Average city size and economic growth

by

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Abstract

This paper examines the link between average city size and aggregate economic growth in a total of 114 countries for the period between 1960 and 2010. The analysis – which includes pooled two-stage least-squares (2SLS), panel data analysis, system generalized method-of-moments (GMM) estimator, and an instrumental variable (IV) approach – finds that, in contrast to the prevailing view, there is no universal positive relationship between average city size and economic growth and that the results vary between high-income and developing countries. In high-income countries, there is consistent evidence of a positive albeit decreasing link between city size and economic growth. In contrast, the relationship does not hold for developing countries, for which most of the coefficients display insignificant results or point towards a negative connection between both factors.

Keywords: Cities, city size, economic growth, high-income countries, low-income countries

JEL Codes: R11, R12

Introduction

The role of cities has been at the forefront of development policy debates over the past two decades. The rapid urbanization process in many developing countries, paired with the ever increasing size of cities are simultaneously hailed as key drivers of productivity and growth, as well as big challenges for the developing and emerging worlds. The prominence of the topic is not a surprise given the sheer magnitude and speed of the changes. Recent statistics (United Nations, 2014) illustrate well these developments. While there were only 3 cities with more than 10 million inhabitants in 1960, there are 29 today. Similarly, the number of cities with 5 to 10 million inhabitants increased from 9 to 44. Hence, not only do more people live in cities, they also live on average in far larger cities than 50 years ago.

This is particularly true for the developing world, where the most dramatic changes have occurred in the past decades. Massive mega-cities have sprung up virtually anywhere, including countries as diverse as Pakistan, Peru, the Philippines, the Democratic Republic of the Congo, and Bangladesh, driving up average city sizes everywhere in the developing world. Once the largest cities were found in high-income countries; today it is the developing world that accounts for the majority of the global urbanization drive and for most mega cities (McCann and Acs, 2011, United Nations, 2014).

While many researchers and policy makers have voiced concerns about these trends and their social (i.e. increased urban congestion), environmental (i.e. increased pollution), and economic (i.e. rising interpersonal and interspatial inequality) consequences, the 2009 World Development Report summarizes well an often dominant view in the economic development policy sphere: "No country has grown to middle-income without industrializing and urbanizing. None has grown to high-income without vibrant cities. The rush to cities in developing countries seems chaotic, but it is necessary. It seems unprecedented, but it has happened before" (The World Bank, 2009, p.24). Consequently, the rapid urbanization in the developing world, with its rising average city size and sprawling megacities, are seen as inevitable and beneficial from an economic perspective.

A wealth of theoretical and empirical literature lends support to this notion. The New Economic Geography School (NEG) emphasises the benefits of agglomeration and growing cities for economic growth in particular at low levels of economic development (Martin and Ottaviano, 2001, Fujita and Thisse, 2003, Henderson, 2003). Similarly, urban economists stress the static and dynamic productivity gains from increased city size (Duranton and Puga, 2004, Rosenthal and Strange, 2004, Duranton, 2015).

However, some caveats in the existing literature raise questions about the universal applicability of the benefits of increases in average city size. First, most empirical research focuses, with few exceptions, on developed countries, and on the US and the UK in particular. Recent literature (Gollin et al., 2013, Jedwab and Vollrath, 2015) suggests however that the drivers of urbanization differ significantly between developed and developing countries. Such differences in turn may impact on the expected productivity gains from increases in average city size. Furthermore, the sheer size of many cities in developing countries, differences industrial structure, lower institutional capacity, and limited infrastructure can reduce the benefits developing countries can extract from rapid increases in average city size. More empirical evidence from developing countries is therefore sorely needed.

Second, the analytical focus of the empirical literature leaves room for interpretation with regards to the impact of recent urbanization trends on aggregate economic growth. Studies in urban economics have been mainly concerned with comparisons of productivity levels and changes involving cities of different sizes (Duranton and Puga, 2004, Rosenthal and Strange, 2004), but do not address the question at an aggregate level. Some NEG research delves into the link between levels of urban concentration and aggregate growth (Henderson, 2003, Brülhart and Sbergami, 2009, Castells-Quintana and Royuela, 2014). However, while frequently cited in the literature as driving growth in countries with large cities, the indicators used are only indirectly linked with city sizes and do not reflect the size aspect of current urbanization trends. It is therefore pertinent to specifically look at the relationship between an aggregate measure of city size, i.e. average city size, and national economic growth.

In this paper, we address these two gaps by empirically examining the question of whether the average size of a country's cities affects economic growth at the national level. The analysis covers average city size in 114 countries for the period between 1960 and 2010, specifically distinguishing between industrialized and developing countries. Different estimation techniques – including system generalized method-of-moments (GMM) estimator and an instrumental variable design (IV) – are used in order to address potential endogeneity concerns arising from the intimate relationship between urbanization and economic development. Our results suggest that there is indeed a positive effect of average city size on economic growth, however only for developed countries. We do not find evidence that the presence of large cities is growth inducing in developing countries – to the contrary, the IV results suggest a negative impact of city size on growth at the national level.

The remainder of the paper is structured as follows. The following section describes the theoretical and empirical literature that explores the link between city size and economic growth. The third section introduces the methodology, indicators used, and presents the dataset. The results and a test of their robustness by means of an IV approach are included in the fourth section, and section five discusses them in the context of the existing literature. The final part concludes and proposes areas for further research.

Average city size and economic growth: from theory to empirical evidence

The question of whether a country's cities influences economic growth has been addressed by several streams of literature, most prominently by the New Economic Geography School (NEG) and urban economics. The underlying assumption is that cities, in particular larger ones, create agglomeration economies and thereby make people more productive. This in turn increases the level of economic development at any given level of inputs (Duranton, 2008).

The NEG School emphasizes the economic efficiency-related benefits of agglomeration. In the traditional NEG framework, centripetal forces, such as localized knowledge spill-overs, pooled labour markets, and forward and backward linkages, make companies and people more productive if they concentrate in one area. Centrifugal forces, such as immobile factors, increasing rents and congestion in the prime area, however, incentivize people and firms to locate elsewhere. The relative strength of these two forces shapes the economy's spatial structure and hence if people concentrate in one large city or, by contrast, spread out to smaller ones (Fujita et al., 1999). Several authors combine this basic framework with an endogenous growth model to analyse the effect of agglomeration on economic growth and vice versa. While the approaches vary in the specific channels used as agglomeration and dispersion forces, they generally conclude that more agglomeration and thus larger cities are beneficial for economic growth (Martin and Ottaviano, 2001, Fujita and Thisse, 2003).

A number of empirical studies confirm this relationship. Henderson (2003), Bertinelli and Strobl (2007), Brülhart and Sbergami (2009), and Castells-Quintana and Royuela (2014) use urban primacy, the percentage of the urban population which lives in the largest city, as a measure of agglomeration and test its influence on national economic growth. They all find that primacy has a positive effect on economic growth, but that the positive effect decreases as the level of economic development rises. Brülhart and Sbergami (2009) also use the percentage of the urban population living in cities above 750,000 inhabitants as an alternative measure of urban concentration and come to the same conclusions. Evidence emerging from the theoretical and empirical NEG literature suggests that a more concentrated urban structure with larger cities spurs economic growth, in particular at low levels of economic development. Consequently, recent urbanization trends in the developing world are considered beneficial for economic development in these countries.

