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The New Urban Peripheries, 1990-2014: Selected Findings from a Global Sample of Cities

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FROM THE INTRODUCTION

Cities grow in population and wealth and as they grow they both densify and expand. As cities expand, they convert new areas on their rural peripheries to urban use and create new urban peripheries in the process, newly settled areas or newly annexed villages and towns that were formerly on the outskirts of cities and are now contiguous with or engulfed by the city's expanding urban footprint. These new urban peripheries are the focus of this essay. Previous research, supported by a rigorous theoretical framework, has established an important empirical regularity that characterizes new urban peripheries: They typically have lower average densities. More generally, it has been shown in numerous studies that population densities decline as distance from the city center increases and hence we can expect that as cities expand outwards and away from their older centers, newly built areas will be further away from areas built earlier and will thus have lower average densities as well. Unfortunately, beyond this important finding, very little is known about urban peripheries and particularly about the new urban peripheries, areas built or incorporated into the urban footprint in recent decades. In this essay, which is discursive and non-technical in nature, we report on a number of recent findings than characterize the new urban peripheries—in our case, areas added to cities between 1990 and 2014—the world over, based on our analysis of satellite imagery and census data in a stratified global sample of 200 cities, a 4.7 percent sample of the universe of all 4,231 freestanding cities and metropolitan areas that had 100,000 people or more in 2010. We also report on a few additional findings from a pilot study now underway in ten cities in ten different world sub-regions.

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I Introduction

Cities grow in population and wealth and as they grow they both densify and expand. As cities expand, they convert new areas on their rural peripheries to urban use and create *new urban peripheries* in the process, newly settled areas or newly annexed villages and towns that were formerly on the outskirts of cities and are now contiguous with or engulfed by the city's expanding urban footprint. These new urban peripheries are the focus of this essay. Previous research, supported by a rigorous theoretical framework, has established an important empirical regularity that characterizes new urban peripheries: They typically have lower average densities. More generally, it has been shown in numerous studies that population densities decline as distance from the city center increases and hence we can expect that as cities expand outwards and away from their older centers, newly built areas will be further away from areas built earlier and will thus have lower average densities as well. Unfortunately, beyond this important finding, very little is known about urban peripheries and particularly about the new urban peripheries, areas built or incorporated into the urban footprint in recent decades. In this essay, which is discursive and non-technical in nature, we report on a number of recent findings than characterize the new urban peripheries—in our case, areas added to cities between 1990 and 2014—the world over, based on our analysis of satellite imagery and census data in a stratified global sample of 200 cities, a 4.7 percent sample of the universe of all 4,231 freestanding cities and metropolitan areas that had 100,000 people or more in 2010. We also report on a few additional findings from a pilot study now underway in ten cities in ten different world sub-regions.

This essay seeks to begin to answer five important questions about the new urban peripheries that could not be addressed before and explores some of the more obvious policy implications of the answers to these questions. The first four questions focus on the more quantitative dimensions of the new urban peripheries while the fifth question focuses on the qualitative differences between the urban fabrics of the areas of cities created before 1990 and those prevailing in new urban peripheries added to cities in the 1990-2014 period. These five questions aim to alert readers—be they municipal officials, policy makers at all levels, civic leaders, and interested citizens—to the vast new territories that were converted from rural to urban use during the 1990-2014 period, with the view to paying more attention and investing more resources in properly preparing new urban peripheries for urban settlement in the years to come before they are occupied, by at the very least identifying the lands needed for public works—arterial road and infrastructure networks—and retaining now, protecting areas of high environmental risk from settlement, and improving land subdivision practices.

These five questions are listed below.

