UNITED NATIONS UNIVERSITY

UNU-WIDER
World Institute for Development Economics Research

Working Paper No. 2010/12

Urban Settlement

Data, Measures, and Trends

David E. Bloom,[1] David Canning,[1] Günther Fink,[1] Tarun Khanna,[2] and Patrick Salyer[3]

February 2010

Abstract

This paper examines data on urbanization. We review the most commonly used data sources, and highlight the difficulties inherent in defining and measuring the size of urban versus rural populations. We show that differences in the measurement of urban populations across countries and over time are significant, and discuss the methods used to obtain these measurements, as well as those for projecting urbanization. We also analyze recent trends and patterns in urbanization. Finally, we describe the principal channels of urbanization and examine their relative contributions to the global urbanization process.

Keywords: urbanization, measurement, urban population

JEL classification: O18, R11

[1] Harvard School of Public Health, email of corresponding author dbloom@hsph.harvard.edu, [2] Harvard Business School, [3] Gigya, Inc.

This study has been prepared within the UNU-WIDER project on Beyond the Tipping Point: Development in an Urban World directed by Jo Beall, Basudeb Guha-Khasnobis, and Ravi Kanbur.

UNU-WIDER gratefully acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1798-7237 ISBN 978-92-9230-247-4

Acknowledgements

The authors thank the employees of the Center for International Earth Science Information Network, Oak Ridge National Laboratory, and the Penn State Maps Library for providing assistance with several of the figures included in this article.

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Anne Ruohonen at UNU-WIDER

1 Introduction

According to United Nations (UN) projections, more than half the world's population will live in urban areas by the end of 2008. If current trends hold, the urban share of the global population could reach 60 per cent by 2030 (UN 2005). From an economic perspective, increases in the share of the population living in urban areas are usually considered to be a natural by-product of modernization and industrialization (Bradshaw and Fraser 1989). When economic activities are clustered in small geographic spaces, firms have access to a larger labour pool and are in closer proximity to customers and suppliers, with the benefit that intra-industry specialization is encouraged (Ciccone and Hall 1996; Becker 2007). Advances in individual welfare parallel these firm-level economic advantages: on average, urban dwellers have higher incomes than their rural counterparts (Kamete *et al*. 2001; Njoh 2003), together with better health (Montgomery *et al*. 2003), and greater access to education.

Despite these positive associations, the increasingly large urban population shares are a major concern in many developing countries. The growth of urban areas has promoted land, water, and air pollution (UN-HABITAT/DFID 2002), and has resulted in the formation of large and rapidly growing slum populations around many major cities. According to the UN, more than one billion people, or about 14 per cent of the total global population, lived in areas classified as slums in 2005 (UN-HABITAT 2007). Characterized by unhealthy living conditions and a lack of the most basic services, slums in the developing world are among the most graphic representations of social exclusion and extreme poverty.

The objective of this paper is to provide a descriptive statistical analysis of urbanization. In the next section, we review the data sources for urban populations. We analyse the difficulties of defining and measuring the populations of urban areas and rural areas, and discuss the statistical concepts used in the main database on urban population share, produced and published by the UN. We show that inconsistent definitions of the term 'urban' across time and countries imply significant measurement errors in the data. We therefore compare official urban population numbers with alternative estimations based on spatial (as opposed to administrative) concepts. We find that the average urban population share in the world is similar across datasets, even though country-specific measures show significant variation. In the subsequent section, we provide a descriptive statistical analysis of past trends and patterns in the level of urban population shares, and decompose the change in urban population shares into its main components. We show that population growth will naturally promote higher levels of urban population shares in the long run, because increases in the size of a given settlement either lead directly to increases in urban populations or, for smaller settlements, lead to their reclassification from rural to urban settlements as populations exceed predetermined thresholds. In the absence of population growth, migration becomes the key determinant of changes in the urban population share. Migration toward cities can occur both from within and from outside a given country. Although migration flows in some countries – for example, China – are sizable, our analysis suggests that population growth is probably the principal driver of urban population growth in most countries, as observed over the last few decades. We go on to analyse the UN's current urban population forecasts. We show that even though the basic model underlying current forecasts is simple, it nevertheless performs quite well because of the highly persistent and relatively stable nature of the urbanization process across countries and over time. We conclude with a short summary and a discussion of the implications of our work for future research.

2 Measurement and data

The most basic concept underlying the measurement of urban populations is that of the city. According to the 2007 edition of the *Merriam-Webster Online Dictionary*, a city is 'an inhabited place of greater size, population, or importance than a town or village'. For statistical purposes, where more specific definitions are needed, three concepts are generally used to define urban areas and populations: the 'city proper', the 'urban agglomeration', and the 'metropolitan area'.

The city proper is determined by legal and administrative criteria, and typically comprises only those geographical areas that are part of a legally defined, and often historically-established administrative unit. However, many urban areas have grown far beyond the limits of the city proper, necessitating other measures. An urban agglomeration is the 'de facto population contained within the contours of a contiguous territory inhabited at urban density levels without regard to administrative boundaries' (UN 2006: glossary). Urban agglomerations are thus determined by density: the agglomeration ends where the density of settlement drops below some critical threshold. A still more comprehensive concept is the metropolitan area. This concept includes both urban agglomerations and any 'surrounding areas of lower settlement density that are also under the direct influence of the city' (UN 2006: glossary). Populations in rural settlements can thus be counted as urban, as long as they fall under the direct political or economic influence of a city.

Using these varying definitions, highly different population numbers have been published for most cities. In 2001, London's official city population (city proper) was estimated at 7.5 million inhabitants, its urban area was estimated at 8.3 million, and its metropolitan area population was estimated at between 12 and 14 million (UK Census 2001; *Demographia*). In 2006, New York's city proper population was estimated at 8.2 million people, its urban agglomeration population at 18.5 million, and its metropolitan area population at 22 million (US Census Bureau 2007).

Table 1 ranks the world's 20 largest cities using the definitions 'city proper' and 'urban agglomeration'. Tokyo, the world's largest urban agglomeration, illustrates the important and quantitatively large differences between these definitions. Even though the greater Tokyo area has a population of 35 million people, the population of Tokyo's city proper is only eight million. This latter number reflects the population within 23 municipalities (wards) in the city centre, which historically have been considered as comprising the city. Legally, each of these municipalities has independent city status and could therefore be listed as an independent city proper (*Demographia*). The Chinese city of Chongqing is another case in point. Even though the municipal district of Chongqing has a total population of more than 30 million inhabitants, fewer than 6 million actually live in Chongqing city proper. Depending on which classification is used, Chongqing is sometimes listed as the world's largest city and, in other cases, does not even appear in the top rung of urban population rankings.

Table 1: The world's 20 most populous urban agglomerations, and 20 most populous cities proper in 2005

	Urban agglomeration		City proper	
Rank	Name	Population	Name	Population
1	Tokyo	35.2	Shanghai	15.4
2	Mexico City	19.4	Bombay	13.1
3	New York-Newark	18.7	Karachi	12.3
4	São Paulo	18.3	Buenos Aires	11.6
5	Bombay	18.2	Delhi	11.5
6	Delhi	15.0	Manila	10.7
7	Shanghai	14.5	Moscow	10.6
8	Calcutta	14.3	Seoul	10.5
9	Jakarta	13.2	Istanbul	10.3
10	Buenos Aires	12.6	São Paulo	10.1
11	Dhaka	12.4	Lagos	9.2
12	Los Angeles	12.3	Mexico City	8.7
13	Karachi	11.6	Jakarta	8.6
14	Rio de Janeiro	11.5	Kinshasa	8.4
15	Osaka-Kobe	11.3	Tokyo	8.4
16	Cairo	11.1	New York	8.1
17	Lagos	10.9	Lima	8.0
18	Beijing	10.7	Cairo	7.9
19	Manila	10.7	Beijing	7.7
20	Moscow	10.7	London	7.6

Source: UN (2006).