The urban economics literature also emphasizes productivity gains stemming from increases in city size but gives no unambiguous answer regarding the effect of average city size on national economic performance. Duranton and Puga (2004) describe a number of channels – similar to the NEG drivers of growth – which make people in cities more productive: the sharing and the matching of infrastructure, inputs, suppliers and labour as well as learning through the generation, diffusion, and accumulation of knowledge. Urban economics also underlines the importance of a dynamic effect of cities on worker's productivity through learning, which increases over time (Duranton, 2008). The dominant view is that agglomeration economies increase with city size.

This sort of productivity gains have been often documented at the city level. Rosenthal and Strange (2004), for example, indicate that a doubling of city size leads to a productivity increase of 3–8%. Melo, Graham, and Noland (2009) confirm this positive relationship in their meta-analysis of 34 studies, despite uncovering important regional differences. In the same vein, Duranton (2015) reviews the studies examining developing countries and concludes that productivity increases are even higher in developing countries than in the industrialized world. Differences in terms of productivity gains for different sectors are also in evidence in this type of research, with high-tech sectors and service industries exhibiting the strongest agglomeration economies (Graham, 2009, Henderson, 2010).

A rise in city size also leads, however, to negative externalities such as congestion, higher rents and commuting time which undermine the benefits of agglomeration (Duranton and Puga, 2004). People's productivity within a city, therefore, does not rise *ad infinitum* with increases in city size. It follows an inverted U-shape function: productivity increases up to a certain threshold of city population, after which congestion costs outweigh the benefits from agglomeration and productivity starts to decrease. Beyond the said threshold, workers and firms would be better off relocating to a different city. Through this process, a system of cities arises within a country which – if adequately functioning – efficiently allocates people to cities and maximises the productivity of a country's urban population, as well as its national growth (Henderson, 1974, Duranton and Puga, 2004).

In practice, however, this process can be obstructed by a number of factors. Coordination failure may prevent migration from the prime to secondary cities, as a single actor – i.e. an individual employee or company – cannot internalize the external benefits it creates for others by moving (Venables, 2005, Duranton, 2008). Furthermore, the political sway of the primary city, openness to trade, and a lack of an adequate intercity transport infrastructure network can all hamper the emergence of secondary cities (Ades and Glaeser, 1995, Puga, 1998, Duranton, 2008). A prime city whose size is beyond optimal can therefore emerge. perhaps in combination with small or virtually non-existing secondary cities. Venables (2005) argues that this may result in a low economic development trap. The larger-than-optimum city reduces the productivity of workers and firms which, in turn, curtails economic growth (Venables, 2005). Low growth makes the possibility of starting a new city more difficult, often leading to an ever-growing expansion of prime city, even after it has exceeded the optimal size threshold.

Hence, from a theoretical urban economics perspective whether recent dramatic increases in city size in the developing world are growth-inducing or detrimental to economic growth depends crucially on where on the productivity curve a country's cities are and on whether a functioning system of cities has emerged. Whether this is the case needs to be determined empirically.

As described above, the existing empirical evidence from both NEG and urban economics is large and points relatively uniformly to a growth promoting effect of increasing city size. However despite the wealth of studies, some important limitations remain. First, most research addressing these issues, in particular from the empirical urban economics literature, focuses on the developed world. Only a handful of developing countries are covered. This is problematic for a number of reasons related to the underlying urbanization process, likely differences in the balance between agglomeration economies and diseconomies, as well as the absolute size of the cities in the developing world. With regards to the urbanization process, it is frequently assumed that developing countries follow the same path industrialized countries did in the past (as is the case in the World Development Report 2009). There is, however,_increasing evidence that questions this assumption. Economists traditionally explain the urbanization process with a structural shift from an agricultural to a manufacturing-based economy in which higher (expected) wages in the urban industrial sectors stimulate migration from rural areas to cities (Lewis, 1954, Harris and Todaro, 1970). Urbanization in today's developed countries is considered to have been strongly tied to industrialization and economic growth. In contrast, many developing countries are urbanizing in the presence of low growth and without a strong, accompanying industrialization process. Fay and Opal (2000) described this situation of "urbanization without growth" and pointed to a wide array of factors driving urbanization in developing countries. These included push factors in the rural countryside such as conflict, negative agricultural shocks, and rural poverty as well as pull factors from cities, such as better urban living conditions through improved access to public services and other urban amenities. Glaeser (2014) also suggested that cities have grown larger in the developing world due to their ability to import food. In developed countries in contrast, cities are historically deemed to have increased in population as the agricultural hinterland became more productive and could feed a larger non-food producing urban population. Furthermore, Jedwab and co-authors (Gollin et al., 2013, Jedwab and Vollrath, 2015) recently reported that urbanization in developing countries is strongly linked to natural resource exports as opposed to industrialization. As a consequence, the share of urban dwellers working in the non-tradable service sector is much higher than in developed countries, where urban population grew as employment in manufacturing and in the tradable service sectors. This has important implications for the magnitude of agglomeration economies that a city generates. As Gollin et al. (2013) have stressed, cities growing as a consequence of the expansion of resource exports do not create the same push in productivity as industrial cities.

Related to the previous point are differences in urban infrastructure endowments and in the industry composition of the cities in developing countries. As pointed out above, the balance between agglomeration economies and diseconomies determines the benefits from increasing city size. The fast growth of cities in the developing world, together with a lack of public resources for infrastructure investments, and economies based on low technology sectors imply that cities in the developing world face decreasing productivity levels at a lower city size than cities in the developed world. Limited institutional capacity to deal with the challenges aggravates this situation (Glaeser, 2014).

Finally, cities in the developing world are frequently much larger than their counterparts in industrialized countries. Empirical evidence stemming from what are smaller cities in the developed world is unlikely to be a good *explanans* for the situation in developing countries, in particular bearing in mind the U-shaped productivity function of cities. All these aspects − urbanization path, the balance between agglomeration economies and diseconomies as well as overall city size − strongly call for caution when applying evidence generated on the basis of analysis conducted in developed countries to the developing world. Empirical evidence, which focuses on differences between developed and developing countries, is, in this respect, still much needed.

The second limitation relates to the analytical focus of the existing empirical literature. On the one hand, empirical studies with an urban economics lens take a city perspective, i.e. they provide an answer to the question if people in large cities are more productive than in small cities. They do, however, not tackle the question at the national level. Following the system of cities approach it is not necessarily evident that because one city is more productive than another implies an overall productivity maximising effect at the country level if all resources are pooled in the larger city. For example, increasing the population in 'city one' through migration from 'city two' may make 'city one' more productive, but the reduction in size of 'city two' may result in a larger decrease in productivity there. The result will then be sub-optimal at the national level. As most countries include more than one city, looking purely at this question from a city-level perspective may not be very revealing.

On the other hand, a relatively large number of NEG studies address the issue at the national level. However, the focus of this literature is not the actual size of a country's cities, but how concentrated the urban structure is. While these studies are frequently cited as evidence to support the notion of fostering agglomeration within developing countries, they do not say much about the size-related effect of cities. Most studies use urban primacy, which − if at all − is negatively correlated with the size of a country's cities (e.g. there is a very low primacy in India despite its cities being large, but a very high primacy in most island states which have very small cities). The results therefore are more likely to reflect the benefits of being able to focus public spending in one place as a result of a concentrated urban population as opposed to agglomeration economies arising through city size.