1. **The relative size of new urban peripheries**: On average, were the areas of new urban peripheries built between 1990 and 2014 smaller or larger—and by how much—than the areas of cities built before 1990?
2. **The rate of urban expansion**: During the 1990-2014 period, at what rate were new areas added to urban peripheries of cities compared to the rate of growth of their populations?
3. **Urban expansion rates in more-developed and less-developed countries**: Were there differences in the rates of urban expansion between cities in more developed and less developed countries?
4. **Densification vs. expansion**: Of the populations added to cities in the 1990-2014 period, what share densified the areas built before 1990 and what share settled in new urban peripheries?
5. **The quality of the urban fabric in new urban peripheries**: Did the quality of the urban fabric in new urban peripheries built in the 1990-2014 period improve or deteriorate, on average, in comparison to the quality of the urban fabric in areas built before 1990?

We suspect that most urban planners and policy makers—at the local, national, and international level—are not fully aware of the extent to which urban peripheries are now growing and are unsure whether the quality of the urban fabric in these new urban peripheries has improved or deteriorated during the past 25 years. The bulk of the essay reports on these matters. The concluding section of this essay outlines a number of simple pragmatic interventions that can assist rapidly growing cities in preparing their urban peripheries to absorb the expected growth of populations, especially in the less-developed countries where most growth is projected to take place in the coming decades.

The essay is structured as follows: The following Section II summarizes the methodology employed in obtaining the maps and metrics that allowed us to answer the questions posed above. Section III summarizes the answers to the questions posed above and discusses their implications for urban planning and policymaking in general, and for preparing cities for their orderly expansion in particular. The concluding Section IV outlines a pragmatic program of intervention in the urban peripheries of rapidly growing cities.

II Notes on Methodology

The methodology employed in seeking answers to the questions posed above proceeded in a discrete set of steps that are described in this section. The outlines below are short summaries of more detailed descriptions of the methodology that are available elsewhere (Blei *et al*, 2018; Galarza *et al*, 2018; Lamson-Hall *et al*, 2018). The reader is referred to these sources for a more elaborate description of this section of the paper.

1. Defining cities by the limits of their built-up areas

We defined cities in a manner that blends a number of physical and functional attributes that allowed us to identify and measure the urban extent of these cities using satellite imagery. The urban extent of cities thus defined does not necessarily correspond to the municipal boundary of a city, and may include parts of a large number of municipalities (see figure 1). We identify cities by the edge of their built-up areas—what the ancient Romans used to refer to as the *Extrema Tectorum*—and their location with the Central Business District (CBD) of its main municipal area. In a small number of cases, those associated with cities that are part of larger metropolitan conurbations—such as the Northeast Corridor in the United States—the locally-defined administrative boundary of the city was used to differentiate one built-up extent from another, resulting in the separation of the New York and Philadelphia built-up areas, for example. In applying administrative boundaries as edges of cities—rather than applying the edge of their built-up area as their boundary—we acknowledge that a city's extent cannot extend endlessly; it should roughly correspond to a commuting area or labor market area; in other words, the area linked together by social and economic spatial interaction.

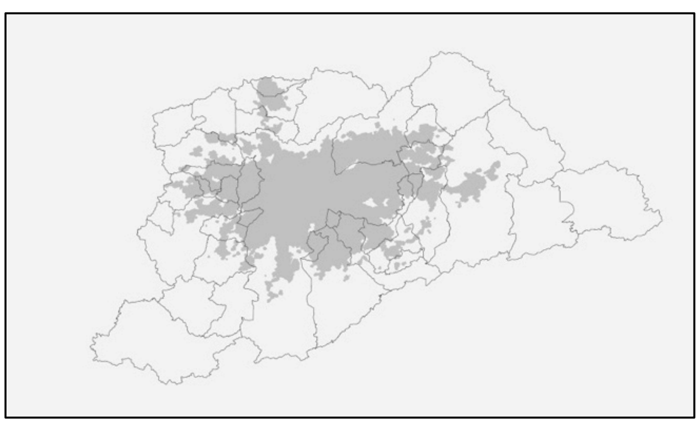


Figure 1: The urban extent of São Paulo, Brazil (grey) in 2014 extended over 29 municipalities.