These classification issues are not the only challenge involved in studying urban populations. Collecting accurate population data on cities is difficult. Censuses, which are the principal source of information, occur once a decade or less frequently, and tend to undercount urban populations because large, mobile populations are often difficult to reach (Cohen 2004).

Comparing data across countries and time magnifies the problem. Countries can manipulate statistics on the size and number of cities by adopting different definitions (Hardoy *et al*. 2001; Satterthwaite 2007). For example, in 1986, to cope with growing administrative demands at the local level, China essentially reclassified counties as cities in order to allow local city governments to control the surrounding areas. Although the UN has adjusted historical data ex-post whenever possible, a proper reclassification of historical data can be an arduous, or even impossible, task.

2.1 Statistical population datasets

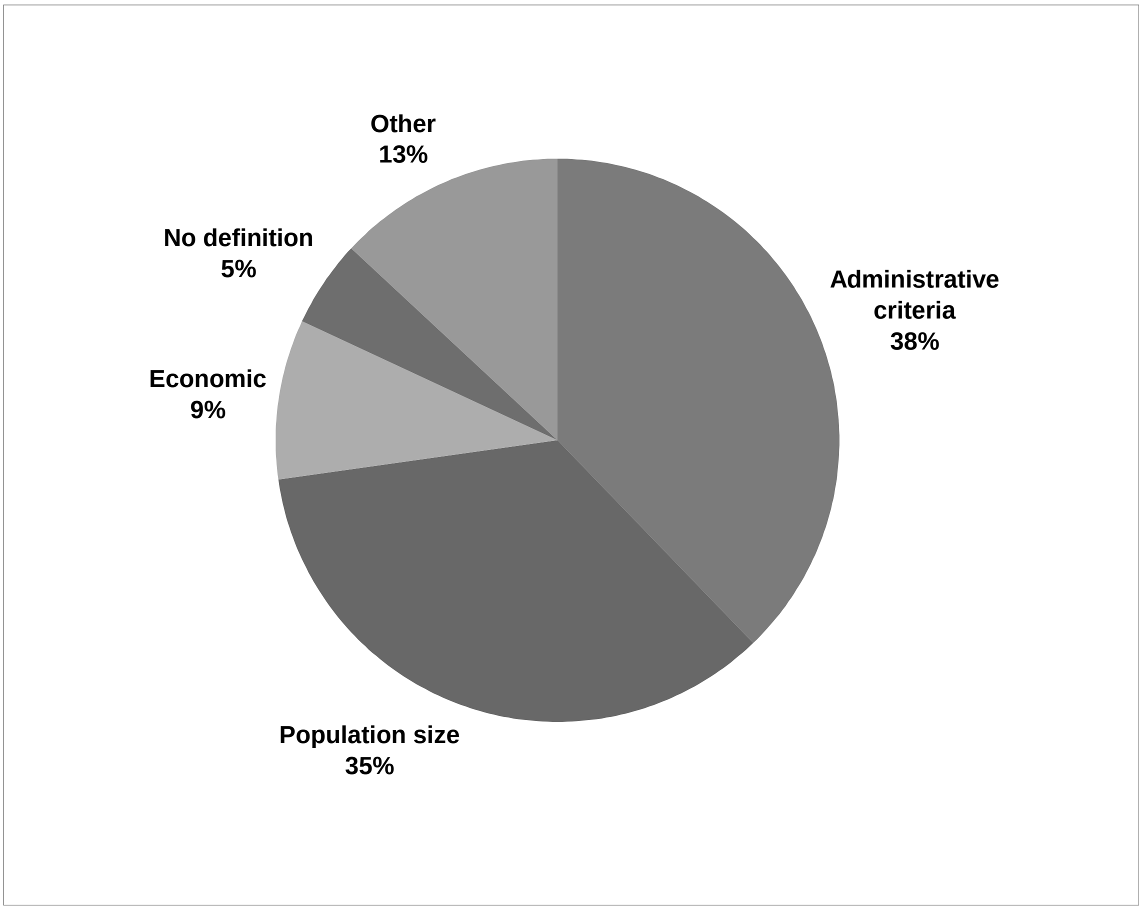
The most commonly cited statistical population dataset for city and urban population data is the UN Population Division's *World Urbanization Prospects* (WUP). The Population Division produces a new revision of the WUP every two years. The dataset is based on data from the UN Statistics Division's *Demographic Yearbook*. The yearbooks track country-by-country population data, beginning in 1948, and are compiled using questionnaires dispatched annually to more than 230 national statistical offices. Even though the UN has devised general guidelines, countries use country-specific standards to designate urban and rural areas. As Figure 1 shows, the urban area definition applied by each individual country in the UN sample (UN 2003) varies widely: 38 per cent of the countries in the sample use administrative criteria (city proper), 35 per cent use population (size) thresholds, 9 per cent use economic criteria, and the remaining 18 per cent have more complex definitions or no definitions at all.

Table 2 displays the definitions used by all countries in the UN sample whose names start with the letters 'A' or 'Z'. The arbitrarily selected list of countries illustrates the large variety of definitions national statistical offices use. While some countries, such as Afghanistan, include only the populations of locations officially classified as cities (the 'city proper' definition), other countries rely on more general definitions that are usually based on population size. The threshold for a settlement to be classified as urban varies widely across countries, ranging from 400 in Albania to 5,000 in Zambia.[1] Some countries, such as Zambia, exclude settlements that are primarily agricultural, while others, such as Austria, include rural areas if they are closely connected to nearby cities in line with the definition of a metropolitan area.

---

1 As we show later in this paper, a majority of the urban population lives in small to intermediate-sized urban settlements. In 2005, only 38.5 per cent of the urban population lived in urban agglomerations larger than one million (UN 2006).

Figure 1: Urban area definitions used in WUP samples



Source: UN (2003).

Table 2: Examples of national urban definitions

Country	Urban population selection criterion
Afghanistan	63 localities
Albania	Towns and other industrial centres with more than 400 inhabitants.
Algeria	All communes having as centre a city, a rural town or an urban agglomeration.
American Samoa	Densely settled territory that meets minimum population density requirements and encompasses a population of at least 2,500.
Andorra	Parishes of Andorra la Vella, Escolades-Engordany, Sant Julia, Encamp and La Massana.
Angola	Localities with a population of 2,000 or more.
Anguilla	Entire population.
Antigua & Barbuda	Saint John's.
Argentina	Population centres with 2,000 inhabitants or more.
Armenia	Cities and urban-type localities officially designated as such.
Aruba	Oranjestad and Sant Nicolas.
Australia	One or more census divisions with urban characteristics and representing a cluster of 1,000 people or more, as well as known holiday resorts of less population if they contain 250 dwellings or more, of which at least 100 were occupied on census night.
Austria	Based on the concept of a functional and structural urban area (Stadtregion) consisting of an urban core area (Kernzone) and surrounding urban areas (Aussenzone). The surrounding urban area is defined as an area in which at least 30 per cent of working adults commute daily into the corresponding core area.
Azerbaijan	Cities and urban-type localities, officially designated as such, usually according to the criteria of number of inhabitants and predominance of agricultural or non-agricultural workers and their families.
Zambia	Localities of 5,000 inhabitants or more, with a majority of the labour force not in agricultural cities.
Zimbabwe	Not defined.

Source: UN (2003).

2.2 Geo-referenced datasets

Two main geography-based spatial systems have emerged over the last 20 years in the pursuit of better measures of the global spatial distribution of urban populations. The first such system was the Digital Chart of the World (DCW), created in 1992 by the Environmental Systems Research Institute for the US Defense Mapping Agency. The DCW is based on a set of computerized global maps, which for the most part were created by scanning and digitizing available paper sources. These digitized global maps enabled geo-referenced datasets for cities, country boundaries, and other characteristics to be made available country by country. In these maps, officially registered settlements appear as points, while polygons represent urbanized or built-up areas that do not necessarily conform to political boundaries. Figure 2 shows a typical DCW map for the State of California. Points indicate individual settlements and the polygons show larger urban zones.