We aim to address these two limitations by studying the effect of increased average city size on economic growth at an aggregate level. In other words we ask the question of whether countries grow faster if the urban population lives on average in larger cities? We furthermore specifically focus on possible differences in this respect between developed and developing countries.

Model and data

In order to test these two issues, we follow the dominant approach of the empirical literature on urban concentration and national economic growth (Henderson, 2003, Brülhart and Sbergami, 2009, Castells-Quintana and Royuela, 2014). We build a simple GDP per capita growth equation based on the extended Solow growth model (Durlauf et al., 2005). A country's growth rate in 5 year periods is estimated as a function of GDP per capita at the beginning of the period and a set control variables which reflect both variables related to the accumulation of factors, as well as a set of other characteristics influencing national growth and the size of a country's cities. Rather than a measure for the level of urban concentration, as has frequently been the case in the above-mentioned literature, we include an indicator depicting the average size of a country's cities. If living in larger cities boosts people's productivity, economic growth should be higher while holding the other inputs constant. The model takes the following form:

$$\Delta GDPpc_{ip} = \alpha + \beta \, citysize_{ip} + \gamma \, GDPpc_{ip} + \delta \, \boldsymbol{X}_{ip} + \mu_p + \varepsilon_{ip}$$

Where

p denotes five year intervals;

$\Delta GDPpc_{ip}$ is the GDP per capita growth rate of country *i* in period *p*;

$\mathrm{citysize_{ip}}$ is an aggregate indicator for the average size of cities in country *i*;

$\mathrm{GDPpc_{ip}}$ represents the log GDP per capita of country *i* at the beginning of period *p*;

X_{ip} depicts a set of control variables for country *i*, measured either at the beginning or as an average of period *p*;

μ_p represents time fixed effects; and

ε_{ip} is the error term.

The variable of interest is $citysize_{ip}$. Testing if the size of a country's cities has an impact on national economic performance requires an aggregate measure of city size at the country level. For this purpose, we calculate the population-weighted average city size as the sum of the absolute number of each city's population multiplied by its share of the urban population. This indicator reflects the average agglomeration (dis-)economies which a typical urban dweller experiences.

The source of data is the 2014 revision of the World Urbanization Prospects [WUPS] (United Nations, 2014). WUPS 2014 includes, among other data, information about (i) the population of every city above 300,000 inhabitants, (ii) the share of the urban population living in cities below 300,000 and (iii) the total urban population. It covers a total of 199 countries from 1960 to 2010.[1]

We multiply the exact population size of each city above 300K with its share of the urban population. As there is no information available about the exact size of cities below 300K, we use a proxy for the average city size of cities below 300K and multiply it by the share of the urban population living in cities below 300K.[2] These fractions are subsequently added in order to obtain the population weighted average city size of a country.

How the population-weighted average city size indicator works is reflected in the following examples. Let us take country A which has two cities, each with 1M inhabitants. In this case, the population weighted average city size is: 1M*50% + 1M*50% = 1M (as would be the simple average). Country B, by contrast, has one city of 1.9M inhabitants and a second city of

0.1M inhabitants. The resulting population weighted average city size is: 1.9M*95% + 0.1M*5% = 1.81. In contrast to the simple average which as in country A would be 1M, this number reflects the fact that the vast majority of people live in the larger city of 1.9M inhabitants and therefore experience the agglomeration economies and diseconomies of a city of such size. Finally, country C has one city of 1.15M inhabitants and a second city of 0.2M inhabitants. The population weighted average city size is with roughly 1M similar to that of country A. This takes into account that, in spite of the differences between the two countries, the majority of the urban population lives in a city of a similar size.

The population-weighted average city size indicator also differs considerably from primacy, the traditional measure used by the literature concerned with urban concentration. A country in which city 1 has a population of 0.3M and a city 2 has a population of 0.5M has the same primacy level (62.5%) as a country with one city of 3M and another city of 5M inhabitants. This difference in absolute size is, however, reflected in our average city size measure.

Figure 1: Evolution of the median of average city size between 1960 and 2010 (in thousands)

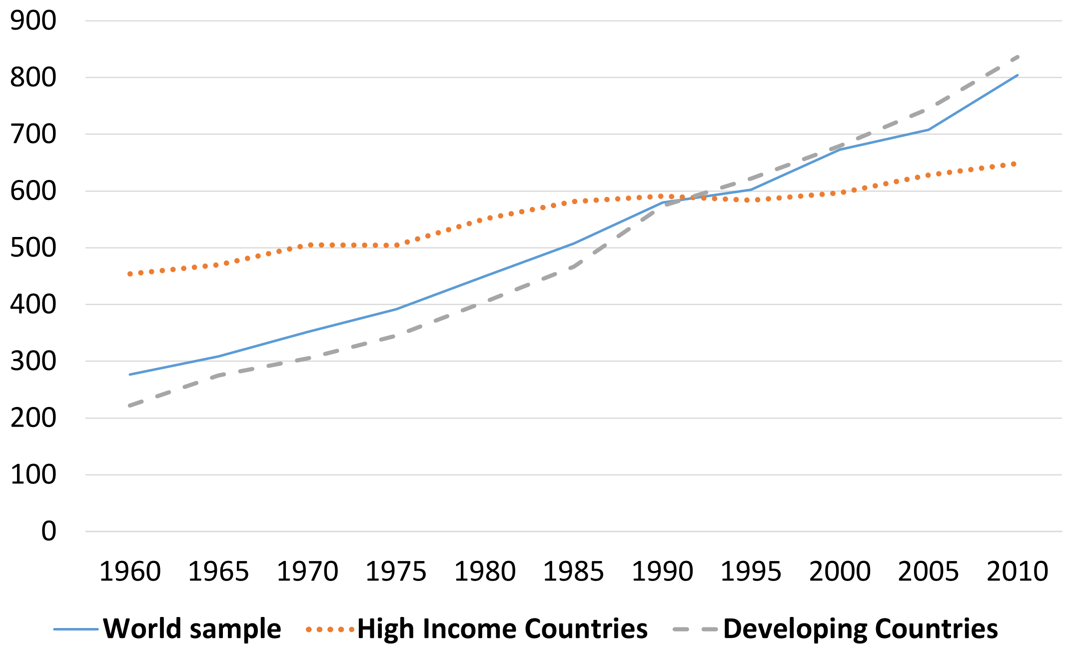


Figure 1 shows the evolution of the average city size as the median for the countries included in our regressions. The numbers are consistent with the urbanization trends addressed in the introduction of this paper. Overall city size increased from a median of approximately 280,000 in 1960 to 800,000 in 2010, signalling almost a tripling of average city size. Figure 1 also illustrates the diverging trends between the industrialized and the developing world. Average city size in developing countries increased from 220,000 to 845,000 during the 50 year period considered, surpassing average city size in high-income countries around the year 1990. In the same period average city size in developed countries only increased from 500,000 to 650,000. In 1960, 12 of the top 20 countries in terms of largest average city were high-income countries. Today, developed countries only take 6 spots on that list, with the remaining 14 countries belonging to the developing world.