Indeed, identifying cities as spatial units that are associated with urban labor markets, rather than with administrative boundaries, is in line with our finding that agglomeration economies in cities are metropolitan in scale, grounded in the advantages that metropolitan labor markets offer by making all jobs accessible to all residents. In a study of U.S. cities (Angel and Blei 2016), we found that residents take advantage of job opportunities throughout the metropolitan areas, rather than restricting themselves to jobs in their vicinity or to jobs in the CBD (see figure 2).

Figure 2: A representative sample of home-job links in 2010 in Los Angeles (left) and Atlanta (right).

2. The 2010 universe of cities

Given the above definition of cities, we identified the universe of all 4,231 cities that had 100,000 people or more in 2010 (see figure 3). To construct the universe of cities it was necessary to first identify candidate cities from lists of cities and towns, municipalities, metropolitan areas, and urban agglomerations with a reliable population estimate for 2010 or for which a population value at 2010 could be estimated. The three main data sources for this effort were the UN Population Division, which provided data for settlements with populations of at least 300,000, the website www.citypopulation.de, which reproduces census data and census maps for all countries, and the Chinese Academy of Sciences which provided information for Chinese cities and towns. Google Earth satellite imagery was used to inspect each candidate city, both to confirm its existence and to determine whether it should be merged with neighboring cities as part of a larger urban extent. Candidate cities below the population threshold that were not part of a larger extent were excluded from the analysis. Details regarding the statistical properties of the universe of cities can be found in Galarza *et al.* (2018). It should be noted that cities that were home to 100,000 people or more in 2010 had a total population of 2.0 billion in that year. The U.N. Population division estimated that the total urban population in the world in 2010—based on collecting national statistics and relying on national definitions of what constituted 'urban'—amounted to 3.6 billion. The urban population in the universe of cities thus constituted 56% of the total urban population in the world in 2010; the rest, we must assume, were in cities and towns with less than 100,000 people.

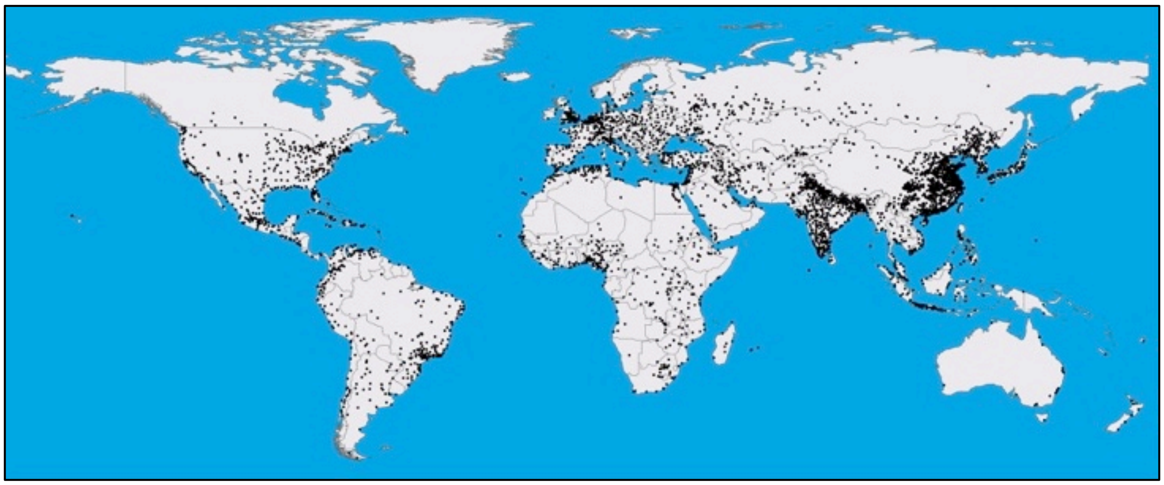


Figure 3: The location of all 4,231 cities in the 2010 universe of cities.

3. The global sample of cities

We sampled 200 cities from the 2010 universe of cities (see figure 4) based on three sampling stratifications—eight world regions, four city population size ranges, and three categories pertaining to the number of cities in the country.

