Chapter 1

The Chinese urban system and its challenges*

This chapter presents an overview of China's recent urbanisation, looking first at the growth of Chinese cities' populations and the evolution of the urban hierarchy and then at their economic performance. It considers both the continuing concentration of population in the largest cities and the differences in economic performance observed across different classes of city. This analysis is based in large part on the redefinition of Chinese functional urban areas rather than administrative units. When cities are defined on the basis of settlement patterns and commuting times rather than administrative borders, the picture of China's urban hierarchy changes substantially. The chapter also examines trends in inequality at different spatial scales, as well as interpersonal inequality, and at the economic structure of Chinese cities. Finally, it explores some of the environmental challenges facing China's fast-growing cities, particularly with respect to air quality.

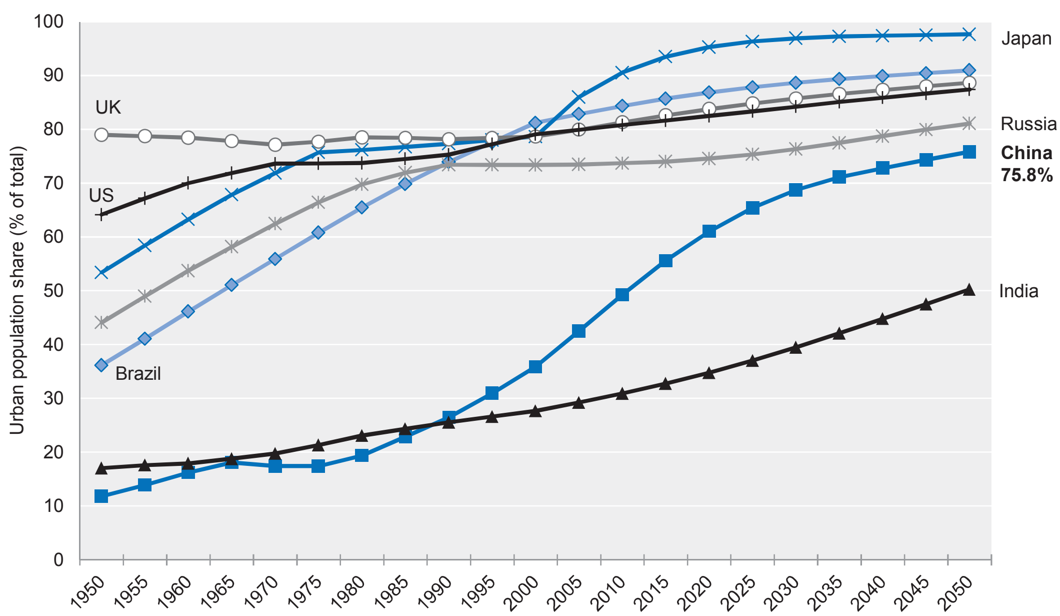
* The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

Since the onset of the period of reforms and opening up in 1978, the People's Republic of China (hereafter "China") has transformed itself from an under-developed and largely agrarian country into a rapidly urbanising industrial economy. It has managed to sustain high growth of rates of almost 10% per year for the last three decades. The sectoral structure of the Chinese economy has changed rapidly, as it has become an industrial powerhouse with an emerging services sector. This mainly export-led economic growth has raised the living standards of the Chinese people and offered economic opportunities in new sectors and locations. Urbanisation has to a large extent proceeded in parallel with the growth of the economy, which has entailed a massive migration of rural dwellers to cities. China has in recent decades been the most rapidly urbanising major country in the world, with an annual growth rate of the urban population of 4.2% since 1978. The overall urbanisation rate rose moderately from 12% in 1950 to 19% in 1980, before almost doubling in the next 20 years to 36% in 2000 and rising to just over 54% in 2014. The Chinese authorities expect the rate to reach 60% by 2020 (National Plan, 2014-2020), a goal that will be easily met according to the UN projections (Figure 1.1).

Figure 1.1. **Urbanisation trends in China and selected countries**

1950-2010



Source: UNDESA (2014), *World Urbanization Prospects: The 2014 Revision*, United Nations Department of Economic and Social Affairs, June; accessed online January 2015.

This Review considers the issues that are raised by the projected growth of China's urban population by perhaps 240 million people over the next 35 years. Such massive, sustained urbanisation presents both opportunities and challenges for the authorities, for whom urbanisation policies constitute an increasingly important part of the overall economic reform agenda. It also entails important changes in the governance of Chinese cities. This chapter presents an overview of urbanisation in China and an analysis of its economic drivers and impacts. Urbanisation is fundamentally about shifts in settlement patterns – that is, about the relationship between people and land. Chapter 2 thus focuses on policies concerned with these two factors: the human (rural-urban migration and the social policy implications of urbanisation) and the physical (land conversion and use, urban planning). Finally, Chapter 3 explores the governance and financing challenges raised by China's continued transformation into an urban society.

China and its urban areas

Defining and measuring "urban areas" is difficult…

Urbanisation is most often defined as the process whereby the number of people living in cities (urban areas) increases relative to the number of people living in rural areas. This definition, of course, begs a number of questions, particularly the definitions of urban and rural areas. Above all, cities are distinguished from rural places in terms of their higher population density and the consequent degree to which human, as opposed to natural, geography defines their character. In addition, factors such as the extent of the built-up area and the share of the population engaged in "urban" (i.e. secondary and tertiary sector) activities come into play. Many developed countries, for example, define urbanised areas on the basis of land use and density criteria, and utilise satellite remote-sensing information in order to delineate urban area boundaries. In developing and middle-income countries, like China, India, Russia and South Africa, there is often an additional criterion concerning the share of the population not employed in the primary sector (agriculture, fisheries or mining). Such differences complicate the task of discussing urbanisation processes in a comparative context. Even when relying solely on density as a criterion, definitions vary across the world, because the densities typical of both rural and urban areas vary so widely (OECD, 2012 and 2013d).

Even where common criteria for urbanisation are applied, city definitions vary widely across countries, since they are often based on political and historical criteria, as well as current policy priorities. A large urban area may consist of a very large number of local administrative units (cities or municipalities). This has implications for the availability of data on cities, which is most often based on administrative definitions, making cross-country – and even within-country – comparisons highly problematic. While some countries have definitions of statistical cities, like the metropolitan statistical areas in the United States, many do not, relying wholly on data broken down by administrative units. In order to overcome this problem, the OECD, with the support of the European Commission, recently established a new method for defining cities according to functional economic linkages rather than administrative boundaries (OECD, 2012). Urban policies that do not treat cities as functional economies, based on human settlement and activity, may fall short, particularly when it comes to implementing effective co-ordinated actions in land-use management, transport and labour markets. The OECD method takes into account population density and commuting patterns to define functional urban areas (FUAs), so that they correspond to integrated urban labour markets (Annex 1.A1).

… particularly in China

China presents a particularly complex challenge when it comes to defining the term "urban", for two additional reasons:

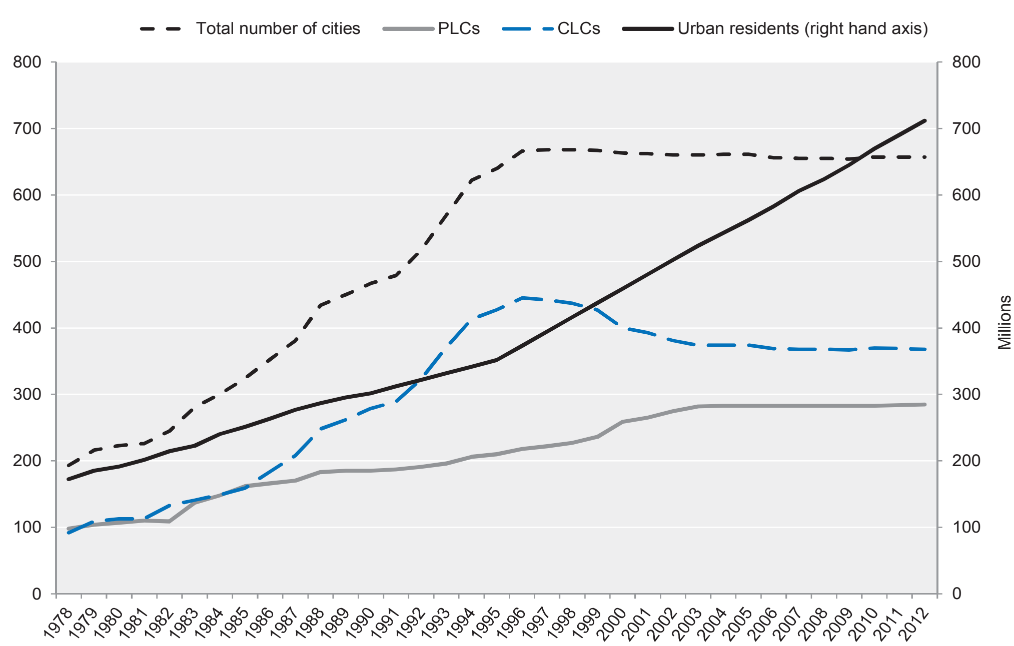
- Historically, urban areas have been defined administratively rather than on the basis of the kinds of criteria used elsewhere. As a result, Chinese cities can encompass within their boundaries places that would probably be classed as rural elsewhere in the world. At the same time, much of "rural China" is now both densely settled and largely dependent on nonrural economic activities. Over time, the significance of this factor is declining, as places are reclassified – around 15.5% of the increase in China's urban population during 1970-2010 has been the product of redesignation of places as urban rather than the result of migration or natural increase (OECD, 2013a). Nevertheless, the historic patterns of urban/rural designation continue to bedevil comparisons of China with other places and assessments of actual (as opposed to purely definitional) changes in urbanisation over time.

- As noted above, density thresholds are relative. Many undoubtedly rural places in China (i.e. not simply places that are so designated but places where agriculture really is the mainstay of the economy and urban amenities/lifestyles are lacking) are very dense by Western standards (Friedmann, 2006).

The current Chinese definition for designating statutory cities, such as prefectural-level cities (PLCs) and county-level cities (CLCs), takes into account both density and non-agricultural employment criteria. However, during the period of rapid urbanisation since the mid-1990s, the total number of statutory cities has remained stable, at around 657 (Figure 1.2). Reclassification of cities (from CLCs to PLCs) and the incorporation of urbanised areas within their periphery have been the prevailing patterns, rather than the creation of new statutory cities. Just as the criteria to designate statutory cities have changed since the formation of the People's Republic,[1] so there have also been important changes in the definition of "urban areas" (Box 1.1). These factors should be borne in mind when assessing data on the scale and speed of Chinese urbanisation. While there is no doubt that an extraordinary transformation is under way – both economic and geophysical data make this clear – it is not always possible to be very precise about the extent of Chinese urbanisation at any given time or about comparisons to other countries.

Figure 1.2. **China's statutory cities over time**

1978-2012



Note: The left vertical axis refers to the number of prefectural-level cities (PLCs), county-level cities (CLCs) and the total number of cities (PLCs + CLCs). The right vertical axis refers to the percentage share of urbanisation in mainland China ("urban population"/total population).

Source: Authors' calculations based on NBS data provided by the China Centre for Urban Development.

Box 1.1. **Current Chinese definitions for designating "statutory cities" and "urban areas"**

The standards for designating cities and towns in China include indicators such as total population, population density, economic scale, fiscal income and infrastructure. According to the standards, a county can be designated a county-level city if it meets the following requirements:

1. population density is over 400 persons per square kilometre, non-agricultural employment exceeds 80 000, and the non-agricultural share of total employment exceeds 30%; or
2. population density is between 100 and 400 persons per square kilometre, non-agricultural employment exceeds 120 000 and non-agricultural share of total employment exceeds 25%.

For a county-level city to be upgraded upgraded into a prefectural-level city, it must meet the following requirements: total non-agricultural population in excess of 150 000 with a non-agricultural population in the seat of government of at least 120 000, and a tertiary sector share in total GDP of at least 30%. Nevertheless, the central government has not formed the detailed and unified standards for merging villages into designated towns, and it is left for local government to define standards for designating towns.

According to the *Stipulations on Statistical Classification for Rural and Urban Areas* (adopted in 2008 and applied to the Sixth Population Census, 2010), "urban areas" include the urban areas of cities and towns. The *urban areas of cities* include: municipal districts, cities without districts and the associated residents' committees and other areas. *Urban areas of towns* include: seats of county government that are not classified as cities, and the associated residents' committees, as well as other places.

Source: Zhang J. and Y. Cai (2012), "Urbanisation in China Today", in OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264174108-en.

Most research on urbanisation in China uses administrative definitions of cities. This can be problematic, since they do not always correspond to economically meaningful spatial entities. Nevertheless, some recent approaches have deviated from this pattern and attempt to use definitions that correspond more closely to functional urban areas (Kamal-Chaoui, Leman and Rufei, 2009; OECD, 2013a). The difficulty of defining and measuring urbanisation in a way that allows for cross-country comparisons is relevant to assessments not only of China's level of urbanisation at any given time but also to debates about the relationship between its industrial and urban development.

The definition of China's urban population is further complicated by the fact that around one-third of the country's urban dwellers are classed as rural citizens for administrative purposes. Although a majority of Chinese now live in areas classified as urban (54% in 2014), only 36% of the population holds urban registration permits (known as *hukou*[2] in Chinese).[3] Almost 20% of the Chinese population consists of internal migrants from rural areas. Estimates of the exact number of internal migrants who live in cities without holding a local *hukou* vary, ranging from 234 million (National Plan, 2014-2020) to 275 million (OECD, 2013a). These migrants do not have full access to the public services in such fields as education, health care, pensions, employment and social housing, which are available to registered urban residents (local *hukou* holders). The consequences of this situation and possible policy responses will be treated in depth in Chapter 2, but it is important to understand the *hukou* system at the outset, because it is central to many debates about different aspects of Chinese urbanisation, including the structure of the urban system and the question of whether China is under- or over-urbanised. This is because the *hukou* system has impeded the mobility of citizens and thus the natural growth of cities. City size has not been determined freely, through a demand and supply mechanism between residents and available jobs and amenities offered in cities.

The lack of free movement of labour has deprived China of an important equilibrating force between its rural and urban areas, as well as between its more prosperous eastern cities and its lagging western ones. Recent liberalisation of the system in many cities (notably Shanghai) has been a positive change, but it may take time to reverse patterns that were shaped over decades. Migrants are in important respects treated as second-class citizens, and they, along with their families, are unable to take full advantage of the benefits of urbanisation. The disadvantage for the migrants themselves in terms of human capital development and access to opportunity is a cost for Chinese cities and the economy as a whole, since it means that cities are not realising the full potential of their residents in economic, social and cultural terms.

The *hukou* system, along with prevailing land use and industrial policies, might have created a distorted urban system (Lu and Wan, 2014). There is a growing literature examining whether China is under-urbanised or not. Most researchers and policy makers would agree that China is under-urbanised, in the sense that its urbanisation process lags behind its rapid industrialisation and economic development due to policy distortions (Au and Henderson, 2006; Chang and Brada, 2006; Lu and Wan, 2014). However, there are also studies that argue that China might be over-urbanised, as it has grown faster than its economic growth since the mid-2000s (Chen and Patridge, 2013). This literature usually compares China's city-size distribution to those of other countries at similar stages of economic development, in order to draw inferences about the optimal or "normal" city-size distribution. It is in general associated with research that studies whether different categories of Chinese cities (megacities, medium, small) underperform and whether there are positive or negative spillovers from neighbouring cities' growth (Chen and Partridge, 2013).

This review redefines functional urban areas in China

In order to address the under-/over-urbanisation debate, and many other critical issues related to Chinese urbanisation, it is first necessary to establish meaningful definitions of what a Chinese city is. It is not possible to apply the OECD/EU method for defining FUAs to China, due both to the lack of commuting data and the absence of a population grid based on the most recent census. An alternative approach was thus followed based on urban density, as well as information on transport and geomorphological characteristics that can offer plausible estimates for the commuting zone of each city. The details of this method are set out in Annex 1.A1.

The focus of the analysis here is on cities with populations above 200 000.[4] This would correspond to *medium-sized areas* (200 000 to 500 000 inhabitants) and *metropolitan areas* (above 500 000 inhabitants) according to the OECD (2012) classification. Although this classification is used here to facilitate comparison, it should be noted that cities of 200 000 to 500 000 might be regarded small by Chinese standards. Since the urban system has a large number of cities of above 5 million, two additional subcategories of the metropolitan areas were defined: very large metropolitan areas (5 million-10 million) and megacities (above 10 million). The final classification of cities for China is thus the following:

- *medium-sized urban areas*, with a population between 200 000 and 500 000;
- *metropolitan areas*, with a population between 500 000 and 1.5 million;
- *large metropolitan areas*, with a population between 1.5 million and 5 million;
- *very large metropolitan areas*, with a population between 5 million and 10 million; and
- *megacities,* with a population larger than 10 million.

China may be both more and less urbanised than the official urbanisation rate suggests

Application of the adapted OECD method results in the definition of 375 Chinese FUAs with populations of above 200 000 (Table 1.1). Of these, 292 can be classified as metropolitan areas, since they have populations above 500 000. The population living in the identified FUAs corresponds to 61% of the total national population, with the vast majority – equivalent to 59% of the national population – living in functional *metropolitan* areas (i.e. those with more than 500 000 inhabitants). This is well above the 54% level that is usually given for China's urbanisation rate. However, it is important to stress that this does *not* mean that one figure is wrong and the other right: the 61% figure includes only urban dwellers in cities of at least 200 000 (residents of smaller cities and towns are excluded), but it also includes millions of rural dwellers who nevertheless live within the hinterlands of relatively large conurbations. The point is not that 61% of the population are urban residents but that they live either in or in close proximity to relatively large cities – in their "gravitational pull", as it were. In that sense, China may be more urbanised than it usually appears. However, because the building blocks for the construction of FUAs are administrative units that can include both urban and rural areas, it is not possible to define FUAs based on areas that are purely urban and thus to offer an appropriate distinction between urban core and hinterland.

Table 1.1. **Functional urban areas in China**

Population 2000-10

Population range	1. Number of FUAs	2. Population 2000	3. Population 2010	4. Annual growth rate 2000-10	5. Urban population 2010
Megacities (> 10m)	15	212 860 603	260 549 325	1.86%	190 024 964
Very large metro areas (5m-10m)	23	128 863 733	148 007 123	1.40%	91 231 962
Large metro areas (1.5m-5m)	89	215 694 602	234 603 655	0.90%	134 145 464
Metro areas (0.5m-1.5m)	165	137 959 460	146 644 039	0.66%	77 023 351
Medium-sized areas (0.2m-0.5m)	83	28 713 162	30 601 406	0.76%	17 076 090
Total metro areas	292	695 378 398	789 804 142	1.28%	492 425 741
Total FUAs	375	724 091 560	820 405 548	1.26%	509 501 831
Total China		1 265 830 000	1 339 724 852	0.57%	678 624 285
FUA share of total population:		*57.2%*	*61.2%*		*38.0%*
Metropolitan areas' share of total population:		*54.9%*	*59.0%*		*36.8%*
Total urbanisation rate					*50.7%*

Note: The total urbanisation rate in 2000 was 36.2% (458 770 983 / 1 265 830 000).

Source: Authors' calculations based on the NBS 2000 and 2010 National Census.