The control variables are those typically employed in cross-country growth regressions: initial GDP per capita (GDPpc) to control initial levels of wealth and for conditional convergence, i.e. countries are expected to grow faster if starting from a lower level, holding other factors constant (Durlauf et al., 2005); years of schooling as a proxy for human capital, since a more educated work force is assumed to be more productive and drive up growth (Romer, 1986, Lucas, 1988); and private investment and government consumption as a percentage of GDP, due to their contribution to a country's capital stock – the crucial growth driver in the basic neoclassical Solow model.

Additionally, the model includes a number of controls which may be directly linked to the effect of city size on growth. The first of these is openness, which is measured as the sum of national exports and imports as a percentage of GDP. A country's openness is believed to influence city size via its effect on the balance between centripetal and centrifugal forces (Krugman and Elizondo, 1996). Openness is also understood to be directly related to growth (Sachs and Warner, 1995). Failure to control for openness may therefore result in an omitted variable bias. The second is national population. A country's population is expected to be closely linked to its average city size (i.e. India has bigger cities than, say, Switzerland). Furthermore, a country's size and, by extension its market potential, can be also envisaged to affect national economic performance (Alesina et al., 2005). Controlling for population size also ensures that the results are not driven by a handful of specific cases, such as China or India, both of whom have experienced extremely strong growth in past decades. The final control relates to a country's political system. Certain political systems such as dictatorships have been shown to increase city size (Ades and Glaeser, 1995) and may at the same time impact on a country's growth performance. We, therefore, include five year averages of the widely used 'polity indicator' which rates countries on a scale from -10 (autocracy) to 10 (consolidated democracy).

The data for the controls is sourced from the eighth edition of the Penn World Tables with the exception of the years of schooling indicator and the measure for the political systems. These come from the Barro and Lee database and the Polity IV project dataset respectively. A more detailed description of the indicators and sources is included in the appendix (Table A1). Depending on the specifications, our analysis covers a maximum of 114 countries.

We estimate the model using pooled 2SLS as a baseline as well as country fixed effects and system GMM to take advantage of the panel structure of the dataset. All regressions include time fixed effects and robust standard errors which are clustered by country in the pooled 2SLS regression. Average city size is instrumented with its second lag in the pooled 2SLS. Furthermore, we employ system GMM to address the issue of reverse causality that inevitably arises when studying the relationship between city size, urbanization, and economic development, to test if city size is in fact a result of economic growth as opposed to being a driver of it. Furthermore, system GMM is appropriate for dynamic panels in which the dependent variable is influenced by its lagged values. This is the case for our estimates because of the inclusion of the lagged value of GDPpc as an explanatory variable and the assumption that growth rates are influenced by GDPpc. System GMM addresses both points by creating a system of equations in which the levels of endogenous variables are instrumented with lagged differences and the first differences are instrumented with past levels (Roodman, 2009). We present these results alongside the 2SLS and fixed effects estimates for all our regressions. As an additional robustness test to address the issue of endogeneity, we conduct an instrumental variable approach in a separate section, which resorts to historical data for the construction of the instrument.

Results

Main results

Table 1 displays the results for the 114 countries making the world sample – columns 1, 3, and 5 for the regressions with the simple term only; columns 2, 4, and 6 contain the squared term of average city size in order to account for possible non-linearity.

The model works well and the controls show the expected signs (Table 1). The coefficient of GDP per capita at the beginning of the period is negative and strongly significant in all estimations, indicating conditional convergence. Private investment also displays, as expected, positive and highly significant coefficients across all estimates. Years of schooling is significant in the 2SLS model only. This is in line with previous literature: Henderson (2003), for instance, points out that education is rarely robust in these types of regression as changes in years of schooling are more likely to have an effect over a longer time horizon than in the short-term (Durlauf et al., 2005). Population size is significant, but with different signs depending on the estimation technique. Again this is not surprising as in a cross-section comparison large countries such as China and India have grown faster than smaller ones. If we look at the within changes however, countries which experienced a strong population growth tend to be countries with low-income, in particular in Africa. Many of those countries have also experienced low growth in the past decades.

Table 1: Average city size - Dependent Variable: GDP per capita growth, 1960 to 2010 – World Sample

VARIABLES	(1) Pooled 2SLS	(2) Pooled 2SLS	(3) Fixed Effects	(4) Fixed Effects	(5) System GMM	(6) System GMM
Average city size	6.15e-05	0.0237**	0.0122	0.0461**	-0.0321*	-0.0312
	(0.00388)	(0.0104)	(0.0126)	(0.0215)	(0.0167)	(0.0348)
Average city size squared		-0.00171***		-0.00221**		0.001000
		(0.000584)		(0.000946)		(0.00185)
Initial GDPpc	-0.0360***	-0.0391***	-0.219***	-0.222***	-0.014***	-0.018***
	(0.00979)	(0.00986)	(0.0354)	(0.0352)	(0.0509)	(0.0404)
Years of schooling	0.0166***	0.0172***	0.00667	0.00568	0.00608	0.00906
	(0.00365)	(0.00373)	(0.0112)	(0.0110)	(0.0175)	(0.0150)
Private investment	0.511***	0.512***	0.797***	0.786***	0.784**	0.806***
	(0.117)	(0.114)	(0.141)	(0.142)	(0.357)	(0.311)
Government consumption	0.122	0.144	0.101	0.0981	0.472	0.473
	(0.111)	(0.111)	(0.110)	(0.111)	(0.296)	(0.338)
Openness	-0.00539	-0.00796	-0.0126	-0.0121	-0.0545*	-0.0548**
	(0.0154)	(0.0140)	(0.0160)	(0.0154)	(0.0284)	(0.0268)
Population	0.0162***	0.00926	-0.0945**	-0.122***	0.102*	0.0753*
	(0.00508)	(0.00597)	(0.0450)	(0.0449)	(0.0544)	(0.0401)
Political System	-0.000979	-0.000850	-0.00160	-0.00182	-0.00254	-0.00340
	(0.000937)	(0.000948)	(0.00117)	(0.00116)	(0.00521)	(0.00458)
Constant	0.240***	0.260***	1.759***	1.828***	-0.239	-0.158
	(0.0718)	(0.0724)	(0.338)	(0.334)	(0.329)	(0.273)
Time fixed effects			Yes	Yes	Yes	Yes
Country fixed effects			Yes	Yes	Yes	Yes
Observations	971	971	1,058	1,058	1,058	1,058
R-squared	0.202	0.207	0.270	0.275		
Number of countries			114	114	114	114
Sargans					25.44	32.66
					(0.062)	(0.018)
AR1					2.27	-2.69
					(0.007)	(0.007)
AR2					1.06	1.07
					(0.290)	(0.285)

Notes: Robust standard error clustered by country in parentheses: *** p<0.01, ** p<0.05, * p<0.1
System GMM uses second and third lag 2-step estimator

The results for our variables of interest in the global sample provide mixed evidence. The coefficients for average city size – in those regressions including only average city size and not its squared term – are insignificant in the pooled 2SLS and fixed effects analyses, but negative and significant at the 10% level in the system GMM estimate (Table 1, Regressions 1, 3, and 5). Once we consider the squared term in the regression analysis the picture changes. The pooled 2SLS and fixed effects coefficients for average city size are positive and significant, while the system GMM results insignificant. The squared terms coefficients are negative and significant at the 1% and 5% level in the 2SLS and fixed effects estimates respectively (Table 1, Regressions 2, 4, and 6). This would indicate a positive connection between city size and economic growth, which diminishes as the average size of cities increases. Overall, these results send contrasting messages about the link between average city size and national economic growth. If anything they may signal, as hinted in the theoretical section, widely differing realities about the association between city size and economic growth in developed and developing countries.

