasing urban concentration is good for growth; if income and inequality are both high, the coefficient becomes significantly negative (specification 6). Second, in the case of increasing inequality, the coefficient for the change in inequality over time is insignificant in all specifications. However, specification 7 suggests that increasing inequality can be good for growth when combined with increasing agglomeration. This can be interpreted as capital accumulation, but again as long as countries do not already have high levels of income and inequality.

In relation to the policy debate on agglomeration at country level, what these results suggest is that while urban concentration might be associated with economic development, the process of increasing urban concentration (the ten-year increase) might have opposing effects depending on the circumstances of each country; positive effects in developing countries with relatively good income distribution, non-significant in rich countries, and even negative in those with relatively high inequality. Hence, for the OECD context of relatively high-income countries, these findings do not support pro-agglomeration policies. In developing countries, pro-agglomeration policies may be conducive to subsequent growth only when the concentration of resources has not already gone too far (i.e. in low-income-low-inequality countries).

Table 2.3: Estimations using *UC* as measure for agglomeration

Dependent Variable: LOG_PCGDP(t)	1			2			3			4			5			6			7		
Variable	Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.	
LOG_PCGDP(t-1)	0.8238	0.054	***	0.8339	0.051	***	0.8308	0.053	***	0.8614	0.052	***	0.8474	0.049	***	0.9109	0.036	***	0.8118	0.046	***
SCHOOLING(t-1)	0.0500	0.019	**	0.0453	0.020	**	0.0497	0.026	*	0.0379	0.017	**	0.0421	0.022	*	0.0341	0.016	**	0.0525	0.023	**
PI(t-1)	-0.0014	0.001	**	-0.0014	0.000	***	-0.0011	0.000	**	-0.0017	0.001	**	-0.0010	0.000	**	-0.0015	0.001	***	-0.0010	0.000	**
INEQUALITY(t-1)	-0.0141	0.004	***	-0.0129	0.004	***	-0.0114	0.003	***	-0.0148	0.004	***	-0.0120	0.004	***	-0.0105	0.004	***	-0.0136	0.003	***
UCt-1)	0.0046	0.002	***	0.0044	0.001	***	0.0045	0.001	***	0.0052	0.002	**	0.0034	0.001	**	0.0028	0.002		0.0045	0.001	***
ΔINE	0.0030	0.003		0.0025	0.003																
ΔUC	-0.0008	0.012		-0.0001	0.011																
ΔINE*ΔUC				0.0001	0.002		0.0008	0.001													
ΔUC*GDP_LOW										0.0284	0.015	*									
ΔUC*GDP_HIGH										-0.0196	0.009	**									
ΔINE*GDP_LOW										0.0037	0.003										
ΔINE*GDP_HIGH										0.0013	0.005										
ΔUC*GINI_LOW													0.0202	0.007	***						
ΔUC*GINI_HIGH													-0.0201	0.012							
ΔINE*GINI_LOW													0.0006	0.004							
ΔINE*GINI_HIGH													0.0075	0.005							
ΔUC*GDP_LOW*GINI_LOW																0.0519	0.019	***			
ΔUC*GDP_HIGH*GINI_LOW																-0.0020	0.011				
ΔUC*GDP_LOW*GINI_HIGH																0.0040	0.029				
ΔUC*GDP_HIGH*GINI_HIGH																-0.0389	0.019	**			
ΔINE*GDP_LOW*GINI_LOW																0.0046	0.007				
ΔINE*GDP_HIGH*GINI_LOW																-0.0019	0.005				
ΔINE*GDP_LOW*GINI_HIGH																0.0004	0.007				
ΔINE*GDP_HIGH*GINI_HIGH																0.0063	0.004				
ΔINE*ΔUC*GDP_LOW*GINI_LOW																			0.0104	0.002	***
ΔINE*ΔUC*GDP_HIGH*GINI_LOW																			-0.0024	0.002	
ΔINE*ΔUC*GDP_LOW*GINI_HIGH																			0.0016	0.002	
ΔINE*ΔUC*GDP_HIGH*GINI_HIGH																			-0.0005	0.002	
CONSTANT	2.0444	0.518	***	1.9354	0.475	***	1.8366	0.397	***	1.8217	0.506	***	1.7893	0.441	***	1.2472	0.388	***	2.0797	0.398	***
Obs	153			153			153			153			153			153			153		
ar1 p-value	0.108			0.099			0.070			0.039			0.082			0.110			0.045		
J stat p-value	0.176			0.258			0.192			0.199			0.199			0.245			0.162		

Estimation by System GMM using variables lagged 2 and 3 periods as instruments. Second order autocorrelation test (ar2) cannot be computed with only 3 periods, as is our case.
Period dummies in all estimations not shown. Robust standard errors clustered by continent. Δ represents change between t-2 and t-1. Asterisks indicate significance: *** 1%, ** 5% and * 10%.

Table 2.4: Estimations using *URB* as measure for agglomeration

Dependent Variable: LOG_PCGDP(t)	1			2			3			4			5			6			7		
Variable	Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.		Coeff.	s.e.	
LOG_PCGDP(t-1)	0.8548	0.086	***	0.8510	0.072	***	0.8784	0.070	***	0.8857	0.093	***	0.8668	0.067	***	0.9136	0.063	***	0.8190	0.079	***
SCHOOLING(t-1)	0.0635	0.031	**	0.0653	0.031	**	0.0468	0.030		0.0537	0.032		0.0610	0.024	**	0.0473	0.017	***	0.0549	0.036	
PI(t-1)	-0.0012	0.001	*	-0.0013	0.001	**	-0.0014	0.001		-0.0013	0.001	*	-0.0012	0.001	**	-0.0012	0.001	*	-0.0018	0.001	**
INEQUALITY(t-1)	-0.0143	0.004	***	-0.0142	0.004	***	-0.0102	0.003	***	-0.0145	0.005	***	-0.0102	0.005	**	-0.0080	0.005	*	-0.0141	0.004	***
URB(t-1)	-0.0014	0.005		-0.0011	0.005		-0.0004	0.004		-0.0028	0.005		-0.0016	0.004		-0.0012	0.004		0.0004	0.004	
ΔINE	0.0035	0.002		0.0042	0.003																
ΔURB	0.0128	0.007	*	0.0129	0.007	*															
ΔINE*ΔURB				-0.0003	0.001		0.0005	0.001													
ΔURB*GDP_LOW										0.0085	0.012										
ΔURB*GDP_HIGH										0.0106	0.009										
ΔINE*GDP_LOW										0.0047	0.003										
ΔINE*GDP_HIGH										0.0027	0.004										
ΔURB*GINI_LOW													0.0203	0.005	***						
ΔURB*GINI_HIGH													0.0048	0.008							
ΔINE*GINI_LOW													0.0040	0.004							
ΔINE*GINI_HIGH													0.0029	0.006							
ΔURB*GDP_LOW*GINI_LOW																0.0382	0.007	***			
ΔURB*GDP_HIGH*GINI_LOW																0.0073	0.004	*			
ΔURB*GDP_LOW*GINI_HIGH																-0.0027	0.011				
ΔURB*GDP_HIGH*GINI_HIGH																0.0064	0.010				
ΔINE*GDP_LOW*GINI_LOW																0.0073	0.004	*			
ΔINE*GDP_HIGH*GINI_LOW																-0.0035	0.005				
ΔINE*GDP_LOW*GINI_HIGH																0.0008	0.006				
ΔINE*GDP_HIGH*GINI_HIGH																0.0079	0.008				
ΔINE*ΔURB*GDP_LOW*GINI_LOW																			0.0039	0.001	***
ΔINE*ΔURB*GDP_HIGH*GINI_LOW																			-0.0004	0.002	
ΔINE*ΔURB*GDP_LOW*GINI_HIGH																			-0.0012	0.001	
ΔINE*ΔURB*GDP_HIGH*GINI_HIGH																			0.0015	0.001	
CONSTANT	1.7822	0.709	**	1.7858	0.603	***	1.5096	0.526	***	1.6845	0.784	**	1.5354	0.609	**	1.0841	0.596	*	2.1616	0.646	***
Obs	153			153			153			153			153			153			153		
ar1 p-value	0.077			0.071			0.097			0.106			0.096			0.259			0.227		
J stat p-value	0.214			0.319			0.0539			0.0890			0.395			0.414			0.0262		

Estimation by System GMM using variables lagged 2 and 3 periods as instruments. Second order autocorrelation test (ar2) cannot be computed with only 3 periods, as is our case.

Period dummies in all estimations not shown. Robust standard errors clustered by continent. Δ represents change between t-2 and t-1. Asterisks indicate significance: *** 1%, ** 5% and * 10%

Table 2.4 reproduces the estimations but this time considering URB, our urbanisation variable, rather than using urban concentration.[29] Results are slightly different. Although higher initial levels of urbanisation do not seem to affect growth, the coefficient for increasing urbanisation (i.e. the within country's change in URB) is positive and significant (specification 1 and 2). As such, increasing urbanisation seems to be good for growth. However, our key result holds; the positive effect from agglomeration is no longer significant when inequality is high (specifications 5, 6 and 7). As for increasing inequality, this variable seems to have a significant and positive effect on growth, but again only in initially low-income, low-inequality countries (specification 6 and 7).

A comparison of the results in Tables 2.3 and 2.4 seems to tell us that high urban concentration levels are positively related to subsequent economic growth, while the correlation with urbanisation levels is not significant. However, it might be the case that for small to medium-sized cities (where higher rates of urbanisation do not necessarily imply greater urban concentration at country levels) the process of increasing agglomeration, as opposed to its level, is indeed positively related to growth.[30] This occurs, in particular and again, if inequality levels remain relatively low. A further difference between the results obtained with URB and those obtained with UC is that increasing urbanisation (URB) seems to be positive and significant for the full sample of countries, while increasing urban concentration is positive and significant only for low-income countries, and can even degenerate into congestion diseconomies outweighing the benefits from agglomeration in rich countries.

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[29] While urban concentration rates only give us information on the role of large agglomerations, more likely to be subject of congestion diseconomies, urbanisation rates also inform us of the role of small to medium-sized cities. When we experimented with the other measures considered for agglomeration at country level (PRIMACY, GEO_CONC and DENSITY) our key results did not vary much. Here we only present results for URB and UC. These urbanisation measures, besides being the most widely used, capture the agglomeration of population and economic activity and seem to relate more closely to the analysis conducted here, as our results show.

[30] Following recent evidence suggesting that economic growth today is given in small to medium-sized cities, especially in developed countries (McCann 2012). If we look at the association between economic growth and urbanisation processes decade by decade in our sample, we find that while in the 1980s and 1990s economic growth seems more closely associated with increasing urban concentration, during the 2000s economic growth is far more correlated with increasing urbanisation in small to medium-sized cities - urbanisation that does not take place in agglomeration of more than 1 million inhabitants.

2.5. Conclusion and Policy Implications

Summary and conclusion:

The main goal addressed in this chapter was to describe the main stylised facts in the association between concentration of resources and economic development, and establish the effects of concentration on long-run growth. In order to do so both the personal dimension *(inequality*) and the spatial dimension (*urbanisation*) of concentration of resources have been considered. In a first step the chapter has revised the main theories relating to these issues and has descriptively analysed the main stylised facts by using a panel of 51 countries over the period 1970-2007. In a second step econometric analysis, using dynamic panel data techniques, has been carried out to further explore the effects of concentration of resources, inequality and agglomeration, on long-run economic growth (and taking into account not only the levels but also the evolution of the variables over time).

The descriptive analysis identified three non-linearities: 1) Kuznets inverted-U between development and inequality; 2) Williamson-Henderson inverted-U between spatial concentration and development; and 3) a non-linear relationship between inequality and urbanisation that is dependent on the level of development, i.e. if a country is initially rural and income is equally distributed, increasing urbanisation and inequality are associated with economic growth while, by contrast, in countries that are initially unequal, this association is not found. These non-linearities suggest that while increasing inequalities and urbanisation of the last decades have been associated with growth during their early stages of development, as countries develop the beneficial forces behind the concentration of resources are likely to become exhausted. In this line, the analysis performed has also considered urbanisation rates in small and medium-sized cities. In already developed or unequal countries, i.e. countries in which concentration of resources is already high, urbanisation in small and medium-sized cities appears to be associated with decreasing inequality. Small and medium-sized cities emerge as an alternative for growth opposed to urban congestion in larger cities (an issue addressed in chapter 4). Indeed, a negative correlation exists between these two types of urbanisation in these countries, and increasing urbanisation in large cities is expected to lead to increasing inequalities (Behrens and Robert-Nicoud 2009).

The econometric analysis has confirmed differentiated effects of agglomeration depending on initial levels of concentration of resources. Empirical results confirm that growth-deterring effects of high inequality levels in the long run. Yet, results also confirm potential benefits from urban concentration (the proportion of total population living in large cities). Here, the possibilities for higher growth can be associated with growth-enhancing agglomeration economies which countries acquire as economic activity concentrates at the urban level. However, in the case of the processes of increasing inequality and increasing agglomeration (i.e., the variables of change as opposed to those associated with levels), initial conditions seem fundamental, whether the country is relatively poor or rich but also whether income levels are relatively equal or unequal. On the one hand, increasing agglomeration - be it increasing urbanisation or increasing urban concentration - fosters growth in low-income countries; on the other hand, increasing urbanisation, as opposed to increasing urban concentration, seems beneficial for high-income countries. The key outcome (and the main contribution from the chapter) is that in both high- and low-income countries the positive effects of increasing agglomeration are felt in low-inequality countries. When inequality is particularly high, that is not the case, with congestion diseconomies of large cities in high-income countries actually seeming to outweigh the benefits from urban concentration.

Policy Implications:

The policy implications of these findings vary according to the level of development. In the case of low-income countries, it has been argued that they should pursue growth first and then, when growth is secured, tackle problems of distribution - the frequently argued trade-off between efficiency and equity. This acknowledges the empirical fact that growth is by nature, and at least in the short-run, uneven. This unevenness is, quite crucially, also spatial, associated with the geographical concentration of economic activity (WDR 2009). Yet, it also seems quite clear that sooner or later inequality becomes a handicap to growth. Indeed, developing countries that face high inequalities also face greater obstacles to achieving sustained long-run economic growth. Both facts taken together mean that while achieving higher economic growth may imply greater inequality, due to a greater geographical concentration of economic activity in the short run, it might also imply efforts for better income distribution in the long run. For high-income countries, congestion

diseconomies from urban concentration would seem to be a relevant issue that has to be addressed. A more balanced urban system, in which small and medium-sized cities play a fundamental role in the mobilisation of local assets to exploit local synergies, seems to be a better strategy than intense urban concentration (OECD 2009). Finally, the fact that the benefits to be derived from agglomeration seem to depend on income distribution appears to point to the relevance of socio-economic and institutional factors in the process of development, particularly in relation to economic geography. The current policy debate on whether countries should foster increasing urban concentration, even at the risk of higher inequalities, has to be contextualized. In particular, acknowledging the powerful forces of agglomeration economies while also acknowledging the fact that socio-economic and institutional factors and circumstances, like inequalities, are relevant factors in themselves and as shifters on how agglomeration forces play a role on economic growth.

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Annex Chapter 2:

Table A.2.1: Variables used: definitions and sources

Variable	Description	Source
GROWTH	Cumulative annual average per capita GDP growth rate	Constructed with data from PWT 7.1 (Heston et al. 2012), using real GDP chain data (rgdpch)
LOG_PCGDP	Per capita GDP (in log)	Constructed with data from PWT 7.1 (Heston et al. 2012), using real GDP chain data (rgdpch)
PI	Price of investment. PPP over investment divided by the exchange rate times 100	PWT 7.1 (Heston et al. 2012)
SCHOOLING	Mean years of schooling, age 15+, total	World Bank*
INEQUALITY	Gini coefficient	Gruen and Klasen 2008**
UC	Population in agglomerations of more than one million as percentage of total population	World Bank
URB	Urban population as percentage of total population	World Bank
PRIMACY	Population in largest city as percentage of urban population	World Bank
GEO_CONC	Geographical concentration of population	Collier 2009
DENSITY	Average population by square km of land	World Bank

Note: * Missing values for MDG and NGA filled using "IIASA/VID Projection". ** Missing values filled based on trends: BOL 1980 and 2000, ECU 1980, EGY 1980, HND 1980, KOR 1980, NPL 1990, PER 1980 ZAF 1980, TZA 1980 and ZMB 1990.

Table A.2.2: Countries considered

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, Rep. 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	UK	GBR
France	FRA	Netherlands	NLD	United States	USA
Greece	GRC	Nigeria	NGA	Zambia	ZMB

Table A.2.3: Correlation coefficients

	ALL COUNTRIES					MORE DEVELOPED COUNTRIES (GDP above the median)					LESS DEVELOPED COUNTRIES (GDP below the median)					MORE EQUAL COUNTRIES (Gini below the median)					MORE UNEQUAL COUNTRIES (Gini above the median)				
	gdp growth	rgdpch	gini	urb	urb 1m	gdp growth	rgdpch	gini	urb	urb 1m	gdp growth	rgdpch	gini	urb	urb 1m	gdp growth	rgdpch	gini	urb	urb 1m	gdp growth	rgdpch	gini	urb	urb 1m
	1970					**1970**					**1970**					**1970**					**1970**				
rgdpch	0,00					-0,11					0,21					-0,15					0,07				
gini	-0,06	**-0,49**				0,01	**-0,74**				-0,11	**0,44**				0,05	-0,08				0,00	0,21			
urb	0,18	**0,85**	**-0,30**			0,22	**0,64**	**-0,52**			0,31	**0,86**	0,29			-0,02	**0,89**	-0,18			0,31	**0,83**	0,32		
urb 1m	**0,33**	**0,41**	-0,09	**0,67**		**0,50**	0,01	-0,01	**0,45**		0,32	**0,65**	0,11	**0,81**		0,10	**0,42**	0,10	**0,52**		**0,42**	**0,63**	0,07	**0,84**	
urb t1m	-0,06	**0,77**	**-0,32**	**0,75**	0,00	-0,29	**0,57**	**-0,46**	**0,46**	**-0,59**	0,15	**0,72**	*0,36*	**0,77**	0,25	-0,09	**0,77**	-0,27	**0,83**	-0,04	-0,14	**0,46**	**0,47**	**0,42**	-0,13
	1980					**1980**					**1980**					**1980**					**1980**				
rgdpch	0,10					**0,47**					0,06					**-0,50**					0,04				
gini	**-0,53**	**-0,51**				**-0,52**	**-0,61**				**-0,69**	0,22				0,20	-0,07				*-0,39*	-0,28			
urb	0,03	**0,84**	**-0,34**			0,32	**0,66**	**-0,48**			0,00	**0,89**	0,28			-0,24	**0,85**	-0,15			-0,13	**0,83**	-0,15		
urb 1m	0,14	**0,41**	-0,09	**0,62**		0,18	0,09	0,07	0,37		0,25	**0,80**	0,05	**0,86**		0,27	0,25	0,26	**0,48**		-0,15	**0,84**	-0,14	**0,86**	
urb t1m	-0,09	**0,70**	**-0,36**	**0,72**	-0,11	0,09	**0,45**	**-0,46**	**0,46**	**-0,65**	-0,30	**0,66**	**0,46**	**0,79**	0,37	**-0,47**	**0,74**	*-0,36*	**0,72**	-0,26	-0,03	*0,35*	-0,09	**0,67**	0,19
	1990					**1990**					**1990**					**1990**					**1990**				
rgdpch	0,21					0,12					0,18					-0,17					*0,38*				
gini	**-0,42**	**-0,58**				-0,22	**-0,70**				**-0,51**	0,02				0,18	-0,28				**-0,44**	**-0,41**			
urb	0,08	**0,79**	**-0,32**			-0,09	**0,59**	**-0,41**			-0,09	**0,72**	0,25			-0,15	**0,89**	-0,39			0,22	**0,70**	-0,22		
urb 1m	0,09	**0,42**	-0,01	**0,63**		0,06	0,12	0,16	**0,43**		-0,07	**0,67**	0,22	**0,87**		0,04	**0,40**	0,16	**0,56**		0,18	**0,85**	-0,22	**0,80**	
urb t1m	0,02	**0,59**	**-0,39**	**0,66**	-0,17	-0,14	0,32	**-0,48**	0,29	**-0,73**	-0,10	**0,61**	0,23	**0,89**	**0,56**	-0,21	**0,78**	**-0,58**	**0,81**	-0,04	0,05	-0,27	0,00	0,28	*-0,35*
	2000					**2000**					**2000**					**2000**					**2000**				
rgdpch	-0,22					-0,16					-0,11					**-0,55**					0,01				
gini	0,08	**-0,57**				-0,03	**-0,59**				-0,03	0,19				0,09	-0,28				0,33	*-0,36*			
urb	-0,22	**0,74**	-0,27			-0,04	**0,53**	-0,09			-0,12	**0,65**	0,20			**-0,55**	**0,82**	-0,15			-0,01	**0,70**	-0,22		
urb 1m	-0,06	**0,40**	0,03	**0,63**		0,22	0,16	0,27	**0,46**		-0,12	**0,64**	0,15	**0,92**		-0,25	0,29	0,18	**0,39**		0,03	**0,81**	-0,13	**0,83**	
urb t1m	-0,23	**0,54**	**-0,36**	**0,64**	-0,19	-0,27	0,20	*-0,36*	0,21	**-0,77**	-0,10	**0,55**	0,22	**0,91**	**0,68**	**-0,44**	**0,71**	-0,26	**0,84**	-0,18	-0,06	-0,14	-0,15	*0,35*	-0,24

Note: bolded correlations were significant at the 5% level and coefficients in italics were significant at 10%

Tables A.2.4: Correlation between growth rates (1970-80; 1980-90; 1990-2000): Subsamples

	gdp growth	Urb growth	Urb 1M growth	Urb SMC growth	gdp growth	Urb growth	Urb 1M growth	Urb SMC growth
	MORE DEVELOPED and MORE EQUAL COUNTRIES (GDP above the median & Gini below the median)				**LESS DEVELOPED and MORE EQUAL COUNTRIES** (GDP below the median & Gini below the median)			
	17 countries: 51 observations				8 countries: 24 observations			
Urb growth	0.10				*0.37*			
Urb 1M growth	0.13	**0.40**			**0.48**	**0.70**		
Urb SMC growth	0.01	**0.77**	*-0.27*		0.11	**0.81**	0.14	
Gini Growth	-0.14	-0.17	-0.10	-0.11	*0.36*	0.26	0.24	0.16
Gini g * Urb g	-0.04	**-0.29**	-0.21	-0.16	**0.51**	0.25	0.23	0.16
Gini g * Urb1M g	-0.06	-0.19	**-0.39**	0.07	**0.49**	0.20	0.23	0.09
Gini g * UrbSMC g	-0.01	-0.21	0.01	-0.23	**0.47**	0.25	0.21	0.17
	MORE DEVELOPED and MORE UNEQUAL COUNTRIES (GDP above the median & Gini above the median)				**LESS DEVELOPED and MORE UNEQUAL COUNTRIES** (GDP below the median & Gini above the median)			
	9 countries: 27 observations				17 countries: 51 observations			
Urb growth	0.02				-0.19			
Urb 1M growth	-0.31	**0.41**			-0.16	**0.54**		
Urb SMC growth	0.23	**0.79**	-0.23		-0.15	**0.92**	0.17	
Gini Growth	0.20	**-0.55**	-0.25	**-0.42**	0.13	**-0.29**	-0.21	*-0.24*
Gini g * Urb g	0.23	-0.24	-0.24	-0.09	-0.17	*0.26*	0.19	0.21
Gini g * Urb1M g	0.26	*-0.37*	-0.04	*-0.37*	-0.06	0.16	**0.50**	-0.04
Gini g * UrbSMC g	0.15	-0.08	*-0.35*	0.15	-0.20	*0.26*	-0.03	**0.32**

Note: correlations in bold are significant at the 5% level and correlations in italics are significant at 10%.