Figure 2: DCW map of California

Source: Map courtesy of Penn State Maps Library, created with ESRI data.

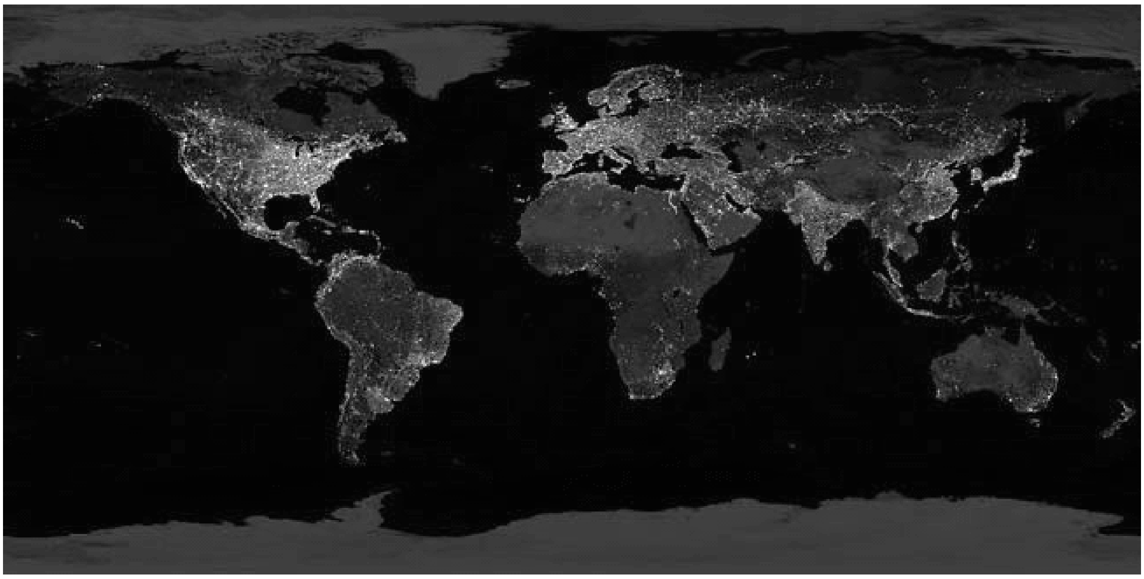
From the perspective of studying the dynamics of urban population shares, the usefulness of the DCW database is limited. The points database does not provide population information and the polygons tend to be conservative and inconsistent measures of urban areas.

The second source of information on the spatial distribution of urban areas is the Nighttime Lights dataset from the National Oceanic and Atmospheric Administration. This dataset consists of data collected by the Operational Linescan System of the US Air Force’s Defense Meteorological Satellite Program. Even though development of this dataset began in the 1970s, it has only been used to develop a global image complete with the spatial distribution of human settlements since 1997. Figure 3 shows typical Nighttime Lights for North America and for the world as a whole.

Figure 3: Nighttime Lights

North America

The world



Source: Defense Meteorological Satellite Program; National Aeronautic and Space Administration.

The Defense Meteorological Satellite Program has created and released four datasets, including a time-series dataset and map images showing light sources and changes covering 1992–93 and 2000. These datasets have several problems as discussed in Brown (2008). First, electricity might be correlated with economic development, so more developed areas appear to have higher densities on the Nighttime Lights map than less developed areas. Second, the Nighttime Lights images tend to overestimate the actual extent of urban areas because of the relatively long exposure necessary, which is commonly referred to as the blooming effect (Elvidge *et al*. 1997, 2004). Attempts have been made to correct this effect (Imhoff *et al*. 1997), but the result is a loss of small settlements with modest lighting at night. Another technical problem occurs in the northern hemisphere above 40 degrees latitude, where snow affects the extent and brightness of lights.

Various attempts are under way to correct for these biases, and the increasing availability of satellite imagery is likely to cause a marked improvement in the spatial precision of settlement estimates in coming years (Elvidge *et al*. 2004). As pointed out by Montgomery and Balk (2007), continued interaction between social and physical scientists will be crucial to ensure the usefulness of resulting datasets in demographic and economic research.

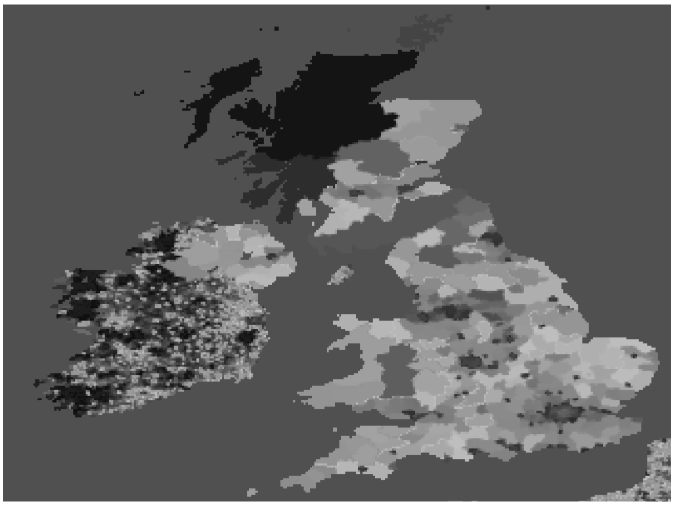
2.3 Geo-referenced global population distribution databases

To move from settlement to population density measures, spatial data need to be matched to population data. Since satellite data are often used in these efforts, population is generally represented in grids, rather than in the irregular administrative units from which they originate. Two main databases combine geo-referenced data with population data: the Gridded Population of the World (GPW) database and the LandScan Global Population database.

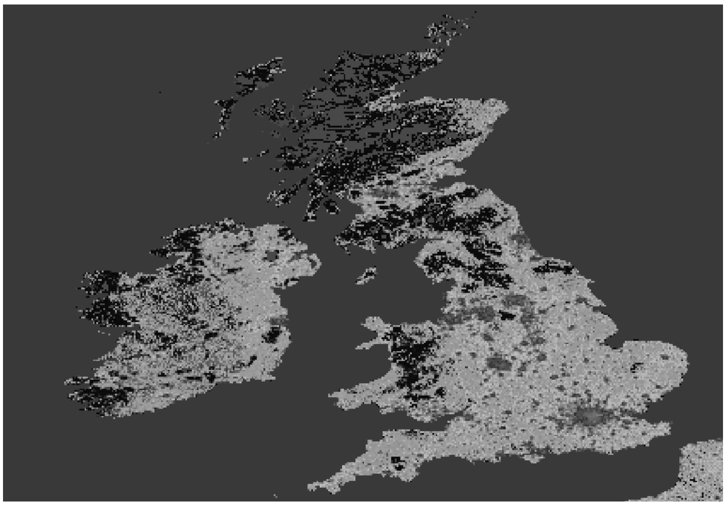
As described in further detail in Salvatore *et al*. (2005), the GPW was established by the National Center for Geographic Information and Analysis at the University of California, Santa Barbara, with partial support from the Center for International Earth Science Information Network (CIESIN) at Columbia University (SEDAC, accessed 2007). The GPW is based on population data for the smallest administrative units available across countries. The GPW assumes a uniform population distribution within a given geographical unit or grid cell, and has focused on finding the most disaggregated data possible. The first round of GPW (v1) was released in 1995 and was based on 19,000 sub-national geographic units. The latest version of the GPW (v3) was launched in 2005, and contains land area and population density data derived from almost 400,000 administrative units (SEDAC, accessed 2007).