In order to assess whether this is the case, we divide the sample into high-income and low- and middle-income countries, using the World Bank's classification. Columns 1-6 of Table 2 show the results for 38 high-income and columns 7-12 for 76 low- and middle-income (developing) countries. The results differ sharply between the two samples, but provide consistent results within the two groups. For high-income countries, there is now strong evidence that average city size does indeed drive national economic growth. In all regressions where the squared term for average city size is included (Table 2, Regressions 2, 4, and 6), the coefficient for the main term is positive and significant in all estimates, including the system GMM results. The negative and significant coefficient of the squared term in all estimates indicates that the positive effect of city size on national growth diminishes as the average size of a city grows. The coefficients are similar between the fixed effects and system GMM, but lower in the 2SLS estimate (Table 2, Regressions 2, 4, and 6).

Table 2: Average city size - Dependent Variable: GDP per capita growth, 1960 to 2010 – by income group

	High-income Countries						Developing Countries					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Pooled 2SLS	Pooled 2SLS	Fixed Effects	Fixed Effects	System GMM	System GMM	Pooled 2SLS	Pooled 2SLS	Fixed Effects	Fixed Effects	System GMM	System GMM
Average city size	-0.000278	0.0172*	0.0119	0.120***	0.00785	0.0945***	-0.000215	0.0248	0.00956	0.01000	-0.0355	-0.108
	(0.00241)	(0.00939)	(0.0125)	(0.0434)	(0.0158)	(0.0281)	(0.00945)	(0.0244)	(0.0133)	(0.0437)	(0.0243)	(0.0698)
Average city size squared		-0.00112**		-0.00485**		-0.00494***		-0.00440		-6.30e-05		0.00910
		(0.000523)		(0.00180)		(0.00141)		(0.00348)		(0.00502)		(0.00967)
Initial GDPpc	-0.115***	-0.109***	-0.267***	-0.299***	-0.038***	-0.050***	-0.0238*	-0.0268*	-0.224***	-0.224***	0.027***	0.016***
	(0.0144)	(0.0136)	(0.0543)	(0.0521)	(0.0885)	(0.0702)	(0.0138)	(0.0147)	(0.0406)	(0.0404)	(0.0506)	(0.0490)
Years of schooling	0.00657*	0.00628*	0.0118	0.00903	-0.0201	-0.0147	0.0172***	0.0177***	0.00296	0.00297	0.00686	0.00829
	(0.00348)	(0.00336)	(0.0138)	(0.0117)	(0.0356)	(0.0305)	(0.00437)	(0.00455)	(0.0146)	(0.0145)	(0.0105)	(0.0108)
Private investment	0.574***	0.556**	0.427*	0.383*	0.225	-0.105	0.340***	0.344***	0.831***	0.831***	-0.143	0.0447
	(0.221)	(0.219)	(0.225)	(0.206)	(0.779)	(0.572)	(0.123)	(0.123)	(0.170)	(0.168)	(0.468)	(0.406)
Government investment	0.238	0.272	-0.0756	-0.0352	0.722	0.749	0.0980	0.106	0.0631	0.0629	0.0996	0.227
	(0.171)	(0.173)	(0.355)	(0.369)	(0.805)	(0.814)	(0.115)	(0.115)	(0.114)	(0.119)	(0.281)	(0.316)
Openness	0.0309*	0.0270	0.0871*	0.0736	0.107	0.0942	-0.0155*	-0.0170*	-0.0208	-0.0208	-0.00803	-0.0291
	(0.0185)	(0.0192)	(0.0477)	(0.0469)	(0.105)	(0.0773)	(0.00916)	(0.00923)	(0.0132)	(0.0132)	(0.0323)	(0.0344)
Population	0.0134*	0.00813	0.0732	-0.0506	0.0313	-0.0423	0.0189***	0.0145*	-0.240***	-0.240***	0.0610**	0.106***
	(0.00696)	(0.00765)	(0.0873)	(0.118)	(0.0669)	(0.0583)	(0.00647)	(0.00808)	(0.0823)	(0.0826)	(0.0279)	(0.0374)
Political System	0.000788	0.00114	0.00193	0.000729	-0.00345	0.00455	-0.00184	-0.00194*	-0.00267*	-0.00267*	-0.00407	-0.00427
	(0.00177)	(0.00170)	(0.00209)	(0.00210)	(0.0109)	(0.00579)	(0.00115)	(0.00117)	(0.00149)	(0.00150)	(0.00472)	(0.00486)
Constant	0.966***	0.914***	2.158***	2.645***	0.392	0.581	0.172*	0.190*	1.856***	1.857***	-0.185	-0.217
	(0.172)	(0.171)	(0.645)	(0.611)	(0.817)	(0.724)	(0.0985)	(0.105)	(0.351)	(0.344)	(0.279)	(0.275)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects			Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Observations	317	317	361	361	361	361	654	654	697	697	697	697
R-squared	0.494	0.499	0.468	0.497			0.180	0.178	0.261	0.261		
Number of countries			38	38	38	38			76	76	76	76
AR1	-	-	-	-	-2.47	-2.79	-	-	-	-	-2.32	-2.36
					(0.017)	(0.005)					(0.020)	(0.017)
AR2	-	-	-	-	-0.64	-0.14	-	-	-	-	0.92	1.00
					(0.524)	(0.888)					(0.356)	(0.317)
Sargan	-	-	-	-	30.18	28.05	-	-	-	-	19.32	20.48
					(0.017)	(0.061)					(0.252)	(0.306)

Notes: Robust standard error clustered by country in parentheses: *** p<0.01, ** p<0.05, * p<0.1
System GMM uses second and third lag 2-step estimator

In order to understand the magnitude of the effect, we calculate the fitted values of the partial association between average city size and economic growth based on the system GMM coefficients. Raising average city size from 1M to 1.1M increases the five year growth rate by 0.84%. When average city size increases from 5 to 5.1M, growth rises by 0.45%. Values become close to 0 around 7.5M and turn negative at approximately 9.7M. This last value should be interpreted with caution, as there are very few observations in our sample with such high average city sizes. The evidence, thus, strongly suggests that high-income countries indeed grow faster when the population on average lives in larger cities, although the impact is relatively modest.

The contrary is true for developing countries, as shown in columns 7 to 12 of Table 2. No evidence at all can be found of an impact of average city size on economic growth. Neither the main term of average city size nor the squared term is significant in any of the estimations. We have also experimented by further dividing the sample into a low- and a middle-income group. The results remain insignificant for both groups. It is worth noting that the R-squared drops somewhat in the regressions for developing countries compared to the global sample, while it significantly increases for the high-income group. This is reflective of the fact that in general developing countries' growth does not seem to follow the same patterns and rules as in developed countries.

Instrumental variable approach

A frequent concern in regressions addressing the relationship between city size and economic growth is reverse causality. Is city size in fact a mere result of economic growth as opposed to a driver of it? In the previous section we partially addressed this issue by including system GMM estimations alongside the other estimation techniques. To further test the robustness of the results, we employ an additional instrumental variable design.