Chapter 3. Income inequality and long-run economic growth:[31]

3.1. Introduction

3.1.1. Aim and Contribution:

As it has already been analysed, increasing inequalities is one trend associated with the process of economic development. While in the first chapter inequality was considered along geographical concentration of economic activity as the two dimensions of concentration of resources within countries, this chapter expressly focuses on the relationship between income inequality and long-run economic growth. In particular, the chapter studies the different transmission channels through which inequality operates and the possibility of positive as well as negative effects on economic growth.

The aim and contribution of the analysis is twofold. By using several variables - that can be related to the different transmission channels - one aim and contribution is to decompose the variance of inequality using a system of

[31] The analysis described in this chapter is also based on two papers. The main analysis (sections 2 to 5) is available as an AQR-IREA Working Paper: *Tracking positive and negative effects of inequality on long-run growth* (AQR-IREA Working Paper 2014/01), co-authored with Vicente Royuela. The paper has been presented at the Encuentros de Economía Aplicada (Granada-Spain, June 2013) and at the Ubeconomics PhD Workshop of the University of Barcelona (Barcelona, December 2013). The analysis described in section 6 (as an extension of the chapter) is available in its full version as a scientific article: 'Unemployment and long-run growth: The role of income inequality and urbanisation' (*Investigaciones Regionales* 24: 153-173 (2012)), also co-authored with Vicente Royuela.

recursive equations to provide empirical evidence of positive and negative effects of inequality on a single model of long-run economic growth (something to the best of our knowledge not done before in the literature). A second aim and contribution is the use of a Control Function Approach (CFA) in the empirical analysis of the relationship between inequality and growth, and in particular to assess the weight of the different channels between inequality and growth.

3.1.2. Main findings:

The first main finding of the analysis carried out is that indeed inequality influences economic growth both positively and negatively. Secondly, we argue that the negative influence accounts for roughly 80 per cent of the total effect. In this regard, among the variables considered to decompose the variance of inequality the proportion of mountainous land has been identified as a powerful geographical determinant of inequality levels across countries, something surprisingly obviated in the literature on inequality. Third, it is found that the role that each channel plays may depend critically on the circumstances of each country, with the negative influence of inequality being significant in developing countries. These results are crucially important for policy makers, as their challenge is to find out how, and not just if, inequality is affecting the process of economic growth.

3.1.3. Structure:

In section 2 the theoretical and empirical literature on different effects of inequality on economic growth is reviewed. In section 3 the empirical approach followed and the data used are described. In section 4 estimations are presented, results discussed and sensitivity analysis performed. Conclusions and policy implications are derived in section 5. Finally, section 6 presents a brief extension of the analysis on inequality and growth considering unemployment and its associated increasing inequalities.

3.2. Literature review: The different effects of inequality on economic growth

Inequality of opportunities vs. inequality of outcomes:

The complex influence of inequality on the dynamics of economic growth has recently attracted attention of the scientific community after the world financial and economic crisis of 2008. Several authors have placed a strengthened emphasis on the role of inequalities in the growth process of the last decades, but also on the role of the dramatic rise of these inequalities in many countries as a cause of the crisis itself (Krugman 2008; Stiglitz 2009; Brescia 2010; Rajan 2010). According to these authors, current high levels of inequality help to explain evident deficiencies in terms of economic performance, which have accumulated over the long run.

Indeed, the debate about the effects of inequality on economic growth is a long-standing and intense one in the economics literature. This on-going debate rotates around possible negative as well as positive effects of inequality on growth. One factor seems to be of major relevance; whether inequality is due to available opportunities and particular socio-economic and institutional contexts, or due to market dynamics and unequal outcomes - and uneven success. The World Bank World Development Report 2006 (WDR 2006) differentiates between *equality of opportunities* and *equality of outcomes* as two parallel and differentiated components of inequality. While unequal opportunities are detrimental for development, unequal outcomes generate necessary incentives for capital accumulation, innovation and economic growth; "inequality of opportunity is wasteful and inimical to sustainable development and poverty reduction" but there is an "important role of income differences in providing incentives to invest in education and physical capital, to work hard, and to take risks (WDR 2006)." Similarly to WDR 2006, Easterly (2007) refers to "*structural inequality*" - due to socio-institutional factors - and to "*market inequality*" - due to market forces. While the former relates to bad institutions, low human capital investment and underdevelopment, the latter relates to uneven success in free markets. *Structural inequality* is expected to have a negative effect on subsequent economic growth while *market inequality* is expected to have a positive effect. However, the traditional econometric approach in the literature has been to assess the overall impact of inequality on growth introducing a single measure of income distribution in an

economic growth model.[32] Along these lines, and not surprisingly, there is seemingly conflicting evidence in the literature. On the one hand several authors argue that there is a negative effect of inequality (Alesina and Rodrik 1994; Persson and Tabellini 1994; Clarke 1995; Perotti1994, 1996; and Easterly 2007, among others). Their results are usually based on cross-section analyses, an approach that, to the best of our knowledge, has never provided evidence of a positive effect. On the other hand other authors have found a positive impact of inequality (Forbes 2000; Barro 2000; Chen 2003 and Voitchovsky 2005, among others). However, this positive impact relies on panel data analysis and is either associated with short-term economic growth (Forbes 2000) or is dependent on countries' income (Barro 2000), on the initial income distribution itself (Chen 2003), on the profile of inequality (Voitchovsky 2005), or on the process of urbanization, as discussed in chapter 2. The main argument for using panel techniques is that they allow controlling for omitted time-invariant factors and to address how a change in a country's level of inequality will affect growth within that country (Forbes 2000). When using fixed effects, however, if the underlying causal factors in the growth process are persistent, the long-run cross-sectional effects will be subsumed into the fixed effects (Fallah and Partridge 2007). Indeed, as Forbes (2000) highlights, it could be interesting to identify the time-invariant variables, omitted in panel analysis and that could generate the negative bias in the inequality coefficient in cross-country growth regressions, as well as to evaluate the different channels through which inequality, growth, and any other variables are related. Removing time-invariant factors, which, as we will see, are precisely those to which the negative effect of inequality is related, limits the possibility of empirically assessing the role of the different mechanisms behind the impact of inequality on growth.[33]

Regarding the different transmission channels through which inequality operates, the literature provides theoretical justifications for a potentially

[32] The most used measures are the Gini coefficients and the Theil indices. Some authors have also worked with different shares and ratios of the percentiles along the whole distribution of income. On one side, the percentage of the third quartile has been of particular interest to capture the weight of the middle class; on the basis that having a strong middle class boosts economic development (Easterly 2001; Partridge 2005). On the other side, the use of different percentile ratios allows for a focus on differentiated effects depending on the specific distributional forms of income (Voitchovsky 2005).

[33] On a similar line, Davis and Hopkins (2011) have recently argued that panel techniques are not very informative about the relationship between inequality and long-run economic growth.

beneficial effect as well as for a potentially adverse effect on the process of economic growth. In particular, while classical and neoclassical approaches have underlined a beneficial effect of inequality on growth, modern perspectives highlight potential adverse effects of inequality (Galor 2009). As the empirical aim here is to identify differentiated negative and positive effects, we first summarize how the different approaches predict a negative effect of inequality, and then demonstrate that a positive effect can also be predicted.[34]

The negative effects of inequality on growth:

Up to five differentiated approaches have been identified to try to explain the mechanisms through which inequality has a negative effect on long-run growth, which we briefly list:

1) One main transmission channel is through increased *socio-political instability* and risk of violent conflict, which translates into uncertainty of property rights and reduces investment and growth (Alesina and Perotti 1996). Additionally, stability-threatening activities represent an unproductive waste of resources and reduce the overall productivity of an economy (Barro 2000).

2) According to the *political economy approach*, either high inequality leads to higher redistributive pressure, which in turn may lead to economic distortions and disincentives (Alesina and Rodrik 1994; Persson and Tabellini 1994), or leads the rich to lobby to prevent efficient redistribution policies from being implemented (Saint-Paul and Vardier 1996; Bénabou 2002; Acemoglu and Robinson 2008).[35] These lobbying activities represent a waste of resources related to rent seeking and corruption and precisely characterize what several authors have highlighted as the fundamental adverse role of inequality in the current global crisis (Stiglitz 2009; Krugman 2012).

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[34] Ferreira (1999) presents "a brief overview to theories of growth and distribution", including a review of three mechanisms that give rise to an effect of distribution on growth; political economy channels, capital market imperfections and social conflict channels. More recently, Ehrhart (2009) and Galor (2009) also present a short, though exhaustive and comprehensive overview of the theories and empirical evidence on the relationship between inequality and economic development. Neves and Silva (2013) provide a critical survey of the empirical literature trying to explain the sources of conflicting results.

[35] Saint Paul and Verdier (1996) challenge the conventional political economy approach and argue that in fact unequal societies redistribute less and that this in turn is detrimental to growth. More recently, Woo (2011) has suggested a fiscal volatility channel for inequality to negatively influence growth.

3) In a different way, the *credit-market imperfections approach* predicts that higher inequality reduces the capacity of many individuals to invest when capital markets are imperfect and set-up costs are large. On one side this increases macroeconomic volatility (Aghion et al. 1999), while on the other it reduces average investment - especially in human capital (Galor and Zeira 1993). Both higher macroeconomic volatility and lower investment reduce long-run growth.

4) The *market size approach* emphasizes the relevance of the middle class and the risks of lower aggregate demand, derived from a higher proportion of population with lower purchasing power and the fact that lower income groups tend to have higher propensity to demand local products (Murphy, Schleifer and Vishny 1989; Todaro 1997).

5) Finally, the *endogenous fertility approach* highlights the link between higher inequality and higher fertility rates, which in turn reduce growth. In particular, this happens given that as the number of children per family increases, the average investment in education decreases (Barro 2000; Ehrhart 2009).

The positive effects of inequality on growth:

In parallel to the predicted negative effects, the literature also predicts possible positive effects of inequality through different mechanisms.

1) The first of these mechanisms relates to a presumed greater propensity to save among the rich embodied in classical and neoclassical models of growth. Along these lines, an increase in inequality leads to *higher aggregate savings* and therefore to higher levels of investment and growth (Kaldor 1956), this effect being lower the more open the economy is.

2) Moving into the modern perspectives, a second but related mechanism relies on the existence of large set-up costs or *investment indivisibilities*, assumed in the capital market imperfections approach. Under investment indivisibilities, higher inequality allows for greater aggregate investment (Aghion et al. 1999).

3) Furthermore, differentiating inequality of outcomes from inequality of opportunities, both classical and modern perspectives acknowledge a growth-enhancing effect of inequality of outcomes. This growth-enhancing

effect relates to incentives for capital accumulation (Galor 2009) and for innovation (Mirrlees 1971), and to incentives to work hard and take risks (WDR 2006). The positive effect can also be associated with agglomeration economies (Fallah and Partridge 2007; Castells-Quintana and Royuela 2014b).[36]

Examining each transmission channel:

The above transmission channels have all been described in the related literature. Nevertheless, given data constraints and the difficult task of separately measuring each channel, few studies have attempted to empirically and independently assess each of the transmission channels through which inequality has a positive influence on growth in some cases, but negative in others. Indeed, despite extensive evidence on the overall impact of inequality on growth, a comprehensive empirical analysis and joint examination of the several transmission channels is still missing in the literature. Those studies that have tried to analyse the dynamics of the transmissions channels have usually focused on a single theoretical approach. The aim of these studies is to first see the relationship between inequality and a given variable, as a proxy for the channel under analysis, to then see the effect of this variable on growth (or variables that we know are relevant for growth, like investment). Table A.3.1 in the annex lists the main papers providing empirical evidence for the different channels, the variables they use as proxy for the channel, and the effect they find either on growth or investment. Seminal works are Perotti (1994, 1996), Persson and Tabellini (1994) and Alesina and Perotti (1996). While the latter provides evidence on the negative role of socio-political instability (using several variables for social unrest), the former test two other approaches, namely the capital-market imperfections approach (using loan-to-value payment for mortgages as variable), and the political economy approach (using the share of government transfers in GDP as a proxy for redistribution). However, none of these papers considers the different channels in a single model. In a similar fashion to Alesina and Perotti, later studies have focused on liberties, institutions and the quality of property rights

[36] Barro (2000) provides a good understanding of how some approaches predict at the same time a negative and a positive effect on growth. As Barro notes, even under the socio-political instability approach, lower inequality may not lead to higher growth. If economic resources are required for the poor to effectively threaten the socio-political stability, then income-equalizing transfers promote stability only to the extent that that they do not encourage the poor to involve in disruptive actions rather than work.

as the main transmission channel within the socio-political instability approach (Svensson 98; Keefer and Knack 2002). Persson and Tabellini (1994) focused on the political economy approach, by considering welfare transfers on a small sample of 13 OECD countries for which data were available, to find non-significant results about the prediction that inequality increases redistribution, and that redistribution reduces growth. In fact, as noted before, other authors support a different relationship between inequalities and redistributive polices. Concerning the role of the domestic market, on the one hand Falkinger and Zweimmuller (1997) consider product diversity, while on the other hand Keefer and Knack (2002) consider variables related to population, aggregate GDP and openness. In both, results are not conclusively supportive of the domestic-market approach. However, Davis (2008) has revalidated the relevance of scale effects, particularly in developing countries, and several other authors have provided evidence of the relevance of the size of the middle class (Easterly 2001; Partridge 2005). Regarding the endogenous fertility approach, several studies provide evidence on the positive link between inequality and fertility rates (Perotti 1996; Koo and Dennis 1999; Kremer and Chen 2002) and on the negative effect of fertility rates on growth (Barro 2000).[37] Finally, although there is evidence of a positive effect of inequality, we have not found in any paper any explicit assessment of the transmission channels related to this positive effect.

Can we see both effects of inequality on growth?

Unifying the classical and modern perspectives, Galor and Moav (2004) suggest a changing relationship between inequality and growth depending on the process of development. Inequality is growth enhancing in early stages of development, adverse afterwards in that process, and irrelevant in developed economies.[38] Papers such as Barro (2000), Chen (2003), and Voitchovsky (2005) provide evidence that inequality can have both negative and positive

[37] Yet, even controlling for fertility, Barro finds a negative effect of inequality in poor countries and a positive effect in rich countries.

[38] In particular, in early stages of development, when physical capital accumulation is the prime engine for growth, inequality can enhance the process of development by channelling resources towards individuals whose marginal propensity to save is higher, allowing for higher levels of investment. In later stages of development, however, when human capital accumulation becomes the prime engine for growth, and given credit constraints, higher inequality leads to a lower spread of education among individuals, handicapping the process of development due to diminishing returns of human capital. Finally, as capital markets develop and credit constrains are relaxed, inequality becomes irrelevant.

effects on economic growth depending on the circumstances of the country (something that has also been examined in chapter 2). Nevertheless, in these papers the two opposing effects are not empirically related to any of the different channels through which inequality might affect growth, neither is there evidence of both effects happening simultaneously.[39] Similarly, looking at two forms of inequality, Easterly's (2007) empirical analysis focuses exclusively on structural inequality, but no attempt is made at capturing market inequality and its relationship with economic development.

Summing up, although theoretically the relationship between inequality and growth works through different channels, and although it is acknowledged that different forms of inequality are likely to have different effects on economic growth, empirical evidence in this sense is still scarce. Few studies have attempted to isolate the multiple channels of inequality. No paper, to the best of our knowledge, has captured separately, in a single model, two different forms of inequality having opposing influences on long-run growth. The closest study to the one performed here is Marrero and Rodriguez (2013). Their results also find opposing effects for inequality of opportunities and for inequality of returns (but based on U.S. states panel data, rather than cross-county data, and without empirically considering the different channels through which inequality affects growth).

3.3. Empirical approach and Data

3.3.1. Empirical Approach

Because the focus is on the long-run effects of income inequality, the analysis follows the literature on the determinants of cross-country differences on long-run economic growth. This literature tends to rely on OLS "*Barro regressions*", using a cross section data of growth rates using initial values of the explanatory variables, and results are interpreted as measuring the long-run effects of those variables (see the methodological appendix 1 for a brief

[39] Voitchovsky (2005) does find parallel positive and negative effects in a single model by using different parts of the income distribution; inequality at the top end of the distribution is positively associated with growth, while inequality lower down the distribution is negatively related to subsequent growth. However, the paper acknowledges that its empirical analysis "is not very informative regarding the different channels through which inequality might affect income."

description on how these growth regressions are derived from neoclassical economic growth theory). In the empirical literature on the effects of inequality on economic growth, the majority of cross sectional studies has found a negative coefficient (Dominicis et al 2008). However, Binder and Georgiadis (2011) list up to four basic problems associated with these regressions: all cross country heterogeneities are assumed to be fully captured by the control variables; they are subject to endogeneity bias; there is no clear distinction between short and long run dynamics; and nonlinearities are not considered. All these arguments have been approached in the literature. The classification of countries and the introduction of interactions is a first strategy to deal with problems of heterogeneities and nonlinearities (Brock and Durlauf 2001; Durlauf et al. 2005). Another strategy is the use panel data sets and techniques. When panel data sets are considered, the negative effect disappears and even becomes positive once fixed effects or GMM methods are used. But Partridge (2005) has criticised the used of fixed effects methods for the analysis of the relationship between inequality and growth, as inequality is a highly persistent variable over time. Similarly, Barro (2000) maintains that fixed-effects estimates exacerbate the bias due to measurement error. Here we take the above into account integrating into a cross section framework both the positive and negative effects of inequality on economic growth focusing on long-run dynamics (as we average growth over 37 years). In particular, Sala-i-Martin et al.'s (2004) analysis on economic growth using cross-sectional data is followed.

We set a neoclassical econometric model of economic growth (equation (1)) where $growth$ is our dependent variable, reflecting cumulative annual average GDP growth rate (in per capita terms), I_{i0} is income inequality, and X_i is a list of control variables, including the initial income, y_{i0}:

$$growth_i = c + X_i\mathbf{\Gamma} + \beta I_{i0} + u_{1i} \quad (3.1)$$

OLS regressions are likely to underestimate the negative effect of inequality, and this could be indeed because of a co-occurring positive effect (Easterly 2007). In fact, reduced form estimations for the effect of inequality on growth are likely to pick up different effects at the same time (Bourguignon 1996), related to the above-discussed transmission channels. A common strategy in the empirical literature reviewed has been the use of intermediate variables as proxies for the channel under analysis. In parallel, taking into account endogeneity concerns on the effect of inequality on growth and the

existence of two differentiated components of inequality, a second approach has been to isolate one of those components using specific instruments for inequality (as in Easterly 2007). Both strategies rely on the use of alternative variables to capture either a particular component of inequality or a particular mechanism through which inequality has an effect on growth. In the first strategy each channel is considered independently and no attempt is made to examine all of them in a single growth model. In fact, as we have seen, few papers consider empirically more than a single channel. Similarly, in the second strategy only the structural component, leading to a negative effect of inequality on growth, is considered empirically. Building on both strategies, our goal was to assess the relevance of each transmission channel by using the different variables proposed in the literature, and to differentiate between two forms of inequality in its relationship with long-run economic growth.

Following the literature inequality is considered as an endogenous variable in equation (3.1). One solution for dealing with endogeneity is to apply the so-called Control Function Approach (CFA). Like instrumental variables (2SLS), this procedure uses instruments to break the correlation between endogenous explanatory variables and unobservable variables affecting the response. In linear models with one endogenous regressor, CFA yields identical results to those obtained with 2SLS. CFA, therefore, yields consistent parameter estimates if instruments are valid (Imbens and Wooldridge 2009 and Wooldridge 2010).

Following Wooldridge's (2010) formalization of the CFA, we considered a list of instruments for inequality, Z, that are exogenous in model (3.1):

$$E(Z'u_1) = 0 \tag{3.2}$$

where X in model (1) is a strict subset of Z. As in 2SLS, we considered the reduced form for inequality as:

$$I = Z\boldsymbol{\Phi} + v_2 \tag{3.3}$$

$$E(Z'v_2) = 0 \tag{3.4}$$

Since u_1 is uncorrelated with Z, it turns out that I is endogenous in (3.1) if and only if $E(u_1 v_2) \neq 0$. The linear projection of u_1 onto v_2 in error form is:

$$u_1 = \rho_1 v_2 + e_1 \quad (3.5)$$

Since both u_1 and v_2 are orthogonal to Z, then $E(Z'e_1) = 0$, and I is exogenous if and only if $\rho_1 = 0$. Plugging equation (3.5) into equation (1) transforms our growth equation into:

$$growth = c + X\boldsymbol{\Gamma} + \beta I_0 + \rho_1 v_2 + e_1 \quad (3.6)$$

where, by construction, e_1 is uncorrelated with X, I and v_2. As we cannot observe v_2, the solution under the CFA is to estimate $\hat{v}_2$ - the residual from an OLS regression of equation (3.3). Replacing v_2 with $\hat{v}_2$ in (3.6) and estimating again by OLS yields consistent estimates for $\boldsymbol{\Gamma}$, β and ρ_1. The parameter ρ_1 in (3.6) will capture the bias that would affect β if we did not control for $\hat{v}_2$, allowing us to see the sign and magnitude of that bias.

Now, if we assume that our instrument set - Z in equation (3.2) - only captures a negative form of inequality, the remaining unexplained variance of inequality, including its positive form, is captured by v_2. In other words, as far as we can capture the negative component of inequality by Z, the remaining variance of inequality will most likely be an approximation of its positive component. Consequently, the parameter ρ_1 in an OLS estimation of equation (3.6), once the original values of I and the estimations of v_2, namely $\hat{v}_2$, are included, can be interpreted as a proxy estimation of the positive association between inequality and long-run economic growth.