The LandScan Global Population database was established by the Oak Ridge National Laboratories in 1998 (Dobson *et al*. 2000). While the GPW has aimed at getting actual population numbers for the smallest geographical units possible from all available sources, LandScan has focused on detailed population distribution modeling within the smallest geographic units available from the US Census Bureau's International Program Center. Landscan uses geographic information (slope of the territory, land cover, elevation) and information on infrastructure (roads and railways) together with, and obtained from, high resolution imagery to impute the within-cell distribution of populations (Bhaduri *et al*. 2007; Dobson *et al*. 2000; Salvatore *et al*. 2005).[2]

Figure 4: Population densities GPW versus LandScan: UK and Ireland
Gridded Population of the World (GPW)*



LandScan**



*Source: Center for International Earth Science Information Network (CIESIN), Columbia University; International Food Policy Research Institute (IFPRI); The World Bank; and Centro Internacional de Agricultura Tropical (CIAT). 2004. Global Rural-Urban Mapping Project (GRUMP), Beta Version: Population Density Grids. Palisades, NY: Socioeconomic Data and Applications Center (SEDAC), Columbia University. Available at http://sedac.ciesin.columbia.edu/gpw.

** Source: This image has been authored by employees of UT-Battelle, LLC, under contract DE-AC05-00OR22725 with the U.S. Department of Energy. Accordingly, the United States Government retains and the publisher, by accepting the article for publication, acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this image, or allow others to do so, for United States Government purposes.

2 For further details on the LandScan data base, see http://www.ornl.gov/sci/landscan/landscanCommon/landscan_documentation.html

Figure 4 illustrates these differences for the case of the UK and Ireland. The Gridded Population of the World (GPW) data rely exclusively on administrative units, and thus have a lower resolution than the LandScan data. The LandScan data use other geographic information to impute the within-cell distribution of population, which implies a higher resolution, but, from a scientific perspective, also comes at the cost of having to rely on the assumption underlying the spatial model used for the imputations.[3]

From an urbanization perspective, the most promising database is the Global Rural Urban Mapping Project (GRUMP) (Balk *et al*. 2005). GRUMP is a result of the cooperation of CIESIN with the International Food Policy Research Institute (IFPRI), the World Bank and the Centro Internacional de Agricultura Tropical (CIAT), its direct aim being to distinguish rural from urban areas (SEDAC, accessed 2007). The GRUMP database offers three different datasets: the Human Settlements database (CIESIN 2004b), the Urban Extent Mask database (CIESEN 2004c), and the Rural-Urban Population Grid database (CIESIN 2004a). The settlement database contains around 55,000 settlement points where the population is greater than 1,000 persons, with corresponding geographic coordinates and official population sizes (Salvatore *et al*. 2005). The Urban Extent database contains the actual spatial extents of urban settlements, which are based on a variety of sources such as the Digital Charts of the World, Nighttime Lights, and tactical pilot charts. The Population Grid database contains the global population distribution with a systematic classification of rural and urban populations. The Population Grid database combines population numbers from the smallest administrative unit available with data on urban extents and urban populations, and uses a relatively simple algorithm to impute local population densities. As discussed in the previous section, the use of Nighttime Lights is problematic, especially in the less developed areas of Africa and South America. Also, even though urban population data are currently available for three periods (1990, 1995, and 2000), all current estimates are constructed based on the 1994/95 Nighttime Lights data, which severely limits the usability of GRUMP data in time-series analysis (Balk *et al*. 2005).

Table 3 compares the GRUMP estimates to the latest numbers published by the UN (2006) for the ten countries with the largest populations. Although the average level of urban population shares of the two estimates is nearly identical, the country-by-country comparison illustrates the differences in measurement methodologies across countries. The two estimates are quite similar for some countries, but deviate considerably for others: the UN estimates for Nigeria are 40 per cent higher than the GRUMP estimates; for India, they are almost 15 per cent lower. The correlation between the two data sources is 0.78. The GRUMP data also provide information on the fraction of countries covered by urban regions. As Table 3 shows, the fraction of land covered by urban clusters is, on average, relatively small (5 per cent), but shows a high degree of variation across countries.

Given their unified framework and the comprehensive use of available datasets, geo-referenced datasets are likely to become the standard in the future. However, for the time being, global grid cell-based data are only available for cross-sectional analysis, and no other spatial data represent urban population beyond those for selected countries. For panel analysis, the WUP data are the best source available; in dynamic analysis, the

[3] For a more detailed discussion of the available data sources, see Potere and Schneider (2007).

effect of different measurement standards can be minimized by basic first-differencing or by fixed-effects approaches.

Table 3: Data comparison: GRUMP versus UN Data, 2000

	Population (mns)	Urban population share (United Nations)	Urban population share (GRUMP)	Land area urban (GRUMP)
China	1,260	36.7	34.2	2.8
India	1,020	27.9	32.6	6.4
USA	282	77.4	81.4	8.2
Indonesia	206	42.1	40.7	1.7
Brazil	174	81.7	72.9	2.2
Russia	146	72.9	67.2	1.1
Pakistan	138	33.4	35.3	3.4
Bangladesh	129	25.6	25.2	7.5
Japan	127	78.9	89.1	28.0
Nigeria	118	44.9	32.1	1.6
Weighted average top 10		*42.6*	*42.6*	*5.1*

Source: SEDAC (2007), UN (2006).

3 Dynamics, trends, and patterns of urbanization

Before going into a detailed description of the currently available data on urban population shares, it is important to present a brief outline of a few basic concepts used in the statistics on urbanization. In any period of time t, the urban–rural ratio URRt is given by

$$URR_t = \frac{PU_t}{PR_t}, \quad (1)$$

where *PU* and *PR* denote the urban and rural populations, respectively. Another commonly used measure of the degree of urbanization is the fraction of the population living in urban areas, which we denote by $Urban_t$, and which is defined as

$$Urban_t = \frac{PU_t}{PU_r + PR_t}. \quad (2)$$

It is easy to see that the two concepts closely relate to each other since

$$Urban_t = \frac{PU_t}{PU_r + PR_t} = \frac{PU_t / PR_t}{PU_r / PR_t + PR_t / PR_t} = \frac{URR_t}{1 + URR_t}. \quad (3)$$

Using the rural–urban ratio as proxy for the urban population share has some intuitive properties when analysing the dynamics of urbanization over time. The growth in the rural–urban ratio gurr, between period t and period t+1 can be expressed as

$$g_{urr} = \ln(\frac{URR_{t+1}}{URR_t}) = \ln(\frac{PU_{t+1} / PR_{t+1}}{PU_t / PR_t}), \quad (4)$$