The challenge is to find a suitable instrument for city size, i.e. a factor that is correlated to the size of a country's cities but not to national economic growth, in order to isolate the exogenous component of city size. We resort to historic data for this purpose and employ a measure of the number of years that the current capital city of a country has been the capital since the 1 A.D.[3] Countries where the current capital has been an important place of political (and economic) power for a long time are more likely to have developed a more concentrated urban structure with a more dominant and larger prime city. Our population weighted average city size indicator should thus also be larger in a country where the current capital has been the main political centre for longer time periods. This hypothesis is confirmed by a brief examination of our dataset. Countries with large average city sizes, such as the United Kingdom, France, Peru, Mexico, Russia, or China also have longstanding capital cities.

The question that remains concerns the exogeneity of the instrument. It could be argued that the 'years as capital' has an impact on the level of economic development and this, in turn, affects growth performance. Countries with long-established capitals may be states where sound political institutions – which are widely regarded as growth enhancing – have had more time to develop. Once again, a brief examination of the dataset suggests that no such correlation exists. There are countries with relatively young capitals, such as Germany and Australia, which are highly developed. At the same time there are countries where the capital was established a long time ago, such as Peru, Nepal, or Mozambique, with much lower levels of economic development. The two-way scatterplot of GDP per capita in 1960 and the instrument confirms this assertion (Appendix, Figure A1). No obvious correlation can be found between both factors. 'Years as a capital' has also an insignificant coefficient when regressed on GDP per capita in 1960. Finally, it is highly unlikely that the existence of a longstanding capital has a direct influence on the growth performance of a country over a specific short period of time. The first-stage F-stat supports the relevance of our instrument.[4]

The model is estimated using pooled 2SLS. For the sake of simplicity, we only include the main term in this estimate (Table 3). The results for high-income countries are confirmed. A country's average city size is positively and significantly associated with economic growth (Table 3, Regression 1). The coefficient is similar to the system GMM estimate reported in Table 2, roughly confirming its accuracy. Every 100,000 population increase in average city size raises the five year growth rate by approximately 0.7%.

Table 3: Average city size - Dependent Variable: GDP per capita growth, 1960 to 2010 – IV estimates

	(1)	(2)
VARIABLES	High-income countries	Developing countries
Average city size	0.0729**	-0.232**
	(0.0359)	(0.102)
Initial GDPpc	-0.075***	0.047***
	(0.0242)	(0.0318)
Years of schooling	0.00685	0.0121**
	(0.00418)	(0.00585)
Private investment	0.298**	0.306**
	(0.151)	(0.143)
Government investment	0.287*	-0.151
	(0.170)	(0.175)
Openness	0.0190	0.00734
	(0.0171)	(0.0169)
Population	-0.0113	0.111***
	(0.0134)	(0.0431)
Political System	0.00272	-0.000589
	(0.00260)	(0.00140)
Constant	0.658***	-0.353
	(0.223)	(0.234)
Observations	258	579
R-squared	0.973	0.955
First stage F-stat	10.07	9.62

For developing countries, the coefficient of average city size is negative and significant at the 5% (Table 3, Regression 2). This contradicts the results in the previous section where no impact of average city size on economic growth for developing countries was reported. This estimate provides evidence of a detrimental impact of large cities on economic growth for developing countries, suggesting a 2.3% decrease in 5 year growth rates for a 100,000 inhabitant increase in average city size.

Discussion

Our results provide novel insights to the debate about the economic impact of mega cities and overall increases in city size around the world. First, they lend support to the hypothesis by Gollin et al. (2013) that many cities in developing countries do not generate the same productivity gains as cities in developed countries. This is evidenced by both the positive results for high-income countries, which suggest the presence of productivity gains associated with larger cities, as well as the insignificant (and negative) IV-results for developing countries. These results are explained by the underlying mechanisms driving urbanization which are fundamentally different for developed and developing countries. Hence, developing country cities have a high share of workers in sectors that do not benefit from agglomeration economies. Simultaneously, developing countries' cities are now much larger than their counterparts were in the developed world when they had reached the same level of economic development. The greater size of developing world cities has been facilitated, among other factors, by the possibility of importing more food, aid inflows, and improved public service provision (Fay and Opal, 2000, Glaeser, 2014). This in turn has contributed to intensify the urban diseconomies present in developing countries' cities. Instead of being the place for industrialization and productivity growth as in the developed world, they are increasingly becoming loci for the concentration of the poor and those at risk of severe poverty in the emerging world.

Second, the evidence presented in this paper complements past empirical research on urban concentration and economic growth (Henderson, 2003, Brülhart and Sbergami, 2009, Castells-Quintana and Royuela, 2014). At first sight, our insignificant results for developing countries may seem at odds with the findings of this literature, which suggest a particularly important role for agglomeration at early stages of development. However, they may simply reflect different coverage and a focus on different aspects. Urban concentration, even when the actual urban population is small, provides benefits for the provision of public infrastructure, in particular in the face of limited resources. As countries grow richer and have more resources, this advantage loses some of its relevance. The urban concentration literature may, to a considerable degree, also capture this aspect. Our average city size measure in turn reflects the agglomeration (dis-) economies which arise through the actual size of the cities. Industrialized countries with a strong tradable service sector and high-tech manufacturing benefit from larger cities, while in developing countries diseconomies of scale and negative externalities may prevail.

Third, from a system of cities perspective, our results are also telling. The positive results for high-income countries suggest that people and firms are more prone to relocate in high-income countries, once the primary city reaches the tipping point on the productivity curve. Furthermore, cities in developed countries are able to overcome some of the diseconomies by innovating their function within the system of cities (Camagni et al., 2015). In contrast, our results indicate that this is not the case for developing countries and that many of the cities may even be already in a low economic development trap, as suggested by Venables (2005). This finding is consistent with observations by other authors that show that mature manufacturing sectors are still located within the prime cities in developing countries as opposed to secondary cities, as should be expected following the systems of cities approach (Duranton, 2015).

Finally, the results also point to the need to adapt theoretical models and their assumptions developed based on high-income countries more strongly to the realities of the developing world. While the analysis for high income countries is broadly in line with the predictions of the NEG models (Martin and Ottaviano, 2001, Fujita and Thisse, 2003), the insignificant coefficients for the developing countries sample are clearly not. One explanation may be the already mentioned balance between urban economies and diseconomies, which is probably different for developing and high income countries. NEG models may be well calibrated to capture the situation for high income countries, while they may underestimate urban diseconomies and over-emphasize the benefits of agglomeration in developing countries' context. Some authors (Martin, 2008, Henderson, 2010) support this notion and argue that the treatment of urban diseconomies is still limited in the literature.

Conclusion

In this paper we have analysed whether countries grow faster if their population lives on average in larger cities, as has been frequently implied by recent economic theories and development policy alike. For this purpose, we have used a panel of 114 countries for the period between 1960 and 2010. We have specifically tested for varying effects of average city size on economic growth in high-income and in developing countries, as, until now, most evidence has been based on data from the developed world. A raft of estimation techniques – including pooled 2SLS, fixed effects, system GMM, and a novel instrumental variable – has been used in order to establish the relationship between average city size and economic growth. The system GMM and the IV analyses allow us to address statistically the concern of reverse causality when considering questions of urbanization, city size, and economic growth.