Alternatively, we could consider inequality as $I = Z\boldsymbol{\Pi_1} + W\boldsymbol{\Pi_2} + \omega_2$, where only the negative component can be captured with healthy instruments (Z), while the positive component can only be captured through covariates, W, that are correlated with u_1. Hence, the residual of the linear projection of I on Z, v_2, would equal $W\boldsymbol{\Pi_2} + \omega_2$, and the linear projection of u_1 onto v_2 in error form would be $u_1 = \rho_1(W\boldsymbol{\Pi_2} + \omega_2) + e_1$. Consequently, the remaining estimated component $\hat{v}_2$ in our growth equation would include $W\boldsymbol{\Pi_2}$ plus any unexplained variance, ω_2. In this case β would consistently estimate the negative influence of inequality on economic growth. It can happen that some mechanisms of inequality are at the same time related to their positive and to their negative associations with growth, as suggested in the literature, and consequently $E(Z'W) \neq 0$. In such case, the estimation of $\boldsymbol{\Phi}$ in (3.3) would not equal $\boldsymbol{\Pi_1}$, being the bias linked to $E(Z'W)$. As a consequence our

approach would be affected and we could expect a bias towards zero of both β and ρ_1 in (3.6). Subsequently, we understand that the misspecification in (3.3) coming from not considering instruments of the positive channel of inequality, W, that could be correlated with the instruments of negative channels, Z, would be driving our estimates in (3.6) to be non-significant. Hence, if we find significant results for both β and ρ_1, we will be able to say that they are downward bounded.

The use of residual variation in recursive estimation to disentangle opposing dynamics has been used in the macroeconomic literature (e.g. Bruckner 2012). As far as we know, however, it is the first time it has been used for inequality.[40]

3.3.2. Data

The dataset for this chapter departs from the dataset used in chapter 2 but extends it by considering a wide array of new variables (mainly to capture the different transmission mechanisms under analysis). However, while in chapter 2 the panel structure of the dataset was exploited, here we rely on cross-section analysis. As control variables in our growth model we used *log_pcgdp* - the initial level of per capita GDP (in log), *life_exp* - the life expectancy at birth, *p60* - the primary enrolment rate, *yrsopen* - the number of years the economy has been open between 1950 and 1994, *primary_exports* - the fraction of primary exports in total exports, and *mining* - the fraction of GDP in mining - to capture natural endowments.[41] The data, aside that for income inequality, comes from Sala-i-Martin et al. (2004), the Penn World Table (PWT), and the World Bank Development Indicators database. Income inequality is measured by the Gini coefficient, and we relied on Gruen and Klasen (2008).[42] (A table with the variables used and their sources is annexed -

[40] Bruckner (2012) aims at differentiating two causal effects running in opposite directions. Our aim is to differentiate the different signed relationships between inequality and long-run economic growth.

[41] See footnote 23 for references and previous results in the empirical literature on economic growth considering these control variables.

[42] We relied on income, rather than land or wealth, inequality. It is income distribution that possibly reflects two distinct sources of inequality, namely inequality of opportunities and inequality of returns, which influence economic growth in opposite directions (Neves and Silva 2013). See footnote 18 for more on the data used for income inequality.

Table A.3.2). Data as close to 1970 as possible is used to explain average growth rates between 1970-2007 in a sample of 51 countries (see Table A.2.2).

Table 3.1 presents descriptive statistics for the variables used in the growth equation, while Table 3.2 presents correlations among these variables. Growth is positively correlated with initial values of *life_exp*, *p60* and *yrsopen*. By contrast, growth is negatively correlated with initial values of *log_pcgdp*, *primary_exports*, *mining* and *inequality*. The correlation between growth and *inequality* is -0.371. Regarding inequality and the controls, inequality is positively correlated with *mining* and *primary_exports* and negatively correlated with all the other variables.

Table 3.1. Descriptive statistics: variables in the growth equation

	Mean	Std. Dev.	Maximum	Minimum
growth	2.222	1.515	-0.903	7.620
inequality	44.108	9.377	26.400	62.400
log_pcgdp	8.381	1.010	6.332	9.891
life_exp	60.206	10.586	40.365	74.649
p60	0.799	0.237	0.100	1.000
yrsopen	0.447	0.357	0.000	1.000
primary_exports	0.104	0.097	0.009	0.555
mining	0.040	0.047	0.000	0.208

No. of observations included: 51

Table 3.2. Correlations: variables in the growth equation

	growth	inequality	log_pcgdp	life_exp	p60	yrsopen	primary_ exports	mining
growth	1.000							
inequality	**-0.371**	1.000						
log_pcgdp	-0.079	-0.301	1.000					
life_exp	0.302	-0.498	0.854	1.000				
p60	0.375	-0.321	0.703	0.837	1.000			
yrsopen	0.264	-0.337	0.696	0.707	0.629	1.000		
primary_exports	-0.345	0.239	-0.177	-0.264	-0.203	-0.120	1.000	
mining	-0.199	0.259	-0.253	-0.402	-0.254	-0.228	0.509	1.000

No. of observations included: 51

Additionally, we looked for variables related to inequality that we could use to identify each of the transmission channels that give rise to an effect on long-run economic growth. For Socio-Political Instability (SPI) variables related to social unrest and violence, following Alesina and Perotti (1996), are considered. A parsimonious strategy (looking at the highest R-square in a regression for inequality) was followed to select three variables (*assassp2*, *death* and *wardum*) among those positively correlated with inequality and negatively with growth.[43] For redistributive policies, as one main focus of the Political Economy (PE) approach, average government spending (*kg702007*) and average expenditure on education (*exp_edu*), both as share of GDP, are considered. Regarding the Credit Market Imperfections (CMI) approach, access to sound money (*fi_sm*) and patents (*innovation*), as proxies for innovation, were used. For Domestic Market size and the role of the middle class (DM) the chosen variables are aggregate GDP (*logGDP1970*) and the share of the third quintile in the income distribution (*Q3*). The use of openness as one of the controls included in the growth equation captures the role of foreign markets. Finally, for the role of Fertility decisions (FER) population growth rates (*pop_growth*), infant mortality rates (*mortality*), and the proportion of family farms (*family*), all highly correlated with fertility rates and inequality levels, are used.[44] As the goal is to use these variables to disentangle different dynamics in the relationship between initial inequality and subsequent growth data as close to 1970 as possible (and with controls in the growth equation) is considered.

Following Easterly (2007), geographical time-invariant variables are taken into account to capture factor endowments defining the structural component of inequality: the exogenous suitability of land for wheat versus sugarcane (*wheat_sugar*) - as proxy for factor endowment differentials across countries - and the proportion of population in tropical areas (*troppop*). The proportion of mountainous lands (*mount*) is also included, as it seems to have a high and significant explanatory power for inequality, as discussed below.

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[43] Other variables for social unrest and violence were also considered as robustness checks in the estimations performed. Aside from social unrest and violence, other authors have considered variables related to liberties, rights and institutions. However, data for these variables are only available from the 80s and are expected to by highly affected by economic performance. The analysis was therefore restricted to the selected variables, which are some of the most commonly used in the literature and helped to reduce endogeneity.

[44] When inequality was regressed on the selected controls, fertility rates did not add significant explanatory power, and their use as a valid instrument for inequality was rejected by the instrument tests implemented.

These variables can help isolate the negative effect of inequality from its positive effect (as suggested by Easterly himself). However, as these variables only identify part of the variability of inequality and cannot be associated with a particular transmission channel, relying only on them would prevent our aim of identifying different dynamics between inequality and growth.

Table 3.3 presents descriptive statistics for the different variables considered as well as their correlation with inequality.

Table 3.3: Descriptive statistics: variables in the inequality equation

Considered variables	Mean	Std. Dev.	Min	Max	Corr. with Inequality
SPI					
assassp2	0.005	0.021	0.000	0.138	0.254
death	12.102	4.365	5.678	23.500	0.173
wardum	0.392	0.493	0.000	1.000	0.265
Political Economy					
kg702007	8.593	4.264	2.221	20.918	0.020
exp_edu	15.070	4.403	6.187	24.478	0.358
CMI					
fi_sm	7.017	1.608	2.518	9.647	-0.029
innovation	74.704	124.992	0.000	539.986	-0.492
Domestic Market					
Q3	13.979	3.187	7.700	18.720	-0.792
logGDP1970	10.470	0.780	8.740	12.573	-0.412
Fertility					
pop_growth	1.969	1.068	-0.584	4.458	0.512
mortality	76.691	51.507	11.200	193.000	0.460
familyf	46.843	25.808	2.000	94.000	-0.435
Geographical factors					
wheat_sugar	0.079	0.182	-0.393	0.442	-0.625
troppop	0.197	0.315	0.000	1.000	0.339
mount	17.587	18.651	0.000	73.700	0.412

3.4. Estimation, Results and Sensitivity analysis

3.4.1. Estimation and Results:

The empirical strategy is implemented by recursive estimation. In a first equation income inequality is related to different variables according to transmission channel (as in equation 3). For each set of variables a residual term, $\hat{v}_2$, is estimated capturing the unexplained variance in inequality. The aim here is simply to decompose the variance in inequality. In a second equation, and again for each set of variables, inequality and the estimated residual term from the first equation are introduced, along with control variables, in our model of long-run economic growth. By introducing both terms, i.e. inequality and the estimated residual, it is possible to assess the effects of two different components of inequality on economic growth. By using different sets of variables, it is possible to analyse which factors are needed to be controlled for the estimated residual to capture a long-run growth-enhancing component of inequality. This is something that is not done in panel data analysis, which suggests a positive effect of inequality on growth.

Table 3.4 presents the results from estimating equation (3), the inequality equation, including controls from the growth equation. Standardized (*beta*) coefficients are reported along and Shea's Partial R-squares to measure the relevance of the considered variables excluded from the growth equation. When all variables related to a negative effect of inequality are included about 80 per cent of the variance in inequality can be explained (column 7). It is important to note the relevance of the geographical variables considered, yielding a partial R-square of 0.489. These variables are time-invariant factors that are cancelled out in the panel data analysis with fixed effects or first differences. This could explain why a positive effect of inequality is found in this type of analysis. The proportion of mountainous land deserves special attention in this regard. Although not considered before in the literature as an instrument for inequality, it has a high correlation with inequality and remains highly significant even when controlling for other proxies for structural inequality. According to Collier (2009), the proportion of mountainous land is a significant determinant of the feasibility of conflict. Conflict is precisely a core element in one of the transmission channels between inequality and growth, namely the socio-political instability channel. But, beyond conflict, mountainous land could also create spatial disparities that translate into higher levels of inequality, or at least this is what our data seems to suggest.

Table 3.4: Results for the inequality equation

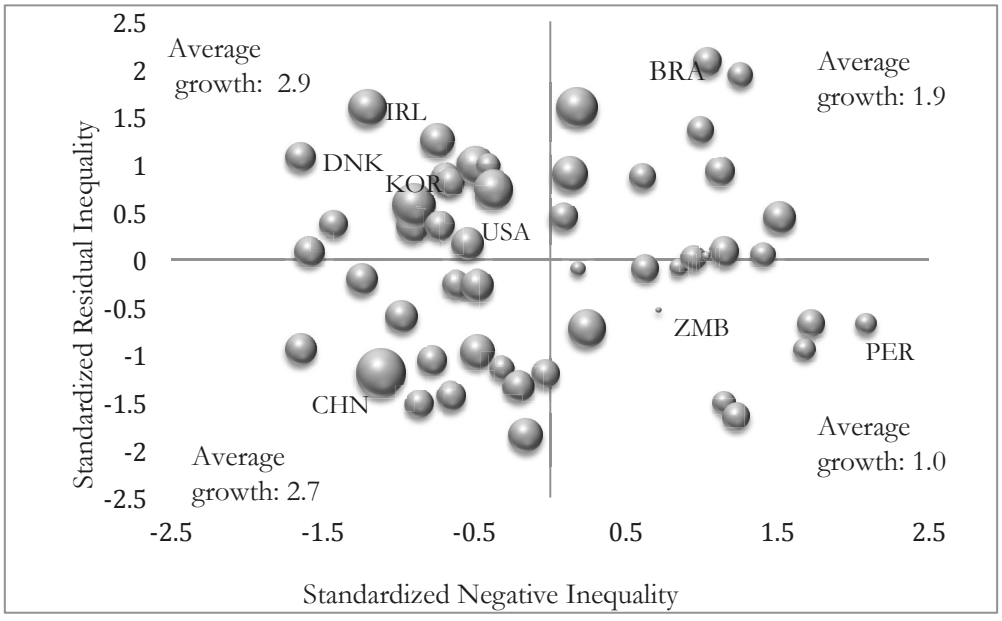
	1	2	3	4	5	6	7
	SPI	Political Economy	CMI	Domestic Market	Fertility	Geographical factors	
assassp2	0.187 ***						0.196 ***
death	-0.956 ***						-0.566 **
wardum	0.024						-0.054
kg702007		0.044					
exp_edu		0.345 **					
fi_sm			0.035				
innovation			-0.453***				
Q3				-0.727 ***			-0.518 ***
logGDP1970				-0.164			-0.016
pop_growth					0.400 *		-0.170
mortality					-0.135		-0.089
familyf					-0.286 *		-0.038
wheat_sugar						-0.481 ***	-0.124
troppop						0.123	-0.101
mount						0.298 ***	0.249 **
R^2	0.612	0.447	0.454	0.666	0.843	0.670	0.825
Shea's Partial R^2	0.399	0.143	0.155	0.483	0.199	0.489	0.728

Notes: First-stage estimations using robust standard errors and small-sample correction. *p<0.10, **p<0.05, ***p<0.01. OLS coefficients have been standardized to ease comparability. Controls from the growth equation (*log_pcgdp*, *life_exp*, *p60*, *yrsopen*, *primary_exports* and *mining*) are also included. Shea's partial R^2 measures the relevance of the excluded instruments (i.e. those not included in the growth equation). Column 7 excludes instruments for PE and CMI channels, rejected by the Hansen test.

Before the two components of inequality are assessed in the growth equation, it can be tested to what extent they indeed captured negative and positive dynamics in the growth process, based on the theory revised in section 2. One simple and straightforward way is to see how the two components correlate with long-run growth, as well as with physical and human capital accumulation, innovation and institutional quality. On the one hand, our *estimated negative inequality* (i.e. predicted values for inequality when we consider all the different variables related to a negative effect) has a significant negative correlation with growth, -0.462, as well as with the average investment during the whole period (*ki*), -0.247, and with the total average years of schooling in 2005 (*schooling*), -0.429. The correlation with innovation

and institutional quality (*icrg_qog*) are also negative, -0.517 and -0.578, respectively. On the other hand, our second component has a positive correlation with growth, 0.117, as well as with physical capital accumulation, 0.191. Figure 3.1 plots our two orthogonal components and their relationship with long-run growth. Both components have been standardized to split the sample of countries in four quadrants. It can be seen that countries with lower estimated negative inequality had higher growth rates (represented with larger bubbles in the graph). Furthermore, the highest average growth rates were found in the top left quadrant of the figure. In this quadrant we find countries with low estimated negative inequality but a high estimated residual (our positive component); e.g. Denmark, Hungary, Ireland, South Korea and the United States. By contrast, the lowest average growth rates were found in countries with high estimated negative inequality but a low estimated residual (the bottom right quadrant, including mostly Latin American countries like Peru and El Salvador, but also other countries like Zambia and Cote d'Ivoire).

Figure 3.1: Two components of inequality and long-run growth



Notes: The size of each bubble is proportional to the long-run growth rates for each country. Average growth figures reported represent averages calculated for the countries in each quadrant.

Table 3.5 presents results for the impact of inequality on long-run growth. Column 1 shows the results from the OLS estimation of model (1). Columns 2 to 6 present the results from our 2SRI (two-stage residual inclusion) estimations (Terza et al. 2008). In each column the residual from the first set of estimations for inequality is introduced as a further control in the growth equation (as suggested by the CFA) and for each considered channel. Column 7 only considers the geographical variables as instruments for inequality. Finally, column 8 considers all factors associated by the empirical literature to a negative effect of inequality. Estimations were done using bootstrap standard errors to adjust for the generated regressor bias from the first equation. The Kleibergen-Paap LM test probability, to check for under-identification, and the Hansen test probability, to check for the validity of our approach, are reported.[45]

All controls have the expected sign in all estimations and their coefficients are all significant (except for that of mining). Results are consistent with conditional convergence, with a negative coefficient for initial per capita GDP of around 2 per cent - as in Sala-i-Martin 2004 - and higher human capital levels increasing long-run growth (i.e. a positive coefficient for *life_exp* and *p60*). Openness is also positively associated with growth while primary sector specialization is negatively so (i.e. a negative coefficient for *primary_exports*). For inequality the OLS estimation yields a negative although non-significant coefficient. As aforementioned, this could be the result of two significant effects cancelling each other out.[46] When the two estimated differentiated components of inequality are controlled for, the coefficient for inequality became significant in some of the estimations. In particular, the sets of variables associated with domestic market (column 5), the set for geographical instrument (column 7), and all factors associated to a negative effect of inequality (column 8) yield in each case a significant and negative

[45] Some variables were in fact excluded as found invalid by the performed tests. The relevance and validity of the approach was tested in different ways. For relevance, the F statistic and the Partial-R-squared of the first regression were considered, and under-identification tests performed. For validity over-identification tests were also performed. In Table 4, for simplicity, only the Kleibergen-Paap LM statistic test and the Hansen J test are reported.

[46] Endogeneity of inequality was tested. While Durbin and DWH tests reject the null hypothesis of no endogeneity, the Wooldridge test, which considers robust standard errors, did not (but with a p-value of 0.12, still close to suggesting endogeneity).

coefficient for inequality. In these estimations the coefficient for our forecasted residual, which captures the remaining variance in inequality not explained by the variables considered, is positive and significant (borderline significant in column 7). As we saw above any bias in our procedure for not considering the full set of variables would lower towards zero the estimates of both components. Consequently, the results are not only significant, but also downward-bounded, reinforcing our intuition.

Results support previous evidence of negative effects of inequality on long-run growth. These negative effects seem related to the size of the domestic market and the middle class and to geographical factors defining structural inequality. Furthermore, our results support the idea of two differentiated components of inequality, associated with two different-signed effects. Nevertheless, these two parallel effects only become evident when the differentiated mechanisms for inequality are appropriately controlled for. Regarding the total impact of inequality, the OLS estimation in column 1 yields a net impact of inequality of -0.015. By contrast, controlling for two different components of inequality yields a negative effect of -0.038 and a positive effect of 0.083. However, considering that our negative component of inequality captured around 80 per cent of the variance in inequality, with the residual capturing the remaining variance, the weighted average of the two can be approximated to -0.017. This is close to the value reported in column 1 and results in previous studies, and an economically significant effect after considering the wide differences in the Gini coefficients among countries. The difference between the country with the highest inequality in 1970, Honduras, and the country with the lowest, Hungary, can represent a difference of half a point of average annual growth.

Table 3.5: Results for the growth equation

	1	2	3	4	5	6	7	8
	OLS	2SRI	2SRI	2SRI	2SRI	2SRI	2SRI	2SRI
		Socio-Pol. Instability	Political Economy	Credit Market Imperfections	Domestic Market	Fertility	Geographical factors	
Inequality	-0.0154	0.0001	-0.0146	0.0017	-0.0613**	-0.0374	-0.0444*	-0.0380**
s.e.	*-0.0144*	*0.026*	*0.045*	*0.046*	*0.027*	*0.040*	*0.026*	*0.019*
Resid		-0.0258	-0.0009	-0.0202	0.0887**	0.0275	0.0569	0.0830**
s.e.		*0.038*	*0.052*	*0.046*	*0.037*	*0.049*	*0.037*	*0.040*
Controls:								
log_pcgdp	-1.9404***	-2.0141***	-1.9442***	-2.0217***	-1.7224***	-1.8360***	-1.8025***	-1.8333***
life_exp	0.1175***	0.1336***	0.1184**	0.1352**	0.0700	0.0948	0.0875*	0.0942**
p60	2.0914**	1.8668*	2.0799*	1.8439	2.7562**	2.4099**	2.5118**	2.4180**
yrsopen	1.4495**	1.4897**	1.4516**	1.4938**	1.3305**	1.3925**	1.3743**	1.3911**
primary_exports	-4.6566**	-4.8338**	-4.6659*	-4.8562**	-4.1205**	-4.3998**	-4.3176**	-4.3932**
mining	4.4766	4.6984	4.4880	4.7211	3.8201	4.1621	4.0614	4.1540
Constant	10.0773***	9.2157***	10.0329***	9.1276**	12.6272***	11.2989***	11.6899***	11.3301***
Observations	51	51	51	51	51	51	51	51
R squared	0.672	0.676	0.672	0.674	0.721	0.675	0.692	0.706
K-P p-value		0.008	0.024	0.004	0	0.028	0.001	0.028
Hansen p-value		0.406	0.068	0.039	0.364	0.178	0.771	0.368
Excluded instruments:		death assassp2 wardrum	kg exp_edu	fi_sm innovation	Q3 logGDP1970	pop_growth mortality familyf	wheat_sugar troppop mount	death, assassp2 wardrum, Q3 logGDP1970, pop_growth mortality, familyf 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. Column 8 excludes instruments for PE and CMI channels, rejected by the Hansen test.

Results by level of development:

Is there always a positive effect of inequality on economic growth? According to Galor and Moav (2004), as we have seen, the relationship between inequality and growth changes with the stage of development and is expected to be positive only in early stages, and non-significant in developed economies.[47] However, Galor and Moav's analysis only focuses on the role of credit market imperfections. However, we have seen that there are other channels at work. Thus, we can still have a positive effect of inequality at early stages of development, as suggested by Galor and Moav, but also a negative effect, as suggested by other approaches. We performed structural stability tests on our sample by differentiating countries based on whether they were OECD members in 1970 or not, as a proxy for stage of development.[48] As the tests support the possibility of differentiated effects, in Table 3.6 the impact of our two components of inequality is let to vary for countries that were OECD members in 1970 and for countries that were non-members.[49] All controls remained significant except that for mining. Once we controlled for two components of inequality, the negative and positive effects of inequality are only significant in developing countries. For developed countries the two components still have coefficients with opposing signs, although they are non-significant (in line with Galor and Moav 2004).[50]

[47] Indeed, the previously studied correlations of the two components of inequality with growth and capital accumulation become stronger if developing and developed countries are considered separately.

[48] In particular, parameter heterogeneity for the coefficients for the two components of inequality was tested based on the OECD-non-OECD dichotomy.

[49] Thus, partly controlling for heterogeneity across countries.

[50] Chambers and Krause (2010) provide evidence of the second phase of Galor and Moav's (2004) hypothesis; in particular that in countries with low educational attainments the negative effects of inequality increase with higher capital stocks.

Table 3.6: Results by level of development

Dependent variable: growth		
	2SRI coef.	s.e.
INEQUALITY*OECD	-0.0339	*0.033*
INEQUALITY*nonOECD	-0.0365*	*0.022*
Resid*OECD	0.0598	*0.058*
Resid*nonOCDE	0.0898*	*0.048*
Controls:		
log_pcgdp	-1.8726***	*0.380*
life_exp	0.0941**	*0.046*
p60	2.4309*	*1.294*
yrsopen	1.4035**	*0.601*
primary_exports	-4.3623**	*2.061*
mining	4.1268	*4.005*
Constant	11.5439***	*2.577*
Observations	51	
R squared	0.707	

Notes: Estimations using bootstrap standard errors (1,000 repetitions). * p<0.10, **p<0.05, ***p<0.01

3.4.2. Sensitivity and Robustness checks:

Because our procedure relies on the selection of variables to identify the transmission channels, a first check of our results was to use a different set of variables for each of the channels. For most channels this is complicated because of data scarcity. However, the role of the different channels, and in particular the existence of a positive and a negative effect of inequality, appeared robust to the selection of variables to capture these channels. For instance, to capture the idea of socio-political instability we also tried the variables considered by Alesina et al. (1996, political instability dataset), although at the expense of losing 4 observations due to data availability, and we were still able to find significant coefficients (one positive and one negative) for our two components of inequality (see estimation 1 in Table 3.7).