The first stratum organized cities by eight world regions: (1) East Asia and the Pacific, (2) Southeast Asia, (3) South and Central Asia, (4) Western Asia and North Africa, (5) Sub-Saharan Africa, (6) Latin America and the Caribbean, (7) Europe and Japan, and (8) Land-Rich Developed Countries (the U.S., Canada, Australia and New Zealand). These world regions largely correspond to the regional divisions in the United Nation's *World Urbanization Prospects.* Cities were sampled from the eight regions in proportion to the population of the universe of cities in these regions.

The second stratum organized cities by city population size, of which there were four ranges—roughly corresponding to small, medium, large, and very large city population sizes—so that the total population of the universe of cities in each of these four ranges was approximately the same, about 622 million: (1) 100,000–427,000; (2) 427,001–1,570,000; (3) 1,570,001–5,715,000; and (4) 5,715,001 and above. An approximately equal number of cities were then sampled from each of the four population size categories. This sampling procedure resulted in many more large and very large cities and far fewer small and medium size cities in the sample than their relative shares in the universe of cities.

A third stratum was included in the sampling framework so that the sample would contain cities from countries with few cities as well as cities from countries with many cities. The number of cities in the country stratum contained three categories: (1) 1–9 cities; (2) 10–19 cities; and (3) 20 or more cities. Cities were sampled from these categories in proportion to the population of the universe of cities in these categories.

When combined, the eight regions, four population size ranges, and three 'number of cities in the country' categories create 96 subcategories (8 × 4 × 3 = 96), or boxes, to which an observation in the universe of cities must belong. After distributing all 4,231 observations, 71 non-empty boxes remained. Sample cities were randomly drawn from these non-empty boxes in accordance with the sampling strategy. Although the sample is representative of the universe by design, we can adjust a city's representativeness by using information associated with that city's sampling box. Since each sampling box contains a unique number of cities and a unique population total, the findings for a particular city may be weighted to reflect the number of cities that city represents, using a city-based weight, or the total number of people that a city population represents, using a population-based weight. The weighting system employed in calculating global averages corrects for the bias in the sample towards larger cities.

Figure 4: The locations of the 200 cities in the global sample of cities

4. Classifying urban extents using *Landsat* imagery and mapping urban peripheries

Using *Landsat* satellite imagery with a 30-meter pixel resolution, we identified and mapped the urban extents of the 200 cities in the sample in three time periods—circa 1990, circa 2000, and circa 2014. Using GIS mapping software, we calculated a number of metrics pertaining to these maps of the urban extents of cities—population, extent, average density, the saturation of urban extents by built-up areas, the shape compactness of urban extents, the shares of the added extents between two time periods that were infill, extension, leapfrog or inclusion of older settlements, and the changes in these values over time.

To obtain maps of the urban extent of the cities in the sample at different time periods, we identified study areas for the cities large enough to contain their most recent urban extent, using night light imagery to estimate that extent. We then collected *Landsat* imagery for three given periods—one circa 1990, one circa 2000 and one circa 2014—and classified pixels in that imagery into three categories: built-up, open space, and water. Given that classification, we distinguished between urban, suburban, and rural built-up pixels by the amount of built-up pixels in their walking distance circle—a circle with an area of one kilometer around them. We defined Urban pixels as pixels that had more than 50% of their walking distance circle built-up, and Suburban pixels as pixels that had 25-50% of their walking distance circle built-up. We then identified Fringe Open Space by all the open space pixels within 100 meters of urban and suburban pixels, and Captured Open Space as all open space pixels fully contained by Yrban, Suburban and Fringe Open Space pixels. These urbanized open spaces, together with Urban and Suburban built-up areas form urban clusters. We used an inclusion rule to combine urban clusters to each other to determine the urban extent of a city in a given time period. The classification of the *Landsat* imagery for Addis Ababa, Ethiopia, in 1990 into built-up, open, and water pixels appears in figure 5 below, left. The identification of urban clusters is shown in figure 5, middle, and the identifiction of the urban extent of Addis Ababa in 1990, using the inclusion rule is shown in figure 5, right.