The analysis has revealed that any statement about a uniform relationship between average city size and economic growth does not hold. For the whole sample, the evidence of such a relationship is inconclusive, with results differing depending on the estimation technique. However, there is consistent evidence of a growth promoting effect of average city size in high-income countries throughout all our estimation techniques. The robustness of the effect is confirmed by the IV-results. An increase in the average city size of 100,000 inhabitants boosts a country's five year growth performance by up to 0.84%. This effect decreases as the average city size increases. Conversely, in developing countries all coefficients of the average city size indicator are insignificant. The IV results even suggest a negative impact of average city size on economic growth. The results for developing countries thus imply that city size is not a driver of economic growth. If it has an impact at all, it is negative.

Whether recent urbanization trends with increasing average city size are a growth driver or not seems highly context dependent and the answer may very well be negative for many developing countries. Heterogeneity in the underlying urbanization patterns between developed and developing countries, a differing balance between agglomeration economies and diseconomies, and structural barriers to the creation of a functioning system of cities in developing countries may result in an urban environment which does not make its inhabitants more productive, as would be expected based on the literature for developed countries.

The analysis opens several avenues for future research. In order to better understand how city size shapes economic growth at an aggregate level, greater protagonism needs to be awarded to understand the underlying urbanization paths and how these ultimately influence the balance between urban economies and diseconomies. In particular, there is a clear need to analyse in greater detail the extent and possibilities of managing urban diseconomies in a developing country context. Another line of analysis should explore the structural barriers to the creation of a functioning system of cities in developing countries.

Finally, our analysis underlines the need to re-evaluate the increasingly widespread policy view that bigger cities spur economic growth. A more nuanced view of how urban policies impinge on overall economic growth, especially in the developing world, is required. It should be based on new empirical analysis, as well as on theoretical approaches that are more attuned to the realities of emerging countries. Otherwise the risk of coming to simplistic and, in some cases, perhaps overly harmful policy recommendations may increase based on the wrong assumption that developing countries simply follow the same urbanisation path was previously followed by developed countries.

ENDNOTES

[1] One challenge with data on cities and urbanization is that the definition of what constitutes a city varies across countries. While some countries count villages over 1,000 inhabitants as cities, others only include cities starting from 10,000 inhabitants. Similarly, some consider the administrative city, while others have measures that are closer to the agglomeration. This makes comparisons between countries challenging. While WUPS 2014 relies on the local definitions, it aims to smooth out these issues as far as possible by correcting for agglomeration size and standardizing urban definitions. This system is not without problems, but despite these caveats, WUPS remains the best available dataset for the purpose of our analysis.

[2] In order to obtain a reasonable proxy for the cities below 300K inhabitants, we use a complementary dataset based on census data sourced from citypopulation.de, which includes population numbers for each city (including those below the 300K threshold) in a country during the period between 1985 and 2010. The correlation between the proxy based on the WUPS data and the more finely-tuned average from the second dataset is 0.94. This is a clear indication that the proxy works well. We resort to the WUPS dataset.

[3] We rely on Pierskalla, Schultz and Wibbels (2014) for this purpose.

[4] The first stage results are included in Table A2 in the appendix.

Bibliography

ADES, A. F. & GLAESER, E. L. 1995. Trade and Circuses – Explaining Urban Giants. Quarterly Journal of Economics, 110, 195-227.

ALESINA, A., SPOLAORE, E. & WACZIARG, R. 2005. Chapter 23 - Trade, Growth and the Size of Countries. In: AGHION, P. & DURLAUF, S. N. (eds.) Handbook of Economic Growth. Elsevier.

BERTINELLI, L. & STROBL, E. 2007. Urbanisation, urban concentration and economic development. Urban Studies, 44, 2499-2510.

BRÜLHART, M. & SBERGAMI, F. 2009. Agglomeration and growth: Cross-country evidence. Journal of Urban Economics, 65, 48-63.

CAMAGNI, R., CAPELLO, R. & CARAGLIU, A. 2015. The Rise of Second-Rank Cities: What Role for Agglomeration Economies? European Planning Studies, 23, 1069-1089.

CASTELLS-QUINTANA, D. & ROYUELA, V. 2014. Agglomeration, inequality and economic growth. Annals of Regional Science, 52, 343-366.

DURANTON, G. 2008. Viewpoint: From cities to productivity and growth in developing countries. Canadian Journal of Economics-Revue Canadienne D'Economique, 41, 689-736.

DURANTON, G. 2015. Growing through Cities in Developing Countries. World Bank Research Observer, 30, 39-73.

DURANTON, G. & PUGA, D. 2004. Micro-foundations of urban agglomeration economies. In: HENDERSON, J. V. & THISSE, J. F. (eds.) Handbook of Regional and Urban Economics. Elsevier B.V.

DURLAUF, S. N., JOHNSON, P. A. & TEMPLE, J. R. W. 2005. Chapter 8 Growth Econometrics. In: PHILIPPE AGHION AND STEVEN, N. D. (ed.) Handbook of Economic Growth. Elsevier.

FAY, M. & OPAL, C. 2000. Urbanization without Growth: A Not-So-Uncommon Phenomenon.

FUJITA, M., KRUGMAN, P. & VENABLES, A. J. 1999. The spatial economy: cities, regions and international trade, Cambridge Mass., MIT Press.

FUJITA, M. & THISSE, J. F. 2003. Does geographical agglomeration foster economic growth? And who gains and loses from it? Japanese Economic Review, 54, 121-145.

GLAESER, E. L. 2014. A World of Cities: The Causes and Consequences of Urbanization in Poorer Countries. Journal of the European Economic Association, 12, 1154-1199.

GOLLIN, D., JEDWAB, R. & VOLLRATH, D. 2013. Urbanization with and without Industrialization. Journal of Economic Growth, 1-36.

GRAHAM, D. J. 2009. Identifying urbanisation and localisation externalities in manufacturing and service industries. Papers in Regional Science, 88, 63-84.

HARRIS, J. R. & TODARO, M. P. 1970. Migration, unemployment and development – 2-sector analysis. American Economic Review, 60, 126-142.

HENDERSON, J. V. 1974. Sizes and types of cities. American Economic Review, 64, 640-656.

HENDERSON, J. V. 2003. The urbanization process and economic growth: The so-what question. Journal of Economic Growth, 8, 47-71.

HENDERSON, J. V. 2010. Cities and Development. Journal of Regional Science, 50, 515-540.

JEDWAB, R. & VOLLRATH, D. 2015. Urbanization without growth in historical perspective. Explorations in Economic History, 58, 1-21.

KRUGMAN, P. & ELIZONDO, R. L. 1996. Trade policy and the Third World metropolis. Journal of Development Economics, 49, 137-150.

LEWIS, A. W. 1954. Economic Development with Unlimited Supplies of Labour. The Manchester School, 28, 139-191.

LUCAS, R. E. 1988. On the mechanisms of economic development. Journal of Monetary Economics, 22, 3-42.

MARTIN, P. & OTTAVIANO, G. I. P. 2001. Growth and agglomeration. International Economic Review, 42, 947-968.