As a second check of our results the possibility of direct effects on economic growth (not through inequality) of some of the channels considered

can be analysed. In particular, the fertility mechanism is expected to have a direct and negative effect on long-run growth, associated with family decisions relevant for physical and human capital accumulation (Barro 2000), and in fact fertility rates were discarded as they violated validity tests. When controlling for fertility rates directly in the growth equation (see estimation 2 in Table 7) its coefficient is negative and significant, as expected. However, even after controlling for fertility rates two significant effects of inequality on growth are found. Barro found a non-significant effect for inequality after controlling for fertility, but did not consider, as we did, further opposing and significant effects of inequality that could be cancelling each other out.

As with fertility, the sensitivity analysis can be expanded to the consideration of the direct (disaggregated) role of the different transmission channels in the growth equation. For the first channel under consideration one option is to consider several variables of social unrest and construct an index that proxies for socio-political instability (*SPI index*) using the method of principal components analysis (following Alesina and Perotti 1996). For redistributive policies the share of government consumption over GDP (*kg*), capturing government spending, can be considered. Initial income (*logGDP1970*), capturing domestic market size, and the share of the third quintile in the income distribution (*Q3*), capturing the role of the middle class, can be used to assess the role of the domestic market. Finally, fertility rates can be kept as a further control. Our main result of two opposing effects associated with inequality holds (estimation 3 of Table 7).

Table 3.7: Robustness checks

Dependent variable: growth

	2SRI (1)		2SRI (2)		2SRI (3)	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Inequality	-0.0373**	*0.018*	-0.0212*	*0.009*		
Resid	0.0797**	*0.033*	0.0727***	*0.015*	0.0597*	*0.031*
fertility			-0.8818**	*0.264*	-0.8295***	*0.307*
SPI_index					-0.1488	*0.168*
kg702007					-0.0338	*0.040*
logGDP1970					0.3503	*0.248*
Q3					0.0712	*0.051*
Controls:						
log_pcgdp	-1.4518***	*0.251*	-1.9032***	*0.366*	-2.0890***	*0.329*
life_exp	0.0701*	*0.037*	0.0400	*0.064*	0.0451	*0.056*
p60	2.1799**	*0.829*	0.7530	*0.412*	0.3046	*1.202*
yrsopen	1.1894**	*0.455*	0.8005*	*0.360*	0.6223	*0.501*
primary_exports	-3.5561***	*1.212*	-0.8232	*1.147*	0.7057	*2.461*
mining	3.6833	*3.014*	4.4076	*2.884*	3.1386	*2.998*
Constant	9.6529***	*1.852*	18.7118***	*2.046*	14.8024***	*3.352*
Observations	47		51		51	
R squared	0.619		0.778		0.818	

Notes: Estimations using bootstrap standard errors (1,000 repetitions). *p<0.10, **p<0.05, ***p<0.01. The instrument set in estimation 1 replaces *assassp2*, *death* and *wardum* with *riotan*, *scoup*, *polrig*, *assass*, *attack*, *democy*, *execute* and *repress* (all expressed as yearly averages for the period 1950 to 1982. The instrument set in estimation 2 excludes *pop_growth*, *mortality* and *familif* because fertility enters directly as a regressor.

3.5. Conclusion and Policy Implications

Summary and conclusion

Control function approach, traditionally used to address endogeneity concerns, has been implemented to analyse the relationship between inequality and economic growth. The CFA has allowed to track different transmission channels of the effects of inequality on long-run economic growth, by using alternative sets of variables. By considering the idea of two differentiated

components of inequality (WDR 2006) and different proxies expected to relate to different transmission channels, the analysis performed has empirically distinguished in a single model both negative and positive effects of inequality on long-run growth. The results obtained suggest, in line with the literature, that high inequality has indeed a negative effect on long-run growth, very likely by increasing social unrest and political instability, by lowering aggregate demand, and given its relationship with higher fertility rates. However, the results obtained also support the possibility of a long-run growth-enhancing component of inequality, and have allowed seeing the relevance of the mechanisms that need to be controlled for that positive effect of inequality to become empirically evident.

Policy Implications

The results presented emphasize the complexity of the relationships between income distribution and economic growth. This complexity exists everywhere but is more intense in developing countries. In this manner, what is interesting is not whether inequality is harmful or beneficial for growth but rather to attain a satisfactory description of the dynamics of the relationship in these countries. In order to assess the impact of inequality on economic growth in a given country, one should focus on analyzing what is driving inequality. When inequality is associated with political instability and social unrest, rent-seeking and distortive policies, lower capacities for investments in human capital and a stagnant domestic market, it is mostly expected to harm long-run economic performance, as suggested by many authors. Accordingly, improving income distribution is expected to foster long-run economic growth, especially in low-income countries, where the levels of inequality are usually very high. However, some degree of inequality can also be good, as has been theoretically argued before in the literature and as empirically suggested in this study. A degree of inequality, when driven by market forces and related to hard work and growth-enhancing incentives, like risk taking, innovation, capital investments and agglomeration economies, can play a beneficial role for economic growth. According to the analysis carried out, the challenge for policy makers is to control structural inequality that reduces the country's capacities for economic development, while at the same time keeping in place those positive incentives that are also necessary for growth.

3.6. Extension: Unemployment and increasing inequalities

As an extension of the analysis on inequality on economic growth two additional aspects were studied: high and persistent unemployment rates and the increasing inequalities associated with it. This analysis of unemployment, increasing inequality and growth constitutes an independent paper (Castells-Quintana and Royuela 2012) of which only the core analysis is synthetized here.

The extension has three main motivations. The first one is contextual: two of the most dramatic aspects of the current economic crisis are the high and persistent rates of unemployment and the accelerated pace at which inequalities are increasing. The second one is theoretical: the factors that provide the theoretical base to expect that high and persistent unemployment will reduce growth seem to be closely associated with inequality. But, surprisingly, unemployment and increasing inequalities have not been studied together in an empirical framework of economic growth. Moreover, as noted in the introduction of the thesis, unemployment is expected to play a relevant role in the process of structural change that takes place with economic development. The final motivation is empirical: while there is a vast literature on the causes and consequences of unemployment there is little of empirical evidence of the impact of unemployment on long-run economic growth (Martin and Rogers, 2000, for industrialised countries but not for developing countries).

Unemployment and growth:

Unemployment may be associated with structural change and subsequent economic growth. The focus of the current analysis resides on the mechanisms through which high and persistent unemployment may directly hinder economic growth. In the short run, economic growth and unemployment are inversely related along the business cycle. However, *structural* unemployment mainly depends on factors related to the labour market. Moreover, when unemployment becomes significantly high and persistent there are economic costs that can become detrimental for subsequent long-run growth. Unemployment not only represents a high social cost for the individual, it also represents a high economic cost for the society (Sanchis-i-Marco 2011). In first place, high unemployment implies an inefficient use of resources and wasted work, not performed by the

unemployed, which can never be recovered. Secondly, high unemployment also means a lower aggregate demand; not just consumption is lower - harming current growth, private investment in physical and human capital is also reduced - harming future production capacities. In parallel to this, high unemployment increases fiscal burden, through lower income revenues and higher welfare spending. Higher fiscal burden is likely to reduce public investment and to increase public debt, which handicaps future growth capacities.[51] In third place, unemployment can lead to an erosion of human capital; people unemployed for long periods may become de-skilled, as their professional skills get dated in an era of rapid technological change and its associated rapidly changing job market (Pissarides 1992). The time dimension is present in the "unemployment hysteresis" hypothesis, according to which short raises in unemployment may result in pockets of long-term unemployment, as long-term unemployed do not perform a hard search for jobs and therefore do not exercise sufficient downward pressure on wages (Layard et al. 1991). Finally, high and persistent unemployment erodes individual self-esteem and satisfaction as well as confidence in the society as a whole (Ochsen and Welsch 2011). Lower confidence and socio-economic deprivation, exclusion and marginalization from unemployment increase social dislocation, leading to unrest and conflict (ILO 2011) and decreasing labour market performance (Mares and Sirovátka 2005), thus harming long-run growth.

Empirical evidence on the effect of unemployment: the role of increasing inequality

To empirically asses a possible effect of unemployment associated with increasing inequalities, the analysis performed relies on data from the experience and evolution of a previous and recent major world crisis, that of the end of 1970s and beginning of the 80s, when unemployment and inequalities also soared. The analysis relies on cross-section international data from 1980 onwards to estimate a long-run growth equation. Accordingly, we extended our dataset to consider not only initial levels of income inequality but also initial levels of unemployment - ue_{i0} (for which we consider either

[51] European countries like Spain, Greece and Portugal today are a clear example of this mechanism, by which higher unemployment has increased fiscal burden, public debt and, therefore, forcing contractive austerity policies harmful for subsequent growth.

the 1980s mean - UE_MEAN - or the 1980s maximum value - UE_MAX), changes in inequality (ΔI_{i0}), and interactions between both:

$$growth_i = c + X_i\Gamma + \beta I_{i0} + \alpha_1(ue_{i0}) + \alpha_2(\Delta I_{i0}) + \alpha_2(ue_{i0}\Delta I_{i0}) + u_i \qquad (3.7)$$

Results confirm the negative role that high inequality levels play on long-run economic growth. But even controlling for this negative effect of inequality levels the results also suggest that higher unemployment, when associated with increasing inequality, has a negative effect on subsequent long-run economic growth (Table 3.8). In particular, the results point to a strong negative impact of increasing inequality in association with high levels of unemployment: the third quartile of the interaction between the two variables implies a GDP per capita decrease of 3.8% over the 17 years considered.

The results suggest that policies aiming at controlling the dramatic rise in unemployment associated with the current crisis, and in particular at reducing its inequality-associated effects, are not just pressing for the obvious current difficulties that they represent for society today, but also because of the handicap that they represent for future long-run growth.

Table 3.8: Unemployment, increasing inequality and economic growth

Dependent Variable: GROWTH (90-2007)										
	1		2		3		4		5	
Variable	Coeff.		Coeff.		Coeff.		Coeff.		Coeff.	
LOG_PCGDP (1990)	-1.5367	*	-1.6015	*	-1.8267		-1.8659	*	-1.8801	*
	(0.838)		(0.869)		(1.087)		(1.045)		(1.062)	
INEQUALITY (1980)	-0.0712	*	-0.0699	*	-0.0807	*	-0.0822	*	-0.0804	*
	(0.038)		(0.039)		(0.042)		(0.042)		(0.042)	
UE_MEAN (1980-1990)	-0.0515									
	(0.035)									
UE_MAX (1980-1990)			-0.0342							
			(0.033)							
ΔINEQUALITY					-0.0404					
					(0.031)					
ΔINEQUALITY*UE_MEAN							-0.0077	*		
							(0.004)			
ΔINEQUALITY*UE_MAX									-0.0056	*
									(0.003)	
CONTROLS	YES		YES		YES		YES		YES	
CONSTANT	7.8041	*	7.7162	*	10.2659	**	10.8906	**	10.7991	**
	(4.342)		(4.345)		(4.927)		(4.821)		(4.858)	
Obs.	48		48		39		39		39	
R-sqd.	0.302		0.288		0.298		0.328		0.320	

Estimation by OLS
Robust standard errors in brackets. Asterisks indicate significance: ***1%, **5%, *10%

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Annex Chapter 3:

Table A.3.1: Main papers providing empirical evidence for the different channels

	Socio-Political Instability	Political Economy	CMI	Domestic Market	Fertility	Effect on growth or inv.
Persson&Tabellini (94)		1 Welfare transfers				1) Non-significant
Alesina&Perotti (96)	1 Number of assassinations Number of violent deaths Number of successful coups Number of unsuccessful coups Dummy for Democracy					1) Negative
Perotti (94)	1 Number of assassinations Number of violent deaths Number of successful coups Number of unsuccessful coups Dummy for Democracy	2 Marginal tax rate Welfare expenditures	3 Loan-to-value payments			1) Negative; 2) Non-sig.; 3) Negative
Falkinger&Zweimmuller (97)				1 Index of Product Diversity		1) Non-significant
Svensson (98)	1 Quality of property rights					1) Negative
Keefer&Knack (2002)	1 Quality of property rights			2 Population Aggregate GDP Openness		1) Negative; 2) Non-significant
Barro (2000)					1 Fertility rates	1) Negative

Table A.3.2: Variables used: definitions and sources

Growth model	Description	Source
growth	Cumulative annual average per capita GDP growth rate	Constructed with data from PWT (Heston et al.), using real GDP chain data (rgdpch)
inequality	Gini coefficient. 1970	Gruen and Klasen (2008)
log_pcgdp	Per capita GDP (in logs)	Constructed with data from PWT (Heston et al.), using real GDP chain data (rgdpch)
life_exp	Life Expectancy at birth, total years. 1970	World Bank
p60	Primary enrolment rate. 1960	Sala-i-Martin et al. (2004). From Barro and Lee (1993)
yrsopen	Number of years the economy has been open between 1950 and 1994.	Sala-i-Martin et al. (2004). From Sachs and Warner (1995)
primary_exports	Fraction of primary exports in total exports. 1970	Sala-i-Martin et al. (2004). From Sachs and Warner (1997)
mining	Fraction of GDP in mining. 1970	Sala-i-Martin et al. (2004). From Hall and Jones (1999)
Inequality Model		
assassp2	Number of political assassinations.	Sala-i-Martin (2004). From Barro and Lee (1993)
death	Crude death rate per 1000 people. Average 1960-1990	Constructed using data from World Bank
wardum	Dummy for countries that have been involved in a war any time between 1960 and 1990.	Sala-i-Martin (2004). From Barro and Lee (1993)
kg702007	Share of government consumption to real GDP. Average between 1970 and 2007	PWT. (Heston et al.)
exp_edu	Expenditure in education.	World Bank
fi_sm	Access to sound money.	PRS Group, International Country Risk Guide
innovation	Patents per million inhabitants. Closest value to 1970	World Bank
Q3	Share of the third quintile in the income distribution.	From WIDER dataset (cross section constructed taking data for each country in the closest available year to 1970)
logGDP1970	GDP (in log). 1970	PWT. (Heston et al.)
pop_growth	Population growth rate. 1970	World Bank
mortality	Infant mortality rate, per 1000 live births. 1969	World Bank*
familyf	Family farms. As percentage of total cultivated area.	Vanhanen's indicators of power resource distribution
wheat_sugar	Proportion of land suitable to wheat compared to land suitable to sugar (in logs).	Easterly (2007)
troppop	Proportion of population living in tropical areas.	Easterly (2007)
mount	Proportion of mountainous land.	Collier (2009)

Table A.3.2 (continued)

Other variables		
	Share of investment to real GDP.	
ki	Average between 1970 and 2007	PWT. (Heston et al.)
fertility	Fertility rate, 1970.	World Bank
schooling2005	Mean years of schooling, age 15+, total. 2005	World Bank**
icrg_qog_1984	Quality of Government Index. 1984	PRS Group, International Country Risk Guide
riotan	Number of riots.	Alesina et al. (1996) dataset
scoup	Number of successful coups.	Alesina et al. (1996) dataset
polrig	Measure of political rights.	Alesina et al. (1996) dataset
assass	Number of assassinations per million population per year.	Alesina et al. (1996) dataset
attack	Number of armed attacks per year.	Alesina et al. (1996) dataset
democy	Index of democracy.	Alesina et al. (1996) dataset
execute	Number of political executions per year.	Alesina et al. (1996) dataset
repres	Number of repressions per year.	Alesina et al. (1996) dataset

Notes: * Missing value for Hong Kong filled with those of China. ** Missing values for MDG and NGA filled using International Institute for Applied System Analysis and the Vienna Institute of Demography (IIASA/VID) projections.

Chapter 4.

Urban concentration, infrastructures and economic growth[52]

4.1. Introduction

4.1.1. Context and Motivation:

Whereas the previous chapter focused on the personal dimension of concentration of resources, i.e. income inequality, this chapter does it on the geographical dimension, i.e. urban concentration, and on its relationship with long-run economic growth.

The link between urban concentration and economic growth at country level is not straightforward, since there are benefits as well as costs associated with urban concentration, as already highlighted in the introduction of the thesis. Indeed, recent empirical evidence suggests different effects of urban concentration on growth depending on the level of development and the world region under analysis. Differences in the process of urbanisation, and in the quality of the urban environment itself, have been suggested as most likely

[52] The research carried out for this chapter has also been presented in several national and international conferences: the Conference on International Development at the University of East Anglia (2013), the XXXIX Reunión de Estudios Regionales of the Spanish Regional Science Association, the AQR-IREA seminars-2014, the Economic Geography work-in-progress-2014 seminars of the London School of Economics, the 4th European Meeting of the Urban Economics Association (2014), and at the INFER Workshop in Urban and Regional Economics (2014). The chapter is available as working paper: *Malthus living in a slum: urban concentration, infrastructures and economic growth*.

defining the balance between benefits and costs from urban concentration, and are probably behind these differences in the relationship between concentration and growth. However, empirical evidence in this regard remains very limited.

As noted, one particular aspect of the urban environment associated with the two trends analysed throughout the thesis, increasing agglomeration and rising inequalities, is the rapid growth of slums in many large agglomerations around the world, especially in developing countries, where millions live lacking access to basic services like electricity, clean water and improved sanitation.

4.1.2. Aim and Contribution:

The aim of this work is to fill the above-mentioned gap in the relationship between concentration and growth by paying special and explicit attention to differences between world regions in terms of urban infrastructure, essentially access to basic urban services. The main contribution of the paper is to provide empirical evidence on the role that the urban environment plays in the relationship between urban concentration and economic growth.

The focus on access to basic services lies with two major reasons. The first relates to magnitude. As we have seen, today at least 1 billion people worldwide, of whom the vast majority are in the developing world, live in slums. The second reason relates to the fact that access to basic services is expected to play a key role in the trade-off between the benefits and the costs that come with urban concentration, especially in developing countries. On the one side low coverage of basic services are likely to handicap the benefits from agglomeration (as specialisation, labour pooling and knowledge diffusion) as they hinder physical and social mobility and interaction, information flow and knowledge spillovers and trust. On the other side, deficiencies in terms of access to basic services dramatically increase congestion costs for urban inhabitants in terms of transport costs, but also in terms of disease transmission, pollution, conflict and crime (most likely reducing the capacity of cities to develop and attract talent and investment).

4.1.3. Main findings:

Looking at different world regions the analysis carried out finds that while increasing urban concentration might have been associated with growth in Asian countries, congestion diseconomies have prevailed over agglomeration benefits in Sub-Saharan African (SSA) countries. These negative effects from concentration found in Africa seem associated with the severe lack of adequate basic infrastructure in the urban areas of the region, rather than to other region-specific characteristics (as the degree of ethnic fractionalisation or the institutional framework) as suggested by previous papers. The results suggest that, as in the rest of the developing world, improvements in urban infrastructure can also unleash agglomeration economies while helping to control congestion costs in Sub-Sahara African countries. Access to basic services emerges as fundamental in this regard.

4.1.4. Structure:

The remainder of the chapter is organized as follows. Section 2 sets the theoretical framework reviewing related strands in the literature and highlighting possible contribution. Section 3 sets a simple economic growth model for the empirical specification to be derived. In section 4 the data used are described along some basic stylized facts. Section 5 discusses estimations and results. The section includes an analysis using the complete world simple, some robustness checks, and a specific analysis for SSA countries. Finally, section 6 concludes and derives policy implications from the results.

4.2. Literature review

Slums, temporary stage or Malthusian trap?:

Slums are traditionally considered as a phasing phenomenon characteristic of fast-growing economies, and representing a temporary stage in the structural change from rural to industrial activities. However, slums have tended to grow more in poor and stagnant countries where urbanisation and urban concentration do not seem associated with economic growth (Fay and Opal 2000; Kim 2008; Bloom et al. 2008). Indeed as the World

Development Report (2011) acknowledges the growth-enhancing benefits from urban concentration, it also warns about the risks of "rapid urbanisation" in developing countries.[53] With most of their inhabitants having been born in the slum where they live, and with their living standards hardly improving over time, slums in developing countries today are considered a form of poverty trap for a majority of their residents (Marx et al. 2013).[54] In fact, growth of large agglomerations in developing countries today is mostly given in slums, being their growth more the outcome of fast natural growth than the outcome of rural-urban migration: Jedwab et al. (2014) report a contribution of natural increase to urban growth for 10 African countries from 1950 to 2010 of 2.9%, compared to a contribution of 1.8% due to migration. Even growth driven by migration has been more associated with push rather than pull factors (Lipton 1977; Bates 1981; Bairoch 1988; Barrios et al. 2006; Swanson and Buckley 2013), with population being "expulsed" from rural areas rather than attracted to urban areas by the prospects of better living standards.[55] In this line, several authors are now referring to *Malthusian cities*, especially in SSA (Jedwab et al. 2014; Swanson and Buckley 2013).[56] With more than half of the 7 billion inhabitants of the planet living today in urban areas, it is indeed very likely that in many developing countries the Malthusian dilemma of low living standards has in some way moved from the countryside to the main urban centres,

[53] The UNFPA State of World Population 2011 estimates that there are 60 million new urban inhabitants every year worldwide, most of them in the developing world. Comparing the speed of urbanisation processes in Asia and Africa between 1950 and 2010, on the one hand, and in Europe between 1800 and 1910, on the other hand, Jedwab et al. (2014) conclude that developing countries today have experienced the same growth in urbanisation in half the time.

[54] Marx et al. (2013) summarise evidence on living standards based on surveys carried-out in slums around the world. According to these surveys, the majority of slum residents were either born in the slum where they live or have been living there most of their live (or moved from a different slum).

[55] Even when driven by urban pull factors, expectations of high returns from moving to urban areas do not necessarily materialise and can lead to additional pressure from new incomers, as the well-know Todaro paradox describes (Todaro 1976). This will be especially true when both rural and urban incomes are close to subsistence levels, as it is the case in SSA.

[56] In a Malthusian equilibrium those societies with greater availability of resources have higher population density but living standards remain low unless productivity is sufficiently increased. Such equilibrium was the rule for most human history (See Ashraf and Galor 2011 for a modern modelling of Malthusian growth equilibrium as well as for transition dynamics out of it and into sustained growth). In its purely rural setting a Malthusian equilibrium has also been considered as a relevant possibility today for many poor countries with large rural populations and largely dependent on low-productivity agriculture and mineral exports (Weil and Wilde 2009).

where a large proportion of urban dwellers reside under inadequate living conditions and where congestion effects of population growth are expected to dominate the positive effects from urban concentration.

Urban concentration and economic growth:

There are at least three main reasons why higher geographical concentration (due to urbanisation and urban concentration) is expected to increase productivity and economic growth: first, due to the reallocation of people and resources from agricultural activities towards industrial activities of higher productivity and value added, which takes places with urbanisation - as in classical models of structural change and economic development (Lewis 1954). Second, due to faster productivity growth linked to the clustering of people and industries and agglomeration economies, which takes place with urban concentration (Spence et al. 2009).[57] Third, due to the fact that concentration enhances economies of scale in the provision of urban infrastructure and public services (Henderson 2003).