which simplifies to

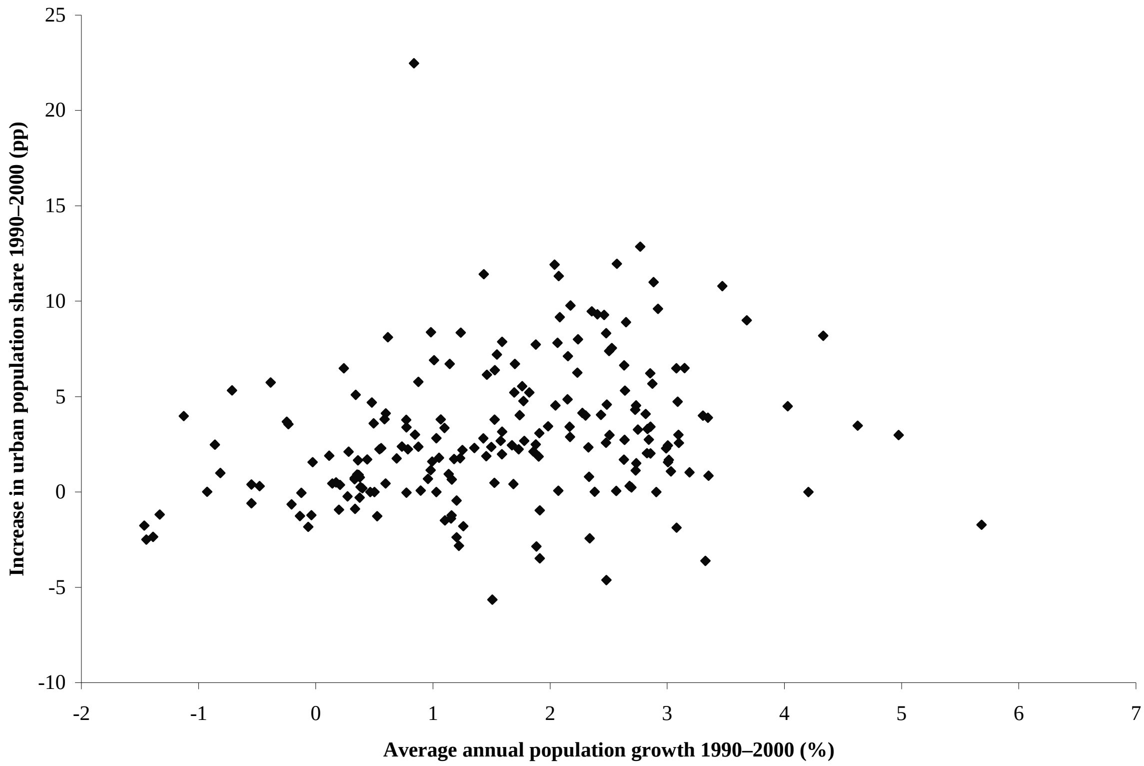
$$g_{urr} = \ln(\frac{PU_{t+1}}{PU_t}) - \ln(\frac{PR_{t+1}}{PR_t}) = g_{pu} - g_{pr}. \quad (5)$$

The growth in the urban–rural ratio over time is, thus, simply the difference in the growth rates of the urban and the rural populations. This is to some extent intuitive: if rural and urban populations grow at the same pace, total population increases without affecting the relative share of people residing in rural and urban areas.

Migration from rural to urban areas is the most intuitive reason for increases in the urban population share, and mechanically increases the relative growth of urban and rural areas. Even though most migration occurs between cities and across rural areas (Mazumdar 1987), migration is an important contributor to urban population growth, especially in developing countries (Mills and Nijkamp 1987). On average, migration is estimated to contribute between 40 and 50 per cent of total urban population growth (Preston 1979; Keyfitz 1980).

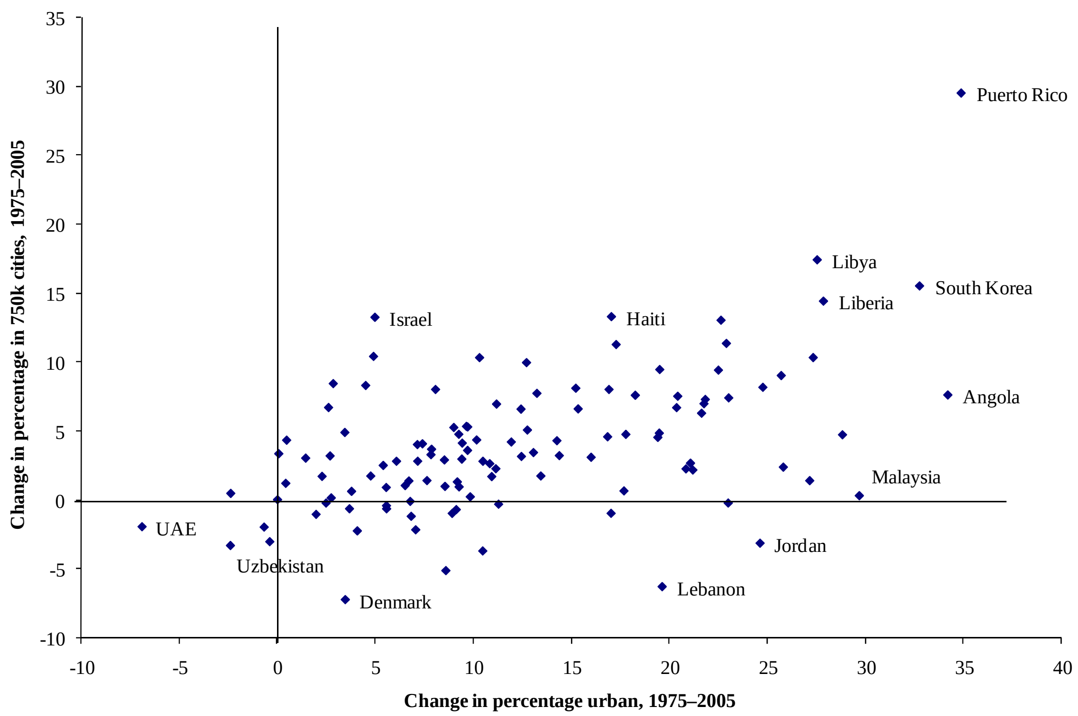
The effect of population growth on urban population shares is more complex, since growth rates in rural and urban areas can differ substantially. Both fertility rates and premature death rates are typically higher in rural areas, so the difference in natural growth rates between urban and rural areas is generally small. Nevertheless, even if the natural growth rates in rural and urban areas are the same, the growth rate of the urban population g_{pu} will always be larger than the growth rate of the rural population g_{pr}, since any growing rural settlement will eventually be classified as urban. Figure 5 compares the increase in the fraction of the population living in urban areas to the annual growth rate of total population in the period 1990–2000. While countries with higher population growth tend to experience a more rapid increase in urban population share, the correlation between population growth and growth in urban population shares does not appear to be very strong.

Figure 5: Population growth and absolute increase in urban population share, 1990–2000



Source: UN (2006).

Figure 6: Change in percentage urban and percentage in cities > 750,000, 1975–2005



Source: UN (2009).

One way to distinguish the actual growth of cities from the reclassification of rural areas as urban areas is to look at a restricted set of urban settlements, and analyse their growth over time. The WUP dataset provides this statistic for cities with populations larger than 750,000 in 2005. In Figure 6, we plot the absolute change in the urban population share relative to the change in the fraction of the population living in cities with populations larger than 750,000 as measured in 2005 over the period 1975–2005.

The increases in the large city population shares are smaller than the increases in the total urban population shares for most countries, and the correlation in the time trends is positive (0.51) but far from perfect. While some countries (such as Libya and South Korea) have seen rapid increases both in the proportion of the population living in large cities and the proportion living in urban areas, others (such as Malaysia and Jordan) have seen increased urban population shares without growth in the population of large cities.

3.1 Forecasting

The principal source of current urbanization forecasts is *World Urbanization Prospects* (UN 2006). The forecasts published by the UN are based on a relatively simple, but rather intuitive model. The model directly builds on the basic relation outlined in Equation (5) and, essentially, predicts future rural–urban growth differentials. The model has two main components: a short-term country-specific trend, and a long-term generic trend. The short-term component corresponds to the most recent growth rates in urban and rural populations. Under the assumption that growth rates do not change significantly in the short run, the urban and rural population growth rates observed between period t-1 and period t are used to predict the evolution of urban and rural populations between period t and period t+1. The long-term trend is based on a panel regression of relative (urban–rural) growth rates on the initial level of urban population share. The regression yields a negative relationship between the initial urban population share and the urban–rural growth differential. This result is intuitive: as the fraction of the population residing in rural areas declines, urban growth generated by within-country migration from rural to urban areas asymptotically approaches zero. The long-term growth differential is a function of the initial urban population share level only and, thus, assumes a constant urbanization path across countries and time. While the UN’s short-term forecasts mostly rely on the growth rates observed over the last few years in a given country, the long-term forecasts for all countries build exclusively on the empirical relation between urban population shares and their historically observed growth rates.