The share of China's population found in functional *metropolitan* areas (i.e. FUAs with at least 500 000 inhabitants) is thus well above the OECD average of 40%. While China is indeed seeing a rapid concentration of population in very large cities, this contrast partly reflects the peculiarities of the method employed here for adapting the

OECD approach to the available Chinese data. The geographical building blocks used to construct Chinese metropolitan areas are counties and districts. While districts are generally quite urbanised, Chinese counties are rather heterogeneous. Large counties often contain both urban and rural areas. There is no information available to subdivide the counties into urban and rural parts, and thus use only the urban areas in the construction of the FUAs. However, the National Bureau of Statistics provides data on the "urban population" of each county and district, and this can be used in order to derive estimates of the strictly urbanised population of the metropolitan areas.[5]

According to the 2010 national census data, the "urban" population living in metropolitan areas corresponds to 36.8% of the total national population. In other words, only 64% of the total metropolitan areas' population (i.e. 492 million individuals out of 790 million) lives in parts of the metropolitan areas that can be strictly identified as urban, according to the working definition of the Chinese authorities. This suggests that a large share of the 59% mentioned above – perhaps as many as almost 300 million people – are likely to be living in small towns or rural areas in proximity to big cities but without the infrastructure and density to be classed as urban. The identification of these areas could help the Chinese authorities in managing future urbanisation: focusing in the nonurban parts of the metropolitan areas for infrastructure upgrade and densification could help reduce the tendency toward sprawl, while improving conditions in peri-urban areas that are already in many cases very dense. There are also around 170 million individuals who live in urban areas outside FUAs. These are smaller cities or towns that are classified as urban by the Chinese authorities but that do not meet the size, density and distance criteria to form an FUA or be part of one.

The proportion of the population living in metropolitan areas has been rising over time, with an increase of four percentage points between 2000 and 2010. This is a relatively modest increase compared to the rapid pace of Chinese urbanisation (Figure 1.1), and it reflects some distinct features of China's urbanisation that are captured by the different indicators. China's urbanisation takes place through three main processes: rural to urban migration, reclassification of rural areas as urban, and natural growth of the urban population. The former two correspond to roughly 40% each of the growth of urban population, while the latter corresponds to the remaining 20%. Migration *within* metropolitan areas is not reflected in the four-point increase, nor is the effect of reclassification, since the metropolitan boundaries used are the same for both periods; it thus reflects only the effects of long-distance migration and natural increase (including the growth of the non-urban population in those areas, which tends to be faster, owing to the application of the one-child policy). The total urbanisation rate, by contrast, reflects both the reclassification of rural areas to urban (raising the urbanisation rate even in the absence of any change in settlement patterns) and the rural-urban migration within metro areas. For the period between the last two censuses, the relevant increase is 14 percentage points, from 36% to 50% (Table 1.1).

China has far more megacities than the administrative data would suggest

The FUA analysis suggests that China's urban system is even more concentrated than it appears from the official data. The country has no fewer than 15 megacities – FUAs with more than 10 million inhabitants. By contrast, the official data for that year show just six megacities. Tables 1.2 and 1.3 give an indication of how the FUA analysis changes the profiles of China's most populous cities in terms of both total population and urban population.

Table 1.2. **FUAs and statutory cities: Total population, 2010**

FUAs		Statutory cities	
City	Population (millions)	City	Population (millions)
Shanghai	34.0	Shanghai	22.3
Guangzhou	25.0	Beijing	18.8
Beijing	24.9	Chongqing	15.7
Shenzhen	23.3	Tianjin	11.1
Wuhan	19.0	Guangzhou	11.1
Chengdu	18.1	Shenzhen	10.4
Chongqing	17.0	Wuhan	9.8
Tianjin	15.4	Dongguan	8.2
Hangzhou	13.4	Chengdu	7.4
Xian	12.9	Foshan	7.2
Changzhou	12.4	Nanjing	7.2
Shantou	12.0	Xian	6.5
Nanjing	11.7	Shenyang	6.3
Jinan	11.0	Hangzhou	6.2
Haerbin	10.5	Haerbin	5.9
Zhengzhou	9.7	Shantou	5.3
Qingdao	9.6	Jinan	4.3
Shenyang	7.7	Zhengzhou	4.3
Wenzhou	7.6	Changchun	4.2
Nanchang	7.4	Dalian	4.1

Source: Authors calculations based on NBS data; NBS (2010) *China Statistical Yearbook 2010,* China Statistics Press, Beijing.

Table 1.3. **FUAs and statutory cities: Urban population, 2010**

FUAs		Statutory cities	
City	Urban population (millions)	City	Urban population (millions)
Shanghai	28.2	Shanghai	20.2
Guangzhou	21.0	Beijing	16.4
Shenzhen	21.7	Chongqing	10.8
Beijing	19.2	Shenzhen	10.4
Wuhan	12.6	Guangzhou	9.7
Tianjin	11.6	Tianjin	9.6
Chengdu	11.3	Wuhan	7.5
Chongqing	11.1	Dongguan	7.3
Hangzhou	9.3	Foshan	6.8
Nanjing	8.3	Chengdu	6.3
Xian	7.8	Nanjing	5.8
Shantou	7.5	Shenyang	5.7
Changzhou	7.3	Xian	5.2
Shenyang	7.0	Hangzhou	5.2
Jinan	6.9	Haerbin	4.9
Haerbin	6.4	Dalian	3.9
Qingdao	6.2	Zhengzhou	3.7
Zhengzhou	5.8	Shantou	3.6
Wenzhou	5.3	Jinan	3.5
Nanchang	4.2	Changchun	3.4

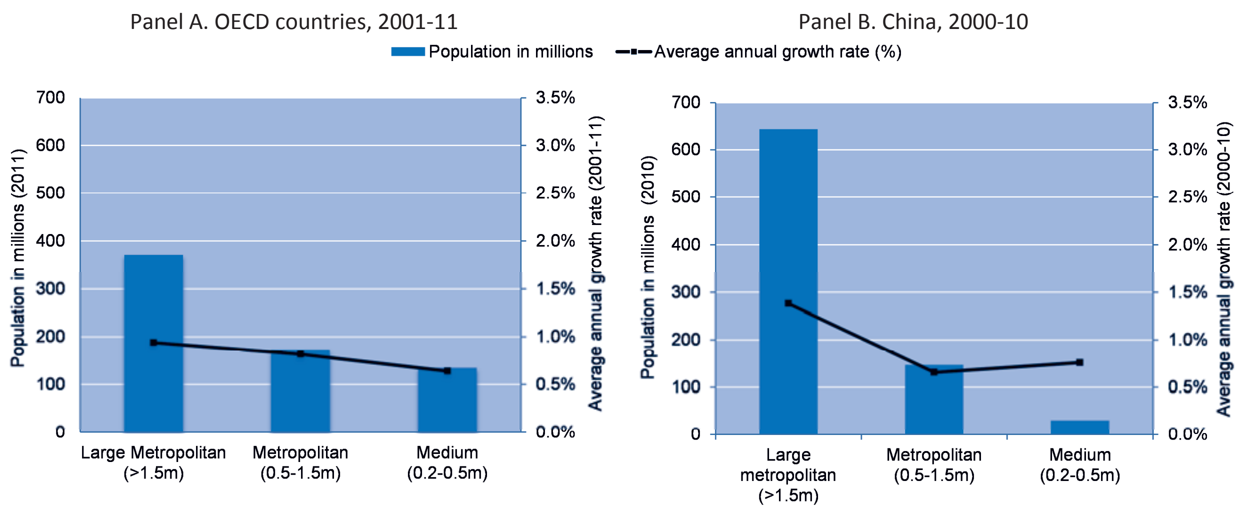
Source: Authors calculations based on NBS data; NBS (2010) *China Statistical Yearbook 2010,* China Statistics Press, Beijing.

Urban trends in China

China's urbanisation is being led by the rapid growth of the largest cities

In the OECD area, the majority of the urban population tends to live in metropolitan areas with populations above 1.5 million (OECD, 2013d). There are almost 540 million people living in metropolitan areas of more than 500 000 inhabitants in OECD countries, 370 million of whom live in metropolitan areas with populations above 1.5 million (Figure 1.3). Metropolitan areas also exhibit the highest population growth, with an annual compound growth rate of around 0.85% over the last decade. FUAs with populations of 0.2 million-1.5 million recorded growth rates of around 0.7%. China's *medium-sized FUAs* (200 000-500 000 population) and the *metropolitan areas* (500 000-1.5 million) have been growing at roughly similar rates, around 0.7% annually. However, the *large* metropolitan areas (above 1.5 million) exhibit a growth rate of 1.4%, which is much higher than the average for OECD countries.

Figure 1.3. **City size and city growth of FUAs: OECD countries and China**

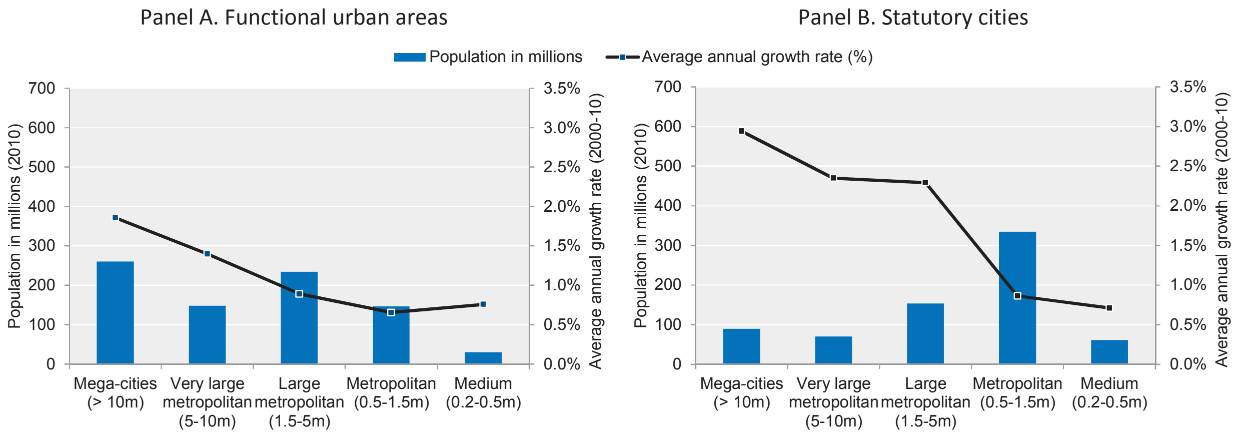


Note: *Small urban areas*, with a population of between 50 000 and 200 000 people; *medium-sized urban areas*, with a population between 200 000 and 500 000; *metropolitan areas*, with a population between 500 000 and 1.5 million; and *large metropolitan areas*, with a population of 1.5 million or more. The OECD Metropolitan Areas Database includes 275 metropolitan areas.

Source: OECD (2013), "Metropolitan areas", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en (accessed on 20 October 2014).

Breaking the large metropolitan areas category down further reveals that this difference is mainly the result of growth in cities with populations of above 5 million (Figure 1.4). The very large metropolitan areas (5 million-10 million) and the megacities (above 10 million) have been growing at rates of 1.4% and 1.9% respectively, while the cities with populations between 1.5 million and 5 million exhibit growth rates similar to those found in OECD economies. The rapid population growth of big cities might in part reflect a policy bias in favour of the largest cities on the part of the Chinese authorities, in terms of infrastructure provision and funding allocation (Henderson, 2009). Investment in fixed assets per capita in China's municipal-level cities and provincial capitals was double that of prefectural-level cities and four to five times that of county-level cities in mid 2000s, helping them attract firms and migrant workers.

Figure 1.4. **City size and city growth for Chinese cities: FUAs vs. statutory cities**



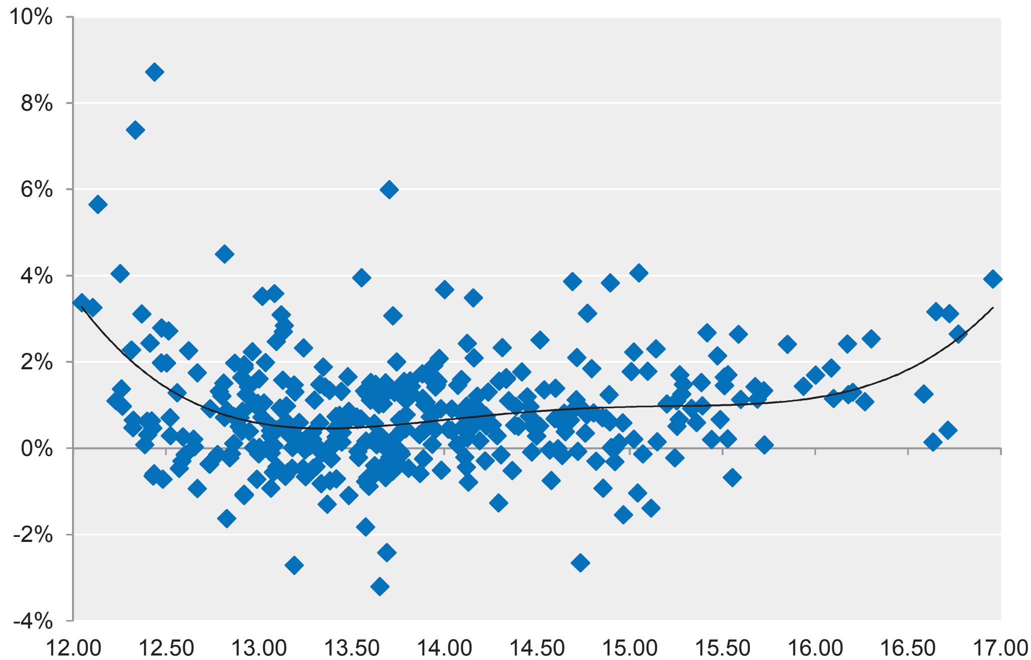
Source: Authors' calculations based on NBS data.

Figure 1.4 reveals what a difference the FUA method makes when it comes to understanding the structure of China's urban system. While the FUA definition shows the bulk of the population living in urban areas with populations above 1.5 million, data based on the administrative definition show the urban population divided almost equally between cities of 0.5 million-1.5 million and those with populations above 1.5 million. Around two-thirds of this difference stems from the "reclassification" of individuals living in statutory cities of less than 1.5 million, which are found to form parts of larger agglomerations, and one-third from individuals living in counties that are not officially part of any statutory city but that fall within an FUA.[6] Therefore, it appears that the larger boundaries of the constructed FUAs capture recent changes in the urban hierarchy, while the administrative definitions of cities appear to be slow in adapting to change. Neighbouring counties and districts might form functional urban labour markets that extend beyond the boundaries of the statutory cities and, in that respect, establish *de facto* agglomerations that the current governance structures do not reflect. Furthermore, the growth rates of the constructed Chinese FUAs and the statutory cities display different trends. While the situation is not very different for the medium/smaller cities, statutory cities with populations above 1.5 million demonstrate robust annual growth of almost 2.5%, compared to the 1.4% observed for the FUAs of similar size. (The growth rates for statutory cities are higher across the board; this reflects in part the effect of holding the FUA boundaries constant, as noted above.)

A look at how the individual cities are performing demonstrates that there is a great deal of variation within each category (Figure 1.5). Furthermore, it appears that there are some cities with relatively small populations that are booming and that exhibit annual growth rates above 2%.

Figure 1.5. **Population growth rate and initial population for China**

FUAs 2000-10



Note: The *x*-axis represents FUA population logged for 2000 and the *y*-axis represents annual population growth rate for the period 2000-10.

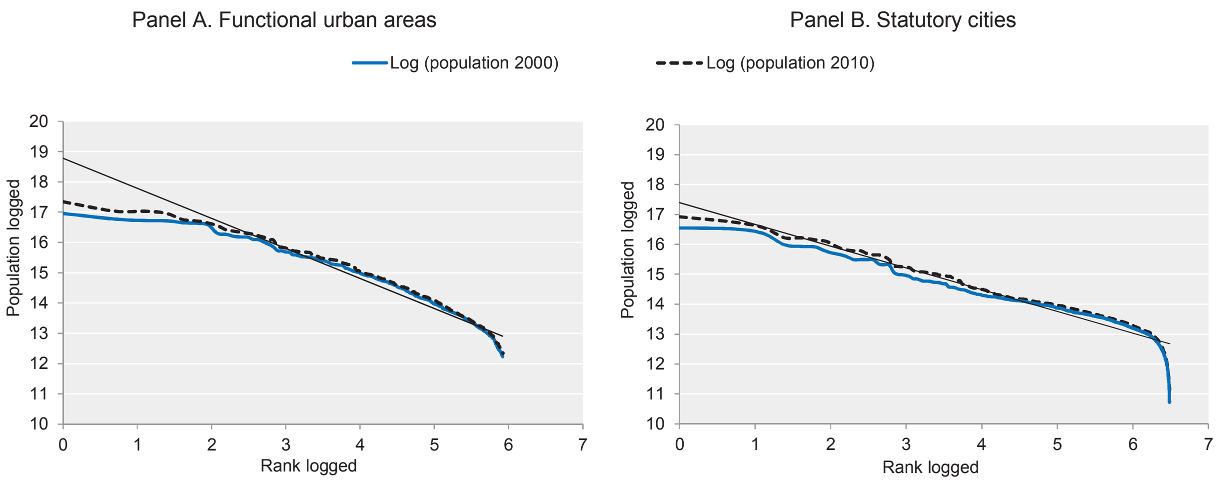
Source: Authors' calculations based on NBS data.

China's urban hierarchy is growing more concentrated

The constructed FUAs follow to a large extent the expected relationship of the between population and rank (Figure 1.6) as described by "Zipf's law" (Box 2). Zipf's law presents an empirical regularity, rather than the urban ideal for a nation. There has been some argument that China's megacities might be over-sized, while the medium-sized cities might be under-sized (Au and Henderson, 2006), but the data suggest that the largest cities are in fact smaller than one might expect. Looking at the evolution of the rank-size relationship between the last two census years, there is a shift of the distribution towards a Zipf's law pattern, with the highest population increase occurring in the largest 50 cities and particularly the first dozen. The functionally defined cities appear to conform better to Zipf's law than the statutory cities. This is consistent with other work suggesting that functionally defined urban systems approximate better the rank-size rule than administratively defined systems (Veneri, 2013; Cheshire 1999). Also remarkable is that for the statutory cities, a substantive shift upwards also takes place at the middle of the distribution and not just at its upper limits, as was the case for the FUAs.

Figure 1.6. **Zipf's law for China's functional urban areas and statutory cities**

Relationship of population logged and rank logged (2000, 2010)



Note: The fitted lines of the rank-size distribution in panel A is y = -1.0208x + 18.995, R^2 = 0.9461; with a slope very close to -1 for 2010 and y = -0.9926x + 18.779. For panel B, the fitted line for 2000 is: y = -0.727x + 17.393; R^2 = 0.8488; the fitted line for 2010 is: y = -0.7627x + 17.686; R^2 = 0.8762.

Source: Authors' calculations based on NBS data.

This suggests that, in the absence of strong policy interventions, the concentration of China's urban system is likely to continue. The implications of this are explored in more detail in Chapter 2. Zipf's law has no obvious normative implications of its own and it does not constitute the basis for any policy recommendations; it merely suggests where the urban hierarchy is likely to be evolving. However, given the scale and cost of interventions designed to reshape that evolution, as well as the lack of strong evidence that China's large cities have exhausted the potential to generate agglomeration benefits, such plans should be viewed with great caution. While Chinese leaders are understandably concerned to avoid uncontrolled urban growth, the example of a city like Tokyo shows that a metropolitan area of very high density can function quite well even with a population of more than 30 million. However, cities of such scale require advanced urban management and well-functioning institutions if they are to avoid congestion, environmental degradation and slums (Henderson, 2009).

Box 1.2. **Zipf's law and the urban hierarchy**

In the context of urban studies, the term "Zipf's law" refers to an empirical regularity concerning city-size distributions that has been observed and debated for over a century (Auerbach, 1913; Zipf, 1949): the population ranks of cities in various countries follow a power law of a specific type such that, under the hypothesis of a Pareto probability distribution, the log(rank)-log(size) relationship is linear, with a coefficient equal or close to -1. Put more simply, this implies that the largest city is twice as large as the second-largest city, three times as large as the third and so on along the urban hierarchy. While the relationship tends to break down at very small scales, it holds remarkably well for many countries across a very wide range of city sizes (Gabaix and Ioannides, 2004). The relevance of Zipf's law in the context of city-size distribution is twofold.

Box 1.2. **Zipf's law and the urban hierarchy** *(cont.)*

First, it relates to efforts to understand the distribution of population and human activity across space; Krugman (1996:40) has argued that such regularity is “spooky” and that there should be a theoretical explanation for it. There is also the question of whether Zipf’s law implies some constraints in the pattern of urban growth, i.e. that the growth trajectories of individual cities could not change the overall city-size distribution (Duranton, 2007). Others raise the question of whether there are different levels of economic efficiency for different urban forms (numbers of cities and their sizes) (Storper, 2013).