However, empirical evidence on the effects of concentration on growth at country level has not been conclusive. Bloom et al. (2008) find no empirical link between urbanisation and economic growth suggesting that the absence of such a link lies in the different types of urbanisation observed across countries. While in developed countries urbanisation is expected to be associated with industrialisation and the reallocation of resources to sectors of higher added value and with more growth potential that is not always the case in many developing countries. In fact, there is growing empirical evidence of urban processes in developing countries not necessarily linked to economic development (Firebaugh 1979; Ades and Glaeser 1995; Davis and Henderson 2003; Gollin et al. 2014; Behrens and Pholo-Bala 2013).[58] For Africa in particular, negative effects on growth of growing urbanisation have been reported, despite increasing returns from agglomeration (Brückner 2012).

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[57] Duranton and Puga (2004) and Rosenthal and Strange (2004) provide a good theoretical survey on micro-foundations of agglomeration economies - both of the Marshall type (due to localization and specialization) and of the Jacobs type (due to diversity), and an extensive review of the empirical evidence. Ottavianno and Thisse (2004) describe and explain the forces shaping the geographical distribution of economic activity. More recently, Spence et al. (2009) provide a comprehensive review linking the literature on agglomeration economies with the literature on urbanisation and growth.

[58] Firebaugh (1979) focuses on Latin America and Asia between 1950 and 1970. The rest of these papers, except for David and Henderson (2003), focus on Sub-Saharan Africa.

Geographic concentration of economic activity not only allows for growth-enhancing agglomeration economies but it also leads to potential growth-deterring diseconomies of congestion. Both the benefits and the costs from concentration tend to become significant for large urban agglomerations. In this line several papers focus on long-run effects of urban concentration (Henderson 2003; Bertinelli and Strobl 2007; Brülhart and Sbergami 2009; Leitão 2103; Castells-Quintana and Royuela 2014).[59] Given benefits and costs, the relationship between urban concentration and economic growth is expected to be non-linear and dependent on the level of development. Hence, according to the Williamson (1965) hypothesis, while increasing urban concentration is desirable and expected in early stages of development, de-concentration eventually occurs as development proceeds. The optimal degree of concentration declines as development proceeds as knowledge gets accumulated, lowering the scope from agglomeration economies, and as better infrastructure allows efficient de-concentration to avoid congestion costs. Furthermore, the optimal level of concentration is expected to decline with the level of development also as institutional environments improve, allowing for economic growth opportunities from a more diverse urban system. Consequently, depending on their level of development, some countries experience insufficient concentration while others experience excessive concentration (Henderson 2003). According to Brülhart and Sbergami (2009) the beneficial net effect of high urban concentration is expected only when income levels are not too high.[60] According to what was found in chapter 2, for net benefits to arise also income distribution has to remain relatively equal.

[59] In fact, according to Henderson (2003), "urbanisation represents sectoral shifts within an economy as development proceeds, but is not a growth stimulus per se. However, the form that urbanisation takes, or the degree of urban concentration, strongly affects productivity growth" (Henderson 2003, pp. 67). Furthermore, Henderson highlights that while urbanisation is not fairly well measured across countries urban concentration (as a ratio) is, giving the focus on urban concentration measures an additional advantage over urbanisation measures.

[60] Brülhart and Sbergami (2009) rely on a standard cross-country specification, with growth in GDP per capita as dependent variable. They find a critical level of per capita GDP of US $10.000 (in 2006 prices) from which higher urban concentration becomes detrimental for growth.

From Optimal to Efficient city size:

The trade-off between the benefits and costs from agglomeration has been also studied in the literature seeking to explain the causes and limits of city growth (von Thunen 1826; Christaller 1933; Alonso 1964), and optimal city size (Mills and De Ferranti 1971; Alonso 1971; Henderson 1974), with some papers aiming to understand the dynamics of rapidly growing megacities around the world (Henderson 1985; Ades and Glaeser 1995), and especially in developing countries (Firebaugh 1979; Kasarda and Crenshaw 1991; Arku 2009; Gollin et al. 2014). Given positive and negative synergies and externalities - location costs and benefits - that cities provide, standard urban economics models predict agglomeration effects increasing with urban size to a given point from which diseconomies of scale, due to congestion, become relevant and decrease the revenue of a given city.[61] In this framework, therefore, urban scale is self-limiting, with the costs of agglomeration otherwise outweighing the benefits (Bertinelli and Black 2004). However, merely physical size is not the only determinant of urban agglomeration economies and congestion costs (Richardson 1972). In fact, cities are different from one another - fundamentally as they perform different functions (Henderson 1974, 1985) - and generate a large variety of different externalities as a result of the qualitative characteristics of the urban production environment (Chinitz 1961; Capello and Camagni 2000). Furthermore, cities operate in different national urban systems where they interact with each other (Camagni 1993), which also determines the benefits and costs from agglomeration (Duranton and Puga 2000). Hence, the need to look not only at urban size but also at other city characteristics when analysing optimal city size has recently been highlighted. In particular, rather than focusing on optimal size, one should focus on efficient size, which depends on the functional characteristics of the city and the spatial organization within the urban system (Capello and Camagni 2000; Royuela and Suriñach 2005; Camagni et al. 2013).[62]

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[61] Thus, while optimal city size refers to the size that maximizes the difference between benefits and costs from agglomeration, the city will tend to grow to the point where benefits and costs cancel each other out.

[62] In particular, Capello and Camagni (2000) consider three urban environments that interact with each other generating positive and negative externalities: the physical, economic and social environments. Based on these interactions they build an index for positive externalities within a city (the "city effect") and an index for negative externalities (the "urban overload")

Different processes of urbanisation (and urban concentration) and economic growth: The role of infrastructures

If characteristics of the cities and the national urban system are relevant to define the benefits and costs from agglomeration, these characteristics must be also relevant to define the relationship between urban concentration and national economic growth. Different urban environments, for instance in terms of the quality of urban infrastructures, could indeed explain empirical evidence on relevant heterogeneity across countries in the relationship between urban concentration and growth (as for instance reported in Pholo-Bala 2009 analysing regional-specific effects by continent). Urban infrastructures are not only fundamental *per se* in the process of economic development[63] but also as they define the urban environment, leading to different capacities for cities to benefit from agglomeration economies and to control congestion diseconomies. As Henderson (2005) notes, "public infrastructure affects not just the resources devoted to urban living such as commuting and congestion costs, but also affects production efficiency - the extent to which knowledge spillovers are fully realized and exploited." Bertinelli and Black's (2004) stylized urban economics model indeed suggests an empirically testable prediction; that the growth-enhancing benefits from concentration are significantly affected by the quality of urban infrastructure affecting the urban production technology.[64] And access to basic services, as noted, is expected to play a key role, with the WDR (2011) highlighting the relevance of these basic services for the well functioning of large cities.

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and present evidence on how the two indices depend not only on city size, but also on proxies for the type of urban functions and network integration.

[63] Straub (2011) provides a recent survey in the macro-level literature on infrastructure and development. Ayogu (2007) and Calderón and Servén (2010) focus on Africa. In an analysis for Indonesia, Lewis (2014) shows how local governments that invest more heavily in infrastructure are better to cope with the apparent detrimental effects of rapid urbanization on local economic growth.

[64] Bertinelli and Black (2004) introduce dynamic human capital externalities, along traditional congestion externalities in the urban sector, to study how urbanisation influences economic growth at country level. In this framework urbanisation enhances growth by the structural change given by the reallocation of resources, and through higher human capital accumulation that increases productivity. Thus, "to the extent that urbanisation encourages human capital accumulation, cities become the engines of economic growth."

While some studies provide empirical evidence on the relevance of infrastructure in economic performance of urban residents - for instance Field and Kremer (2006) focusing on access to basic services in Peru, to the best of my knowledge no paper empirically addresses in a cross-country framework the role that the urban environment plays in the relationship between urban concentration and economic growth.[65]

4.3. A simple theoretical framework

The empirical analysis is based on a GDP per capita growth framework, following works as Henderson (2000) and Brülhart and Sbergami (2009). [66] To derive an empirical specification we can depart from a neoclassical framework of economic growth basis for standard cross-country growth regressions (see the methodological appendix 1). In this framework one can consider country-specific characteristics to allow for heterogeneity in initial conditions, as well as in efficiency growth paths, that influence economic growth. Accordingly, cross-country differences in growth of output per capita are expected to depend not only on initial levels of output per capita and factor accumulation, but also on differences in these country-specific characteristics. The degree of urban concentration represents a relevant characteristic affecting growth in efficiency (Henderson 2003), as it reflects agglomeration economies that remain unexploited, and therefore offering possibilities for growth, or that become exhausted and subject to congestion.[67] Hence, we can specify:

$$\Delta y_i = \beta\left(logy_{i,0}\right) + \psi X_{i,0} + \lambda UC_{i,0} + \pi Z_{1i,0} + \varepsilon_i \qquad (4.1)$$

[65] Sekkat (2013) studies the relationship between urban concentration, poverty and infrastructure in a cross-country setting, but looking at nation-wide, rather than urban-specific, infrastructure.

[66] While Henderson (2000) is based on a GDP per capita growth specification, Henderson (2003) focuses on TFP growth (but also estimates a GDP per capita growth model as robustness). While both analyses are similar, a GDP per capita growth specification allows for the use of a larger dataset.

[67] According to Henderson (2003), "urbanisation represents sectoral shifts within an economy as development proceeds, but is not a growth stimulus per se. However, the form that urbanisation takes, or the degree of urban concentration, strongly affects productivity growth" (Henderson 2003, pp. 67).

where Δy_i is per capita average growth rate of country i, $y_{i,0}$ is initial output per capita, $X_{i,0}$ represents variables reflecting factor accumulation (i.e. the standard Solow determinants) plus a constant term, UC_{i0} is the degree of urban concentration and $Z_{1i,0}$ other relevant country-specific factors. However, as suggested, the way urban concentration affects growth in efficiency depends on specificities of the urban process. In particular, urban infrastructures define the urban environment, leading to different capacities for cities to benefit from agglomeration economies and to control congestion diseconomies. Hence, taking this prediction into account, equation (4.1) extends to:

$$\Delta y_i = \beta(log y_{i,0}) + \psi X_{i,0} + \lambda_1 UC_{i,0} + \lambda_2 G_{i,0} UC_{i,0} + \pi Z_{1i,0} + \varepsilon_i \qquad (4.2)$$

where $G_{i,0}$ captures specificities of the urban process as the quality of urban infrastructure. Equation (4.2) is our main equation of analysis.

4.4. Data and Stylised Facts

4.4.1. Data:

As in chapter 2, in this chapter we rely on panel data. However, as we now focus on the relationship between urban concentration and growth, and do not consider inequality data, we are able to expand our dataset to consider significantly more countries (up to 193) and a longer time span (1960 to 2010). Our dataset covers more countries and a longer time span than most previous studies on urban concentration and growth. As in chapter 2, the dependent variable is national economic *growth*, for which data from the Penn World Tables are used. For UC_{i0} we now focus on the proportion of urban population living in the primate city (*primacy*), as the most standard measure in the literature on urban concentration.[68] Data for primacy comes from the

[68] Primacy measures consider main metropolitan areas (including core city and satellite cities). It has been shown that primacy correlates very highly with other measures of concentration (as the Hirschman-Herfindahl index for which there is very limited coverage) and reflects fairly well parameters behind Zipf's law curves (the fact that when we rank cities from largest to smallest, rank times population size is approximately the same constant for all cities). The largest city in the country, therefore, delineates all other city sizes and is sufficient information to calculate any comparative index of national urban concentration (Henderson 2003).

World Bank. For the quality of urban infrastructure several measures are considered. Following the World Development Report (2011), we focus on three key indicators: access to improved sanitation, improved water source, and electricity. As data for all these variables is scarce, when we introduce them in the analysis the panel only considers the 1990-2010 period.[69] Finally, as control variables (X_i and Z_{1i} in equation 7) we begin by considering investment, as share of GDP, fertility rates, and average years of secondary and higher education of the adult population, following Henderson (2000) specification. For urban infrastructure variables, as well as for control variables, we rely on a variety of sources. Table A.4.1 in the Annex lists all variables' names, definitions and sources. For robustness a wide variety of other control variables are also considered, following Brülhart and Sbergami (2009) and the literature on cross-country economic growth. In the analysis for SSA, data on rainfall is used to instrument for economic growth (as explained below). Rainfall data comes from the National Aeronautics and Space Administration (NASA) Global Precipitation Climatology Projects (GPCP), as used in previous papers as Brückner and Ciccone (2011). Additionally, also for SSA, data on light density at night is used as robustness for measurement errors in income per capita. This data comes from the Defence Meteorological Satellite Program's Operational Linescan System (DMSP-OLS) and archived by the National Oceanic and Atmospheric Administration (NOAA), and has recently been used as proxy for income by several authors (Henderson et al. 2012; Mveyange 2014; Lowe 2014; Henderson et al. 2014).

4.4.2. Stylised facts:

Before performing econometric analysis, an initial look at urban concentration patterns and economic performance worldwide during the previous decades allows us to highlight some basic but interesting stylised facts. The first of these is that while the proportion of urban population living in the primate city (primacy) has stayed relatively constant over time at around

[69] Main results and discussion focus on access to improved sanitation. According to the World Bank, sanitation remains one of the most off-track Millennium Development Goals (MDG) globally. Access to improved sanitation not only lies at the heart of many other development challenges but the lack of it is also currently holding back economic growth in many less-developed countries. In the robustness section, we discuss results using improved water source and electricity. We further consider infant mortality rates, as a common and basic indicator of health, and access to mass urban transport systems.

40 per cent of total world urban population, there are important differences between developed and developing countries and across world regions. While the average is about 35 per cent for developed countries, it is higher than 43 for developing countries. Figure 4.1 shows primacy levels around the world while Table 4.1 presents descriptive statistics for primacy and economic growth, and the correlation between the two, as well as basic figures related to the urban environment, all for different world regions. Higher values of primacy tend to be concentrated in poorer regions of the globe (as Latin America and the Caribbean -LAC- with average close to 50 per cent, and SSA with an average above 42). The second fact relates to the fast pace of urbanisation processes in developing countries, and especially the current growth of large agglomeration in these countries. While in 1970 large primate cities in developing countries had on average a similar size of those in developed countries (around 1.2 million inhabitants), in 2010 primate cities in developing countries had on average almost one million inhabitants more (with an average of 3.4 million) than their counterparts in developed countries.[70] The third fact relates to the heterogeneity in the correlation between urban concentration and subsequent economic growth. While there is a negative, although insignificant, correlation for the world sample (-0.03), the picture changes if we consider the correlation by level of development; urban concentration is positively correlated with growth in developed but not in developing countries. By regions the correlation is positive in Europe, Asia, LAC and North Africa, and negative in North America, Oceania and SSA.

[70] I calculate these world averages using World Bank data for the largest agglomeration in 193 countries worldwide and considering only countries with a total population of at least 1 million inhabitants. 150 out of these 193 agglomerations are in developing countries. Also note that averages hide high variability in size. Jakarta, Shanghai and Bombay in Asia, Lagos and Cairo in Africa, Mexico City and Sao Paulo in Latin America, are all above or close to 20 million inhabitants in their respective metropolitan areas with a population still growing at a fast pace.

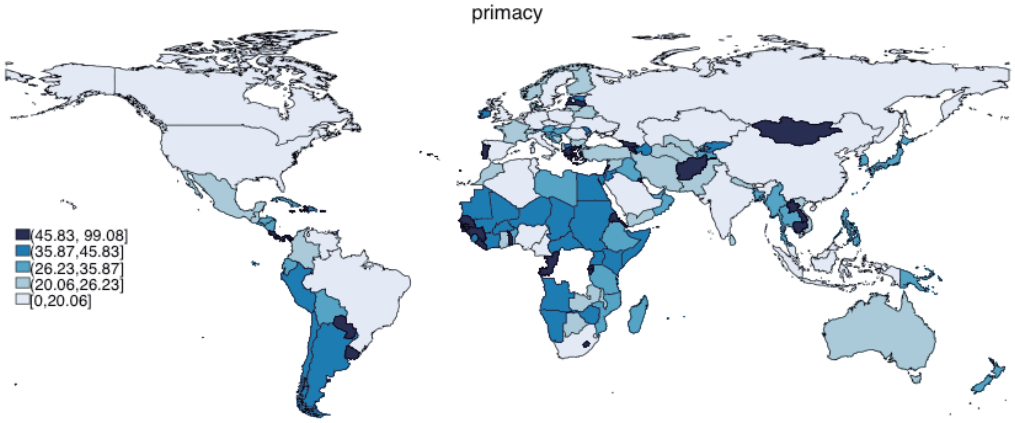
Table 4.1: Some basic figures

Panel A:	growth			primacy			Correlation growth-primacy	slums		
Region	Mean	Std. Dev.	Sample	Mean	Std. Dev.	Sample		Mean	Std. Dev.	Sample
Developed	1.8	1.1	42	35.0	24.8	44	0.17			
Developing	1.9	2.3	128	43.3	24.2	149	-0.08	57.0	28.9	102
North America	1.5	0.1	3	18.0	6.7	4	-0.10	18.0		1
Europe	2.0	1.5	31	28.3	19.0	38	0.10			
Asia	2.9	2.9	39	38.5	24.1	47	0.07	52.2	24.9	26
Oceania	1.1	0.9	12	72.8	30.8	16	-0.07			
North Africa	2.1	1.2	6	25.8	9.6	6	0.20	39.5	29.0	6
LAC	1.9	1.3	34	49.3	23.7	36	0.08	33.7	23.8	28
SSA	1.3	3.0	45	42.1	16.3	46	-0.13	77.1	19.7	41
World	1.9	2.0	170	41.4	25.5	193	-0.03	57.0	28.9	102

Panel B:	sanitation			Other urban infrastructure measures				
Region	Mean	Std. Dev.	Sample	water Mean	electricity Mean	inf. mort. Mean	tel. lines Mean	transport Mean
Developed	98.6	3.59	40	99.6	96.6	11.0	40.9	69%
Developing	70.6	25.71	142	89.4	79.8	62.4	10.8	20%
North America	100.0	0	2	100.0	100.0	8.1	59.9	100%
Europe	97.5	4.6	35	99.7	99.7	13.1	38.4	74%
Asia	83.8	18.25	45	93.3	92.3	50.2	14.1	33%
Oceania	83.3	18.39	14	93.0	74.3	33.6	16.2	6%
North Africa	87.7	15.15	6	85.9	90.5	56.6	5.8	67%
LAC	84.2	15.68	34	94.8	94.9	35.4	17.6	26%
SSA	44.1	20.26	46	81.1	52.7	93.3	2.2	0%
World	76.7	25.55	182	91.7	83.7	50.7	17.8	32%

Note: *growth* is calculated over 1970-2010. "Sample" indicates the number of countries considered (for which we have data for the respective region and variable). *primacy*, *sanitation*, *water*, *electricity* and *tel. lines* are calculated as averages over 1990-2005. *transport* indicates the percentage of countries in the region for which their primate city has a massive transport system (metro, tram or rapid bus).

Figure 4.1: Population living in largest city (percentage of urban population)



Note: values for *primacy* calculated as averages between 1970 and 2010.

The final stylised fact, relevant for our analysis, refers to urban infrastructure and the urban environment, where we also find important heterogeneities across countries. In particular, urbanisation in many developing countries indeed appears as characterised by a large proportion of urban inhabitants living under inadequate conditions. While access to basic services was already virtually universal in developed countries in 1990, it was not in developing countries, with important differences among them and particularly significant deficiencies in SSA. These deficiencies in SSA appear as remarkably severe in terms of access to improved sanitation and electricity and remain quite persistent (sanitation increasing since 1990 on average less than 5 percentage points and electricity around 10). Figures 4.2a and 4.2b display maps of access to improved sanitation and electricity worldwide. For access to improved sanitation while the average for Asia was close to 85 per cent, it was 44 for SSA (taking average values between 1990 and 2005). In terms of electricity the average coverage in SSA reached only half of the urban population. Similarly, in terms of infant mortality - reflecting access to health services - the average was 11 children per 1000 live births in the developed world, higher than 62 in developing countries, and exceeding 93 in SSA. In terms of transport none of the primate cities in SSA had a massive transport system by 2000.[72] In general, looking at data on urban population living in

[72] Lagos inaugurated a bus rapid transit system in 2008, and Accra has now planned a metro monorail project.

slums, we find an average of 57 per cent of urban population in developing countries, the figure reaching 77.9 for SSA. These dramatic deficiencies in SSA do not seem just the consequence of low-income levels. As Figure 4.3 shows for access to improved sanitation, even controlling for income levels SSA countries present significantly lower levels of urban infrastructure.[73] Such deficiencies are in all probability hampering agglomeration benefits while raising congestion costs in Sub-Saharan African cities.

Figure 4.2a: Access to improved sanitation (percentage of urban population)

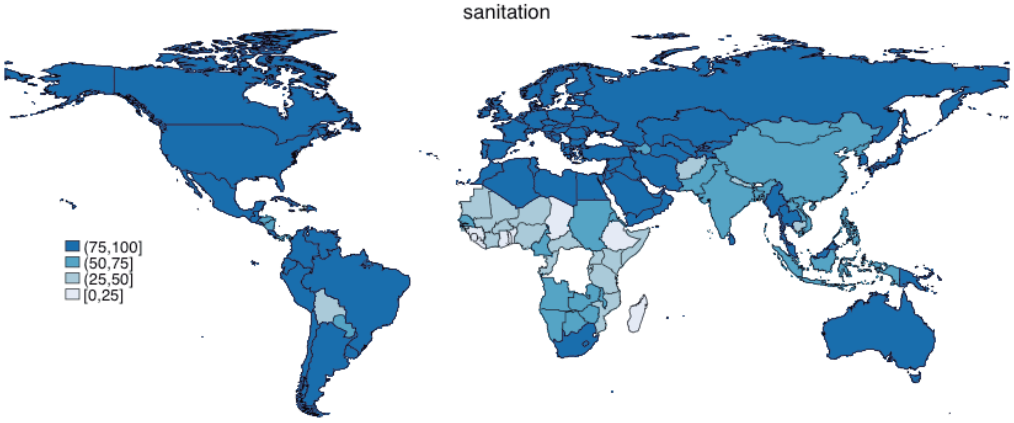
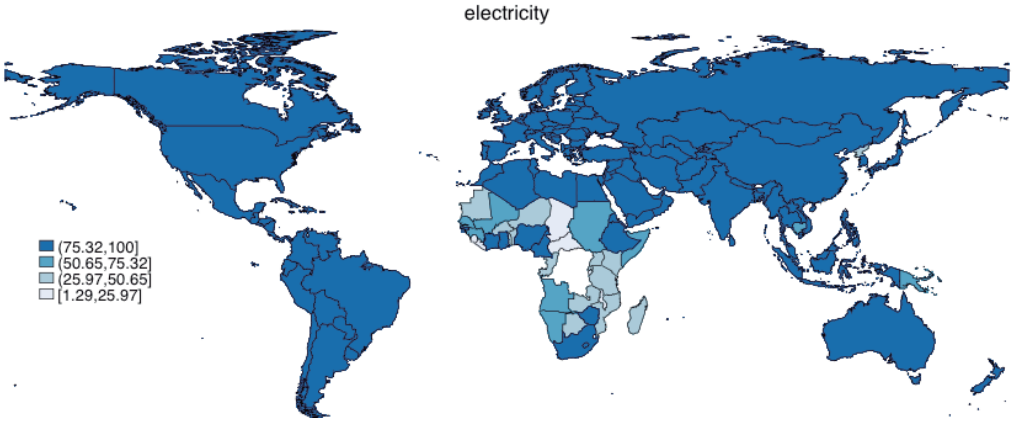


Figure 4.2b: Access to electricity (percentage of urban population)



Note: values for *sanitation* and *electricity* calculated as averages between 1990 and 2005.