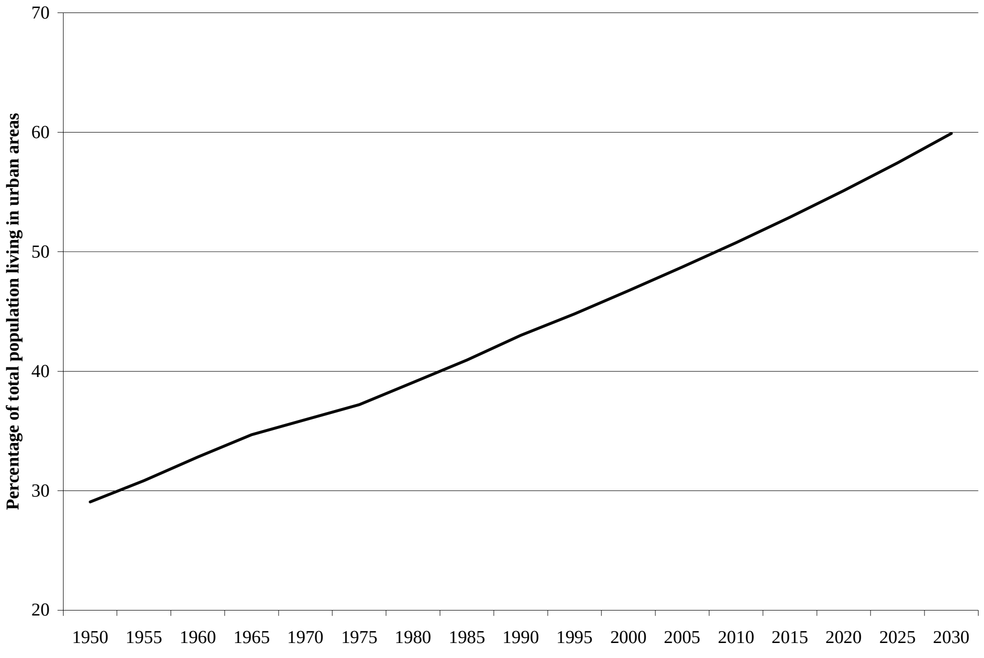
The main advantage of the UN model is its simplicity and transparency. It requires no detailed data and can thus be readily applied across countries. The main problem with the model is that it does not have any theoretical foundations: all forecasts are pure extrapolations of past trends and, thus, do not distinguish urbanization generated by migration from fertility or mortality-driven changes in the composition of the underlying population. The model implicitly assumes that all countries will follow the historical path of now-developed countries and does not take into consideration differences across countries. As a result, the UN projections have been shown to be quite unrealistic for countries near the beginning or at end of their urban transition (Bocquier 2005; Montgomery and Balk 2007).

Comparing the mean percentage errors across 169 countries and territories whose boundaries have not changed substantially over the past 20 years, Cohen (2004) finds that urban population forecasts made by the UN in 1980 for the year were on average 14 per cent (20.6 percentage points) too high, forecasts made 10 years ago were 17 per cent (19.9 percentage points) too high, while forecasts made 5 years ago were, on average, correct. Projections have been most reliable for OECD countries and least reliable for countries in sub-Saharan Africa and for other low-income countries.

3.2 WUP data: trends, patterns, and forecasts

The principal and most commonly cited statistic on urbanization is the fraction of the global population living in urban areas. As summarized in Figure 7 (which is based on the latest release of the UN's *World Urbanization Prospects*), the fraction of the population living in urban areas has been growing rapidly. While only 29 per cent of the global population resided in areas classified as urban in 1950, the fraction of the urban population is currently close to 50 per cent, and is expected to pass the majority threshold very soon (UN 2006).

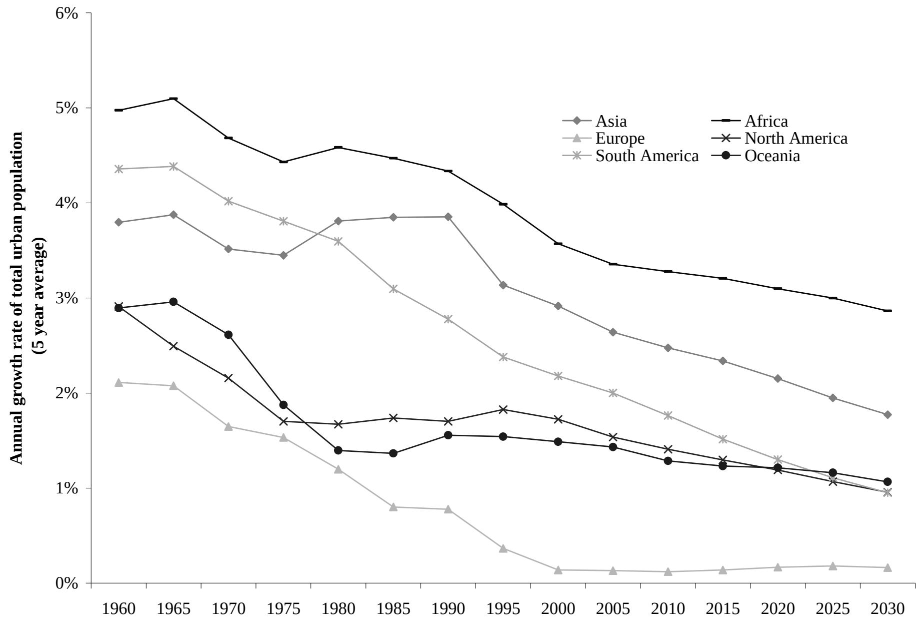
Figure 7: Urban population share, 1950–2030



Source: UN (2006).

As Figure 8 shows, the expected future increase in the number of people living in urban areas is small in developed regions. Not surprisingly, countries with the fastest-growing urban populations are located predominantly in Africa and Asia (Table 4). This is consistent with the empirical evidence on urban growth, which shows that urban concentrations tend to grow most quickly in the early stages of economic development (Williamson 1965; El-Shaks 1972; Alonson 1980; Wheaton and Shishido 1981; Junius 1999; Davis and Henderson 2003).

Figure 8: Growth rate of urban population by region



Source: UN (2006).

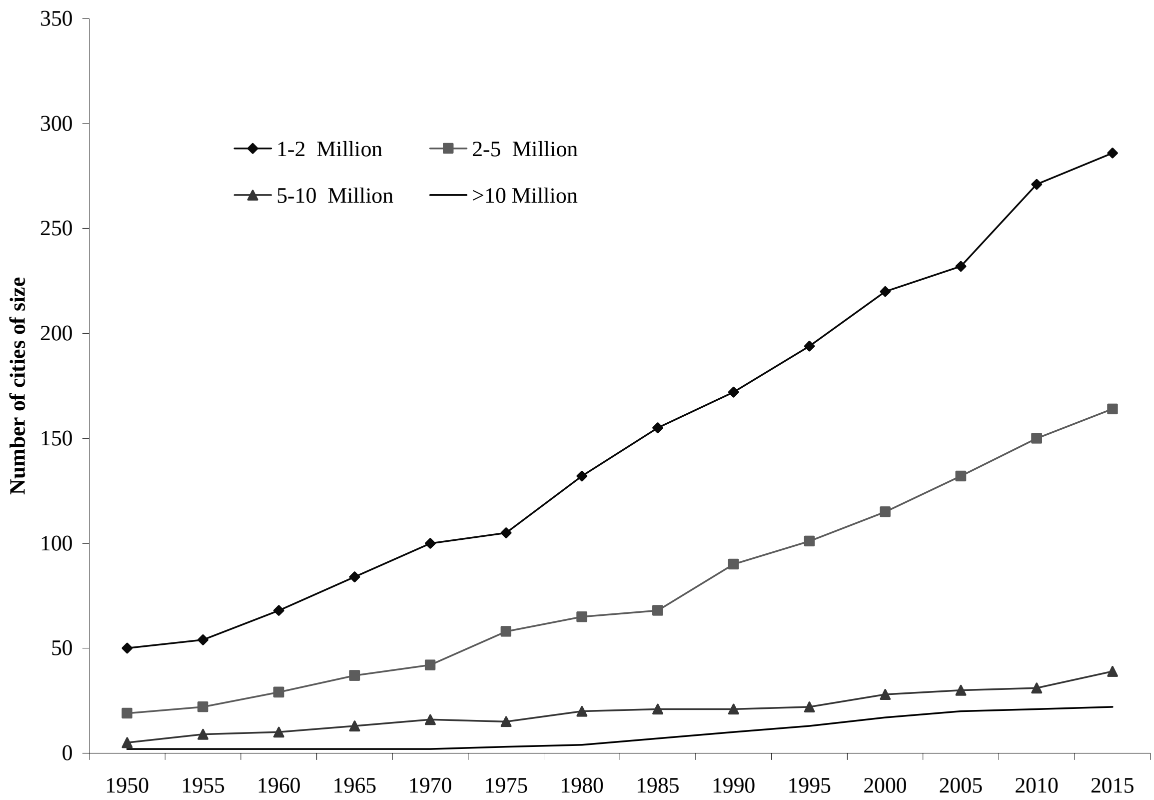
Table 4: Increases in urban population share 1980–2005: top 10 countries