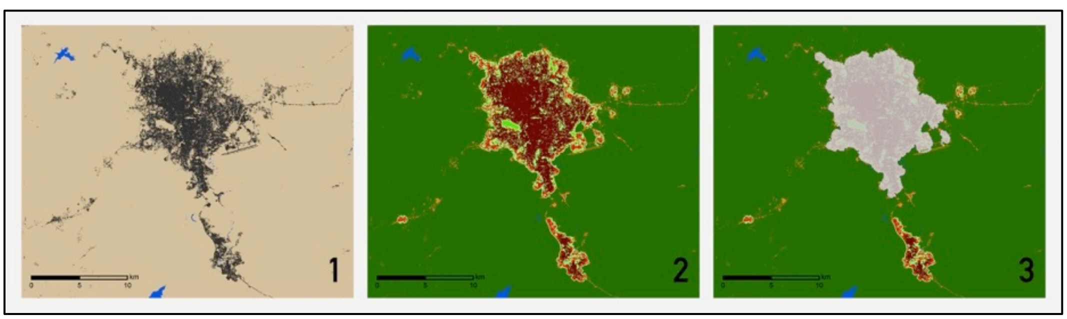


Figure 5: The classification of the *Landsat* imagery for Addis Ababa, Ethiopia in 1990 into built-up, open, and water pixels (left), urban clusters (middle), and urban extent (right).

By superimposing urban extents of different dates on one another, we could determine the new urban peripheries (or expansion areas) of cities, areas built between 1990 and 2000 and areas built between 2000 and 2014. We could then determine the relative size of the new urban peripheries in comparison with areas occupied before 1990. The new urban peripheries, or the expansion areas, added to Addis Ababa between 1990 and 2000 and between 2000 and 2015 are shown in figure 6 below, left. The new urban periphery or the expansion area added between 1990 and 2015 are shown in figure 6, right.

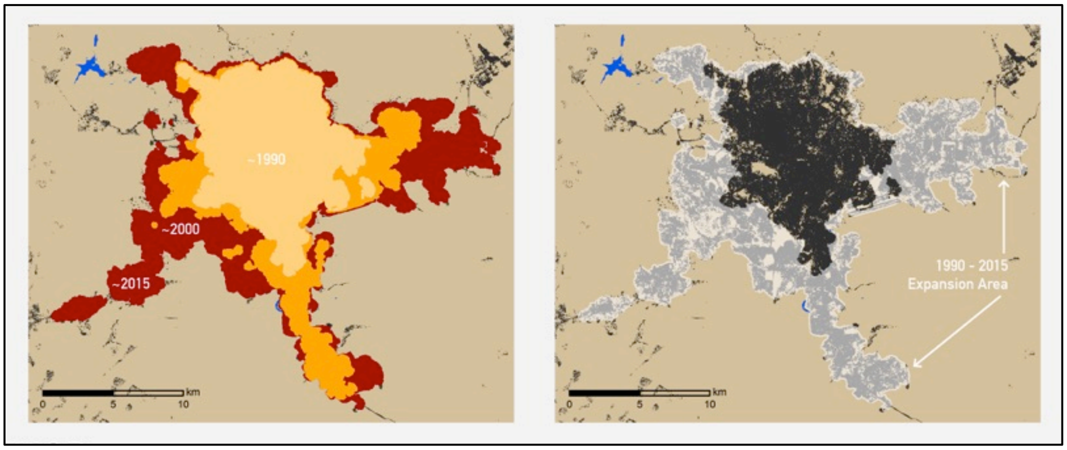


Figure 6: The new urban peripheries added to Addis Ababa between 1990 and 2000 and between 2000 and 2015 (left), and the new urban peripheries added to Addis Ababa between 1990 and 2015 (right).

We created maps of the urban extents of all 200 cities in the global sample for 1990, 2000, and 2014 (Angel *et al*, 2016, online at: www.atlasofurbanexpansion.org). Figure 7 shows a range of cities in the sample with the largest to the smallest area multiples of their urban extents between 1990 and 2014.