[73] A simple regression analysis yields highly significant lower levels of urban infrastructure for SSA countries (16 percentage points on average for sanitation) compared to other developing countries of same income per capita levels. Ghana presents a gap of almost 50 percentage points in terms of access to sanitation.

If we take into account the high heterogeneity in the quality of urban infrastructures, we can see a clearly distinguishable correlation between urban concentration and long-run economic growth; positive in countries with relatively high quality of urban infrastructures and negative in countries with relatively low quality (Figure 4.4).

Figure 4.3: Access to improved sanitation by income levels

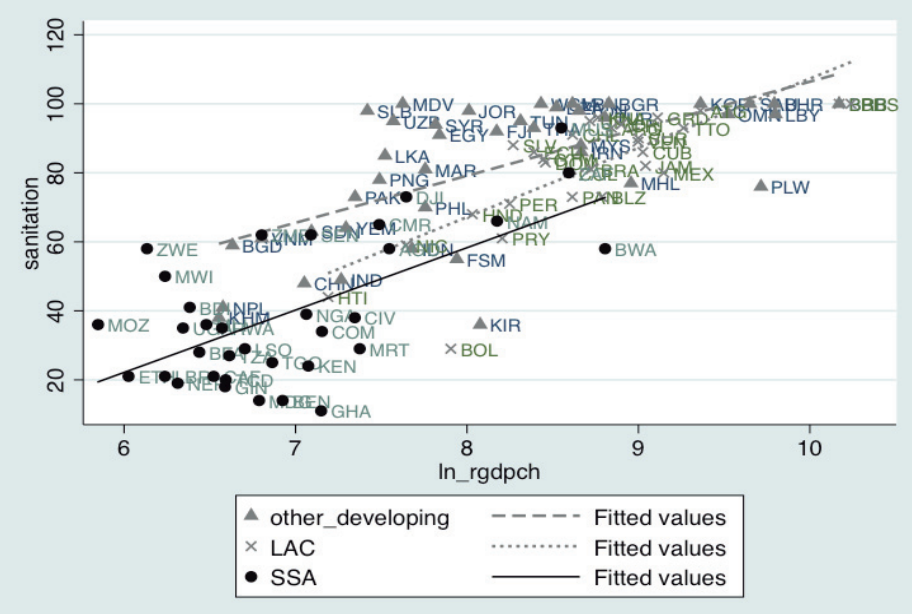
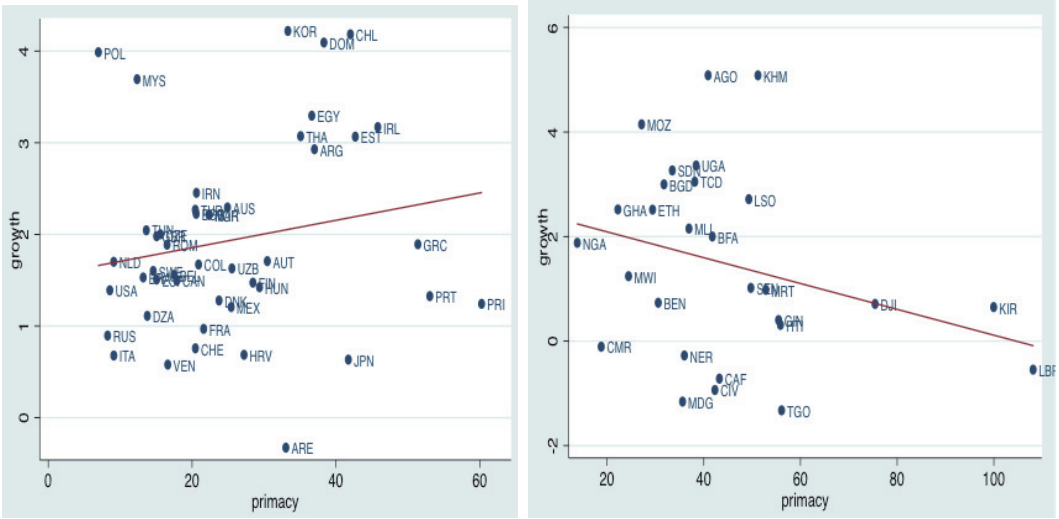


Figure 4.4: Correlation between primacy and growth by quality of the urban infrastructures



Note: Countries have been classified respect to the sample mean. The left panel includes countries above the sample mean (in terms of infrastructure), while the right panel those countries below the sample mean.

4.5. Estimations and results

4.5.1. Urban concentration and economic growth in a panel of countries:

Following the literature on urban concentration and economic growth, we begin by estimating the growth equation based on cross-country panel data (for 137 countries) and without considering differentiated urban patterns across countries. We split 1960-2010 into 5-year periods.[74] As in chapter 2 we face dynamic panel data models, in which we should address concerns regarding reverse causality, unobserved time-invariant country-specific characteristics, and the presence of initial income as a regressor. Accordingly, we complement more standard panel estimation techniques (as pool-OLS and Fixed Effects -FE) with System-GMM estimations.[75] For SSA we extend the empirical analysis with panel Fixed Effects Instrumental Variables (FE-IV) estimations taking advantage of the exogenous variability given by rainfall data.

Table 4.2 presents the result for the first set of estimations of the basic growth model. Columns 1 to 4 present results for different estimation techniques.[76] Control variables have the expected sign reflecting conditional convergence, a positive effect of higher investment and educational levels and a negative effect of higher fertility rates.[77] In column 5 we introduce primacy. Results yield a positive and significant effect (although just at the 10%). But there are reasons to expect that the relationship between urban concentration

[74] I also experimented with 10-year periods in order to reduce any short-term noise from the business cycle, but at the expense of losing observations. Results using 10-year periods are very similar to those presented throughout the paper using 5-year periods.

[75] See the methodological appendix 2 for an explanation of how System-GMM estimations are expected to help dealing with the mentioned concerns regarding dynamic panel data models. Additionally, see Henderson (2003) for first-differences GMM, and Brülhart and Sbegami (2009) for system-GMM, as an alternative explanation on the suitability of these methods for cross-country data on urban concentration and economic growth. For GMM estimations I present standard AR(1), AR(2) and Hansen tests for validity of internal instruments. As Bazzi and Clemens (2013) note, there is yet no reliable and straightforward test for the strength of the instrument set in Sys-GMM estimations. Correlation analysis of our key variables, nevertheless, reveals substantial explanatory power for lagged differences to explain levels and for lagged levels to explain first differences.

[76] OLS, FE, GMM and System GMM -SysGMM- results are presented but I focus throughout the paper on SysGMM results (and panel FE-IV estimations for SSA).

[77] I also calculate the annual speed of convergence to ease comparability of results with previous papers. The values found are within the range of what is commonly found in the literature, although differing depending on the estimation technique considered.

and growth will vary according to the level of development.[78] Following Henderson (2000), column 6 considers a more flexible functional form for the effect of primacy on growth; we introduce not just a linear effect of primacy but also an interaction term with initial income per capita (in logs) and another interaction term with the square of this initial income per capita. Results support the Williamson hypothesis - with a negative coefficient for primacy, a positive for its interaction with income and a negative for the interaction with the square of income (all coefficients significant at the 1%). In Figure 4.5 this quadratic effect of primacy on growth, depending on income levels, is plotted. At very low levels of development the effect of primacy is negative. It then becomes positive and increases as income raises up to levels around $9500 per capita (in PPP converted, at 2005 constant prices) to then start declining.[79] Finally, we take into account the possibility of significant differences across world regions. As column 7 shows, while there seems to be a positive relationship between primacy and growth for the world sample, there is a significantly different relationship for LAC and SSA.[80]

[78] While increasing urban concentration is desirable and expected in early stages of development, de-concentration eventually occurs as development proceeds. The optimal degree of urban concentration declines as development proceeds as knowledge gets accumulated, lowering the scope from agglomeration economies, and as better infrastructure allows efficient de-concentration to avoid congestion costs (Henderson 2003). Furthermore, the optimal level of urban concentration is expected to decline with the level of development also as institutional environments improve (Henderson 2003; Barca et al. 2012).

[79] Semiparametric estimations confirm this nonlinear relationship between primacy and growth. Results available upon request.

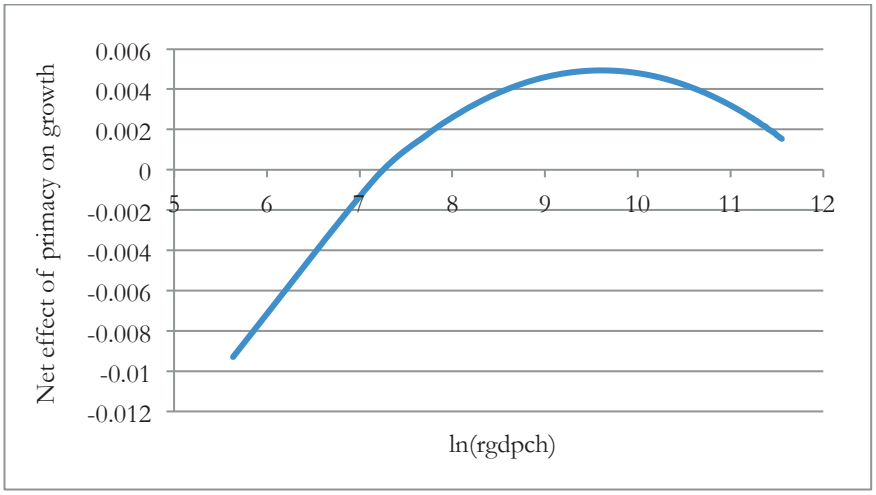
[80] In fact, when I analyse urban concentration by the different world regions, its effect on growth seems to have been positive and significant only in Asia and Europe. When distinguishing between developed and developing countries, rather than between world regions, while linear effects of primacy are only positive and significant in the former countries, it is in developing countries where the evidence of the Williamson hypothesis is clearer (in line with Bertinelli and Strobl 2007).

Table 4.2: Urban concentration and growth in a panel of countries

	(1) OLS	(2) FE	(3) GMM	(4)SysGMM	(5)SysGMM	(6)SysGMM	(7)SysGMM
Dependent variable: Average cumulative annual growth rates of per-capita GDP							
ln(rgdpch)	-0.1031***	-0.4280***	-0.3697***	-0.0362***	-0.0814***	-0.1252***	-0.0715***
	(0.0151)	(0.0686)	(0.1695)	(0.0779)	(0.0507)	(0.0974)	(0.0539)
ki	0.0073***	0.0078***	-0.0019	0.0039*	0.0015	-0.0015	-0.0014
	(0.0012)	(0.0021)	(0.0031)	(0.0021)	(0.0035)	(0.0032)	(0.0036)
fertility	-0.0870***	-0.0546***	0.0315	-0.0487***	-0.0629***	-0.0362**	-0.0448***
	(0.0094)	(0.0183)	(0.0237)	(0.0170)	(0.0170)	(0.0156)	(0.0131)
schooling23	0.0044	0.0116	0.1466**	-0.0186	0.0206	0.0113	-0.0141
	(0.0109)	(0.0280)	(0.0694)	(0.0515)	(0.0388)	(0.0565)	(0.0387)
UC					0.0054*	-0.0782***	0.0049*
					(0.0032)	(0.0269)	(0.0027)
UC*ln(rgdpch)						0.0173***	
						(0.0062)	
UC*(ln(rgdpch))^2						-0.0009***	
						(0.0003)	
UC*LAC							-0.0040***
							(0.0012)
UC*SSA							-0.0070**
							(0.0030)
Year FE	YES	YES	NO	YES	YES	YES	YES
Annual speed of convergence	2.10%	11.27%	9.12%	0.59%	1.70%	2.68%	1.48%
adj R square	0.196	0.216					
Observations	1204	1204	1033	1170	1204	1204	1204
No. of countries	137	137	137	137	137	137	137
AR1 test p-value			0.030	0.001	0.004	0.000	0.002
AR2 test p-value			0.352	0.412	0.437	0.582	0.552
Hansen test p-value			0.032	0.011	0.047	0.166	0.338

Note: *ki*, *fertility* are calculated as averages over 5 years. The time span goes from 1960 to 2010. All remaining variables are measured at the beginning of the period. For GMM and SysGMM estimations variables in levels lagged between 2 and 4 periods are used as instruments for first differences, and variables in first differences lagged between 2 and 4 periods are used as instruments for levels. GMM and SysGMM estimations are done with small sample correction. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 4.5: The Williamson hypothesis



Note: Plot using estimation coefficients (column 6, Table 2)

4.5.2. Positive and negative effects of urban concentration depending on the urban process:

Results in Table 4.2 suggest that the sign and the form of the relationship between urban concentration and growth are not uniform. The relationship is likely to vary not only with the level of development but also with other country's characteristics. In particular, as noted before, the quality of urban infrastructure might be fundamental to unleash positive synergies from agglomeration economies or to increase congestion costs, in both cases affecting national productivity. In Table 4.3 we present results for estimates of equation (2), letting the effect of urban concentration to depend on the quality of urban infrastructure. Results are presented using access to improved urban sanitation facilities (*sanitation*) as a proxy for the quality of urban infrastructure. [81] The coefficients for both the direct effect of urban concentration and for its interaction with sanitation are highly significant under OLS (column 1), being negative the first and positive the second. Results are less significant when we estimate by FE (column 2) or SysGMM (column 3). However, as noted in the descriptive analysis, the quality of urban infrastructure substantially differs between developed and developing

[81] Below I discus some results (presented in the appendix) using other proxies for the quality of urban infrastructure.

countries. Accordingly, in columns 4 and 5 we split the sample into developed and developing countries. SysGMM results are now non-significant for developed countries but they are highly significant for developing countries. The absence of enough variability between developed countries in the variables considered for urban infrastructure could explain their non-significance. As we have seen, access to basic services is very high and quite homogenous among developed countries. However, there is much higher heterogeneity among developing countries, with some of them reaching developed world figures but other lagging behind and with less than half of urban population having access to these services. In the case of developing countries results suggest that urban concentration is negative associated with economic growth for countries with low levels of sanitation. By contrast, the association becomes positive as access to sanitation increases.[82] Hence, the growth-enhancing benefits of urban concentration prevail over congestion costs only when basic services spread to the majority of the urban population.

4.5.3. Robustness checks:

We can check the robustness of the results found in several additional ways. In first place one could worry that the positive effect of the interaction between primacy and sanitation is due to the fact that higher sanitation is correlated with higher income levels (where urban concentration could have more beneficial effects). Nevertheless, as column 6 of Table 4.3 shows, main results for developing countries hold when we introduce an interaction between urban concentration and income levels. Likewise, results hold as we control for the Williamson hypothesis, introducing interactions with income levels and their square (column 7 of Table 4.3). Results are also robust to other regional differences in the relationship between urban concentration and economic growth beyond differences in urban infrastructure (in column 8 the effect of urban concentration is allowed to vary across world regions). This last result suggests that regional effects do not, therefore, drive the significance of infrastructure in determining the net benefits from urban concentration. A second concern might come from the proxy for urban infrastructure. While access to sanitation is a good proxy and very pertinent for the analysis, there

[82] I also obtain similar results when considering *growth* in urban concentration and *growth* in sanitation rather than their levels.

could be different contexts in which the role of other urban infrastructures might be more relevant, for example transport infrastructure (mobility and transport costs being a central issue of congestion analysis in the urban economics literature). In this line, and to expand the analysis, I replicate some of the estimations using other variables for the quality of urban infrastructure. On one side Table A.4.2 in the Annex presents panel results for access to improved water source (*water*) and access to electricity (*electricity*). Results are non-significant for access to water, but are for access to electricity. On the other side Table A.4.3 in the Annex presents some cross-section results. Cross-section analysis is more common in the long-run economic growth literature and, as discussed before, allows us to consider other variables, as transport systems for which there is not enough time variation. Cross-section results for sanitation are in line with panel results. Results also hold when other variables are considered, as *electricity* or *transport_systems*, although the significance is reduced and depends on the controls used.[83] When a composite measure for urban infrastructure is considered, rather than just one indicator, estimations yield highly significant results (and robust to all the considered controls).[84]

[83] Following Brülhart and Sbergami (2009), our cross-section controls include 18 variables found to be robustly associated with long-run growth by Sala-i-Martin et al. (2004) along population growth rates, higher education, fertility, investment share, and population density - to further capture agglomeration between countries. As in the panel analysis, when I analyse by world regions cross-section estimations yield a positive relationship between urban concentration and long-run growth (1990-2010) for Asia, while negative and highly significant for SSA (being robust to all considered controls).

[84] I simply create a composite measure standardizing *sanitation*, *water*, *electricity* and *transport_systems*, and aggregating them with equal weight.

Table 4.3: Urban concentration depending on the urban process

	World sample			Developed	Developing	Developing	Developing	Developing
	(1) OLS	(2) FE	(3)SysGMM	(4)SysGMM	(5)SysGMM	(6)SysGMM	(7)SysGMM	(8)SysGMM
Dependent variable:	growth	growth	growth	growth	growth	growth	growth	growth
UC	-0.0171***	-0.0474***	-0.0331	0.0711	-0.0462***	-0.0031	0.1152	
	(0.005)	(0.016)	(0.020)	(0.061)	(0.011)	(0.0211)	(0.0729)	
sanitation	-0.0035	-0.0057	-0.0197	0.0310	-0.0139	-0.0159	-0.0080	-0.0137
	(0.002)	(0.011)	(0.012)	(0.028)	(0.010)	(0.0109)	(0.0089)	(0.0112)
UC*sanitation	0.0002***	0.0004*	0.0004*	-0.0007	0.0005***	0.0005**	0.0004**	0.0005**
	(0.000)	(0.000)	(0.000)	(0.0006)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
UC*ln(rgdpch)						-0.0053	-0.0360**	-0.0354**
						-0.0037	-0.0177	-0.0134
UC*ln(rgdpch)^2							0.0021*	0.0018**
							-0.0011	-0.0009
UC*region								YES
Country FE	NO	YES						
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Observations	500	500	500	144	356	356	356	356
No. of countries	131	131	131	37	94	94	94	94
AR(1) p-value			0.082	0.192	0.071	0.059	0.029	0.043
AR(2) p-value			0.280	0.371	0.569	0.505	0.863	0.711
Hansen p-value			0.172	0.529	0.424	0.305	0.325	0.272

Note: *UC*region* are interaction terms between *UC* and each world region. Controls include *ln(rgdoch)*, *ki*, *fertility* and *schooling23*. All controls are calculated as averages over 5 years except *ln(rgdoch)* and *schooling23*, which are measured at the beginning of each period. The time span goes from 1990 to 2010. In SysGMM estimations *ki*, *fertility*, *schooling23*, *UC*, *sanitation* and *UC*sanitation* are treated as endogenous using lagged values between 2 and 4 periods as instruments for first differences and variables in first differences lagged between 2 and 4 periods as instruments for variables in levels. SysGMM estimations are done with small sample correction. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.5.4. Sub-Saharan Africa:

A focus on SSA has two main motivations. One resides in the particular deficiencies in urban infrastructure, which could be behind results from previous papers reporting negative effects on growth of growing urbanisation despite increasing returns from agglomeration (i.e. Brückner 2012).[85] The second motivation is methodological. In particular, there might still be concerns about reverse causality from growth to primacy and to the quality of urban infrastructure in the results of Tables 4.2 and 4.3. As noted, SysGMM estimations are expected to address endogeneity concerns. However, SysGMM estimations rely on internal instruments (i.e. variables' transformations and lags). Valid external instruments for primacy and for the quality of the urban infrastructure are hard to find. Yet, we can find reliable external instruments for economic growth, at least for Sub-Sahara African countries, which give us an additional methodological advantage. Being still relatively dependent on agriculture and agricultural-dependent activities, economic growth in SSA countries is significantly determined by rainfall.[86] Following Brückner (2012; 2013), we exploit this exogenous variation to construct instrumental variables that allows us to purge the possible effect that economic growth might have on our key variables, urban concentration and sanitation (reverse causality). The use of exogenous instruments allows us to control for simultaneity bias concerns in a more direct way, alternative to SysGMM and without having to rely on internal instruments. The strategy is based on a two-steps procedure. In a first step primacy and sanitation are regressed on economic growth by using a panel Fixed Effects Instrumental

[85] According to Brückner (2012), high ethnic fractionalization, very low economic development and excessive size of primate cities drive negative effects of growing urbanisation in Africa. Brückner suggests that the negative role of the excessive size of primate cities relates to their large squatter settlements with inadequate access to transport, water, sanitation, electricity, and health services, but he does not explicitly examines the role of these services.

[86] Higher levels of rainfall are expected to increase agricultural productivity and therefore economic growth in these countries. One should also consider rainfall squared, as too much rainfall can lead to floods detrimental for agriculture. See Miguel et al. (2004), Brückner and Ciccone (2011) and Brückner (2012) for more on the significance of rainfall as an exogenous variable determining economic growth in SSA countries. There is also a relatively recent and increasing literature on the effects of decreasing long-term trends of rainfall, associated with climate change, in Sub-Saharan Africa (see for instance Barrios et al. 2006).

Variables (FE-IV) approach using rainfall and rainfall squared as instruments for growth:

$$UC_{it} = \rho_1(\Delta y_{it-1,t}) + a_i + b_t + \varepsilon_{it} \quad (4.3)$$

$$G_{it} = \rho_2(\Delta y_{it-1,t}) + a_i + b_t + \varepsilon_{it} \quad (4.4)$$

where a_i are country fixed effects and b_t are year fixed effects. The introduction of country fixed effects allows us to control for time-invariant country-specific omitted variables, while the introduction of year fixed effects allows us to control for global shocks. Table A.4.4 in the Annex presents first-stage OLS estimation for growth on rainfall and rainfall squared, and FE-IV estimations of equations (4.3) and (4.4). Rainfall (and its square) appears as highly significantly to explain variation in economic growth in SSA, as previously found in the literature. By construction the residual variation on primacy and sanitation from our FE-IV estimations of equations (4.3) and (4.4) capture any variation in these variables that is not due to economic growth. In a second step we use these residual variations in primacy and sanitation as instruments for actual primacy and sanitation to estimate, again by FE-IV, our economic growth equation for SSA.[87] The methodological appendix 3 provides formal proof for why this FE-IV strategy using residual variation can properly address simultaneity bias as long as one has good instruments for the dependent variable (in our case rainfall, and its square, as instruments for economic growth). Table 4.4 presents the results.[88]

Similar to results in column 7 of Table 2, FE-IV results yield a negative and highly significant coefficient for primacy in SSA (column 1 of Table 4) and in line with Brückner (2012). Regarding the role of urban infrastructure FE-IV results - column 2 of Table 4 - are also similar to those in Table 3 (with a negative coefficient for primacy and a positive for its interaction with sanitation, both being highly significant). Coefficients are robust to the

[87] As the instruments used in the growth equation are generated regressors, standard errors on the slope coefficients are usually incorrect for hypothesis testing. However, as shown by Wooldridge (2010, p. 125) and noted by Brückner (2013), in the special case of testing that slope coefficients are equal to zero these standard errors are correct.