	Urban population share		Absolute change in urban share, 1980-2005
	1980	2005	
Botswana	16.5	57.4	40.9
Cape Verde	23.5	57.3	33.8
Angola	24.3	53.3	29.0
Gabon	54.7	83.6	28.9
Oman	44.3	71.5	27.2
Indonesia	22.1	48.1	26.0
Gambia	28.4	53.9	25.5
Malaysia	42.0	67.3	25.3
Philippines	37.5	62.7	25.2
Korea, Rep.	56.7	80.8	24.1
Turkey	43.8	67.3	23.5
Liberia	35.2	58.1	22.9
Cameroon	31.9	54.6	22.7
Jordan	59.9	82.3	22.3
Mozambique	13.1	34.5	21.4

Source: UN (2006).

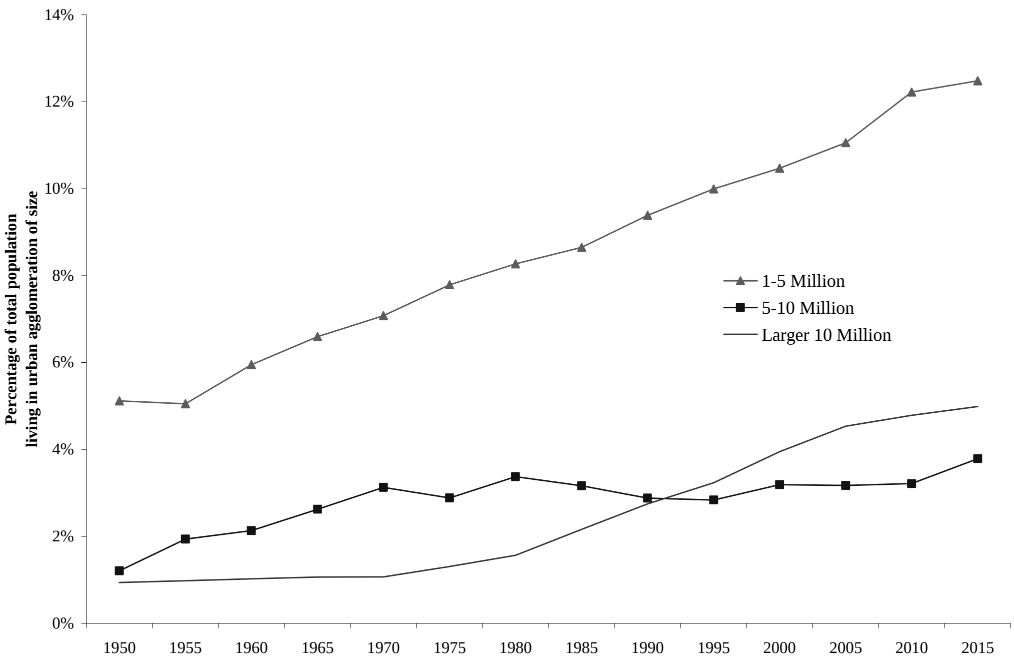
Urban growth in these countries is often spearheaded by the growth of their largest city. For example, Gaborone, the largest city in Botswana, has grown from a population of 18,000 in 1971 to more than 186,000 people today. With the increasing number of large cities (Figure 9), approximately 5 per cent of the world's population are expected to reside in cities with more than 10 million inhabitants ─ generally classified as 'mega-cities' ─ by 2015 (Figure 10). Providing jobs, housing, sanitation, transport facilities, education, and health care to burgeoning urban populations poses a major challenge to governments in developing countries, often exceeding the capacity of local governments.

Figure 9: Number of cities by size of urban agglomeration



Source: UN (2006).

Figure 10: Distribution of urban population by size of urban agglomeration



Source: UN (2006).

4 Discussion and conclusion

The best available data suggest that the increases in urban population share will continue, even though their pace is likely to slow as the relative size of rural populations – and, thus, also the potential inflows to cities – decline. Beyond this basic understanding, it is difficult to characterize urban population shares specifically. As our review shows, each of the several measures of urban shares currently in use has specific strengths and weaknesses. Our review also shows the inconsistencies across time and countries in the datasets most commonly used. Given the rapid progress in global mapping technologies, more detailed and consistent datasets are currently under construction, and these will open the door for further studies of the urbanization process.

The evidence presented in this paper makes clear that the differing sources and mechanisms that underlie the increases in the level of urban population shares have policy implications that further research could clarify. If increases in urban population shares mostly represent the gradual growth of rural areas into urban settlements as population increases, the welfare implications are likely to be limited. This will not be the case if increases in the urban population share reflect a fundamental structural shift from agricultural to industrial societies. If migration to the cities is essentially demand driven, the flow of human capital towards high-skill jobs in the industrialized cities is likely to result in higher individual income and welfare. However, this will not take place if urban populations grow rapidly in a policy and planning vacuum. For example, urban populations that grow faster than employment opportunities are likely to lead to the formation of neighbourhoods characterized by extreme poverty and high levels of crime.

Given the multiple channels and outcomes of changes in urban population shares, a complete evaluation of the urbanization process is rather difficult. From a research perspective, more detailed and structured data are needed; on this, much can be expected from the newly emerging datasets. From a policy perspective, general prescriptions with respect to urbanization hardly seem feasible. As much as urbanization can be a natural by-product of a country's economic development path, it can become a major economic and social problem if effective institutional and policy frameworks are not in place.

References

Alonson, M. (1980). 'Five Bell Shapes in Development'. *Papers of the Regional Science Association*, 45: 5–16.

Balk, D., Pozzi, F., Yetman, G., Deichmann, U., and Nelson, A. (2005). *The Distribution of People and the Dimension of Place: Methodologies to Improve the Global Estimation of Urban Extents*. Columbia University, NY: CIESIN.

Becker, C.M. (2007). 'Urbanization and Rural–Urban Migration'. In A. Dutt, and J. Ros (eds), *International Handbook of Development Economics*, Vols 1 and 2. Northampton, MA: Edward Elgar.

Bhaduri, B., Bright, E., Coleman, P., and Urban, M. (2007). 'LandScan USA: A High Resolution Geospatial and Temporal Modeling Approach for Population Distribution and Dynamics'. *GeoJournal*, 69: 103–17.

Bocquier, P. (2005). 'World Urbanization Prospects: An Alternative to the UN Model of Projection Compatible with the Mobility Transition Theory'. *Demographic Research*, 12(9): 197–236.

Bradshaw, Y.W., and Frazer, E. (1989). 'City Size, Economic Development, and Quality of Life in China: New Empirical Evidence'. *American Sociological Review*, 54(6): 986–1003.