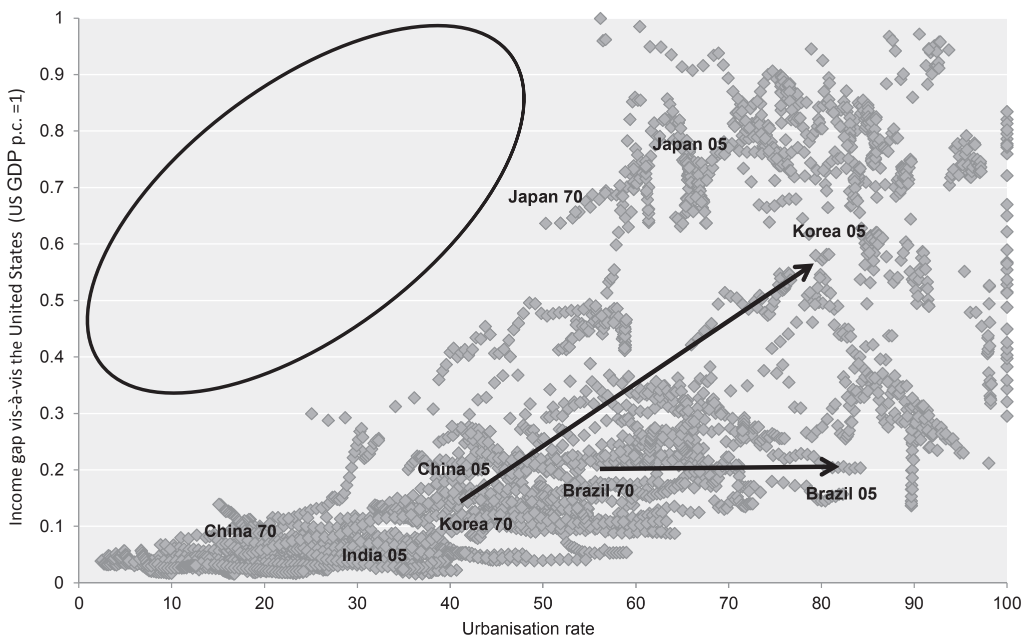
Sources: Veneri, P. (2013), “On City Size Distribution: Evidence from OECD Functional Urban Areas”, *OECD Regional Development Working Papers*, 2013/27, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k3tt100wf7j-en; Auerbach, F. (1913), “Das Gesetz der Bevölkerungskonzentration”, *Petermanns Geographische Mitteilungen*, No. 59, pp. 74-76; Gabaix X. and Y.M. Ioannides (2004), “The Evolution of City Distributions”, in J.V. Henderson and J.F.Thisse (eds.), *Handbook of Regional and Urban Economics*, Ch.53, North Holland, Amsterdam, pp. 2 341-2 378; Duranton, G. (2007) “Urban Evolutions: The Fast, the Slow, and the Still”, *American Economic Review*, Vol. 97, No. 1, pp. 197-221; Krugman, P. (1996), *The Self-Organizing Economy*, Blackwell, Cambridge, Massachusetts; Storper, M. (2013), *Keys to the City. How Economics, Institutions, Social Interaction, and Politics Shape Development,* Princeton University Press, Oxford; Zipf G. (1949), *Human Behavior and the Principle of Least Effort*, Addison-Wesley, Cambridge, Massachusetts.

Urbanisation and economic development

Urbanisation is necessary but not sufficient for development

A country’s urbanisation trajectory has important implications for its economic growth. While urbanisation does not cause development, sustained economic development does not appear to occur without urbanisation. Moreover, the evidence suggests that well-managed cities can and do support economic growth, by allowing countries to enjoy the economic benefits of agglomeration. Some countries have become highly urbanised without becoming rich, but no country has achieved very high levels of per capita income without becoming predominantly urban – as can be seen from the large empty space in the upper left of Figure 1.7. Brazil, for example, saw its urbanisation rate rise from 55% to 85% during 1970-2005, without achieving any progress with respect to income convergence with the United States. Korea, by contrast, managed to reduce the gap with the US by two-thirds, while its urbanisation rate doubled. As China has started from a lower level of urbanisation, it has considerable potential to catch up in terms of both future urbanisation and economic development. The main challenge it faces now is to avoid the middle-income trap and move its economy to a higher position in the global value chain. The experience of countries that faced similar urbanisation challenges in the past can be a useful guide for China in designing policies that will favour smart, sustainable and inclusive urbanisation.

Figure 1.7. **Urban population and income**



Note: Data cover 92 countries for the period 1970-2005.

Source: OECD calculations based on World Bank (2014), *World Development Indicators* (database), http://data.worldbank.org/data-catalog/world-development-indicators.

China has hitherto managed to combine its rapid urbanisation with strong economic development, in a period characterised by vast industrialisation and technological advancement. With its growth rates slowing to 7.0%-7.5% from the double-digit figures that have prevailed in the recent past, China faces an important challenge in a global economy that is cooling down and where export-led growth appears to have reached its limits. In such a setting, the future urbanisation of China can prove valuable in raising the incomes of a new urban middle class that will feed the consumer demand for China's industrial production as well as for the emerging service sector. Urbanisation thus coincides well with the authorities' aim of rebalancing the economy's growth model towards greater reliance on domestic consumption.

External demand can no longer drive Chinese growth, as it once did

This rebalancing is all the more important in view of the increasingly difficult external situation that China now faces. World Bank (2015) estimates that global growth in 2014 reached just 2.6%, only slightly above the 2.5% recorded the year before. For 2015, the Bank envisages only a limited acceleration in the growth of both global GDP and world trade. While softer commodity prices may support recovery in many countries, particularly the OECD area, there are significant downside risks associated with volatility on financial and commodity markets, geopolitical tensions and domestic difficulties in the euro zone and Japan, in particular. Even if this assessment proves overly pessimistic, the scope for reliance on export demand continues to decline as China's share of world exports and GDP rises. The country long benefited from both expanding global demand and rapidly increasing market share; this was much easier when the Chinese economy and its share of global markets were both far smaller. Lower oil prices and rising export demand will thus continue to support Chinese growth, but not to the same extent as in the past. The good news is that the rebalancing of growth that China seeks is broadly consistent with its urbanisation agenda: as will be seen in Chapter 2, policies that aim to improve the quality of Chinese urbanisation tend to support the overall structural reform agenda to which the government is now committed, including fiscal and financial sector reforms.

That said, this agenda is not without its own risks. Many of these reforms – particularly those that will tend to slow down rapid credit growth – are important for long-term stability and the sustainability of growth, but they may contribute to a rapid slowdown if other sources of demand fail to emerge quickly enough. Urbanisation policies can clearly play a role here, not only because urbanisation tends to be associated with consumption growth but also because service-sector growth, in particular, should contribute more to job creation. In the first three quarters of 2014, services contributed to half of Chinese growth. As Hofman (2015) observes, services growth can help to sustain the expansion of domestic consumption precisely because a larger share of value added in services goes to salaries; moreover, he notes that the growth of the services sector is less dependent on credit growth and thus less likely to be choked off by fiscal and financial reforms.

Agglomeration economies are central to the benefits of urbanisation…

The productivity of a country is largely determined by the productivity of its cities, which makes it important for a country's economic development to implement policies that foster robust urban growth. It is well documented that productivity tends to rise with city size. This relationship is attributed to agglomeration benefits that accrue to cities with size and population density, mainly due to thicker labour markets, provision of specialised inputs and knowledge spillovers (Box 1.3). There is a large empirical literature that examines the magnitude of the agglomeration benefits and shows great variation in estimates for different countries (see Melo, Graham and Noland, 2009 for a meta-analysis; Combes, Duranton and Gobillon 2011 for a recent review). Accounting for the fact that more productive individuals tend to live in larger cities, recent work that combines data for five OECD countries finds agglomeration benefits with elasticities of 2%-5%. In other words, a doubling of population while other city characteristics (demography, skills endowments, industrial structure, etc.) remain the same is associated with an increase in productivity of between 2% and 5% (Ahrend et al., 2014). It is important to stress, of course, that this is in addition to other sources of growth commonly associated with urban development – this refers to the "pure" agglomeration after controlling for selection effects and the like. A similar exercise for China has found agglomeration benefits to be much higher, at around 9% (Combes et al., 2013). Even the lower estimate for OECD countries would be meaningful in China: few OECD cities double their size in any very short period, but some Chinese cities have doubled in size two or three times in recent decades. Furthermore, Au and Henderson (2006) find that China has a large number of medium-size cities that would benefit substantially from increases in size, so that a doubling of their population would increase real output per worker by 20%-35%. Although this research refers to data from the 1990s and does not take into account sorting of the more productive individuals to the larger cities (like the Combes et al. 2013 study), it might still suggest that agglomeration benefits for China have higher elasticities than are typical of developed countries.

Box 1.3. **Agglomeration economies**

Three main mechanisms work to produce agglomeration economies:

1. Mechanisms that deal with sharing of:

- *indivisible facilities* such as local public goods or facilities that serve several individuals or firms. Some examples, other than public goods, are facilities such as laboratories, universities and other large goods that do not belong to a particular agent but where some exclusion is implicit in providing them.
- the *gains from the wider variety of input suppliers* that can be sustained by a larger final goods industry. In other words, the presence of increasing returns to scale along with forward and backward linkages allow firms to purchase intermediate inputs at lower costs.
- the *gains from the narrower specialisation* that can be sustained with higher production levels. Certain firms specialise in producing complementary products, reducing overall production costs.
- *risks*. This refers to the idea that an industry gains from having a constant market for skills. If there are market shocks, firms can adjust to changes in demand if they have access to a deep and broad labour market that allows them to expand or contract their demand for labour.

2. Matching mechanisms by which:

- Agglomeration improves the *expected quality of matches between firms and workers*, so both are better able to find a good match for their needs.
- An increase in the number of agents trying to match in the labour market also *improves the probability of matching*.
- *Delays are alleviated*. There is a possibility that contractual problems arising from renegotiation among buyers and suppliers will result in one of the parties losing out to the other party in a renegotiation. However, if the agglomeration is extensive enough, agents can find an alternative partner.

3. Learning mechanisms based on the generation, diffusion and accumulation of knowledge. This refers not only to the learning of technologies, but also the acquisition of skills.

OECD metropolitan regions benefit from agglomeration effects and thus tend to display higher levels of productivity, higher rates of employment and higher levels of GDP per capita than other regions. These benefits, however, are limited by congestion costs, diseconomies of scale and oversupply of labour, among other potential negative elements, and many metro regions have in recent decades tended to underperform national economies.

Source: Duranton, G. and D. Puga (2004), "Micro-foundations of Urban Agglomeration Economies", *Handbook of Regional and Urban Economics*, 4:4, February; OECD (2009), *OECD Economic Outlook*, Vol. 2009/1, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_outlook-v2009-sup1-en.

While important, city size and population density are not by any means the only factors that matter for a city's growth. If density were the critical variable, then *favelas*, shanty towns and refugee camps would be among the most productive places on earth. Many cities in the developing world combine very high densities with weak public transport, inadequate power and sanitation infrastructure, and poor planning (e.g. extreme functional segregation at relatively large scales). The result in many cases is long commutes, severe congestion and heavy reliance on private motorised transport. Often such large conurbations do not function as cities but are instead characterised by fragmentation of labour markets, poor internal connectivity, a lack of co-ordination in land-use planning and infrastructure provision, and high levels of conflict among constituent municipalities. In short, such cities experience a dysfunctional density that is neither economically efficient nor environmentally sustainable (OECD, 2015). The key to realising agglomeration benefits, then, is creating cities that function well as economic systems; as OECD (2013a, pp.67) concludes, "cities, rather than urbanisation, are key to growth."

The distinction between density and agglomeration is thus critical: though closely related, the two are not the same. Agglomeration benefits arise as a result of the ease with which people can interact with large numbers of other people. It is thus possible to increase agglomeration without increasing density by, for example, removing transport bottlenecks in a given place, so that agents can move more easily around the city. Likewise, one can achieve very high densities with little agglomeration benefit if cities are fragmented, internal transport is difficult and markets remain segmented. As OECD (2015) observes, this is characteristic of many cities in the former Soviet Union, where large conurbations were often built as networks of adjacent factory towns, with each part of the city organised around one major production complex, with all of the social and other infrastructure that was needed. Movement around these urban districts was often easy, but movement above them could be difficult, not least as they were often separated by swathes of land given over to large-scale transport infrastructure. This has implications for China, too, given the influence of Soviet urban planning in the first years after the Revolution, which has had a lasting effect on the urban fabric of China's cities (see Chapter 2 for more detail). As will be seen in chapters 2 and 3, well-functioning cities need to be knit together with soft tissue as well as a "skeleton" of physical planning and infrastructure: thus co-ordination across sectoral policies and governance are critical concerns alongside questions of urban form.

Just as density is not enough, neither is size. While OECD research points to agglomeration benefits increasing in city size (OECD, 2014b), it also finds that better connectivity *among* cities can have a beneficial impact on productivity, too. There is evidence that cities can "borrow" agglomeration benefits from near neighbours and in that respect, good connections to larger cities are important. Due to positive spillovers, cities that are closer to nearby populous cities tend to have higher productivity (Ahrend et al., 2014); this relationship is not limited to physical distance – it also holds up when travel times are used (Ahrend and Schumann, 2014). In that respect, the authorities can help a city reap agglomeration benefits by improving external connectivity via transport infrastructure investments. This finding has relevance for attempts to generate growth in satellite cities around the largest Chinese conurbations.

Finally, it is critical to note that a large part of what is meant by "reaping agglomeration benefits" is in fact about mitigating the *costs* of agglomeration: urban diseconomies like congestion, pollution and higher prices for land and other production factors can all inhibit cities' growth. This is a key point, because it is often easier for cities to address the costs of agglomeration rather than its benefits. While there might be limited scope for the authorities to increase the benefits of agglomeration with public spending, many of the key drivers of productivity typically depend on national-level policies (e.g. regulation, competition, human capital and innovation) and on the actions of firms (cluster economies), which policy is ill-equipped to address – cluster policies are popular but the evidence for their effectiveness is thin (Duranton, 2011). When it comes to things like human capital and innovation, regional- and city-level action is often needed to enhance the effectiveness of programmes by adapting them to local conditions, but city-level interventions are rarely decisive, and the relationship between policy intervention and outcome is still poorly understood and hard to predict. By contrast, there is much that policy makers can do to alleviate agglomeration *costs* like congestion and environmental pollution, which affect economic efficiency, environmental sustainability and quality of life. Moreover, it is usually clearer in these cases what can be done and what the results are likely to be.

OECD work on urban and regional growth also underscores the importance of identifying and exploiting complementarities among different strands of sector policies, while managing or mitigating the trade-offs among them: many of the key factors supporting growth only appear to operate in the presence of other factors (Box 1.4). Such cross-sectoral co-ordination implies a need for enhanced co-ordination between and across levels of government, (OECD, 2014b; OECD, 2013b). Less fragmented governance arrangements and a better fit between policies and public investments, on the one hand, and the functional economic boundaries of cities, on the other, has been found to improve cities' performance (Ahrend et al., 2014; Cheshire and Magrini, 2009). For a given population size, a metropolitan area with twice the number of municipalities is associated with around 6% lower productivity, an effect that is mitigated by almost half when a governance body at the metropolitan level exists (Ahrend et al., 2014). This problem is of increasing relevance to China (for an extensive discussion see Chapter 3 in this review). Chinese cities, as administrative units, were initially created with rather generous boundaries around them, so there were not so many problems arising with respect to the governance of very large but administratively fragmented conurbations; usually, the functional city was rather *smaller* than the administrative city. That has changed, though: as is clear from the estimates of FUAs presented above, there is now a large discrepancy between statutory cities and functional urban areas in many places.

Box 1.4. **What makes regions grow?**

Economic growth in urban areas is driven by endogenous factors such as human capital, physical capital, including infrastructure and innovation, but also by spatial factors such as agglomeration economies and proximity to markets. Using a number of econometric techniques, the OECD has developed a regional economic growth model that takes into account endogenous factors and new economic geography elements. Among the results are:

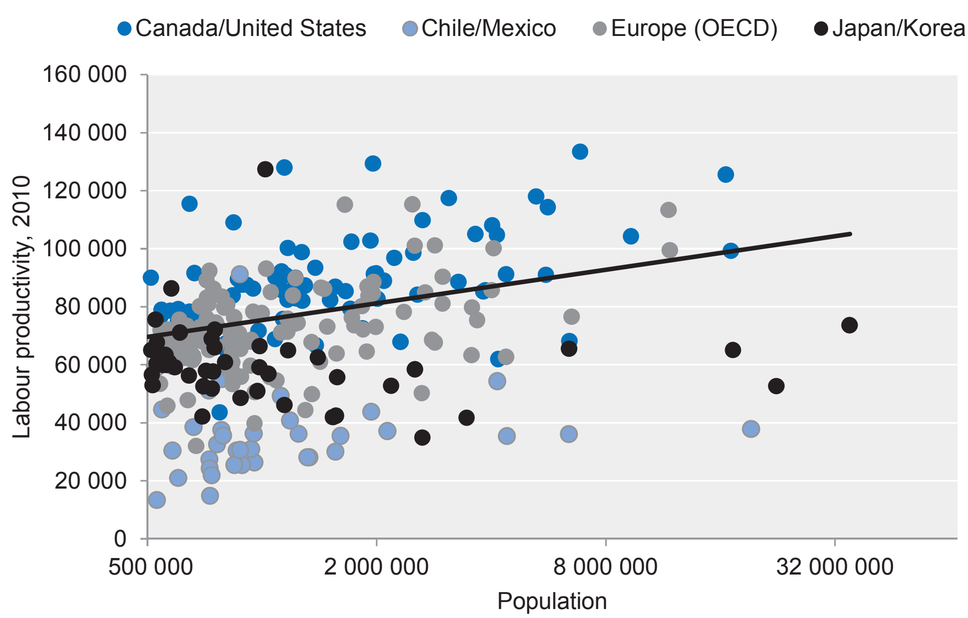
1. Human capital is the most robust factor – taking into account both the presence of workers with tertiary educational attainments and the absence of workers with only modest education – and takes about three years to have an impact.
2. Infrastructure has an impact if other factors, such as human capital and innovation, are also in place.
3. Innovation has an impact on growth, but involves a longer-term process of between 5 to 10 years.
4. Agglomerations in services (measured by a region's specialisation index times its size in financial intermediation) has a positive impact on growth. This result can have particular implications for urban regions, since financial intermediation (or knowledge-intensive services) is confined principally to metropolitan areas.
5. Accessibility to markets has a positive impact on growth, but this result is not very robust, since it is only statistically significant in one model.
6. Urban regions with low employment rates can generate growth if they can manage to mobilise their labour force.

Source: OECD (2009), *How Regions Grow: Trends and Analysis*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264039469-en.

China's growth appears to be benefiting from agglomeration processes

These considerations should be borne in mind when looking at the relationship between productivity and city size in China. Although for OECD countries, there is a clear positive relationship between city size and productivity, for China the pattern is less easy to discern (Figures 1.8 and 1.9), though there is a fairly clear positive relationship for the larger 100 FUAs, that have populations above 2 million. However, if one investigates the relationship between the urban population share of the FUAs and GDP per capita, then the positive association over the whole of the distribution is more apparent (Figure 1.10). A similar pattern appears for the relationship between GDP per capita and the population density of the FUA (Figure 1.11), except that in this case the relationship is clearer at lower densities – at very high densities, it flattens out; this is perhaps what one would expect, given that, at some point, the costs of rising density may match or even outweigh the gains from agglomeration. This suggests that the declining density of many Chinese cities, which has provoked concern in some quarters, may in many cases be good news, especially given that densities have fallen most in the places that were densest to begin with (OECD, 2013a). These results should not come as a surprise, since many of the FUAs calculated for China are quite extended in size and still include large peri-urban and rural areas. This analysis points to the potential for improving urban infrastructure and services in the hinterlands of many of the FUAs, which are in some cases dense but not really delivering urban benefits. Low density and poor internal connectivity will tend to reduce agglomeration benefits.