[88] Standard tests confirm, on one hand, the relevance and validity of rainfall and its square as instruments for growth in our regressions for primacy and sanitation. Angrist-Pischke F tests and Hansen J tests are reported respectively in Table A.4.4. On the other hand, tests also confirm the relevance 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 growth equation. Kleibergen-Paap F and LM tests are reported in Table 4.4.

considered controls as to the introduction of an interaction term between urban concentration and income levels (column 3).[89] They are also highly significant if access to improved water source (column 4) or access to electricity (column 5), rather than sanitation, are considered.

Table 4.4: Urban concentration and growth in SSA

		G = *sanitation*		G = *water*	G = *electricity*
	(1) FE-IV	(2) FE-IV	(3) FE-IV	(4) FE-IV	(5) FE-IV
Dependent variable:	growth	growth	growth	growth	growth
UC	-0.0287**	-0.0874***	-0.0200	-0.3371***	-0.1754**
	(0.0141)	(0.0146)	(0.0697)	(0.0767)	(0.0752)
G		-0.0638***	-0.0725***	-0.1083***	-0.0361***
		(0.0214)	(0.0229)	(0.0301)	(0.0094)
UC*G		0.0013***	0.0015***	0.0024***	0.0007***
		(0.0005)	(0.0005)	(0.0007)	(0.0002)
UC*ln(rgdpch)			-0.0111	0.0125	0.0170
			(0.0113)	(0.0124)	(0.0118)
Country FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	135	103	103	95	108
Number of countries	28	28	28	26	28
Angrist-Pischke F tests p-values	0.000	0.000; 0.000; 0.000	0.007; 0.000; 0.000; 0.009	0.002; 0.000; 0.001; 0.003	0.001; 0.000; 0.000; 0.002
Kleibergen-Paap F-stat	1253.02	40.15	28.19	18.37	70.07
Kleibergen-Paap LM-stat	6.63**	24.26***	23.38***	12.39***	17.10***

Note: Controls include *ln(rgdoch) ki*, *fertility* and *schooling23,* but also *rainfall* and *rainfall squared*. All controls are calculated as averages over 5 years except *ln(rgdoch)* and *schooling23*, which are measured at the beginning of each period. The time span goes from 1990 to 2010. For IV estimations, *UC*, *G* and *UC*G* series adjusted for the effect that *growth* has on them are used as instruments. Kleibergen-Paap stats test the null hypothesis that the equation is underidentified. Estimations are done with small sample correction. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, recent literature has highlighted potential measurement error of income per capita in poor countries, especially sub-Saharan African ones. As a final robustness check we use data on light density at night to measure income (as proposed by Henderson et al. 2012). In Table 4.5 FE and FE-IV

[89] We obtain similar results regardless of the estimation technique: OLS, FE or SysGMM. Results also hold if we consider a role for ethnic polarisation. As suggested by Brückner (2012), important ethnic divisions increase the severity of negative externalities in urbanised areas. Result available upon request.

estimations of equation (4.2) for SSA are replicated using light density at night (as aggregated at the national level by Henderson et al. 2012) and divided per population to proxy for income per capita. Results for primacy and for its interaction with urban infrastructure remain significant. Interestingly, the effect of our interaction term is even larger, while the coefficients for primacy and sanitation remain almost exactly of the same magnitude as those in Table 4.4.

Table 4.5: Estimates for SSA using light density at night data

	(1) FE	(2) FE-IV	(3) FE	(4) FE-IV
Dependent variable:	growthavsd	growthavsd	growthavsd	growthavsd
UC	-0.0175*	-0.0127	-0.0624***	-0.0866***
	(0.0094)	(0.0103)	(0.0212)	(0.0198)
sanitation			-0.0258	-0.0601*
			(0.0304)	(0.0304)
UC*sanitation			0.0019**	0.0029***
			(0.0009)	(0.0008)
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	108	108	103	103
Number of countries	28	28	28	28
Angrist-Pischke F tests p-values		0.000		0.000
Kleibergen-Paap F-stat		2745.44		33.02
Kleibergen-Paap LM-stat		3.93**		21.41***

Note: Controls include *ln(avsd) ki*, *fertility* and *schooling23,* but also *rainfall* and *rainfall squared*. All controls are calculated as averages over 5 years except *ln(avsd)* and *schooling23*, which are measured at the beginning of each period. The time span goes from 1990 to 2010. For IV estimations, *UC*, *sanitation* and *UC*sanitation* series adjusted for the effect that *growth* has on them are used as instruments. IV estimations are done with small sample correction. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In sum, results confirm - in this case for SSA - the role of urban infrastructure when it comes to analysing the relationship between urban concentration and economic growth. According to estimates, for urban concentration to have a positive impact on growth access basic services must at least cover 70 per cent of urban population. But access to basic services is still very deficient in SSA, as we have seen. Only 3 countries out of 34 reached

that 70 per cent threshold of urban population with access to sanitation in 1990 (Djibouti, Mauritius and South Africa), three more countries in 2005 (Angola, Botswana and Seychelles).

4.6. Conclusions and policy implications

Urban concentration plays an important role in the process of economic development. But there are wide heterogeneities across countries in terms of urban processes and urban environments. One aspect of the urban environment that is critical when analysing the relationship between urban concentration and economic growth is the quality of urban infrastructure. The data analysed indeed reflects important differences across countries in terms of access to basic public services, especially in the developing world. The econometric results provide evidence on the relevance of these differences to explain diverse results found in the literature in what refers to the effect of urban concentration in different regions of the world. The role of access to basic services seems robust to a long list of controls and econometric techniques. In this regard, it has been analysed how urban concentration can be negatively associated with national economic growth under urban environments with deficient urban infrastructure. This situation seems common in SSA, where access to improved sanitation and electricity appear as especially deficient and currently hampering structural change as well as the net benefits from urban concentration.

In this line, for large agglomerations in developing countries today a *Malthusian trap* might be a relevant reality, as population growth in these agglomerations exceeds the supply of resources (understood here as urban infrastructure), leading to congestion costs exceeding the benefits from agglomeration. Regarding policy implications previous works have suggested that when urban congestion is due to natural increase rather than due to migration, as seems to be the case for large agglomerations in SSA, investments in urban infrastructure are fundamental (Jedwab et al. 2014). Access to basic services, in particular, is not just desirable per se in terms of quality of life for urban residents but also in terms of capital accumulation as well as in terms of economic efficiency at national level, as they allow for the realisation of agglomeration economies and the control of congestion costs. Consequently, guaranteeing that adequate urban infrastructure in these large

cities (as in all urban areas) keeps pace with their rapid increase in population not only improves living conditions but can also induce a transition away from Malthusian dynamics.

The results presented suggest that the net benefits from agglomeration can arise in places where that is not the case today if efforts are made to improve the quality of the urban environment, and it should not be different in SSA. According to the results provided, the negative effects of urban concentration that the literature has implied in this region (i.e. Brückner 2012) can be associated precisely with its severe lack of adequate basic infrastructure. But, as in other regions, improvements in urban infrastructure, leading to upgraded urban environment, can also unleash agglomeration economies while helping control congestion costs in Sub-Sahara African countries. In other words, the lower economic performance of Sub-Saharan Africa can be in part explained by hampered agglomeration economies due to deficient urban infrastructures.

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Annex Chapter 4:

Table A.4.1: Variables' names, definitions and sources:

Basic growth model	Description	Source
growth	Cumulative annual average per capita GDP growth rate	Constructed with data from PWT 7.1 (Summers and Heston), using real GDP chain data (rgdpch)
primacy	Population living in largest city (percentage of urban population)	World Bank - World Development Indicators
ln(rgdpch)	Per capita GDP (in logs)	Constructed with data from PWT 7.1 (Summers and Heston), using real GDP chain data (rgdpch)
ki	Investment share (percentage of GDP)	PWT 7.1. (Summers and Heston)
fertility	Fertility rates	World Bank - World Development Indicators
schooling23	Average years of secondary and tertiary schooling of adult population	Barro and Lee dataset
Further controls		
primary_edu	Percentage of primary schooling attended in total population	Barro and Lee dataset
higher_edu	Percentage of higher schooling attended in total population	"
pi	Price level of investment	PWT 7.1. (Summers and Heston)
kg	Government consumption (percentage of GDP)	"
openk	Openness	"
life_exp	Life expectancy at birth	World Bank - World Development Indicators
dens65c	Density in coastal regions. 1965	Gallup et al. (2001)
tropicar	Proportion of population living in tropical areas	"
malfal66	Malaria	"
elf60	Ethno linguistic fractionalization	Easterly and Levine (1997)
buddha	Fraction of Buddhist	Sala-i-Martin et al. (2004). (BACE dataset)
confuc	Fraction of Confucian	"
east	Dummy for East Asian countries	"
laam	Dummy for Latin American countries	"
mining	Percentage of GDP in mining	"
muslim00	Fraction of Muslim	"
safrica	Dummy for Sub-Sahara African countries	"
spain	Dummy for Spanish colony	"
pop_density	Population density	World Bank - World Development Indicators
pop_growth	Population growth rate	Constructed with data from PWT 7.1 (Summers and Heston), using data on population

Table A.4.1 *continued*

Urban infrastructure		
sanitation	Population with access to improved sanitation facilities (percentage of urban population)	World Bank - World Development Indicators
water	Population with access to improved water source (percentage of urban population)	"
electricity	Access to electricity (percentage of urban population)	World Bank - Sustainable Energy for All database
transport_systems	Dummy variable indicating if primate city has a massive transport system (metro, tram or rapid bus)	Constructed by the authors
telephones	Telephone lines (per 1000 inhabitants)	World Bank - World Development Indicators
infant mortality	Infant mortality rates (per 1000 births)	"
slums	Population living in slums (percentage of urban population)	UN-Habitat
rainfall	Annual rainfall aggregated at the country level	Global Precipitation Climatology Projects (GPCP)
growthavsd	Per capita growth of light density at night	Constructed with data from Henderson et al. (2012)

Table A.4.2: System GMM results with *water* and *electricity*:

	(1) G=*water*	(2) G=*water*	(4) G=*electricity*	(4) G=*electricity*
	World	Developing	World	Developing
Dependent variable:	growth	growth	growth	growth
UC	0.0256	-0.0536	-0.0224**	-0.0183**
	(0.0455)	(0.0519)	(0.0097)	(0.0081)
G	0.0136	-0.0209	-0.0144**	-0.0057
	(0.0228)	(0.0120)	(0.0072)	(0.0054)
UC*G	-0.0003	0.0005	0.0003**	0.0002**
	(0.0005)	0.0005)	(0.0001)	(0.0001)
Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	497	347	540	374
Number of countries	129	91	137	95
AR(1) p-value	0.071	0.087	0.029	0.050
AR(2) p-value	0.203	0.276	0.187	0.179
Hansen test p-value	0.180	0.271	0.118	0.068

Note: Controls include *ln(rgdoch)*, *ki*, *fertility* and *schooling23*. All controls are calculated as averages over 5 years except *ln(rgdoch)* and *schooling23*, which are measured at the beginning of each period. Estimation done by SysGMM. *ln(rgdoch)*, *ki*, *fertility*, *schooling23*, *UC*, *G* and *UC*G* are treated as endogenous using lagged values between 2 and 4 periods as instruments for first differences and variables in first differences lagged between 2 and 4 periods as instruments for variables in levels. Estimations are done with small sample correction. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4.3: Cross-section results:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	G=*sanitation*		G=*electricity*		G=*transport_systems*		G=composite	
Dependent variable:	growth	growth	growth	growth	growth	growth	growth	growth
UC	-0.0070***	-0.0070***	-0.0025*	-0.0031**	-0.0004	-0.0033***	-0.0067***	-0.0053***
	(0.0026)	(0.0020)	(0.0014)	(0.0013)	(0.0009)	(0.0011)	(0.0019)	(0.0018)
G	-0.0020	-0.0006	0.0004	0.0009	-0.0532	-0.0880	-0.0019	0.0016
	(0.0015)	(0.0011)	(0.0009)	(0.0012)	(0.0572)	(0.0714)	(0.0012)	(0.0018)
UC*G	0.0001***	0.0001**	0.0001**	0.0000	0.0013	0.0039*	0.0001***	0.0001**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0014)	(0.0020)	(0.0000)	(0.0000)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Further controls	NO	YES	NO	YES	NO	YES	NO	YES
adj R sq.	0.294	0.637	0.291	0.609	0.231	0.611	0.316	0.674
Obs.	112	87	129	93	129	93	107	84

Note: *growth* is here calculated as cumulative annual average per capita GDP growth rate between 1990 and 2010. In column 7 and 8 composite is calculated combining *sanitation*, *water*, *electricity* and *transport_systems*. Controls include *ln(rgdoch)*, *ki*, *fertility* and *schooling23*. Further Controls include: *primary_edu, higjher_edu, pi, kg, yrsopen, life_exp, dens65c, tropicar, malfal66, elf60, buddha, confuc, east, laam, mining, muslim, safrica, spain, pop_dens, ki, fertility* and *pop_growth*. All right-hand variables are measured at the beginning of the period or closest year. Estimations are done by OLS. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4.4**:** First step estimations for SSA:

	(1) OLS	(2) FE-IV	(3) FE-IV
Dependent variable:	growth	primacy	sanitation
rainfall	0.0028**		
	(0.0013)		
rainfall_squared	-0.0001***		
	(0.0000)		
growth		-4.1597	-0.4570
		(2.9154)	(1.3064)
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	143	178	143
Number of countries	38	38	38
First-stage F-stat p-value		0.000	0.005
Angrist-Pischke F stat p-value		0.053	0.093
Hansen J stat p-value		0.730	0.944

Note: Columns 2 and 3 use *rainfall* and *rainfall_squared* as instruments for *growth*. IV estimations are done with small sample correction. Angrist-Pischke F tests the significance of excluded instruments. Hansen J tests the null hypothesis of valid instruments. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Chapter 5. Concluding remarks: Main findings, Policy implications and Further research:

Summary and main findings:

The process of economic development is characterised by powerful dynamics that shape the distribution of population, economic activity and income between countries, but most importantly within them. The aim of this thesis has been to analyse interactions between economic geography, socio-economic variables, and economic development processes. The focus of study lied on agglomeration (urbanisation and urban concentration) and inequalities. Both agglomeration and inequalities were identified as having increasing trends worldwide over the last decades and both seem characteristic of modern economic growth dynamics. Hence, we have conceived both, agglomeration and inequalities, as two dimensions of concentration of resources within countries in the process of economic development. In particular, the explicit goal of the research carried out has been to contribute to the understanding of the effects of these two trends on long-run economic growth. In chapter 2 the co-evolution of the three key variables of analysis, inequalities, agglomeration and growth has been studied. In chapter 3 a closer analysis of the relationship between inequality and growth has been performed. In chapter 4 the emphasis moved to the relationship between urban concentration and growth. This last chapter (5) briefly highlights main findings, conclusions and policy implication of the thesis, and discusses relevant lines for further research.

In chapter 2 it was found that the net effects of increasing agglomeration - urbanisation and urban concentration - and raising inequalities within countries seem to depend on countries' initial conditions. In particular, the key finding and contribution from chapter 2 is to show that net benefits from agglomeration depend not only on the level of income, as the literature has highlighted, but also on its distribution; in both high- and low-income countries the growth-enhancing effects of increasing agglomeration are only found when the distribution of income remains relatively egalitarian. As discussed in chapter 2, some degree of inequality intensifies the growth-enhancing incentives and agglomeration economies of urban areas. But high inequality also weakens social cohesion. This weakening may hamper agglomeration economies associated with human interaction - knowledge spillovers and human capital complementarities. In fact, results showed negative effects from urban concentration in rich countries with unequal distribution of income. These last results were interpreted as pointing towards a social dimension of congestion, in which concentration of resources goes too far (high urban concentration and high inequality).

Looking at the dynamics behind the relationship between inequality and growth, the main finding from chapter 3 is the evidence of two parallel and significant effects of inequality (one positive and one negative) on economic growth. These two parallel effects of inequality seem to fit with two different components of inequality: structural inequality (or inequality of opportunities), bad for growth, and market inequality (or inequality of outcomes), good for growth. In particular, the analysis developed took into account the different transmission mechanisms for inequality to have an influence on growth. On the one hand the positive effect of inequality was found to be associated with capital accumulation, investment, incentives and the diversity necessary for the unfolding of the benefits of agglomeration itself (as analysed in chapter 2). On the other hand, the negative effect was found to be associated with lower local demand, social conflict, higher fertility and lower human capital accumulation.

An extension to the analysis done in chapter 3 focused on the link between unemployment and increasing inequalities. Despite well-grounded theoretical arguments for unemployment to have a negative effect on long-run growth, empirical evidence in this regard is very scarce. The negative effect of high and persistent unemployment rates is precisely expected to be associated

with worsening income distribution. The results obtained in chapter 3 found a negative and significant effect of high and persistent unemployment, when associated with worsening income distribution, on long-run economic growth.

In chapter 4 significant differences across countries and world regions in the relationship between urban concentration and economic growth were identified. Differences were found based on levels of economic development but also based on disparities in the urban environment. Across world regions, while increasing urban concentration was found positively associated with growth in Asian countries, the opposite was found for Sub-Saharan African countries. But the main finding and contribution of the chapter is to show that the net benefits of agglomeration depend on the quality of the urban environment (interpreted in terms of urban infrastructure). In particular, access to basic services as improved sanitation, water and electricity, were identified as critical to unleash agglomeration economies while helping to control congestion costs in developing countries. In fact we found that in many developing countries (especially in Sub-Saharan Africa) the provision of basic services remains dramatically limited and does not keep pace with the rapid increase of urban areas. For Sub-Saharan Africa the results obtained point towards net negative effects of concentration, precisely associated with the severe lack of access to basic services in the urban areas of the region, rather than to other region-specific characteristics (like the degree of ethnic fractionalisation or the institutional framework) as suggested by previous papers.

All in all, the analysis carried out throughout the thesis has highlighted how distributional issues (concentration of resources), whether interpersonal or geographical, are not only associated with the process of economic development but also are significant determinants of long-run economic growth. In this line, given the benefits and costs associated with distributional issues, not only the extents of inequalities but also the dynamics behind them have emerged as relevant.

Policy implications:

Relevant policy implications can be derived from the analysis carried out. As we have seen, the concentration of population and economic activity allows benefits from agglomeration to take place, but it also brings important risks associated with rising inequalities, urban congestion and slums. In fact, as

we reviewed in chapter 2, there is a current policy debate regarding the interaction between agglomeration and inequalities. Two main positions were identified. Summarising, one position (defended by the World Development Report 2009) argues for spatially unbalanced growth, implying that countries should pursue concentration to benefit from agglomeration economies and despite the associated inequalities that are expected to emerge. The other position (i.e. Barca et al. 2012 and OECD 2009) argues for a more balanced urban system looking for growth opportunities in both large and smaller (and more peripheral) urban areas. Our results have allowed us to contextualise this debate not only according to the level of development but also according to distributional issues and physical aspects of the urban environment.

1. Regarding the level of development, in the case of low-income countries there indeed seems to be a trade-off between efficiency and equity, at least in the short run and as greater urban concentration may be desirable for growth but may imply greater inequalities. For high-income countries a more balanced urban system, in which small and medium-sized cities play a fundamental role, does seem to be a better strategy than intense urban concentration. This is most likely due to congestion costs already outweighing agglomeration benefits in large agglomerations.
2. In what relate to income distribution, for both high- and low-income countries, the fact that the benefits to be derived from agglomeration seem to depend on inequality highlights the relevance of socio-economic and institutional factors in the debate on concentration. While relatively egalitarian environments allow for net benefits from agglomeration, in highly unequal societies congestion costs seem to prevail.
3. Regarding the urban environment, a related policy debate has to do with the existence and role of slums in the process of development. As discussed in chapter 4, although slums (defined as urban environments lacking basic living conditions) have been traditionally considered as a temporary stage in the structural change from rural to industrial activities, slums have recently tended to grow more in poor and stagnant countries where urbanisation and urban concentration do not seem associated with economic growth. The analysis performed, looking at basic urban infrastructures, supports the concern about slums being a poverty trap for a majority of their

residents and a symptom of Malthusian urban dynamics in some developing countries, where congestion effects of population growth seem to dominate the positive effects from urban concentration. In this line, investments (as those in basic urban infrastructure) that enhance the quality of the urban environment appear as a requirement for growth-enhancing agglomeration economies.

Rising inequalities, urban congestion and deficient urban environments (slums), all associated with concentration, represent great challenges for sustained and sustainable development that policy makers, especially in developing countries, should take into account and properly address. Controlling inequalities and how concentration takes place has been identified as essential for long-run growth. As discussed in chapter 3, an analysis of the different transmission channels between inequality and growth is relevant for policy design. While unequal outcomes generate necessary incentives for risk-taking, capital accumulation and innovation that are also necessary for growth, unequal opportunities are detrimental for economic growth, particularly for developing countries. One key policy with the potential to increase equality of opportunities in developing countries is the expansion in access to public services. Policies in this regard will focus on inequality at the bottom of the income distribution, which has been identified as the inequality that more adversely affects economic growth (Voitchovsky 2005; Cingano 2014). Furthermore, as we analysed in chapter 4, deficient urban environments not only lead to low living conditions and marginalisation, but also to congestion costs outweighing agglomeration benefits, especially in large cities, lower productivity of urban dwellers and lower aggregate economic performance, a situation that reinforces the problem.

Controlling inequalities and investing in congested and marginalised environments is not only relevant in terms of social equity but also in terms of economic efficiency. In the long run, there is no trade-off between equity and efficiency.

Further research:

The research performed has focused on the analysis of aggregate data at the city but mostly at the national level. In this line the research performed

has taken a cross-country perspective. Nevertheless, the topics and ideas developed throughout the thesis open the door for a more detailed analysis of case-studies, taking a cross-regional or cross-city perspective and using more disaggregated data. In this regard further relevant research lies in the analysis of inter-personal and inter-regional inequality, as well as urban concentration patterns, in specific contexts. Two further research lines arise. On the one hand there is the study of the evolution of soaring inequalities in specific countries in the last years with the unfolding of the current economic crisis. Spain is precisely one country where inequalities have dramatically accentuated with very serious economic and social implications yet to be fully appreciated. Looking at their inter-regional and intra-regional (as well as intra-city) dimensions, an analysis of the determinants and consequences of these inequalities arises as more than relevant. On the other hand, the analysis of agglomeration economies across cities within one country is a hot and interesting area of research. While most recent research has focused on developed countries, empirical evidence from developing countries, where cities do not have yet adequate urban infrastructure to fully exploit agglomeration economies, is still scarce. Thus, the focus on developing countries has a special interest given the great challenges for sustainable development that large agglomerations in these countries face. Using micro data for main metropolitan areas the study of these agglomerations can significantly increase our understanding of current economic development in urban areas in these countries.