Brown, M. E. (2008). *The Famine Early Warning Systems and Remote Sensing Data*. New York: Springer.

CIESIN (Center for International Earth Science Information Network) (2004a). IFPRI (Columbia University, International Food Policy Research Institute), CIAT (World Bank, Centro Internacional de Agricultura Tropical), and GRUMP (Global Rural–Urban Mapping Project). Alpha Version: Population Grids. Available at: www.sedac.ciesin.columbia.edu/gpw .

CIESIN (2004b). IFPRI (Columbia University, International Food Policy Research Institute), CIAT (World Bank, Centro Internacional de Agricultura Tropical), and GRUMP (Global Rural–Urban Mapping Project). Alpha Version: Settlement Points. Available at: www.sedac.ciesin.columbia.edu/gpw .

CIESIN (2004c). IFPRI (Columbia University, International Food Policy Research Institute), CIAT (World Bank, Centro Internacional de Agricultura Tropical), and GRUMP (Global Rural–Urban Mapping Project). Alpha Version: Urban Extents. Available at: www.sedac.ciesin.columbia.edu/gpw .

Ciccone, A., and Hall, R. (1996). 'Productivity and the Density of Economic Activity'. *American Economic Review*, 86(1): 54–70.

Cohen, B. (2004). 'Urban Growth in Developing Countries: A Review of Current Trends and A Caution regarding Existing Forecasts'. *World Development*, 32(1): 23–51.

Davis, J.C., and Henderson, J.V. (2003). 'Evidence on the Political Economy of the Urbanization Process'. *Journal of Urban Economics*, 53(1): 98–125.

Demographia (n.d.). '50 Largest World Metropolitan Areas Ranked'. Wendell Cox Consultancy. Available at: www.demographia.com/db-world-metro2000.htm.

Dobson, J.E., Bright, E.A., Coleman, P.R., Durfee, R.C., and Worley, B.A. (2000). 'LandScan: A Global Population Database for Estimating Populations at Risk'. *Photogrammetric Engineering and Remote Sensing*, 66(7): 849–57.

El-Shaks, S. (1972). 'Development, Primacy, and Systems of Cities'. *Journal of Developing Areas*, 7: 11–36.

Elvidge, C.D., Baugh, K.E., Kihn, E.A., Kroehl, H.W., and Davis, E.R. (1997). 'Mapping City Light with Nighttime Data from the DMSP Operational Linescan System'. *Photogrammetric Engineering and Remote Sensing*, 63(6): 727–34.

Elvidge, C.D., Safran, J., Nelson, I.L., Tuttle, B.T., Hobson, V.R., Baugh, K.E., Dietz, J.B., and Erwin, E.H. (2004). 'Area and Position Accuracy of DMSP Nighttime Lights Data'. In R.S. Lunetta, and J.G. Lyon (eds), *Remote Sensing and GIS Accuracy Assessment*. Boca Raton: CRC Press, 281–92.

Hardoy, J.E., Mitlan, D., and Satterthwaite, D. (2001). *Environmental Problems in an Urbanizing World*. London: Earthscan.

Imhoff, M.L., Lawrence, W.T., Stutzer, D.C., and Elvidge, C.D. (1997). 'A Technique for Using Composite DMSP/OLS "City Lights" Satellite Data to Accurately Map Urban Areas'. *Remote Sensing of Environment*, 61: 361–70.

Junius, K. (1999). 'Primacy and Economic Development: Bell Shaped or Parallel Growth of Cities?'. *Journal of Economic Development*, 24(1): 1–22.

Kamete, A.Y., Tostensen, A., and Tvedten, I. (2001). 'From Global Village to Urban Globe: Urbanization and Poverty in Africa: Implications for Norwegian Aid Policy'. Chr. Michelsen Institute Report, 2:1–95.

Keyfitz, N. (1980). 'Do Cities Grow by Natural Increase or by Migration?'. *Geographical Analysis*, 12(2): 142–56.

Mazumdar, D. (1987). 'Rural–Urban Migration in Developing Countries'. In E.S. Mills (ed.), *Handbook of Regional and Urban Economics*. Amsterdam: Elsevier Science BV, 1097–128.

Mills, E.S., and Nijkamp, P. (1987). ‘Advances in Urban Economics’. In E.S. Mills (ed.), *Handbook of Regional and Urban Economics*. Amsterdam: Elsevier Science BV, 703–14.

Montgomery, M.R., and Balk, D. (2007). ‘The Urban Transition in Developing Countries: Demography Meets Geography’. In E. Birch, and S. Wachter (eds), *Global Urbanization in the 21st Century*. Philadelphia, PA: University of Pennsylvania Press.

Montgomery, M.R., Stren, R., Cohen, B., and Reed, H.E. (2003). *Cities Transformed: Demographic Change and Its Implications in the Developing World*. Washington, DC: National Academies Press.

Njoh, A.J. (2003). ‘Urbanization and Development in Sub-Saharan Africa’. *Cities*, 20(3): 167–74.

Preston, S.H. (1979). ‘Urban Growth in Developing Countries: A Demographic Reappraisal’. *Population and Development Review*, 5(2): 195–215.

Potere, D., and Schneider, A. (2007). ‘A Critical Look at Representations of Urban Areas in Global Maps’. *Geojournal, Special Issue on Population Distribution*, 69: 55–80.

Salvatore, M., Pozzi, F., Ataman, E., Huddleston, B., Bloise, M., Balk, D., Brickman, M., Anderson, B., and Yetman, G. (2005). *Mapping Global Urban and Rural Population Distributions*. Rome: FAO.

Satterthwaite, D. (2007). ‘The Transition to a Predominantly Urban World and its Underpinnings’. IIED Human Settlements Discussion Paper, Urban Change 4. London: International Institute for Environment and Development.

SEDAC (n.d.). Gridded Population of the World, GRUMP (Global Rural–Urban Mapping Project). Palisades, NY CIESIN (Center for International Earth Science Information Network, Columbia University. Available at: www.sedac.ciesin.org/ gpw/index.jsp.

SEDAC (n.d.). Gridded Population of the World (GPW), Version 3. Palisades, NY: CIESIN, Columbia University. Available at: www.sedac.ciesin. columbia.edu /gpw.

UK Census (2001). April. London: Office for National Statistics.

UN (United Nations) (2003). *World Urbanization Prospects: The 2003 Revision*. New York: UN.

UN (United Nations) (2005). *World Population Prospects: The 2004 Revision*. CD-ROM edn, Extended Dataset. New York: UN.

UN (United Nations) (2006). *World Urbanization Prospects: The 2005 Revision Population Database*. New York: UN.

UN (United Nations) (2009). *World Urbanization Prospects: The 2008 Revision Population Database*. New York: UN.

UN-HABITAT/DFID (2002). *Sustainable Urbanization: Achieving Agenda 21*. Nairobi: UN-HABITAT/DFID.

UN-HABITAT (2007). *State of the World’s Cities 2006/7*. London: Earthscan.

US Census Bureau (2007). *Population Estimates for the 25 Largest US Cities based on July 1, 2006 Population Estimates*. Washington, DC: US Department of Commerce.

Wheaton, W.C., and Shishido, H. (1981). 'Urban Concentration, Agglomeration Economies, and the Level of Economic Development'. *Economic Development and Cultural Change*, 30: 17–30.

Williamson, J.G. (1965). 'Regional Inequality and the Process of National Development'. *Economic Development and Cultural Change*, 13: 3–45.

Woods, R. (2003). 'Urban–Rural Mortality Differentials: An Unresolved Debate'. *Population and Development Review*, 29(1): 29–46.

World Bank (2006). *World Bank Development Indicators*, CD-ROM.

Zhang, J. (2002). 'Urbanization, Population Transition, and Growth'. *Oxford Economic Papers*, 54: 91–117.