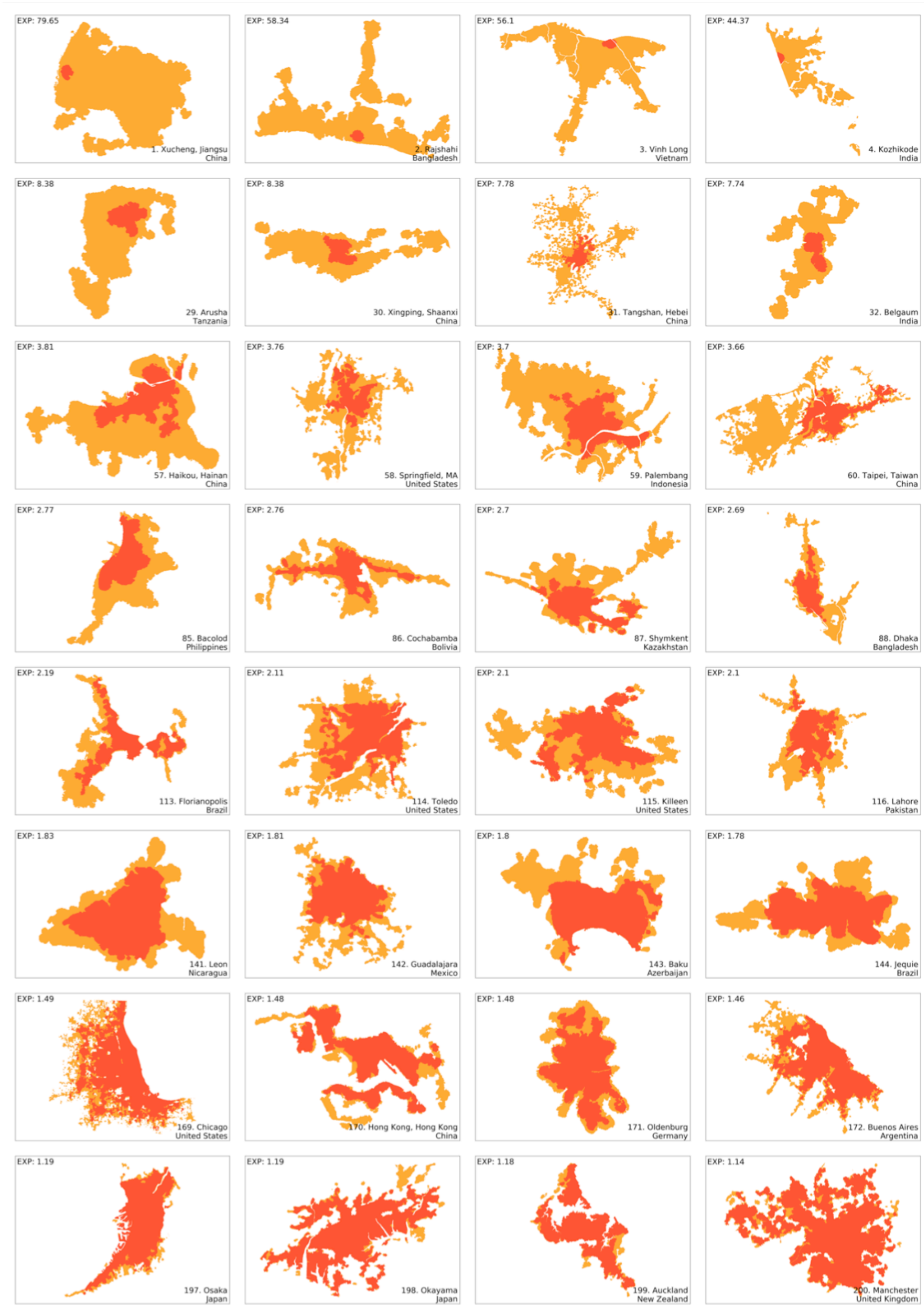


Figure 7: A range of selected cities in the global sample with the largest (rank 1) to the smallest (rank 200) area multiples of their urban extents between 1990 and 2014.