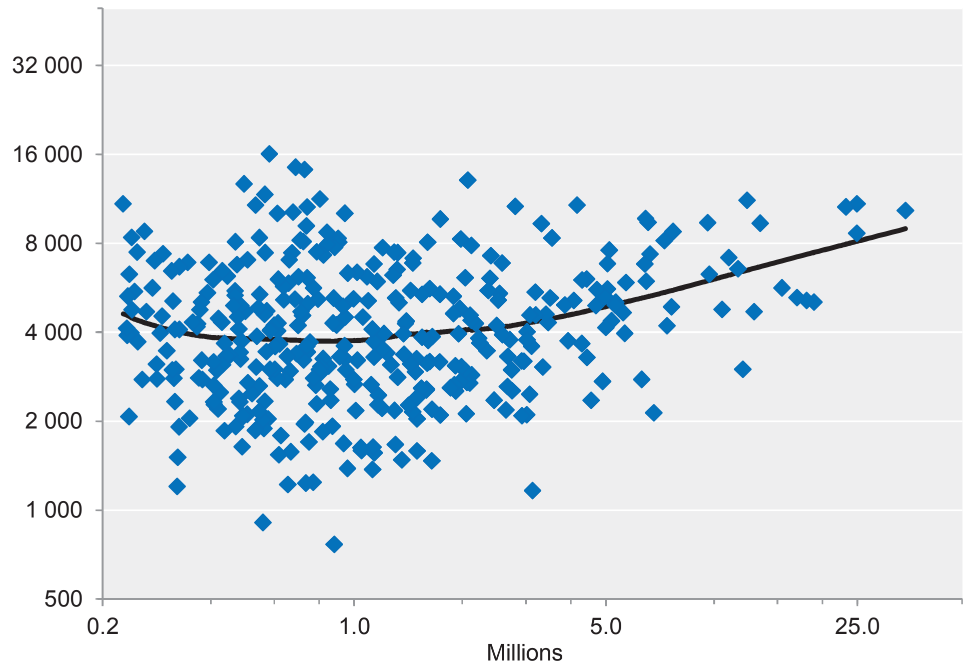
Figure 1.8. **City size and labour productivity: OECD area**



Notes: Labour productivity is measured as GDP (in millions of USD constant PPP, constant prices, reference year is 2005), divided by the total number of employees in a functional urban area. Data refer to 2010 or the closest available year.

Source: OECD (2014) OECD Metropolitan eXplore, http://measuringurban.oecd.org/# (accessed 14 August 2014).

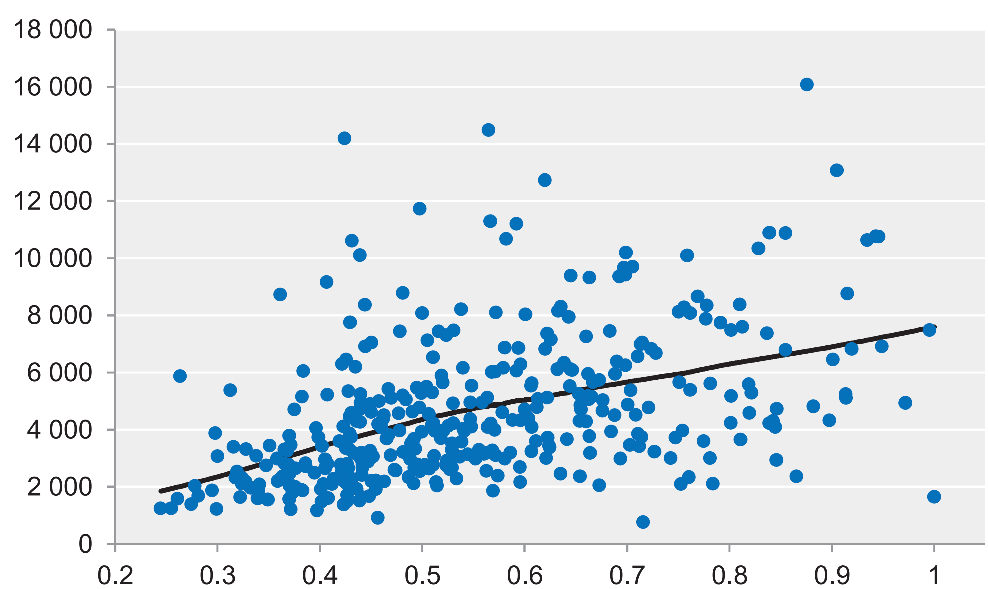
Figure 1.9. **City size and GDP per capita for Chinese FUAs (2010)**



Note: The horizontal axis represents logged values of the 2010 population of the Chinese FUAs. The vertical axis represents logged values of the GDP per capita (in USD) for Chinese FUAs in 2010.

Source: Authors' calculations based on NBS data.

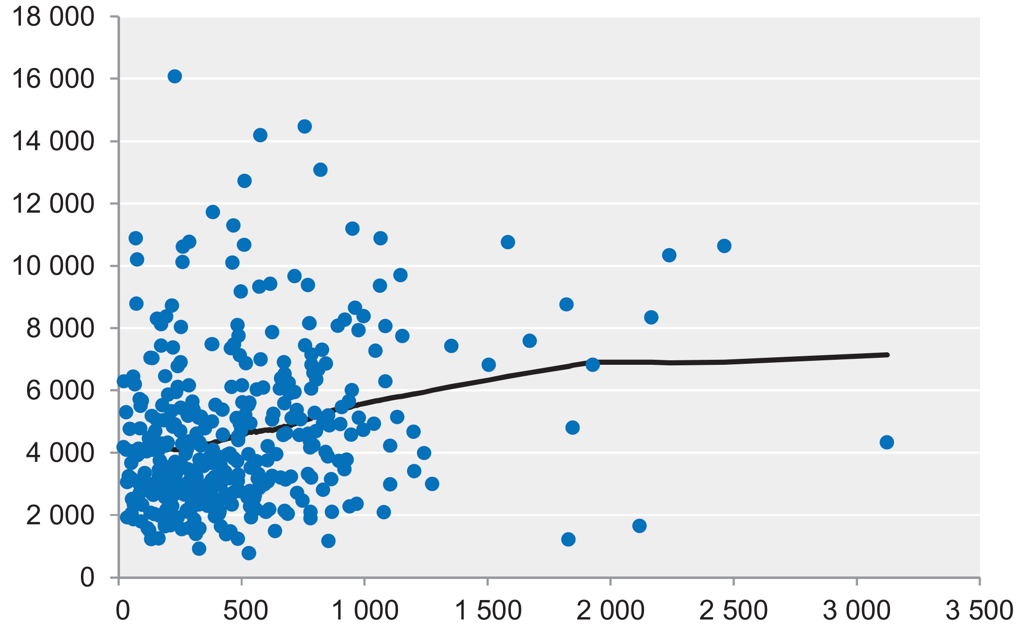
Figure 1.10. **Urban population share and per capita GDP for Chinese FUAs (2010)**



Note: The horizontal axis represents the percentage of the FUA population that lives in urban areas (as defined by the Chinese authorities). The vertical axis represents logged values of the GDP per capita (in USD) for Chinese FUAs in 2010.

Source: Authors' calculations based on NBS data.

Figure 1.11. **GDP per capita and density of Chinese FUAs (2010)**



Note: The horizontal axis represents the 2010 population density of the Chinese FUAs. The vertical axis represents logged values of the GDP per capita (in USD) for Chinese FUAs in 2010.

Source: Authors' calculations based on NBS data.

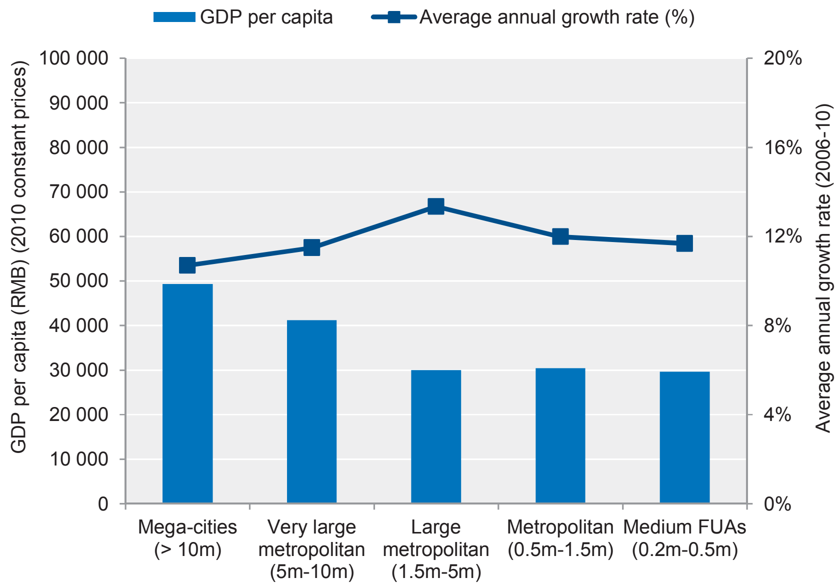
Larger cities enjoyed stronger economic performance

In OECD economies, there is not much relationship between city size and economic growth – larger cities have higher levels of productivity but they do not necessarily grow faster than other places; indeed, they often experience slower growth (Kamal-Chaoui and Sanchez-Reaza, 2012). China is no exception to this rule (Figure 1.12). When FUAs are grouped by size, the strongest growth in per capita terms is observed in the large metropolitan areas of 1.5 million-5 million inhabitants. Other categories experienced slower growth, but still above 10%. This aggregate picture, however, might obscure what happens within each category and the underlying trends. When controlling for other factors, city size (in population or area) is not associated with stronger growth, only with higher levels of income and productivity.

An econometric analysis of the FUAs' growth over 2006-10 suggests a number of interesting observations. First, geography matters: dummy variables for the four main regions of China (east, northeast, central and west) explain a significant part of the observed growth pattern (mainly due to the distinctive pattern for west China), while dummies at the province level have a much stronger effect. This analysis confirms that there has been a degree of convergence at macro-regional level Furthermore, the urban population share of the total FUA population is also associated with stronger growth. The migration share does not exhibit a clear pattern for the different specifications investigated. Controlling for the available FUA variables, it is found that cities which were poorer at the start of the period grew faster in terms of GDP per capita subsequently. This result is robust to the inclusion of regional dummies, showing that the convergence mechanism might be at work both at the macro and the intra-regional levels.

Figure 1.12. **Economic growth by FUA category**

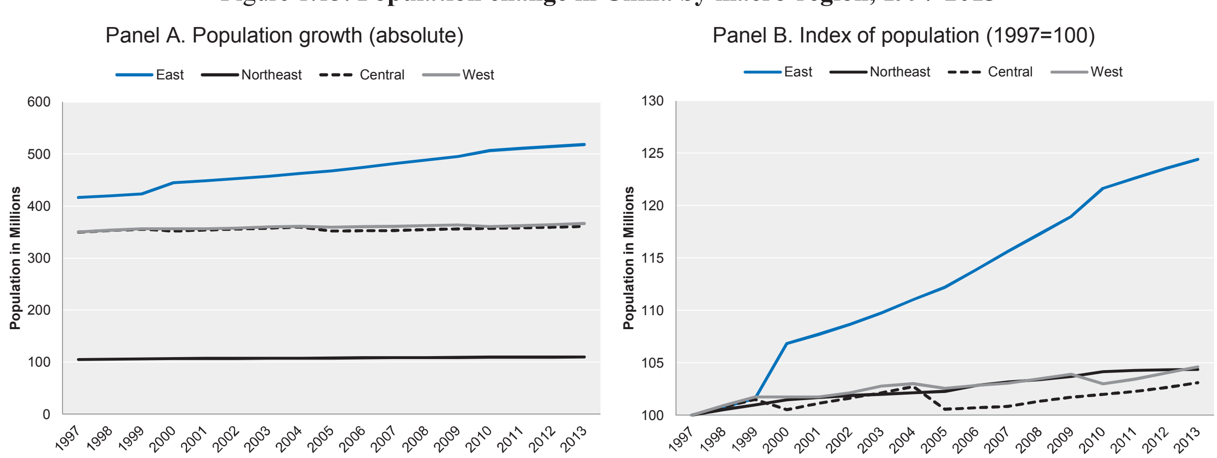
GDP per capita growth, 2006-10 and GDP per capita levels, 2010



Source: OECD calculations based on data from NBS.

Slower growth in per capita GDP among cities of 5 million or more is not necessarily evidence that they lack economic dynamism, however. As noted above, population growth over the period was directly linked to city size; this is mainly because larger cities were taking in more migrants. At the level of macro-regions, this can clearly be seen in the much faster growth of population in the cities of the (already more populous) east of the country (Figure 13). Since new arrivals in a city are likely to be less productive than existing residents, even if they are more productive in their new locations than in their regions of origin, rapid inward migration may contribute to slower growth in GDP per capita and productivity, even in a city or region that is growing strongly and contributing to solid aggregate productivity growth at national level. To that extent, the fact that the megacities, which experienced the fastest population growth, also recorded fast growth in per capita terms (almost 11%) is quite striking and confirms their exceptional dynamism.

Figure 1.13. **Population change in China by macro-region, 1997-2013**



Source: OECD calculations based on data from NBS.

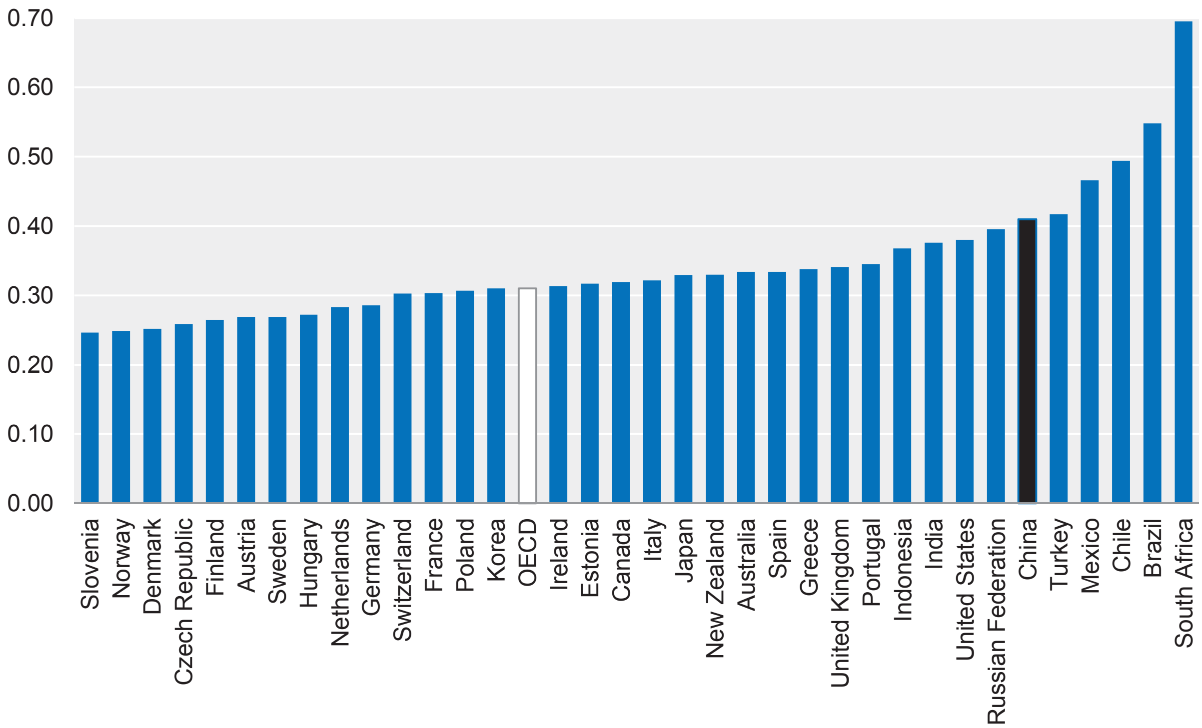
Regarding levels of income, cross-sectional regressions for 2010 give interesting results. There is a strong positive relationship of population density with GDP per capita, and when keeping density constant, cities of larger size (in terms of total land surface) have even higher GDP per capita. However, the coefficients of density and area become insignificant when the urbanisation and the migration shares are included in the regressions; both these variables exhibit strong positive associations. In other words, the richest FUAs are those with higher urban population shares and higher migration rates, and not necessarily the largest ones. Of course, this leaves open the degree to which internal migrants are attracted to cities with a high level of income, as opposed to contributing to it. The inclusion of some other FUA variables points to broadly congruent – and unsurprising – conclusions: the share of farming in total employment is weakly and negatively associated with growth, while higher manufacturing employment is associated strongly with better growth performance. Human capital variables perform as expected, with the negative effect of a large share of illiterate workers appearing stronger than the positive effect of a higher share of tertiary-educated workers.

Substantive research confirms the lower human capital of new migrants to Chinese cities and the degree of discrimination they face in the urban labour markets. This results in lower wages (Démurger et al., 2009). However, there is evidence that migrants might have strong complementarity effects with incumbent urban residents in contributing to overall city productivity. Combes et al. (2013) find that an inflow of new migrants to cities that increases total employment from the first quartile to the last quartile of Chinese cities has a positive effect on city productivity of around 30%. Although one-third of this effect is an agglomeration effect, the other two-thirds is a pure migration externality. This should not come as a surprise, as migrants tend to work at low-skill, labour-intensive occupations and thus may not compete with but rather complement the higher-skilled incumbent urban workers.

Fast growth has generated rising inequality…

Since the period of reforms began in 1978, the national economy has recorded growth rates averaging around 10% per year over a 35-year period. This extraordinary period of rapid growth has made possible a dramatic rise in personal incomes and living standards. Nevertheless, China has also experienced the emergence of very high levels of interpersonal and interregional inequality. A comparison of the Gini coefficient as a measure of interpersonal inequality shows China to have levels of inequality comparable to the United States, the Russian Federation and Turkey (Figure 1.14). China also exhibits high levels of territorial inequality when compared with other OECD and non-OECD countries (Figure 1.15). It should be noted, though, that higher levels of territorial inequality tend to be found in fast-growing emerging economies, and China's inter-regional Gini coefficient has actually fallen since the mid-1990s. High levels of territorial inequality can be attributed mostly to the large differences in development and urbanisation rates between the coastal areas of the East and the Central and Western parts of China (Gustafsson, Li and Sicular, 2008b). The uneven development of these regions has been linked to various factors, such as the level of exports and foreign direct investment (FDI), as well as to state policies that might have favoured particular industries in specific regions (Sutherland and Yao, 2010). The extent to which interregional inequality or intraregional inequality can be seen as the cause of the broader social inequality in China is the subject of ongoing research (Knight, 2013; Li and Luo, 2010; Benjamin, Brandt and Giles, 2008; Gustafsson, Li and Sicular, 2008a and b). While some researchers argue that geography might play a key role in explaining China's inequality, particularly due to the large urban-rural income gaps (Gustafsson, Li and Sicular, 2008b), others have argued that between a half and two-thirds of the inequality can be explained as income differences between neighbours (Benjamin, Brandt and Giles, 2008).