Methodological appendix 1: Deriving a specification for cross-country growth regressions:

The estimating equations followed in each chapter of the thesis have a common root in the empirical literature on cross-country economic growth. In this appendix we briefly summarise how this common econometric setting is derived.[90]

The starting point is the neoclassical framework of economic growth basis for standard cross-country growth regressions. Economic growth is related to growth due to technological progress and to the gap between the initial level of output and the steady state to which the economy converges, with the expectation that countries with lower levels grow faster:

$$\Delta y_i = t^{-1}(log(y_i) - log(y_{i0})) = g + \beta_i((log(y_{i0}) - log(y^E_{i,\infty}) - log\ (A_{i0})) \quad \text{(M.A.1.1)}$$

where Δy_i is per capita average growth rate of economy *i* during time t, $y_{i,0}$ is initial output per capita, $y^E_{i,\infty}$ is its steady state, $A_{i,0}$ is initial efficiency level or technology, and g is the steady-state growth rate. $\beta_i = -t^{-1}(1 - e^{-\lambda t})$, with λ reflecting the speed of convergence to the steady state. To reach to an estimating equation allowing regression analysis linear in observable variables we can follow Mankiw et al. (1992), who extend the Solow (1965) model of economic growth by introducing human capital accumulation, and assume a simple aggregate Cobb-Douglas function of output:

$$Y_{i,t} = K^{\alpha}_{i,t} H^{\phi}_{i,t} (A_{i,t} L_{i,t})^{1-\alpha-\phi} \quad \text{(M.A.1.2)}$$

where $Y_{i,t}$ is output, $K_{i,t}$ is physical capital, $H_{i,t}$ is human capital, and $A_{i,t}L_{i,t}$ is units of efficient labour. Capital (physical and human) is accumulated over time from savings in output (with s_{ki} being the fraction of output invested in physical capital and s_{hi} the fraction invested in human capital). Hence, according to the model, income per capita (in logs) will be:

$$log\ (y_{it}) = log(A_{i,0}) + gt + \frac{\alpha}{1-\alpha-\phi} log(s_{ki}) + \frac{\phi}{1-\alpha-\phi} log(s_{hi}) - \frac{\alpha+\phi}{1-\alpha-\phi} log(n + g + \delta) \quad \text{(M.A.1.3)}$$

[90] See Durlauf et al. (2005) for a more detailed explanation of how to derive cross-country growth regressions from neoclassical economic growth theory.

where n is the rate of population growth and δ the rate of depreciation of capital. Substituting for the steady state in equation (1):

$$\Delta y_i = g + \beta log(y_{i0}) + \beta \frac{\alpha+\phi}{1-\alpha-\phi} log(n+g+\delta) - \beta \frac{\alpha}{1-\alpha-\phi} log(s_{ki}) - \beta \frac{\phi}{1-\alpha-\phi} log(s_{hi}) - \beta log\,(A_{io}) \quad \text{(M.A.1.4)}$$

$A_{i,0}$ can be interpreted in a general way, not only referring to technology which is assumed constant across countries, but also to country-specific factors that influence growth (resources, institutions, location and characteristics of the economic geography), [91] and therefore allow for heterogeneity in initial conditions as well as in efficiency growth paths across countries. Accordingly, equation (M.A.1.4) implies that cross-country differences in output per capita growth finally depend on initial levels of output per capita, factor accumulation, and differences in these country-specific factors. In this line, we derive the standard specification of cross-country economic growth taking the following form:

$$\Delta y_i = \beta\left(log y_{i,0}\right) + \psi X_{i,0} + \pi Z_{i,0} + \varepsilon_i \quad \text{(M.A.1.5)}$$

where $X_{i,0}$ are the standard Solow determinants (factor accumulation) plus a constant term, and $Z_{i,0}$ a vector of country-specific factors explaining cross-country differences in efficiency growth (the evolution of technology) or in initial conditions.

[91] Mankiw et al. (1992) specifically assume $log(A_{i,0}) = log(A) + e_i$

Methodological appendix 2: Estimation considering dynamic panel specifications of economic growth:

To estimate equations like (1.5), both cross-section and panel data have been used in the literature.[92] Cross-section regressions of cross-country growth models have been extensively used. Cross-section regressions have several advantages (as described in section 3) but have also been criticised (i.e. Banerjee and Duflo 2003, in the context of the relationship between inequality and growth). The use of panel data has been the natural alternative. The use of panel data substantially increases the number of observations and the possibilities for econometric analysis. However, the use of panel data to estimate dynamic models of economic growth also faces important econometric challenges. Three main econometric problems arise from estimating these models: reverse causality, unobserved time-invariant country-specific characteristics, and the presence of initial income as a regressor - likely to be correlated with the country-specific characteristics (dynamic bias).

Several panel data techniques can be used to address concerns with dynamic panel data models. Random Effects (RE) estimations allow us to control for unobserved country-specific characteristics retaining cross-sectional differences. However, if the country-specific characteristics are correlated with the regressors - which is highly likely - RE is inconsistent and Fixed Effects (FE) estimations should be preferred. FE also controls for time-invariant country specific effects but only considers within variation. However, FE does not solve reverse causality. Furthermore, estimations of cross-country growth models are usually done on short panels (small T) where the lagged dependent variable is highly persistent over time (its coefficient is close to one) and the between-sample variance is large compared to the within-sample variance. In this case FE is even expected to worsen dynamic bias concerns (see for instance Ostry et al. 2014) as well bias from measurement error (Barro 2000).

Alternative estimation techniques can be performed using instrumental variables, as with panel Fixed Effects Instrumental Variables (FE-IV) estimations. Yet, in the absence of valid external instruments, one can still perform consistent estimations of dynamic panel data models of economic

[92] In this thesis, chapter 3 relies on cross-section data while chapter 2 and 4 rely on panel data.

growth using internal instruments and System-GMM estimators (Blundell and Bond 1998). System-GMM estimates can address the above problems and are expected to be more efficient than any other dynamic GMM estimators (Roodman 2009).

System-GMM estimates rely on two equations: one of first differences instrumented on lagged levels - as in traditional GMM estimators - and one of levels instrumented on lagged first differences, thus also retaining information in the equation in levels. For System-GMM to yield consistent estimates we need to ensure that lagged first differences of the endogenous variables are valid instruments for the untransformed equation in levels, which depends on the instrumented variables to be mean stationary after controlling for time trends. We also need to ensure conventional conditions used in traditional GMM estimations: that the lagged levels of the endogenous variables are valid instruments for the first-differenced equation, which depends on the absence of serial correlation of the residuals. Both things together build in some insurance against weak specification, because if the series are persistent and lagged levels are weak instruments for first differences, it may still be the case that lagged first differences have some explanatory power for levels (Durlauf et al. 2005).[93]

Finally one should not only acknowledge the advantages and the limitations of each technique, but also correctly interpret its results. Regarding interpretation of results in the context on economic growth, while cross-section regressions represent long-run growth dynamics, usually relying on time horizons of 20 years or more, results form panel data regressions can be interpreted as short- or long-run effects (with researchers usually relying on 5- or 10-year periods depending on the frequency with which the data is available and to control for the business cycle). Hence, Pooled-OLS and RE estimations are usually interpreted as long-run dynamics, as they capture how persistent cross-sectional differences affect long-run growth rates, whereas FE results are interpreted as short-run dynamics, as they capture how time-series changes in explanatory variables within a country affect changes in its growth rate over time (see for instance Baltagi and Griffin 1984; Pirotte 2003; Partridge 2005).[94] Finally, Sys-GMM estimations rely on a combination of

[93] Serial correlation tests - AR(1) and AR(2), along with test for overidentifying restrictions (Sagan and Hansen tests), are standard to check the validity of instruments.

[94] Baltagi and Griffin (1984) give a brief explanation on why estimators based on time series (i.e. within or FE estimators) tend to yield short-run responses while estimators based on

within and between variance and can be interpreted as short- or long-run dynamics (as we do in chapter 2 and similar to Brülhart and Mathys 2008 and Brülhart and Sbergami 2009).

cross-sections (between or OLS estimators) tend to yield long-run responses. They also show the extent of problems arising from misspecification of dynamic models (i.e. bias and inefficiency) that different estimators face and one should take into account.

Methodological appendix 3: Adjusting for simultaneity bias, formal proof:

Building on Brückner's (2013), this appendix briefly formalizes how simultaneity bias can be properly addressed by IV estimations using residual variation in urban concentration and in urban infrastructure that is not driven by economic growth. We start by assuming a possible simultaneous equation model:[95]

$$\Delta y = \lambda(UC) + u \quad \text{(M.A.3.1)}$$

$$UC = \gamma(\Delta y) + e \quad \text{(M.A.3.2)}$$

where Δy is growth and UC is urban concentration. We are interested in the coefficient λ. However, if $\gamma \neq 0$ then OLS estimates of λ from equation (E.4.1) will be biased. Nevertheless, if we can consistently estimate γ in equation (E.4.2) we can construct a series for UC that is adjusted for the endogenous response (i.e. $res(UC) = UC - \hat{\gamma}(\Delta y)$) and use $res(UC)$ as an instrument for actual UC in equation (E.1) to estimate λ. The instrumental variables (IV) estimate of λ will not suffer from simultaneity bias:

$$\lambda^{IV} = \frac{cov(res(UC),\Delta y)}{cov(res(UC),UC)} = \lambda + \frac{cov(res(UC),u)}{cov(res(UC),UC)} = \lambda + \frac{cov(e,u)}{cov(e,UC)} \quad \text{(M.A.3.3)}$$

Consistent estimate of γ can only be obtained if one has a valid instrument for Δy in equation (E.4.2) (OLS can not yield a consistent estimate of γ if $\lambda \neq 0$ in equation (E.4.1)). In our case rainfall, and its square, provide these valid instruments for growth.[96]

In fact, we can identify the adjustment in λ when addressing for simultaneity bias in our growth equation. The first stage estimation, in which actual UC is regressed on $res(UC)$, is:

$$UC = \eth\big(res(UC)\big) + v = \eth(UC - \hat{\gamma}\Delta y) + v \quad \text{(M.A.3.4)}$$

the residuals from this stage being:

$$\hat{v} = UC - \hat{\eth}(UC - \hat{\gamma}\Delta y) \quad \text{(M.A.3.5)}$$

[95] We formalize here the procedure to adjust for simultaneity bias between primacy and growth. An equivalent procedure is followed to adjust for simultaneity bias between urban infrastructure and growth.

[96] Note that there will still be omitted variables bias in our IV estimate of λ if $cov(e,u) \neq 0$. This bias will, of course, diminish as further controls are taken into account (as well as fixed effects in panel data estimations are included).

We can introduce $\hat{v}$ as an additional control in our growth equation and estimate by OLS - control function approach. The estimate for λ will be the same than λ^{IV} (see Wooldridge 2010 for the equivalence between IV and control function approach estimates in linear models):

$$\Delta y_{it,t+1} = \beta(logy_{it}) + \psi X_{it} + \lambda UC_{i,t} + \theta\hat{v} + \pi Z_{1it} + \varepsilon_{it} \quad \text{(M.A.3.6)}$$

which equals to:

$$\Delta y_{it,t+1} = \beta(logy_{it}) + \psi X_{it} + (\lambda+\theta(1-\hat{\delta}))UC_{it} + \theta\hat{\gamma}\hat{\delta}\gamma_{it-1,t} + \pi Z_{1it} + \varepsilon_{it} \quad \text{(M.A.3.7)}$$

and where $\theta(1-\hat{\delta})$ will be the adjustment for simultaneity bias done to an estimate of λ in which simultaneity bias was not addressed (i.e. direct OLS without $\hat{v}$). As it can be seen, the adjustment depends on θ, which indicates the role of past growth in explaining current growth, and also on $(1-\hat{\delta})$, which captures the share on the variation of UC that is due to economic growth. If any of the two components, θ or $(1-\hat{\delta})$, is cero then the estimate reduces to the direct OLS estimate (no simultaneity bias).

Resumen en Español:

Existen dos marcadas tendencias en el mundo: el crecimiento de la urbanización y el aumento de las desigualdades en la distribución de la renta. Esta tesis se centra en la interacción entre ambas tendencias y en el impacto de ambas en el crecimiento económico. Las dos tendencias citadas parecen íntimamente asociadas con las dinámicas del crecimiento económico moderno. La co-evolución de ambas tendencias representa desafíos tanto para países desarrollados como para países en vías de desarrollo, particularmente para estos últimos. Como no puede ser de otro modo, estas realidades han atraído cada vez más investigación al respecto, no solo para entender estos fenómenos sino también para proponer políticas para abordarlos. El objetivo central de esta tesis es el de contribuir en este sentido y en particular el de analizar los efectos de la desigualdad y concentración crecientes en el crecimiento económico a largo plazo.

Las investigaciones presentadas en estas tesis analizan los argumentos teóricos detrás de las relaciones estudiadas e intentan ofrecer evidencia empírica a estos argumentos, todo desde una perspectiva internacional. El punto de partida de la tesis es la idea de que la desigualdad y la concentración geográfica de la actividad económica representan dos dimensiones (una personal y otra espacial) de la concentración de los recursos dentro de los países, que está asociada con el proceso de desarrollo económico. Cada uno de los estudios realizados pretende contribuir no solo a la discusión académica de estas relaciones, sino también proporcionar implicaciones políticas pertinentes. La tesis se estructura en un capítulo introductorio, tres capítulos principales, y unas conclusiones. Así, mientras que el capítulo 2 toma una perspectiva más amplia de las tres variables claves de estudio (las desigualdades, la aglomeración y el crecimiento) los capítulos siguientes (3 y 4) analizan más de cerca relaciones específicas. Cada capítulo refleja artículos académicos fruto de la investigación llevada a cabo durante estos últimos años. Los trabajos se han revisado y sintetizado para evitar la repetición de algunos conceptos y para dar simplicidad a la lectura de la tesis. Los documentos de origen son accesibles en su formato publicado (ya sea como artículos científicos o documentos de trabajo).

Capítulo 1:

El contexto y la motivación, la idea central, la hipótesis, y la metodología general seguida a lo largo de la tesis, se describen en el capítulo introductorio de la tesis. La tesis se enmarca como un trabajo de economía aplicada, y por lo tanto la investigación llevada a cabo ha partido del repaso de los fundamentos teóricos de cada concepto y se ha centrado en el análisis descriptivo y econométrico de datos económicos, interpretando los resultados obtenidos a la luz de la teoría económica y del debate de política correspondiente. Las unidades comunes de análisis son los distintos países para los que se han recogido datos y por tanto la mayoría de las variables introducidas en el análisis (como las relacionadas con la desigualdad y la aglomeración) se miden a nivel de país. No obstante, el análisis también incluye variables a nivel de ciudad (como los datos relacionados con el ambiente urbano recogidos en el capítulo 4) y la mayoría de las preguntas de investigación se puede extender hacia niveles de análisis más desagregados espacialmente (como se describe en las líneas futuras de investigación). La variable central explicada en los diferentes capítulos de la tesis es el crecimiento económico nacional a largo plazo. Por lo tanto, el análisis llevado a cabo se basa en su mayor parte en la estimación de modelos econométricos de crecimiento económico. Tanto los datos de corte transversal como los de panel que se utilizan cubren un lapso de tiempo que va desde 1960 hasta 2010. Diferentes técnicas de estimación se estudian y aplican (desde Mínimos Cuadrados Ordinarios, Estimaciones de Efectos Fijos, Metodologías de Funciones de Control: "*Control Function Approach*", Estimaciones de Efectos Fijos con Variables Instrumentales , y Estimaciones por Método Generalizado de Momentos).

Capítulo 2:

En el capítulo 2 se estudia el impacto conjunto del incremento de la urbanización y de la desigualdad en el crecimiento económico a partir de un análisis descriptivo y econométrico para una muestra de países de todo el mundo. Los resultados obtenidos sugieren que los beneficios netos de la aglomeración a nivel de país - urbanización y concentración urbana - no sólo dependen del nivel de ingresos, lo que la literatura ha ya puesto de relieve, sino también de su distribución; los efectos positivos sobre el crecimiento derivados de la aglomeración sólo se encuentran cuando la distribución de ingresos se mantiene relativamente igualitaria. Un cierto grado de desigualdad

intensifica los incentivos y las economías de aglomeración en las zonas urbanas, fomentando el crecimiento económico. No obstante, una alta desigualdad debilita la cohesión social, lo que puede impedir el total aprovechamiento de las economías de aglomeración, sobre todo las asociadas con la interacción humana – en particular la difusión del conocimiento y la complementariedad del capital humano. Así, los resultados apuntan a un efecto negativo de la aglomeración cuando la concentración de los recursos va demasiado lejos: en los países ricos con una distribución muy desigual de los ingresos.

Capítulo 3:

El capítulo 3 se centra en la desigualdad de ingresos y analiza empíricamente los diferentes mecanismos a través de los cuales la desigualdad puede influir en el crecimiento económico a largo plazo. La principal aportación del análisis realizado es la de presentar evidencia sobre dos efectos paralelos y significativos de la desigualdad (uno positivo y uno negativo) en el crecimiento económico. En particular, el análisis desarrollado descompone la varianza de la desigualdad mediante un sistema de ecuaciones recursivas para proporcionar evidencia empírica de estos dos efectos. Estos dos efectos paralelos de la desigualdad parecen encajar con dos componentes diferentes de la misma: la desigualdad estructural (o desigualdad de oportunidades), mala para el crecimiento, y la desigualdad de mercado (o desigualdad de resultados), buena para el crecimiento. El efecto positivo de la desigualdad parece asociado con la acumulación de capital, la inversión, los incentivos, y la diversidad necesaria para el despliegue de los beneficios de la aglomeración (como se analiza en el capítulo 2). Por otro lado, el efecto negativo se asocia con una menor demanda local, mayor conflicto social, mayores tasas de fertilidad, y menor acumulación de capital humano.

El capítulo 3 incluye una extensión centrada en la relación entre el desempleo y el aumento de las desigualdades. Esta extensión está motivada por un lado por la crisis actual de empleo en países como España, con tasas de desempleo superiores al 25%. Por otro lado, la extensión se motiva también en el hecho de que la evidencia empírica sobre los efectos del desempleo en el crecimiento a largo plazo sea muy escasa, a pesar de argumentos teóricos sólidos sugiriendo dichos efectos. Así, una contribución adicional del capítulo 3 es el hallazgo de un efecto negativo y significativo en el crecimiento económico a largo plazo de niveles de desempleo elevados y persistentes,

cuando esos niveles se ven asociados con el empeoramiento de la distribución del ingreso.

Capítulo 4:

En el capítulo 4 el análisis se centra en la aglomeración. El análisis se focaliza en la relación entre la concentración urbana y el crecimiento económico, con especial atención no solo a diferencias basadas en los niveles de desarrollo económico, sino también a diferencias en cuanto al entorno urbano (centrándose en las infraestructuras urbanas). Los resultados del capítulo sugieren que si bien el aumento de la concentración urbana se ha asociado positivamente con el crecimiento económico en los países asiáticos, lo contrario ha sido cierto para los países del África Sub-Sahariana. La principal contribución del capítulo es mostrar que los efectos negativos de la concentración que se encuentran en el África Sub-Sahariana parecen asociados con la grave deficiencia en infraestructuras básicas en las áreas urbanas de la región, y no a otras características específicas de la región (como el grado de fraccionalización étnica o el marco institucional, sugerido por trabajos anteriores). Los resultados obtenidos indican que, al igual que en el resto del mundo en desarrollo, mejoras en las infraestructuras urbanas (en particular en el acceso a servicios básicos) pueden permitir que los beneficios derivados de la aglomeración superen los costes de congestión también en los países del África Sub-Sahariana.

Capítulo 5:

El análisis llevado a cabo a lo largo de la tesis pone de relieve como cuestiones distributivas asociadas con la concentración de los recursos, ya sea a nivel interpersonal o geográfico, no sólo están asociadas con el proceso de desarrollo económico sino que también representan determinantes importantes del crecimiento económico a largo plazo. En esta línea, el estudio de las dinámicas detrás de la desigualdad de ingresos y de la concentración urbana, y no sólo de su extensión, se ha mostrado como relevante.

Implicaciones políticas relevantes se derivan de los análisis realizados. En particular, los resultados obtenidos han permitido contextualizar el debate sobre la aglomeración a nivel nacional no sólo en función del nivel de desarrollo sino también en función de los problemas de distribución y los aspectos físicos del entorno urbano. En cuanto al nivel de desarrollo, en el caso de los países de bajos ingresos parece existir un conflicto entre eficiencia

y equidad, al menos en el corto plazo, debido a que una mayor concentración urbana parece deseable para el crecimiento pero puede implicar mayores desigualdades. Para los países de altos ingresos, por el contrario, un sistema urbano más equilibrado, en el que las pequeñas y medianas ciudades jueguen un papel fundamental, parece ser una estrategia mejor que la intensa concentración urbana. En cuanto a la distribución, tanto para los países de altos como de bajos ingresos, el hecho de que los beneficios que se derivan de la aglomeración dependan de la desigualdad de ingresos destaca la relevancia de los factores socio-económicos e institucionales en el debate sobre la concentración urbana. Por último, en cuanto al entorno urbano, el análisis realizado confirma la preocupación acerca de los asentamientos urbanos informales (*slums*) como una trampa de pobreza para la mayoría de sus residentes, más que como un estado transitorio en el proceso de cambio estructural asociado con el desarrollo económico. En este sentido, los resultados sugieren dinámicas urbanas *Malthusianas* en algunos países en desarrollo, donde los efectos de la congestión debidos al rápido crecimiento de la población parecen dominar los efectos positivos derivados de la concentración urbana.

En conclusión, el control de las desigualdades y de la forma en que se desarrolla la concentración urbana se ha identificado como esencial para el crecimiento a largo plazo. El control de las desigualdades y la provisión de infraestructuras urbanas adecuadas a ritmo con el rápido incremento de las ciudades se deben considerar no sólo en términos de equidad social sino también en términos de eficiencia económica.

Apéndices Metodológicos:

Finalmente, la tesis incluye tres apéndices metodológicos. El primero describe brevemente como se especifican las regresiones estándar para muestras con datos internacionales ("*cross-country regressions*") a partir de la teoría neoclásica del crecimiento. El segundo analiza brevemente las cuestiones relativas a la estimación de modelos dinámicos de crecimiento económico a partir de datos de panel. El tercer y último apéndice presenta una prueba formal sobre como se puede ajustar el sesgo de simultaneidad utilizando estimaciones de Efectos Fijos con Variables Instrumentales usando variación residual de la variables de interés.

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