Note: EXP at the top left of map is EXP = Urban Extent 2014÷Urban Extent 1990; rank is shown on bottom right before city name.

5. Measuring the attributes of the urban fabric with high-resolution satellite imagery

Having identified the new urban peripheries—areas built between 1990 and 2000 and areas built between 2000 and 2014—in the global sample of cities, we spatially sampled an average of 80 10-hectare *locales* in every city, both in the areas built before 1990 and in the two new urban peripheries. The semi-random spatial distribution of potential locales for sampling in Addis Ababa, Ethiopia, using a Halton Sequence[1], is shown in figure 8 below.

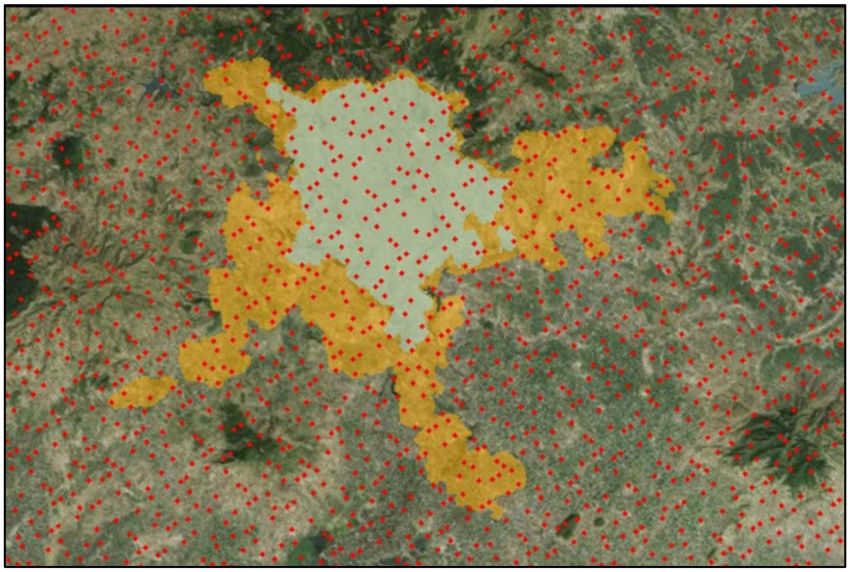


Figure 8: Identifying potential 10-hectare locales for the analysis of the urban fabric using high-resolution satellite imagery using a Halton Sequence on a map of Addis Ababa, Ethiopia.

Using high-resolution Bing and Google Earth imagery, we digitized several spatial features of these locales (see figure 9) to obtain values for a number of metrics that pertain to the quality of the urban fabric—the share of the land in streets, average block size, the share of 4-way intersections, and the share of residential land in atomistic development, in informal land subdivisions, in formal land subdivisions, and in housing projects. We also mapped arterial roads in the sample of cities and calculated the density of arterial roads as well as the average beeline distance to arterial roads in these cities. This phase of our investigation allowed us to obtain average values for a number of qualitative attributes of the urban fabric of cities, and to compare these values in areas built before 1990 and in areas built between 1990 and 2000 and between 2000 and 2014.

[1] For an explanation of Halton Sequences, see https://en.wikipedia.org/wiki/Halton_sequence.