MARTIN, R. 2008. National growth versus spatial equality? A cautionary note on the new ‘trade-off’ thinking in regional policy discourse*. Regional Science Policy & Practice, 1, 3-13.

MCCANN, P. & ACS, Z. J. 2011. Globalization: Countries, Cities and Multinationals. Regional Studies, 45, 17-32.

MELO, P. C., GRAHAM, D. J. & NOLAND, R. B. 2009. A meta-analysis of estimates of urban agglomeration economies. Regional Science and Urban Economics, 39, 332-342.

PIERSKALLA, J., SCHULTZ, A. & WIBBELS, E. 2014. Order, Geography and Development. http://sites.duke.edu/wibbels/files/2014/10/StateAntiquity.pdf

PUGA, D. 1998. Urbanization patterns: European versus less developed countries. Journal of Regional Science, 38, 231-252.

ROMER, P. M. 1986. Increasing Returns and Long-Run Growth. Journal of Political Economy, 94, 1002-1037.

ROODMAN, D. 2009. How to do xtabond2: An introduction to difference and system GMM in Stata. Stata Journal, 9, 86-136.

ROSENTHAL, S. S. & STRANGE, W. C. 2004. Chapter 49 Evidence on the nature and sources of agglomeration economies. In: HENDERSON, J. V. & THISSE, J. F. (eds.) Handbook of Regional and Urban Economics. Elsevier.

SACHS, J. D. & WARNER, A. 1995. Economic reform and the process of global integration. Brookings Papers on Economic Activity, 1-95.

THE WORLD BANK 2009. World Development Report 2009. Reshaping Economic Geography. Washington, DC: The World Bank.

UNITED NATIONS. 2014. World Urbanization Prospects: The 2014 Revision [Online]. Available: http://esa.un.org/unpd/wup/ [Accessed].

VENABLES, A. J. 2005. Spatial disparities in developing countries: cities, regions, and international trade. Journal of Economic Geography, 5, 3-21.

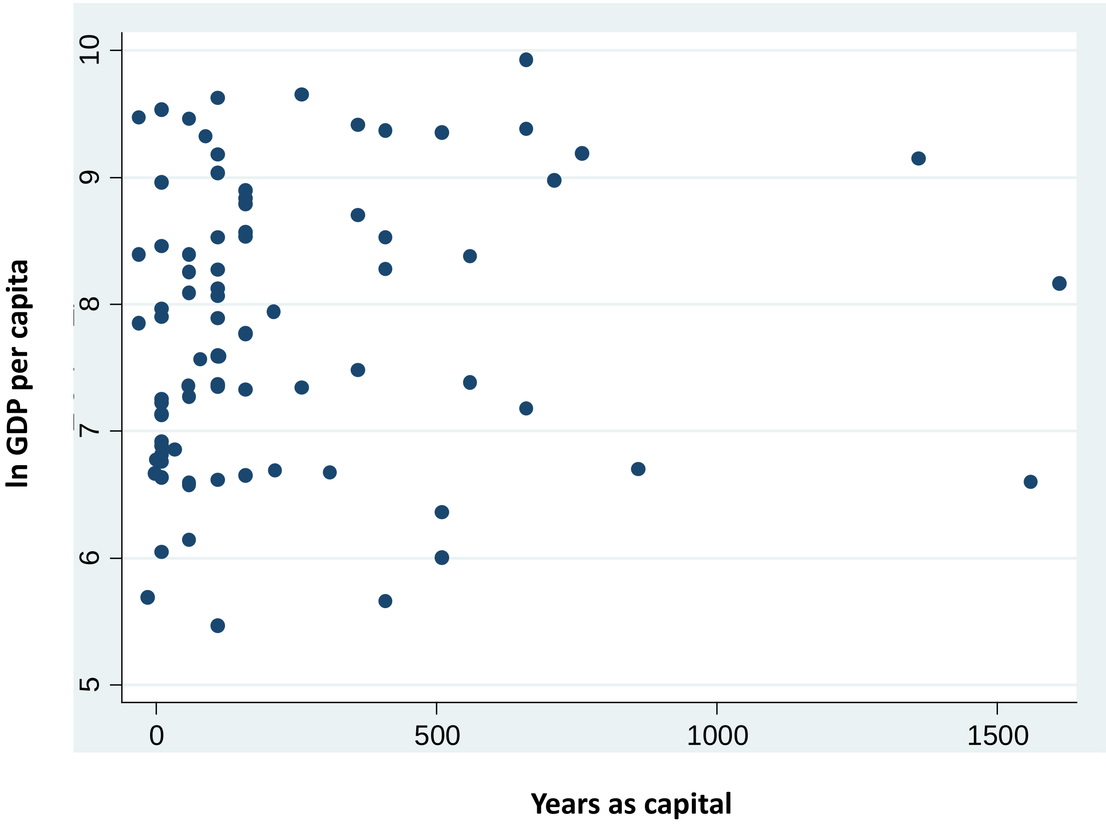
Appendix

Table A1. Data sources

Variable	Source
Average city size	Population weighted average city size at the beginning of the five year period Calculated based on World Urbanization Prospects, the 2014 revision http://esa.un.org/unpd/wup/
GDPpc	Natural logarithm of “Real GDP at constant 2005 national prices “/ “Population” Penn World Tables 8.0 http://www.rug.nl/research/ggdc/data/pwt/
Years of Schooling	Years of schooling at beginning of the five year period Barro & Lee dataset http://www.barrolee.com/
Private Investment	Five year averages of “Share of gross capital formation of GDP at current PPPs” Penn World Tables 8.0 http://www.rug.nl/research/ggdc/data/pwt/
Government Consumption	Five year averages of “Share of government consumption of GDP at current PPPs” Penn World Tables 8.0 http://www.rug.nl/research/ggdc/data/pwt/
Openness	Five year averages of sum of “Share of merchandise exports of GDP at current PPPs”and “Share of merchandise imports of GDP at current PPPs” Penn World Tables 8.0 http://www.rug.nl/research/ggdc/data/pwt/
Population	Population at the beginning of the five year period Penn World Tables 8.0 http://www.rug.nl/research/ggdc/data/pwt/
Political System	Five year averages of “POLITY2” indicator Polity IV: Regime Authority Characteristics and Transitions Datasets http://www.systemicpeace.org/inscrdata.html

Appendix

Figure A1: Scatterplot between GDPpc and years as capital in 1960



Appendix

Table A2: First stage results IV – Dependent Variable: Average City Size

VARIABLES	(1) High-income countries	(2) Developing countries
Years Capital	**0.549***** **(0.173)**	**-0.331***** **(0.107)**
GDPpc	-619.7*** (149.1)	317.4*** (41.01)
Years of schooling	34.15 (37.95)	-31.84* (16.60)
Private Investment	3,375*** (890.2)	-319.4 (300.7)
Government Consumption	-2,822*** (996.8)	-1,222*** (273.6)
Openness	250.1* (141.4)	126.6*** (25.80)
Population	297.7*** (49.96)	476.5*** (29.49)
Political System	-29.07** (14.53)	6.092 (4.378)
Constant	4,948*** (1,151)	-2,122*** (311.1)
Time fixed effects	Yes	Yes
Observations	258	579
R-squared	0.451	0.575
F-stat of excluded instrument	10.07 (0.0017)	9.62 (0.0020)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1