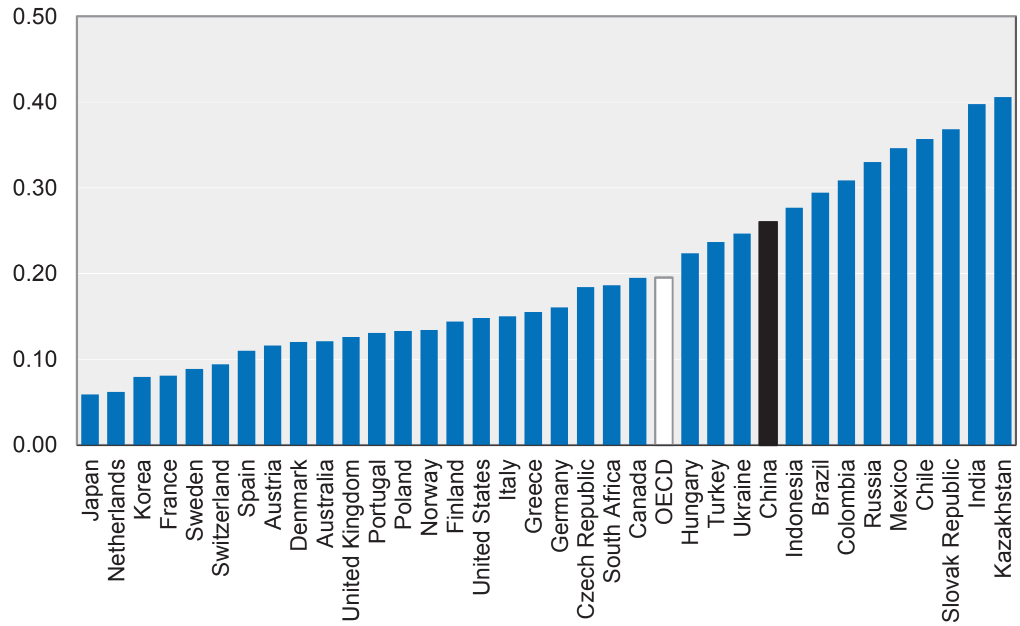
Figure 1.14. **Inter-personal inequality: Gini coefficient for China and selected countries (2010)**



Note: Data refer to 2010 for all countries and measure the level of interpersonal inequality as measured by the Gini coefficient of individual disposable incomes (after taxes and transfers). The Gini coefficient ranges between 0 in the case of perfect equality and 1 in the case of perfect inequality.

Source: OECD (2014), *OECD.Stat*, (database), http://dx.doi.org/10.1787/data-00285-en (accessed 20 June 2014).

Figure 1.15. **Gini index of GDP per capita for selected OECD and non-OECD countries, TL2 regions (2010)**



Note: OECD classifies regions according to two different territorial levels (TL). The higher level (Territorial Level 2) consists of about 362 macro-regions in the OECD member-states, while the lower level (Territorial Level 3) is composed of 1 794 micro-regions. For China, the data refer to the 31 mainland provinces (excluding Hong Kong, Macau and Chinese Taipei)

Source: Authors' calculations based on OECD (2013), "Metropolitan areas", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en (accessed on 20 October 2014) and NBS data.

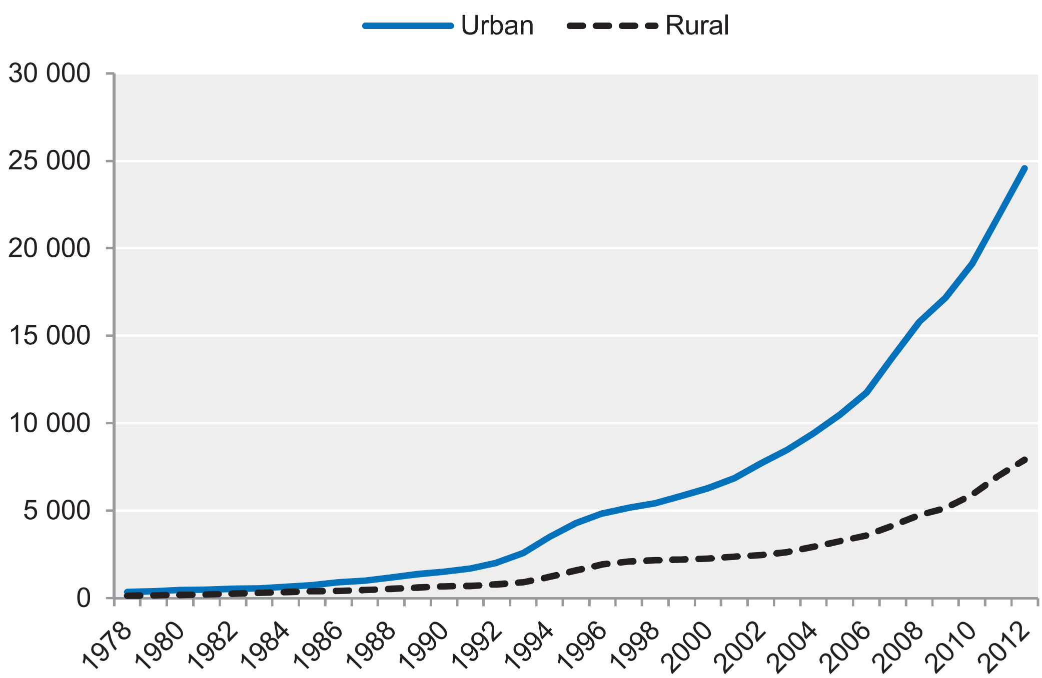
The vast income gap between urban and rural areas is also frequently cited as one of the factors contributing to China's observed inequality. On the official data, the per capita income of urban households in monetary terms in 2012 was about 3.1 times that of rural households (Figure 1.16).[7] The corresponding figure in 1978 was about 2.5 times higher. However, this has taken place against a backdrop of rapid growth in both urban and rural incomes and a dramatic increase in the proportion of the urban population. In any case, these official statistics are widely debated, not least owing to the difficulty of capturing migrants' earnings in the household surveys and the fact that the designation of different places as "urban" or "rural" often has more to do with administrative history than with the actual conditions of the place (see Chapter 2). Some places that are densely built up and reliant on urban economic activities are still classed as rural. Other factors that must be taken into account include the following:

- income subsidies (e.g. via housing) are not included, and since they are higher for urban households, the ratio might be underestimated;
- the cost of living is not taken into account, and since it is higher in urban areas, this would contribute to overestimates of the income gap; and
- the reclassification of rural areas to urban area status hinders meaningful comparison of urban-rural incomes from the official statistics over time.

A number of studies have sought to take account of these and other factors in order to arrive at more reliable estimates of the urban-rural gap (Brandt and Holz, 2006; Sicular, Ximing and Gustafsson, 2007; Gustafsson, Li and Sicular, 2008b; Benjamin, Brandt and Giles, 2008).

Figure 1.16. **Urban and rural income per capita**

1978-2012; nominal income, CNY

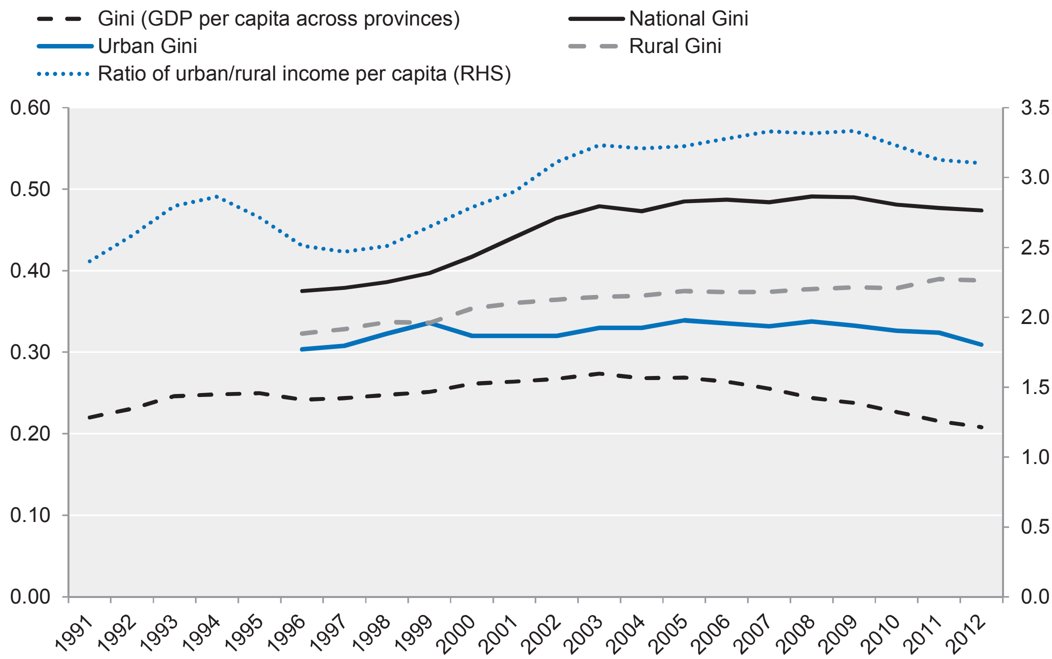


Note: Per capita disposable income for urban households as defined by NBS; per capita net income for rural households as defined by NBS.

Source: NBS (2013) *China Statistical Yearbook 2013,* China Statistics Press, Beijing.

These issues should be borne in mind when examining the evolution of the rural-urban income gap over time as based on the official statistics (Figure 1.17). The income gap fell sharply in the first years of reform, reflecting the fact that the rural sector was the primary target of the first wave of reforms and benefited greatly from them (Wang, Wan and Yang, 2014; Sutherland and Yuao, 2010). As the reforms deepened and the focus shifted towards the urban sector, the urban-rural income gap began to rise again, falling briefly in the mid-1990s. After widening rapidly for several years from 1997, it more or less stabilised at a rather high level in the mid-2000s before falling somewhat in 2009-12. This recent fall in the income gap coincides roughly with a modest decline in the interpersonal Gini coefficient that captures social inequality over the same period. Another contributing factor may be the stabilisation and even slight decline of interpersonal inequality in urban areas over the last five years; however, inequality in rural areas continues to rise.

Figure 1.17. **Time trends for various measures of inequality, 1991-2012**

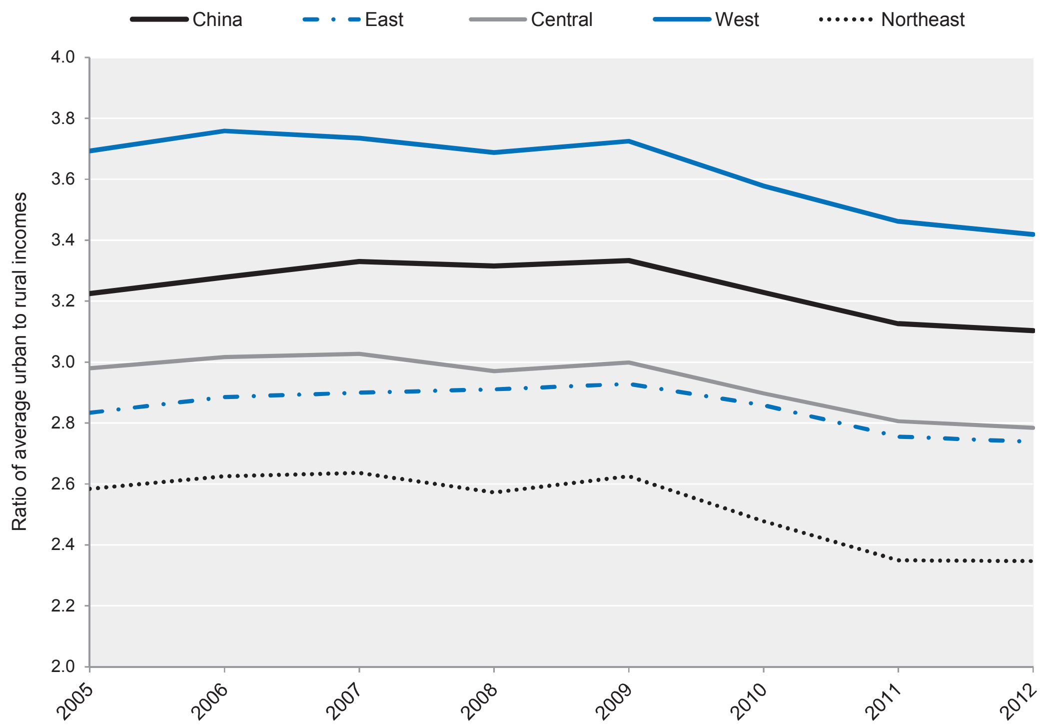


Source: Urban-rural ratio data come from NBS (2013) *China Statistical Yearbook 2013,* China Statistics Press, Beijing; National, Urban Gini and Rural Gini as well as Gini across China's provinces come from the OECD (2013), *OECD Economic Surveys: China 2013*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-chn-2013-en.

Income disparities between urban and rural areas are common in developed and developing countries, but there are some distinct features of the Chinese economy that might explain its large magnitude. The *hukou* system has clearly contributed to the large urban-rural income gaps in China by restricting mobility of Chinese workers between the rural and more productive urban areas (Wang, Wan and Yang, 2014). Free movement of labour would have acted as an equilibrating force between the rural areas that mainly engage in relatively less productive agricultural activities and the urban areas that specialise in manufacturing and service sectors with higher productivity.

The distinct geography of China and the easy access of the coastal areas to trade and export flows, as well as the state's industrial policy, have favoured faster industrialisation and urbanisation in eastern as compared to central and western China. This uneven process of industrialisation and urbanisation has led to higher growth in the east, and living standards in much of eastern China are comparable to those of some OECD members. This process appears also to have benefited the rural parts of the coastal areas, since the urban-rural income gap appears to be smaller in the east and northeast than the rest of China (Figure 1.18). There are substantial differences in the urban-rural income gap across the regions of China, although it has been falling for all of them. The high income-rural gap for western China has been reported elsewhere in the literature (Sicular, Ximing and Gustafsson, 2007; Gustafsson, Li and Sicular, 2008a), although the recent falling trend was not captured in the earlier period data of this literature. What is less clear is the extent to which this reflects the fact that many *de facto* urbanised places in the east are still classed as rural areas – a pattern that is less common in the west, where cities have not so rapidly spilled over their administrative borders. In the west, the complication arises from the fact that many areas that are yet to be urbanised are classed as urban for administrative and statistical purposes.

Figure 1.18. **Urban-rural income gap by geographical area, 2005-12**



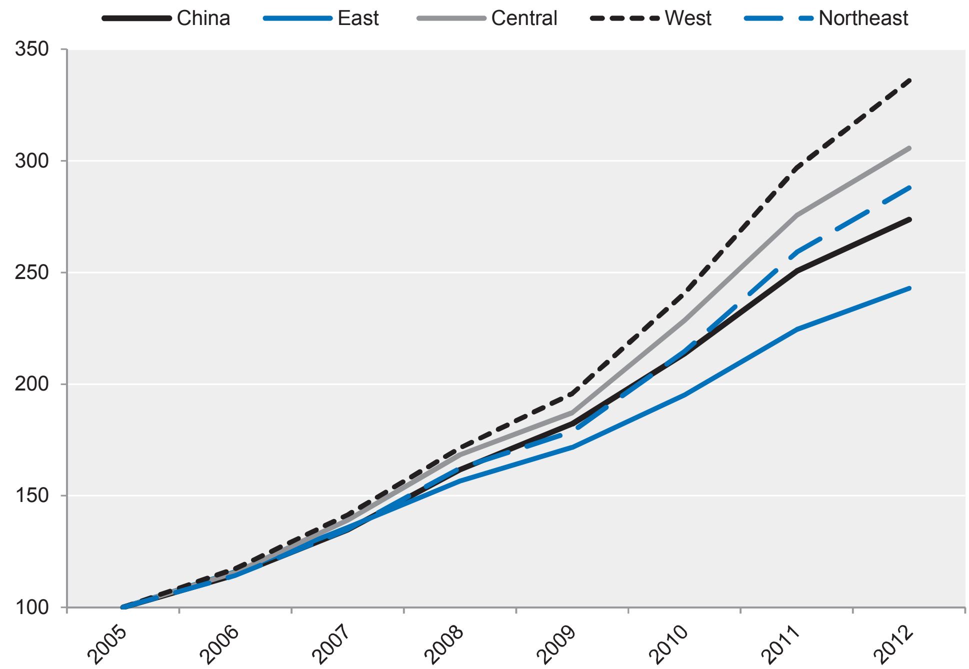
Source: NBS (2013) *China Statistical Yearbook 2013,* China Statistics Press, Beijing.

… but China is experiencing some convergence across regions and cities

While there has been much discussion of rising interpersonal inequality in China, less well known is the degree to which China has experienced some *reduction* in *interregional* disparities: the growth of GDP per capita since 1997 has been faster in the less developed parts of the country like the west and central China (Figure 1.19) and measures of interregional inequality have declined over the period. This convergence trend has also occurred at the province level, with the initial level of income explaining almost 40% of the growth in the 2000s (Figure 1.20). The analysis of FUAs suggests that this is occurring at city level, as well: on the whole, poorer FUAs grew faster in the latter part of the decade than did those that were richer at the start of the period (Figure 1.21). The data for the FUAs cover only a five-year period, but this declining inequality across cities is a useful reminder of the fact that forces of convergence and agglomeration are both at work at different scales. Researchers assert that behind this convergence pattern lies industrial relocation of manufacturing activity towards the central and eastern parts of the country (Houkai, Yeqiang and Mei, 2014). Eastern regions used to account for 53% of the total investment in fixed assets in 2000, but by the end of the decade, this share fell to 42%, with most of the gains going to the western and central region. Houkai, Yeqiang and Mei (2014) note that rising efficiency wages and land prices in eastern regions have narrowed the gap in return on investment between western and central regions. This factor, the increased production efficiency of central and western regions and the shift in Chinese foreign trade policy have all contributed to the shift of manufacturing towards the western and central regions.

Figure 1.19. **GDP per capita growth rates by geographical area, 2005-12**

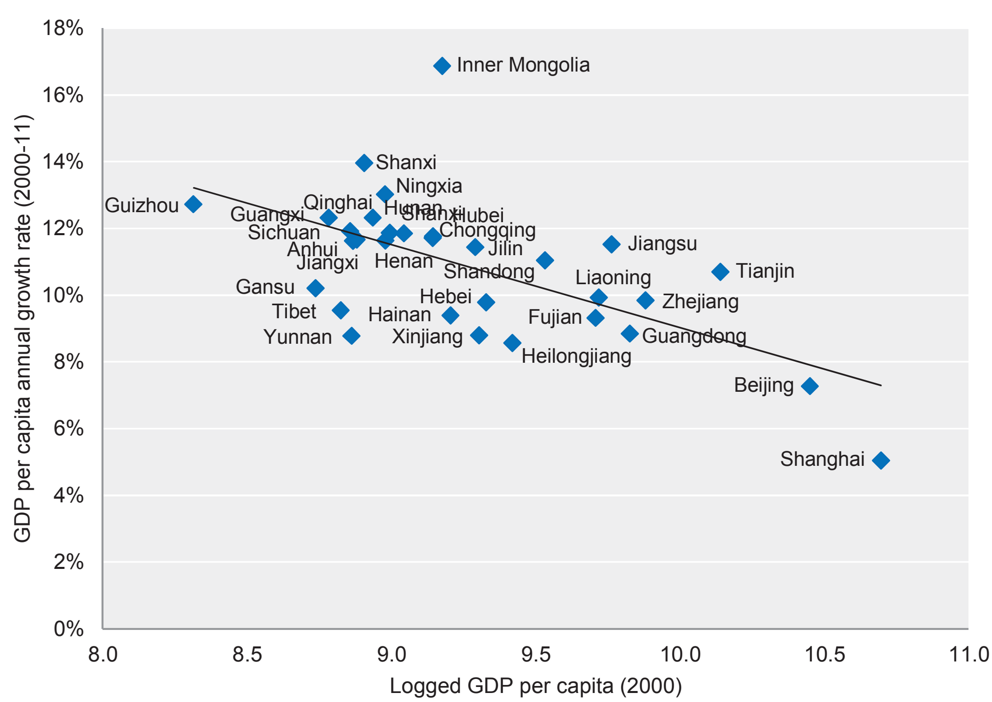
Index base 2005=100



Source: NBS (2013) *China Statistical Yearbook 2013,* China Statistics Press, Beijing.

Figure 1.20. **Income growth and income levels of China's provinces**

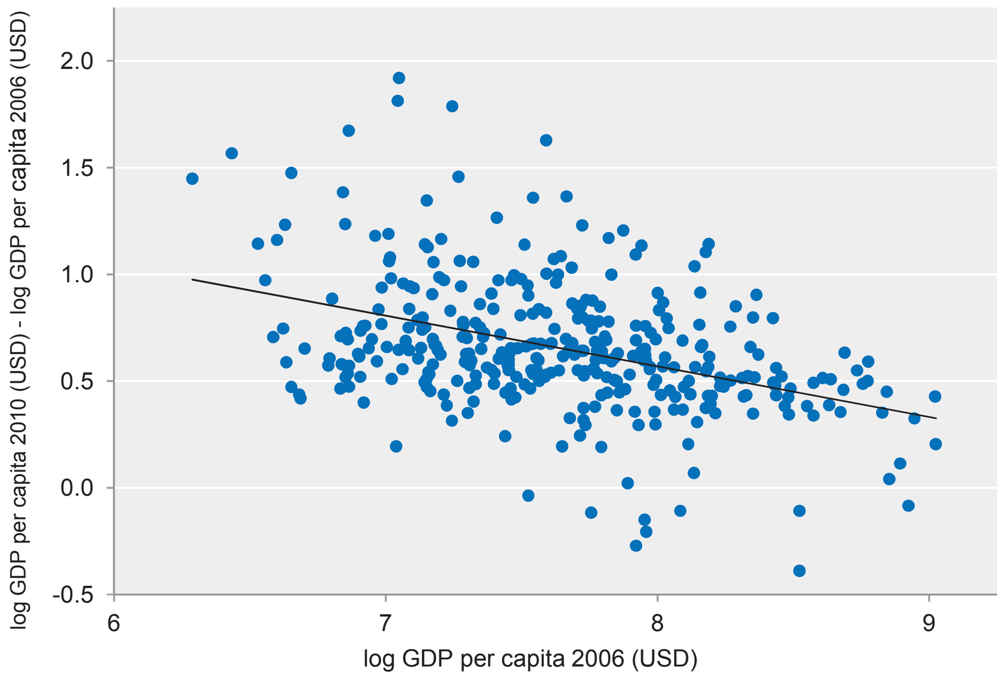
Relationship between GDP per capita growth and initial GDP per capita, 2000-11



Source: Authors' calculations based on NBS data.

Figure 1.21. **Income growth and income levels for Chinese FUAs**

log GDP per capita 2010 - log GDP per capita 2006 vs log GDP per capita 2006



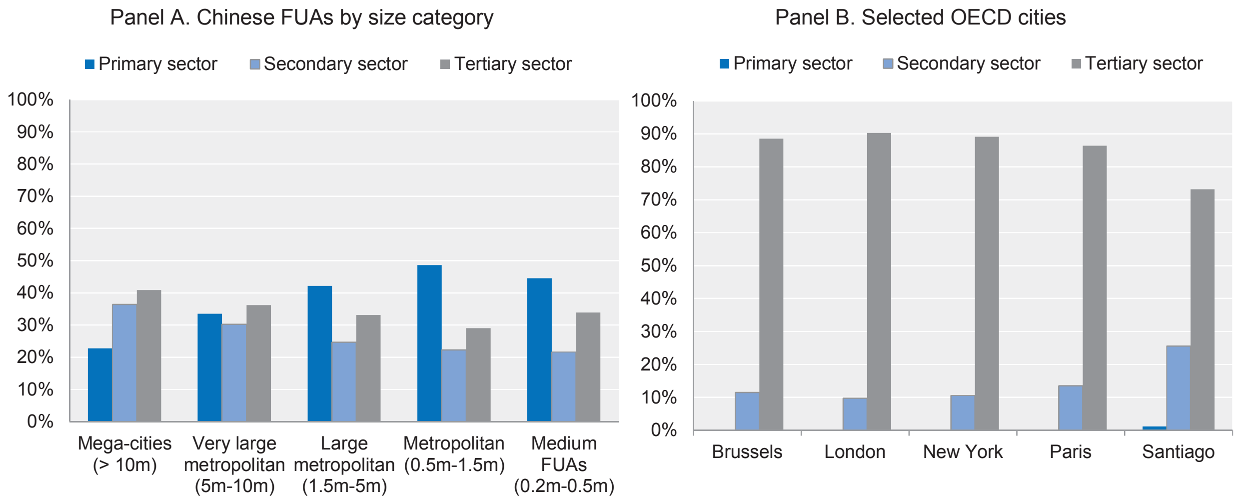
Source: Authors' calculations based on NBS data.

Chinese cities may be "underspecialised"

As noted above, there is some debate about the degree to which fiscal and financial policies privilege the most important cities, possibly leading to inefficient agglomeration patterns (Henderson, 2009). While Chinese cities do not seem to be larger than one might expect, at least in light of Zipf's law, policies that tend to distort land prices and credit allocation could affect firms' location choices. This matter is addressed in greater detail in Chapter 2, but it is important to note at this point that the FUA analysis reveals a surprising pattern of urban specialisation. In particular, China's largest FUAs report a far higher share of industry in value added than would be typical of very large and megacities elsewhere in the world – and a correspondingly low share of services (Figure 1.22). Even in the megacities with populations of 10 million or more, the services sector accounts for only about 41% of gross value added, versus 37% for industry (manufacturing accounts for almost 30% of GVA in such places). This contrasts with service-sector shares of at least 70% in major OECD metros.

Figure 1.22. **Comparison of the industrial composition of China's major cities and that of selected OECD cities**

Share of gross value added



Source: OECD calculations based on OECD (2013), "Metropolitan areas", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en (accessed on 20 October 2014) and NBS data.

Environment and quality of life

Chinese cities face major environmental challenges

Though urbanisation is often seen as generating environmental externalities, its impact on environmental performance is more complex than is often realised. First, many of the environmental problems associated with urbanisation are merely the result of rising production and consumption – they would be felt as Chinese citizens became better off, whether or not they lived in urban places. Secondly, concentration of population can lead to energy consumption savings, through shorter journeys and greater reliance on public transport, as well as more efficient provision of heating and power. However, such concentration may aggravate *local* environmental externalities, even if it somewhat mitigates more global impacts: for example, urbanisation might, if well managed, contribute to lower greenhouse gas emissions, while still reducing local air quality. As China continues to urbanise, its success in pursuing greener urban development will have an enormous impact on the health and well-being of its citizens, as well as on global environmental outcomes and, in particular, efforts to address climate change.

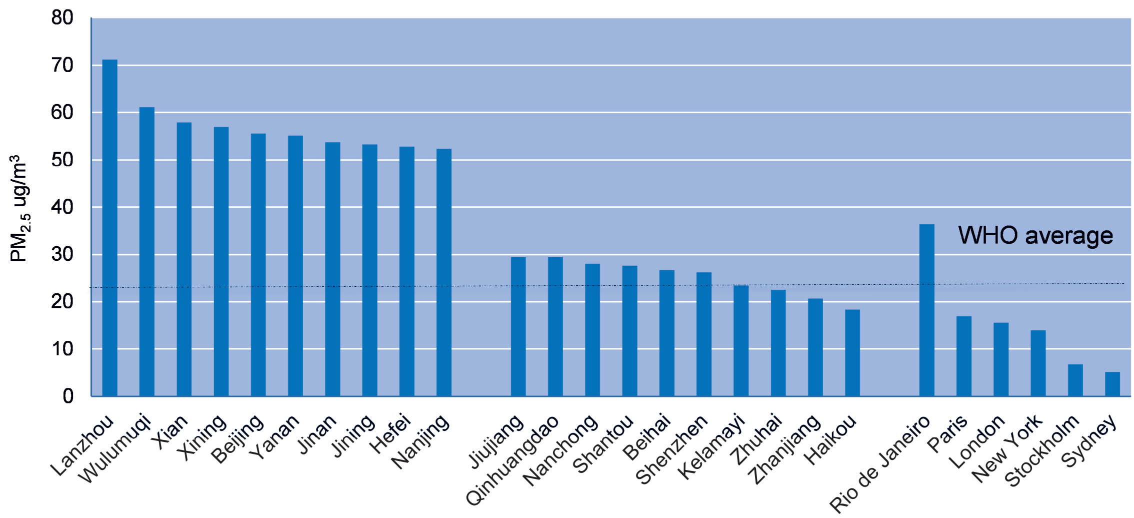
There is some evidence that in China, the income effect is stronger than the density effect (Zheng and Kahn 2013; Zheng et al., 2011). In recent decades, China's efforts to modernise its economy and offer higher living standards to its citizens have generated enormous environmental pressures. As China reaches higher levels of economic development, it has the opportunity to make use of cleaner technology and to combine economic growth with environmental sustainability. Growing numbers of urban residents, with higher incomes and better education, strongly prefer to live in greener cities, and the Chinese authorities are taking measures to accommodate these concerns. Unlike countries that took one or two centuries to industrialise, China has achieved the result in half a century, and it can now use the available technology to promote smart, green cities. In that respect, it can proceed faster down the sloping side of the "Environmental Kuznets Curve" (EKC).

The "EKC" is a hypothesised relationship between economic development and environmental performance that predicts an inverted U-curve, with environmental pressure increasing at the earlier stages of development and declining after a turning point. In fact, there is not one EKC but rather a family of curves: Van Alstine and Neumayer (2010) point to a series of studies highlighting differences in the EKC turning point for various pollutants in substantially similar conditions. Much depends not only on the level of income (richer people tend to be more willing to trade slower income growth for better environmental conditions) but also on the costs of abatement and the damage curves of the pollutants (how severe and how localised the environmental damage is). Although Chinese cities' environmental conditions have deteriorated remarkably in the last 50 years, recent progress on a number of indicators might suggest that China is in a position to reach the turning point in the EKC relatively early (Stern, 2004). Studies analysing the EKC in China find that cities from different regions are at different stages. Some coastal cities have already stepped into the decline stage of the inverted-U curve, whereas most central and western cities with dominant secondary industries are still rising up the curve (Wang, Du and Zhang, 2013; Zhao, Lan and Gan, 2014).

Outdoor air pollution is the major environmental challenge in Chinese cities. Among the 112 cities included in the WHO Ambient Air Pollution in Cities Database 2014, only 22 are below the world average on particulate matter smaller than 2.5 microns ($PM_{2.5}$)[8]. The high level of air pollution is caused by the inefficient use and burning of biomass and fossil fuels in transportation, housing, power production, waste disposal and industry (WHO, 2013). Haikou, a middle-tier prefecture-level city of 2 million situated on Hainan island in the south of mainland China, has the lowest $PM_{2.5}$ (18 µg/m3) among all the monitored Chinese cities (Fig.1.23). Haikou implemented an ambitious programme of environmental action in 1995, including environmentally friendly construction, industrial and other waste treatment, and the expansion of green spaces; since 2009, it has banned the use of petrol-fuelled motorcycles. However, its $PM_{2.5}$ levels are still much higher than those of cities like London, Paris or New York. The Jing-Jin-Ji urban mega-region, which consists of Beijing, Tianjin and part of Hebei province, is one of the country's major growth poles, as well as the most polluted urban cluster in China. Three cities in the area (Tangshan, Tianjin, Handan) are among the cities with the highest SO emissions in China (Figure 1.24), while Beijing ranks fifth in terms of $PM_{2.5}$.

Urban air pollution levels vary among regions (Figure 1.25). High levels of $PM_{2.5}$ and PM_{10} are concentrated in western and central areas. PM values in western cities such as Lanzhou, Wulumuqi, Xian and Xining are the highest in China, exceeding the WHO average almost twofold (Figures 1.23 and 1.24). Following the Chinese authorities' efforts to contain the "urban smog" in eastern cities in recent years, a large number of heavy industries, like coal combustion enterprises, have been relocated to the less developed western and central areas of China. As noted earlier, cities in these areas are experiencing rapid economic development and urbanisation with growing urban infrastructure under an extensive development pattern.

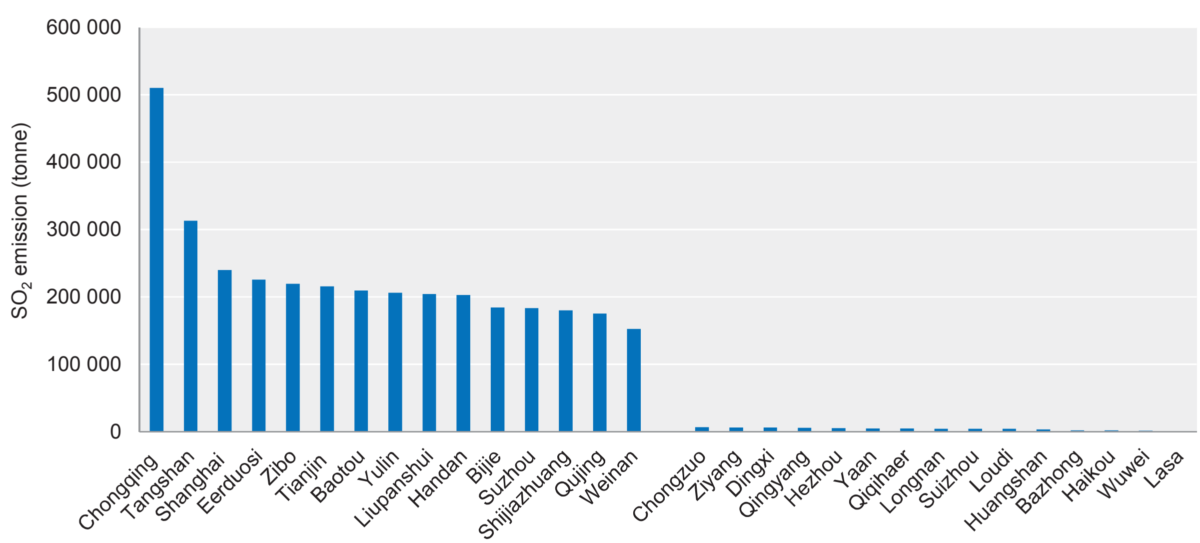
Figure 1.23. **$PM_{2.5}$ emissions of the 10 highest- and 10 lowest-producing Chinese cities and selected foreign cities, 2013**



Note: Out of the 112 cities that are included in the WHO dataset, only 22 have emissions below the WHO average. In the graph, the top 10 and bottom 10 cities are shown, along with selected international cities.

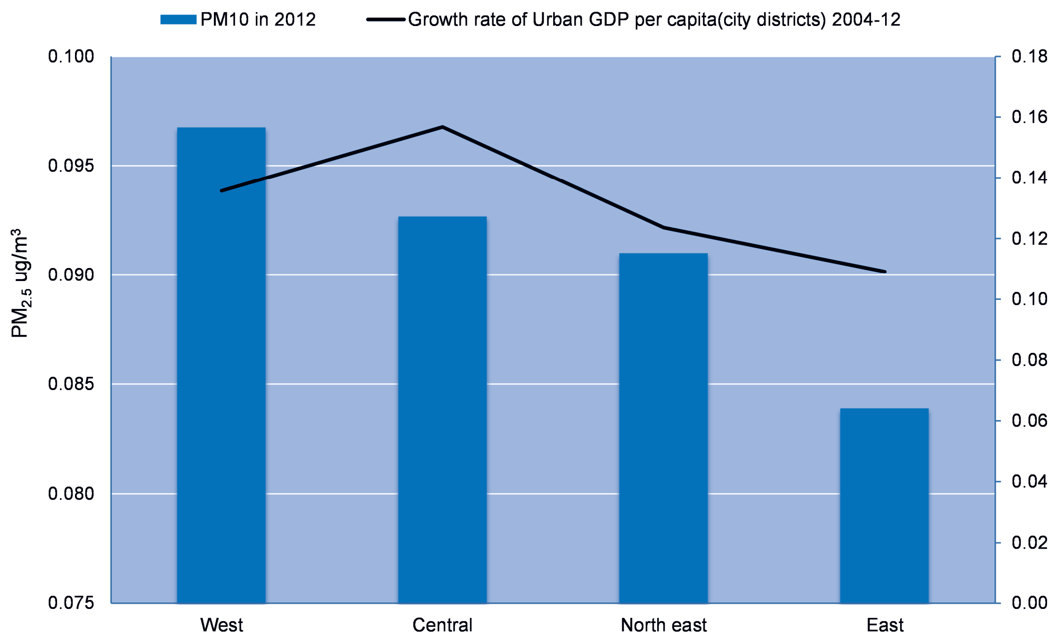
Source: WHO (2014), *Ambient (outdoor) air pollution in cities* (database), http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/ (accessed January 2015).

Figure 1.24. **Top and bottom 15 cities in SO_2 emissions, 2012**



Source: Authors' calculations based on NBS data.

Figure 1.25. **PM_{10} and growth of GDP per capita in regions, 2012**



Source: WHO city PM database, 2014.

The poor air quality in China has increased the incidence of respiratory diseases in the urban population, particularly in infants and other vulnerable groups. The OECD has quantified the cost of air pollution from transport for OECD countries and China (OECD, 2014a). While for the OECD, this cost increased by approximately 10% during 2005-2010 and reached a total level of USD 1.7 trillion, for China, the cost increased by 90%, to reach USD 1.4 trillion. China's death toll due to air pollution rose by 5% over the period and is estimated at close to 1.3 million.[9] Whereas road transport accounts for about 50% of the cost of air pollution in the OECD area, this proportion is lower for China, where booming industrial activity is a major source of pollution (OECD, 2014a). This is the case despite the rapid increase in car ownership in China (Wu et al., 2012). However, as Chinese industry is likely to grow cleaner and motorisation to continue, this pattern could change substantially over coming decades. The rapid growth in motorisation in China is a concern for Chinese cities' future environmental conditions, as is the increasing congestion. By 2010, car ownership in many large and rich cities had already reached over 100 cars per 1 000 inhabitants, and the trend is likely to continue for the foreseeable future (OECD, 2013c). Public transport can mitigate the effects of urban expansion by reducing congestion and increasing accessibility to jobs and services: the development of cleaner vehicles, better public transport and new forms of urban planning will all have a role to play if China is to avoid a heavily car-dependent path (see Chapter 2). However, public transport investment has not managed to keep up with the rapid expansion of Chinese cities.

The forthcoming *OECD Transport Outlook* explores urban transport scenarios for China. Besides a baseline scenario, it presents two alternative scenarios for the China's authorities: one oriented to private transport and one to public transport. Although these two scenarios do not differ that much in terms of the mobility they offer, the results for CO_2 emissions and health impacts are many orders of magnitude apart (Box 1.5).

Box 1.5. Alternative transport scenarios and their impact on Chinese cities

The International Transport Forum (ITF) at the OECD constructed urban transport scenarios with the aim of testing the long-run impact that diverse urban transport policy packages could have on CO_2, pollution and health impacts, if they were adopted as a general strategy for China. The model adopts assumptions on load factors, fuel economy and CO_2 emission factors from the MoMo mobility model of the International Energy Agency (IEA). Emissions of local air pollutants and health impacts that would result from each scenario are calculated by the International Council for Clean Transportation (ICCT). Results presented here correspond to baseline technology and emission standard scenarios from the IEA and ICCT. More information on this work can be found in the *ITF Transport Outlook* 2015 edition.

Four types of variables of the urban context were identified as relevant to transport demand: land use, public transport, road infrastructure and fuel prices. The modelling work is based on analysis of data from the *China Statistical Yearbook* and complemented with extensive city data on public transport and road infrastructure provided by academic experts on the field. The difference in the evolution of variables between scenarios are adjusted to high and low regional variations found in the country.

Scenarios

1. Baseline: Assumes current trends will continue in the future for all variables. Two additional assumptions with respect to future evolution of car ownership restrictions: *i)* the seven cities[10] with a restriction on car ownership in 2010 are assumed to keep the policy in place for the next 40 years (with a constant number of licences issued yearly); *ii)* cities will impose such a restriction if the population reaches at least 2.5 million inhabitants and at least the ratio of cars to road area that the seven cities with car ownership restrictions had in 2010.[11]

2. Private transport-oriented: Applies policy trends that intensify the shift to private mode use; *high sprawl*, *low* expansion of *public transport* and *low fuel prices*; this scenario is combined with a scenario of rapid expansion of road infrastructure (*high roads*); no expansion of car ownership restriction policies is assumed; only cities that enforced restrictions on car ownership restriction by 2010 will maintain them until the end of the projected period.

3. Public transport-oriented: Assumes the alignment of policy trends that increase the role of public transport in urban mobility; *low sprawl*, *high public transport* expansion and *high fuel prices*; policy is modelled according to a scenario in which urban road infrastructure lags behind urban population growth (*low roads*); assumes a stronger willingness to reduce car ownership through expansion of stricter car ownership restrictions in China (assumptions on expansion of car ownership restrictions are the same as in the *Baseline* case, but the number of licences issued is adjusted to population growth, to compensate for the plateauing of population growth in Chinese cities).

Results

Long-term urban transport planning and decisions for the alignment of policies towards promoting private transport or public transport-oriented urbanisation will translate into significant differences in the modal composition of urban mobility. Under a scenario in which urban policies promote private transport use, and in particular car use, by permitting sprawl, letting public transport expansion lag behind population growth, heavily investing in urban road infrastructure expansion and maintaining low fuel prices, public transport accounts for only 9% of urban mobility in China by 2050.

By contrast, policies that contain sprawl, set higher fuel prices and prioritise expansion of public transport infrastructure over urban road infrastructure can significantly slow the shift from public to private mobility. The set of policies modelled in the urbanisation scenarios oriented to private transport increase mobility levels relative to baseline mobility. An important driver is the increase in travel per private vehicle as a result of low oil prices. Additional mobility is more carbon-intensive in each of the three cases and generates significantly higher CO_2 emissions than the respective baseline scenarios. Under this policy framework, CO_2 emissions related to urban transport in China grow 19% more than in the baseline scenario.

Box 1.5. Alternative transport scenarios and their impact on Chinese cities *(cont.)*

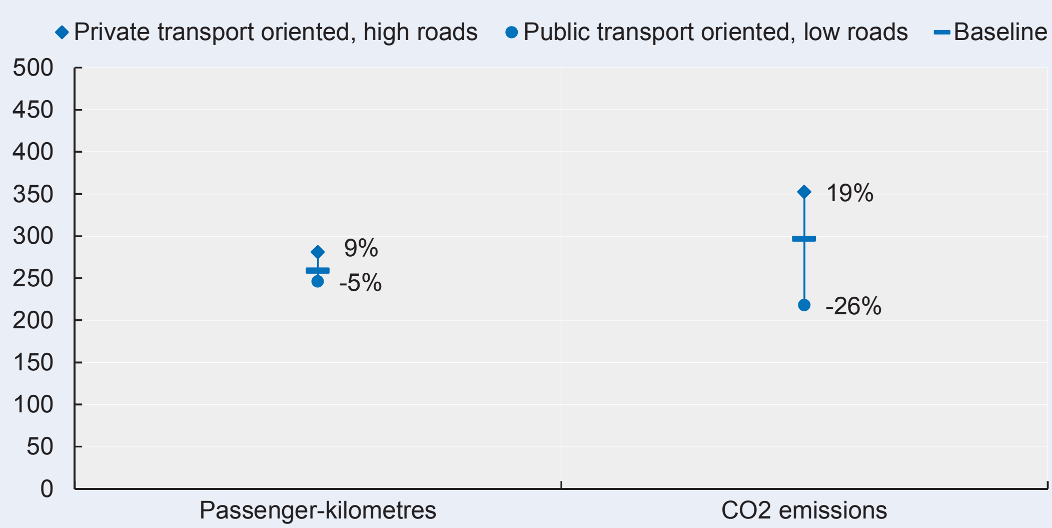
The shift to public transport-oriented urbanisation has certain mobility costs, as significant expansion of public transport, with major extensions of mass-transit systems, will have to be carried out before the public transport systems can absorb the mobility displaced by higher costs for private mobility. Mobility under the *public transport-oriented* scenario with *low road* expansion infrastructure and expansion of stringent car ownership restrictions would catch up with baseline levels towards the end of the period, with a gap of only around 5% of growth in passenger-kilometres. Overall, alignment of policies toward public transport-oriented urbanisation reduces the carbon intensity of urban mobility. This cuts transport related CO_2 emission growth by 26% (Figure 1.26).

In a baseline scenario, total emissions of NO_X and $PM_{2.5}$ decrease by 16% and 17% during the 2010-2050 period in Chinese cities. The main drivers for this reduction are the shift from two-wheeled vehicles to car travel, the high penetration of electric two-wheel vehicles (since two-wheel travel occupies a significant share of total motorised travel), and important reductions in NO_X and $PM_{2.5}$ bus emissions. Despite the lower overall levels of $PM_{2.5}$, increasing the exposure of the urban population to such concentrations by 2050 translates into a 300% increase in premature deaths compared to 2010.

Under baseline technological evolution of the fleet and emission standard adoption, the private transport-oriented urbanisation scenarios, without expanding car ownership restrictions in Chinese cities, would also result in higher-than- baseline growth in pollution and health-related impacts. Alternatively, long-term policy alignment towards public transport-oriented urbanisation and the expansion of stringent car ownership restrictions in middle and large cities could help further reduce growth of NOX and $PM_{2.5}$ concentrations in urban centres, and therefore reduce growth in associated premature mortality.

Figure 1.26. **Growth in mobility and CO_2 emissions in alternative scenarios for China's cities**

2010=100



Source: OECD/ITF (2015), *ITF Transport Outlook 2015*, OECD Publishing, Paris/ITF, Paris, http://dx.doi.org/10.1787/9789282107782-en.

Given urban China's bleak performance in terms of air pollution, it is no surprise that life satisfaction has not improved much in China over the recent decades. Easterlin et al. (2012) draw attention to China's inadequate progress in life satisfaction estimates during a period of rapid economic growth and rising living standards.

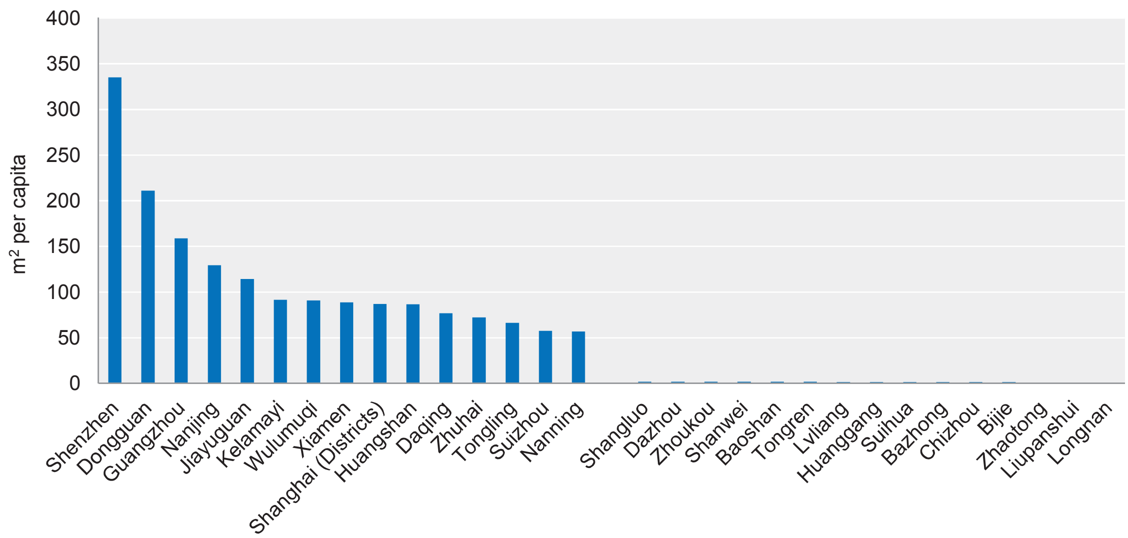
Nevertheless, there is some scope for optimism, given recent policy changes. During the 12th Five-Year Plan (2011-15), low carbon development has followed a more localised approach. Under the combined pressure of urbanisation and energy-intensity targets set the by central governments, many cities have led initiatives exploring their own low-carbon development strategies (Climate Group, 2010). While in the past, growth criteria predominated heavily in assessments of local leaders' performance for the purpose of determining promotions, in the last decade, environmental sustainability and social stability criteria have also been included. Explicit targets are set to reduce COD (Chemical Oxygen Demand) and SO_2 pollutants and decrease energy consumption per unit of GDP. Empirical work by Zheng et al. (2013) suggests that the chances of a local official being promoted depend to some extent on the environmental performance of the city. They also find that public concern about environmental issues is positively associated with income and education, Internet usage and environmental degradation. They conclude that the concerns both of the central government and of residents on environmental issues will lead to improvement in the environmental quality of Chinese cities and to an earlier turning point in the EKC.

Administrative jurisdictions that do not correspond to functional criteria – economic or geographic – might offset some environmental policy efforts. Zheng and Kahn (2013) review evidence that pollution sources are often located across administrative boundaries. Careful planning and co-ordination across administrative boundaries is needed to internalise any external effects of economic activities and policies. Alternative scales need to be used for policy analysis and implementation, such as functional economic city definitions, like the FUAs presented earlier in this chapter, as well as geographic entities, like river basins.

Large disparities are observed in access to urban green space for Chinese urban residents. Among the 235 prefecture-level cities (PLCs), urban green space per capita ranges from 0.09 square metres (Longnan City in Gangsu Province) to 335.13 square metres (Shenzhen city in Guangdong province). Provincial capital cities and major cities such as Shenzhen, Guangzhou, Nanjing and Shanghai rank high in green space accessibility. Significantly, the three cities with the largest quantity of green space per inhabitant are all in Guangdong province: Shenzhen, Donguan and Guangzhou (Figure 1.27). The availability of urban green space is positively correlated with both local government expenditure per capita and per capita GDP (Figures 1.28 and 1.29). In this respect, China is typical of more developed economies: as cities develop, air quality tends to deteriorate until higher incomes and deteriorating air quality prompt a shift in focus towards mitigating local environmental externalities, particularly air pollution (Zheng and Kahn, 2013). The focus is typically on local pollutants in the first instance; concern about global challenges tends to take longer to become a central focus of policy.

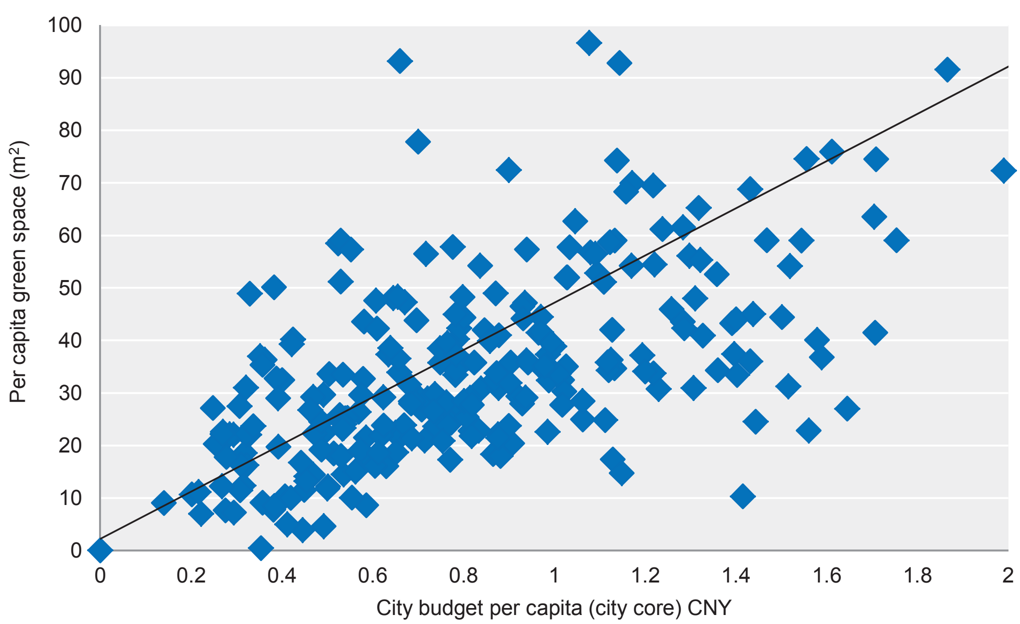
Figure 1.27. **Top and bottom 15 PLCs in access to green area per capita**

Park area (m²) per capita



Source: Authors' calculations based on NBS data.

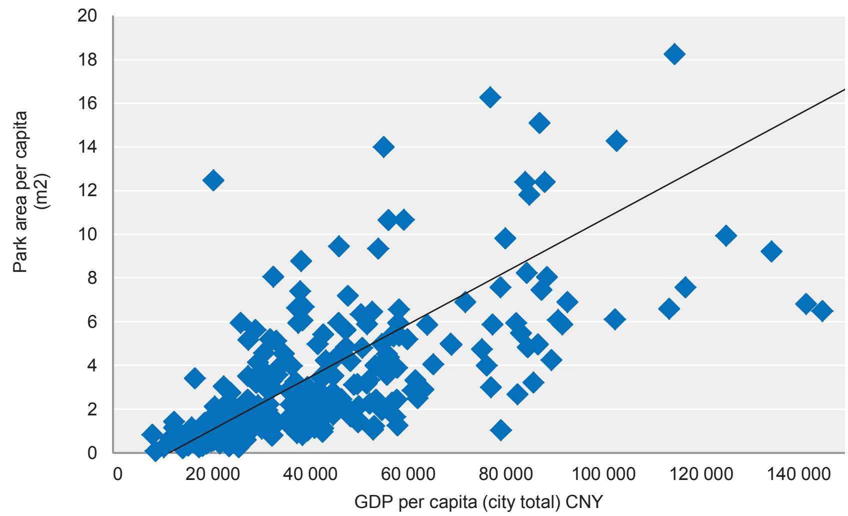
Figure 1.28. **Correlation between green space and city budget per capita in city core**



Note: The fitted line is: $y = 44.97x + 2.2071$, $R^2 = 0.3185$.

Source: Authors' calculations based on NBS data.

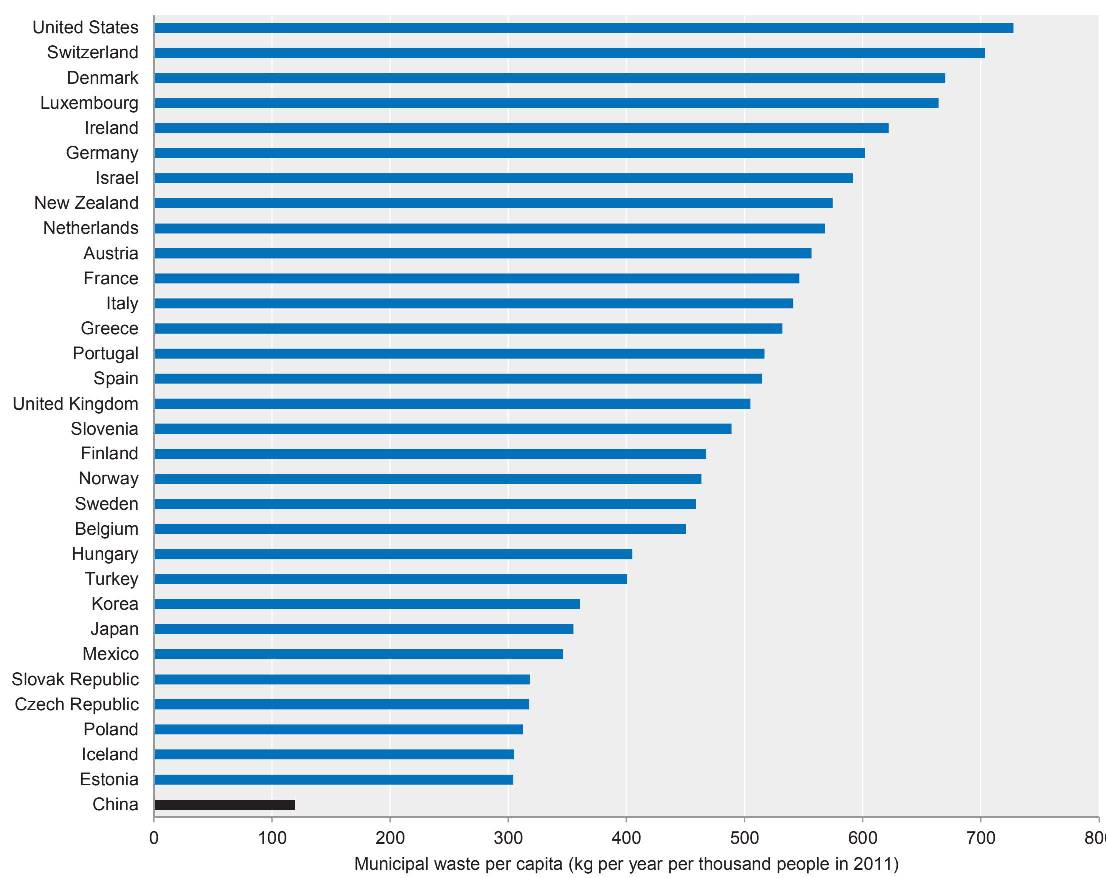
Figure 1.29. **Green area per capita and GDP per capita**



Note: The fitted line is: y = 0.0001x - 1.3853, R^2 = 0.3063.

Source: Authors' calculations based on NBS data.

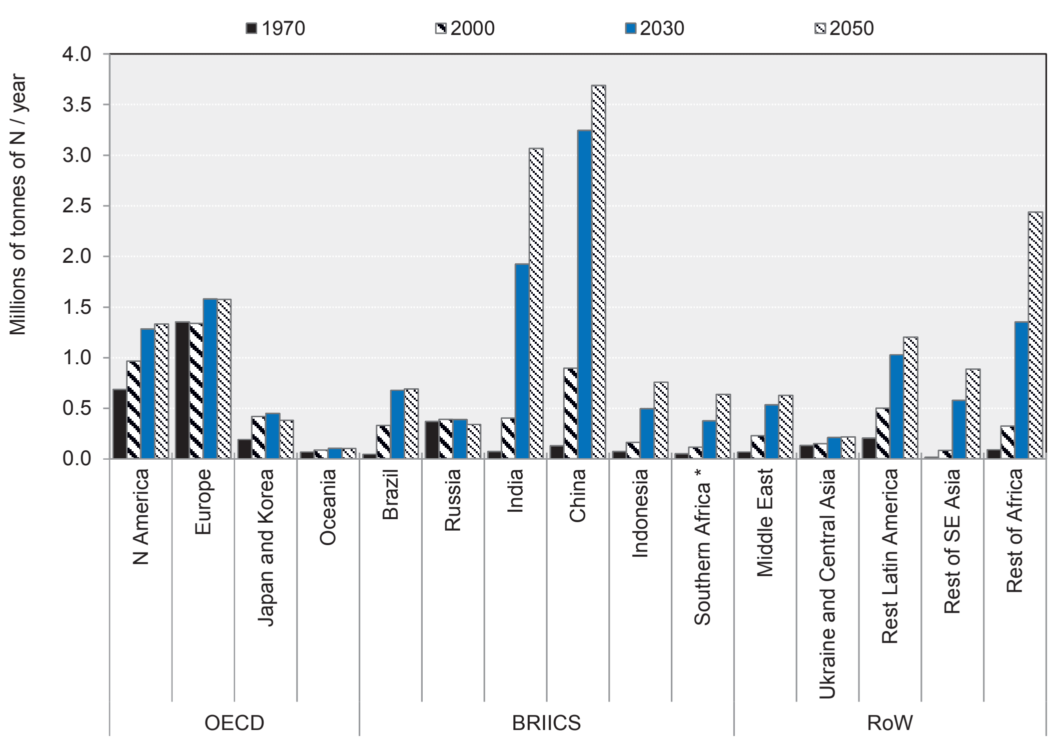
Figure 1.30. **Municipal waste in OECD countries and China, 2011**



Source: OECD (2014), *OECD Environment Statistics*, (database), http://dx.doi.org/10.1787/env-data-enhttp://dx.doi.org/10.1787/data-00285-en (accessed 8 September 2014); OECD (2014), *OECD Demography and Population* (database), http://dx.doi.org/10.1787/5f958f71-en (accessed 15 November 2014); NBS (2012), *China Environment Yearbook 2011,* China Statistics Press, Beijing.

China appears to have a low rate of municipal waste generation per capita compared to the OECD countries. In 2011, China generated 119.8 kilogrammes per capita of municipal waste, several times lower than the figures for OECD countries such as the United States (727.46 kg/per capita), Switzerland (303.32 kg/per capita) or Denmark (669.95 kg/per capita) (see Figure 1.30). In part, this very low figure may be an underestimate, reflecting the fact that rural areas in China do not have specific solid-waste treatment facilities, so the estimate of waste generated is almost certainly on the low side. Per capita municipal waste is expected to rise further as urban residents' disposable income keeps increasing, and thus their consumption preferences resemble more and more those of the advanced economies of the OECD countries. Indeed, increasing levels of urbanisation present significant water challenges. The *OECD Environmental Outlook to 2050* (2012) shows a shifting trend from the OECD countries towards China and India with regard to the nitrogen released untreated from sewerage to the environment. Partly this is due to developing urban sewerage faster than (tertiary) wastewater treatment (Figure 1.31). Water abstraction by industry is also projected to increase, as well as water pollution that is exacerbated by water scarcity, with over 40% of inland rivers that make up China's seven main river systems deemed to be unsuitable for human use. Although wastewater discharges from industry fell during 2005-10, water pollution from urban residents increased. GDP per capita growth is associated with a rise in domestic wastewater discharges (e.g. Shanghai's domestic wastewater discharges per capita (92t) were more than three times higher than Chongqing's (29t) for 2010) (OECD, 2013c).

Figure 1.31. **Nitrogen from untreated urban wastewater in the world**



Source: OECD (2013), *Water Security for Better Lives*, OECD Studies on Water, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264202405-en.

Conclusion

China is undergoing an unprecedented period of urbanisation, with the growth rate of its urban population as high as 4.2% per annum. Its cities have been historically defined in administrative terms and thus make it difficult to draw meaningful comparisons with other cities in China or abroad. A functional economic approach is probably a preferable method for examining cities and apply policies, as it captures urban labour markets in a more meaningful way. A new definition of functional urban areas (FUAs) for China is presented that approximates the original OECD/EU definition. The urban and economic trends presented show the dynamism and the potential of Chinese cities of all sizes. China has high levels of interpersonal and interregional inequality, although in the recent years, this trend has been declining. Particularly important is the urban-rural gap; the official figures show urban incomes to be three times higher than rural. Such high rates of urban transformation in China entail increased environmental pressures that result in poor air quality, congestion, as well as waste and water challenges. Appropriate planning at the right scale, effective policy action and better co-ordination across levels of government can ensure a smart, sustainable and inclusive path for China’s urbanisation. These issues are the centre of attention in the chapters that follow.

Notes

1. See Zhang and Cai, 2012 for an overview of the most important changes.
2. For a more extensive discussion of the *hukou* system and how it has affected China's urbanisation processes, see Chapter 2.
3. As this Review was being completed, the Chinese authorities announced changes to the way residency (but not *hukou* status) would be calculated for this floating population: in future, they will be counted as permanent urban residents, regardless of *hukou*, after six months of living in an urban area. This will affect assessments of city size based on both administrative definitions and the OECD method for calculating functional urban areas.
4. The analysis does not include the small FUAs of population between 50 000 and 200 000 inhabitants, since data limitations would not allow comprehensive coverage of this category for China.
5. Matters are further complicated by the fact that the definition for an area to be classified as "urban" has shifted over time, and reflects both the changing nature of China's population and policy priorities.
6. The FUAs with populations above 1.5 million have a total of 643 million inhabitants, although the statutory cities include 312 million. The functional definition yields a figure 330 million inhabitants higher, calculated by reclassifying counties and districts that used to be part of smaller statutory cities. In total, 190 million inhabitants are reclassified from statutory cities of 0.5 million-1.5 million and 30 million from statutory cities of size 0.2 million-0.5 million. A final 110 million come mostly from the reclassification of counties that are not classified as statutory cities (and about 4 million from reclassification of counties that were part of statutory cities with a population of less than 0.2 million).
7. Preliminary estimates for 2014, released in January 2015, put the gap at just 2.75 times, owing to faster growth in rural incomes; however, the speed of convergence that this implies when compared to the data for 2012 is hardly credible and suggests that some revision of estimates for past years will be forthcoming.
8. This average corresponds to the mean value of $PM_{2.5}$ for the 1 600 cities included in the WHO $PM_{2.5}$ database 2014.
9. The *OECD Environmental Outlook to 2050* (OECD, 2012) projected that the number of premature deaths from exposure to particulate matter would more than double, reaching 3.6 million a year globally, with most deaths occurring in China and India.
10. Beijing, Guangzhou, Guiyang, Hangzhou, Shanghai, Shijiazhuang and Tianjin.
11. The number of licences issued each year is determined by applying a constant coefficient relative to the car-road area ratio, extracted from econometric analysis of permits and congestion in a sample of seven cities.

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Annex 1.A1.
Constructing China's functional urban areas

Defining functional urban areas: The OECD method

This Review has attempted to address the issues arising as a result of the gap between administrative definitions of urban areas and actual settlement/activity patterns by adapting the OECD method for defining "functional urban areas" (FUAs) to China. This method, constructed in collaboration with the European Commission's Directorate-General for Regional and Urban Policy, is set out in detail in OECD (2012). The central elements of the three-step approach can be summarised as follows:

Defining urban cores through gridded population data. Urban cores are constituted by aggregations of contiguous municipalities that have more than 50% of their population living in high-density clusters. The latter are made of contiguous 1 square kilometre grid cells with a population density of at least 1 500 inhabitants per square kilometre (1 000 inhabitants per square kilometre in the US and Canada) and a total population of at least 50 000 people (100 000 in Japan, Korea, Mexico).

Connecting noncontiguous cores belonging to the same functional area on the basis of commuting data. Two urban cores are considered integrated, and thus part of the same metropolitan system, if more than 15% of the working population of any of the cores commutes to work in the other core (taking polycentricity into account).

Identifying the urban hinterlands. The "worker catchment area" of the urban labour markets, outside the cores is composed of those municipalities which send to the cores 15% or more of their employed residents. Municipalities surrounded by a single functional area are included and non-contiguous municipalities are dropped.

This common FUA definition allows for meaningful comparisons within and across countries (comparing like with like) and also makes it possible to identify levels of mono- or polycentricity of FUAs, as well as the extent of concentration.

The OECD classes FUAs according to size, proposing four categories:

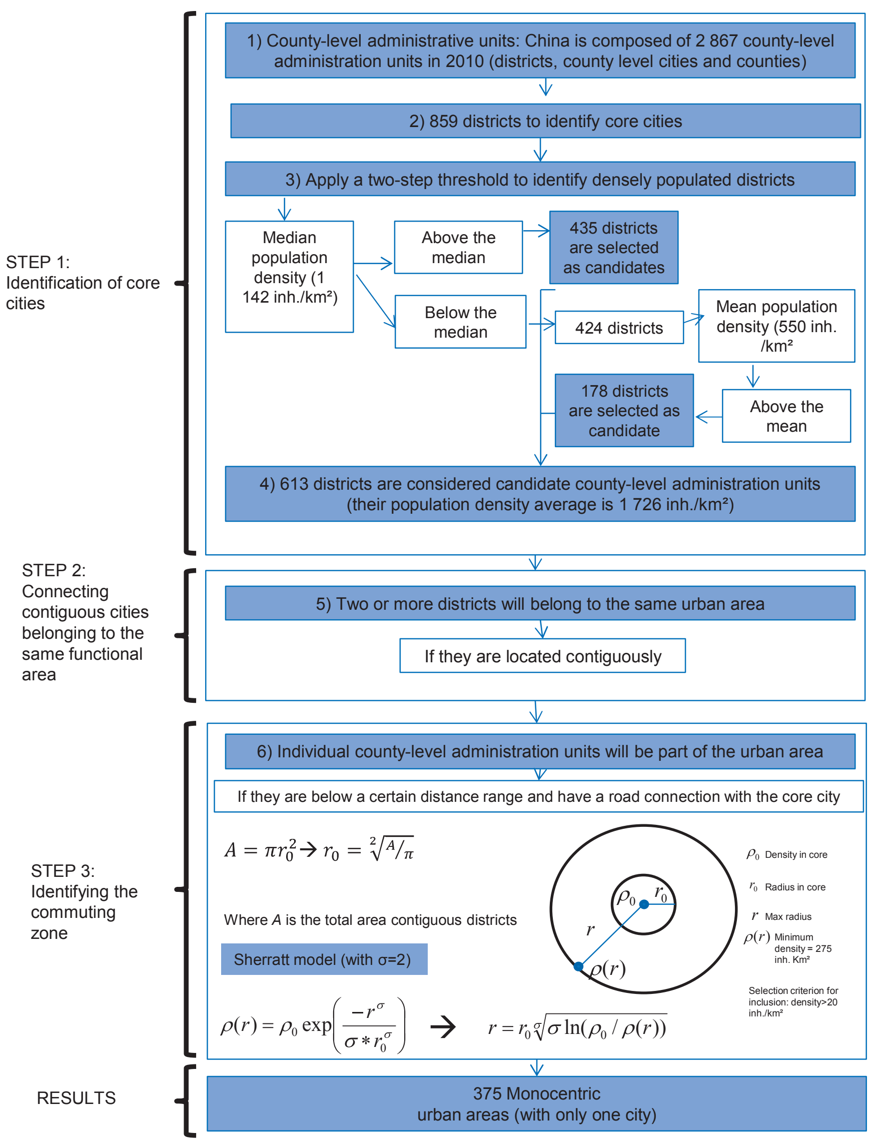
- small urban areas, with a population between 50 000 and 200 000 people;
- medium-sized urban areas, with a population between 200 000 and 500 000;
- metropolitan areas, with a population between 500 000 and 1.5 million; and
- large metropolitan areas, with a population of 1.5 million or more.

OECD (2012) draws attention to the obstacles to applying this method to China, above all the lack of commuting data for the country, and explores ways of overcoming this problem. The adapted method used for the present Review is described below.

Adapting the OECD method to China

The smallest spatial entity for which information is available is the county or district, which is used as the geographical building block to construct urban cores and hinterlands. An approach that is conceptually similar to the OECD method is followed, aggregating districts/counties to urban cores if they have a density above 550 inhabitants/km^2 and are contiguous. For the identification of the hinterland, the rate with which density declines (*density gradient*) as the distance from the urban core increases is used as a proxy to estimate a meaningful commuting radius around the urban core. Information on proximity to railways or highways, as well as on geomorphological characteristics (lakes, mountains, coast, etc.), is used to adjust the estimated commuting zones and decide whether or not to include a neighbouring county in the hinterland of an urban core.

Figure 1.A1.1. **Estimating functional urban areas in China**



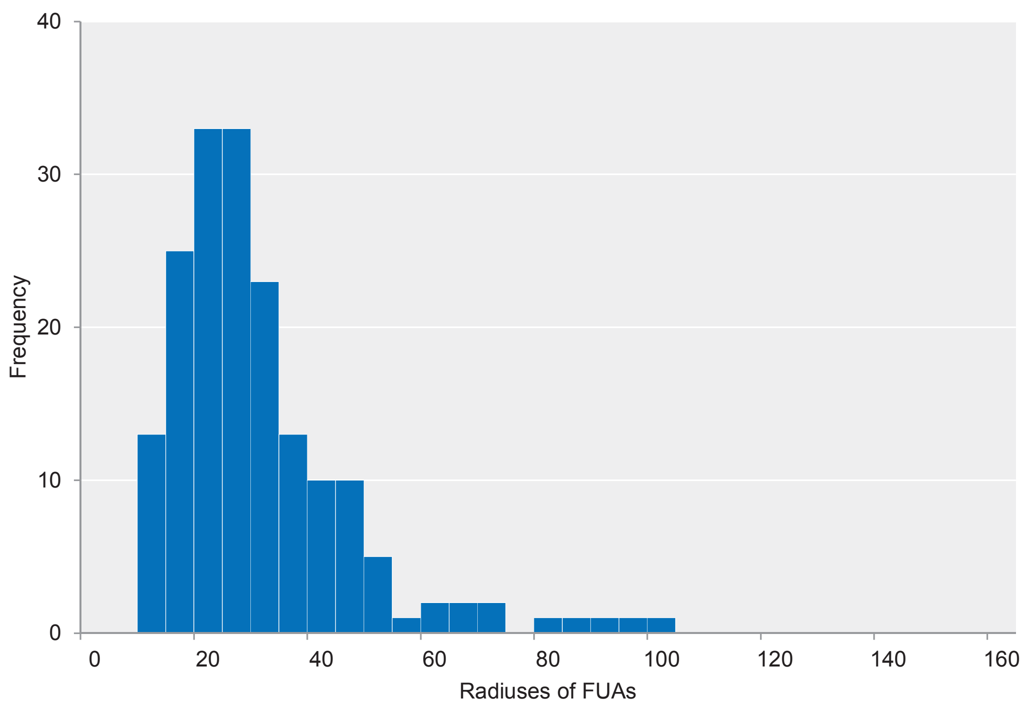
Source: Authors' calculations based on NBS data and Institute of Population and Labour Economics.

This approach has the great advantage of presenting Chinese cities as functional economies rather than administrative units, and, as will be seen, it presents a "new" picture of urban China. Nevertheless, its limitations should be borne in mind when interpreting the results. The method is only an approximation of the labour catchment area, as it is not based on actual commuting patterns. Furthermore, the geographical building block for the construction of the FUAs (the county/district) can be coarse for this exercise, and its size varies substantially. This is less of an issue for the districts, since they are quite dense and cover mostly urban areas; it can be more of an issue for the counties, since some of them are large and uneven in their interior, including both rural and urban areas.

Estimating the commuting radiuses

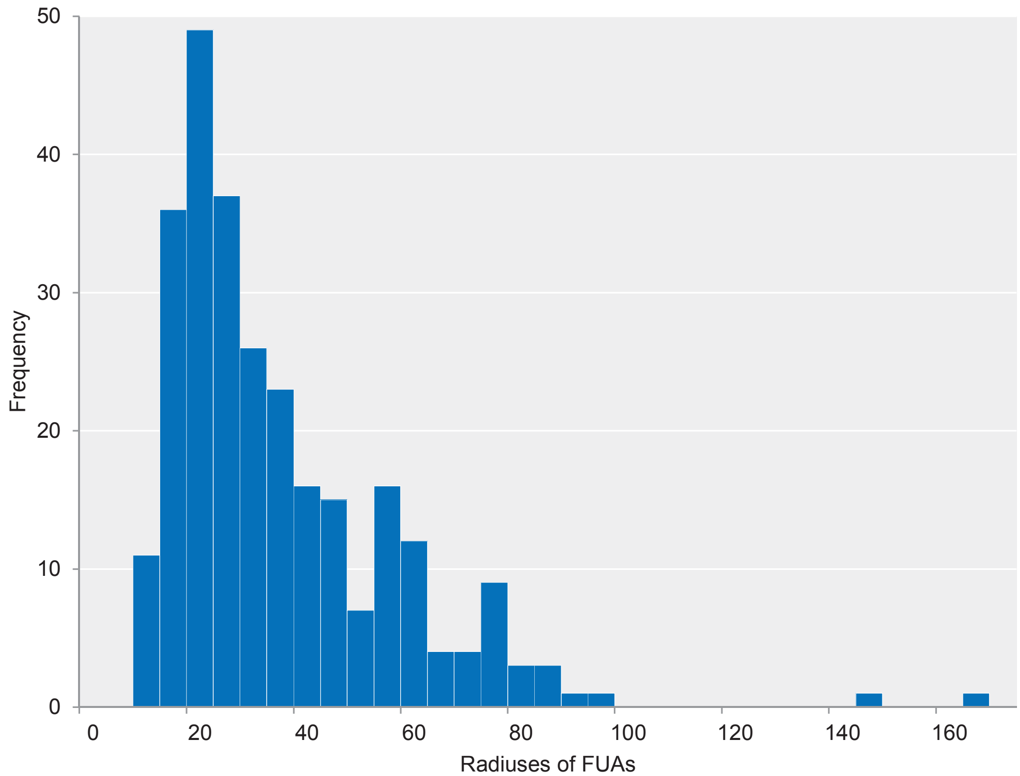
Although a different method has been applied for China in order to approximate the commuting zone of each FUA (due to the lack of commuting data), the commuting radiuses for Chinese and OECD FUAs exhibit quite similar distributions (OECD, 2013d). The distributions are both positively skewed, with the median for China being 26 kilometres and the average 30 kilometres, while for OECD is 29 kilometres and 35 kilometres respectively.

Figure 1.A1.2. **Distribution of radiuses of FUAs for China, 2010**



Source: Authors' calculations based on NBS data.

Figure 1.A1.3. **Distribution of radiuses of OECD FUAs, 2010**



Note: A proxy of the radius for each FUA has been calculated by estimating the radius of a circular area similar to the total FUA area. By using the formula (Total FUA Area)= $\pi * r^2$, an estimate of the radius r can be calculated.

Source: Authors' calculations based on data from the OECD (2013), "Metropolitan areas", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en (accessed on 20 October 2014).

Researchers used different models in their effort to mathematically capture the urban density gradient: negative exponential (Clark, 1951), normal (Sherratt, 1960), inverse power (Smeed, 1963), gamma (Aynvarg, 1969), quadratic negative exponential (Newling, 1969). A large empirical literature exists testing the models against data for various cities, in order to see which gives the best fit (see reviews from Zielinski, 1979, 1980; Smith, 1997). The same empirical literature also aims to identify the city-specific parameters used in the model. For example, the simple negative exponential Clark model may be expressed as follows:

$D(r) = A \cdot e^{-\lambda \cdot r}$ where D(r) is the density at distance r from the city centre.

There are two parameters to be estimated A and λ. The case is simple for A, as it is just the density at the city centre; *i.e.* for $r=0$, we get $A=D(0)$. However, the parameter λ needs to be estimated for each city (or country), and this mainly empirical exercise has been going since Clark's original contribution in 1961.

The theoretical interpretation of the parameter λ becomes more apparent if one takes the first derivative. Following Batty and Kim (1992), this yields:

$$D(r) = D(0) \cdot e^{-\lambda * r}$$

$$\frac{dD(r)}{dr} = -\lambda \cdot D(0) \cdot e^{-\lambda * r} = -\lambda \cdot D(r)$$

$$\frac{dD(r)}{D(r)} = -\lambda \cdot dr$$

Therefore, λ denotes the urban density gradient and represents the percentage change in population density for a marginal increase in the radius, at radius *r* (i.e. from *r* to *r*+*dr*). Empirically, it has been suggested that larger cities have smaller λ, as the density falls with a slower pace compared to the smaller cities (Ishikawa, 1980). Also, the more decentralised and suburbanised a city is, the lower would be λ (Holden and Parr, 2013).

Investigating the urban density gradient for Chinese cities and experimenting with various alternatives, it appeared that a suitable λ that fits the data well is one that follows a Gaussian distribution as proposed by Sherratt (1960), where the radius of the urban core is explicitly factored in (as in Chen, 2010). The more general Clark model can be transformed to the fitted Sherratt model by applying: $\lambda=1/(2*r_0^{\sigma})$, where $\sigma=2$. This specification has the advantage of fitting with the previously mentioned stylised facts of Ishikawa (1980) and Holden and Parr (2013).

The result is the following:

Clark model:

$$D(r) = D(0) \cdot e^{-\lambda * r^{\sigma}}$$

Sherratt model:

$$D(r) = D(0) \cdot e^{-\frac{r^{\sigma}}{\sigma * r_0^{\sigma}}}$$

In order to find the radius *r* that denotes the limit of the hinterland, we solve for r and replace D(r) with a chosen density threshold for the hinterland. Following experimentation, this has been chosen to be 275, half of the density threshold for the urban core, which was 550, as a best approximation to the data (D_{min}=275).

$$r = \sqrt[\sigma]{\frac{1}{\lambda} \ln\left(\frac{D_0}{D_{min}}\right)}$$