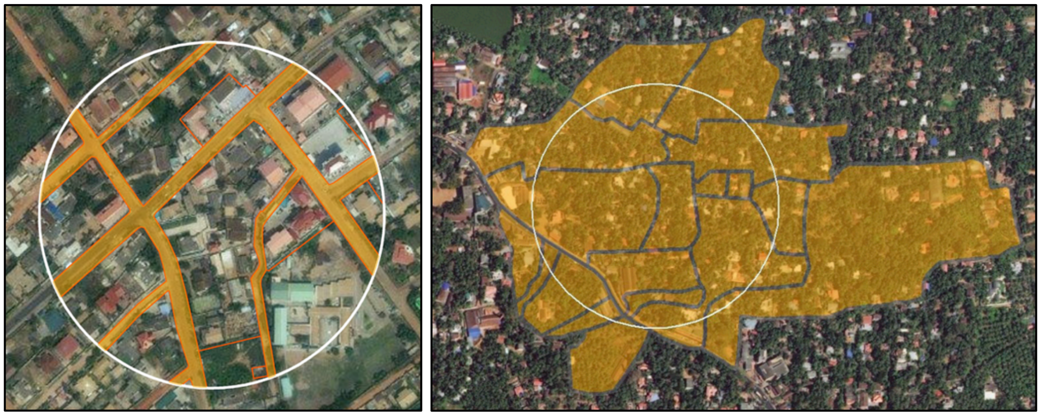


Figure 9: Digitizing 10-hectare locales to identify the areas allocated to roads (left) and the average size of blocks with shares of their areas within the locale (right)

6. Densification vs. expansion:

Urban densification accommodates urban population growth within neighborhoods that are already built. Urban expansion accommodates urban population growth in new neighborhoods built on the periphery of cities. It is generally understood and conceded that cities both densify and expand over time when they grow in population. An evidence-based policy that seeks to balance urban densification and urban expansion should rely on answers to the following questions: (1) What share of the population added to a city between two time periods settled within its existing urban extent and what share occupied new expansion areas? (2) Are recently occupied expansion areas of cities settled at higher or lower urban densities than areas of the cities built earlier? (3) Do newly built areas on the periphery of cities experience densification over time? Given the answers to these questions, we can project our findings into the future, seeking answers to the following questions: (4) Given existing trends, what share of the added population in coming decades can be expected to settle within the areas of cities built earlier? (5) Given existing trends, how much land will cities require to prepare for their orderly expansion in advance of development in coming decades? Answers to these questions are of key importance for the future of evidence-based low-carbon planning of cities.

A global 1-km^2 population grid, *LandScan*, in conjunction with other fine grain population data, allowed us to answer the first three questions for our global sample of 200 cities. More specifically, we have already mapped the expansion areas of the cities in the sample between 1990 and 2014. We could now estimate the share of the added population between 1990 and 2014 that settled in the expansion area and the share that settled in the pre-1990 area. Estimating these shares would allow us to answer the first and the second questions for the global sample of 200 cities. We could also calculate the density of areas built before 1990, areas built between 1990 and 2000, and areas built between 2000 and 2014. If densities in 1990-2000 areas were found to be significantly higher in 2014, on average, than they were in 2000, it will prove that densification occurred naturally as cities expanded.

We have already made these calculations and were able to answer the first three questions posed above for ten pilot cities from the global sample of cities: Bangkok, Bogotá, Baku, Cairo, Dhaka, Hong Kong, Wuhan, Kinshasa, Madrid, and Minneapolis. We report our results in this paper. Given additional resources not yet available, we propose to extend this analysis to all 200 cities in the global sample.

III Findings and Their Implications

In this section, we provide answers to the questions posed in the introduction to this essay and discuss their implications for planning and decision making pertaining to the new peripheries of cities.

1. The relative size of the new urban peripheries

In 1990, the 4,231 cities in the 2010 universe of cities—all the cities, metropolitan areas, and urban agglomerations that had 100,000 people or more in 2010—occupied a total area of 275,000km^2. A decade later, these cities occupied an area of 395,000km^2; and by 2014, these cities occupied an area of 570,000km^2. To put these numbers in perspective, these cities occupied 0.2% of the total land area of countries in 1990 and 0.4% in 2014; in parallel, they occupied 1.8% and 3.6% of the arable land area in the world at large in 1990 and 2014 respectively. If we refer to the expansion areas of cities between 1990 and 2014 as the new urban peripheries, we can conclude that, for the cities in the universe of cities as a whole, *the new urban peripheries were as large as the entire areas of cities built before 1990*. In Accra, Ghana, for example, the 1991-2014 urban periphery was 5.5 times larger than its 1991 area (see figure 10). In fact, the new urban peripheries in almost two-thirds of the cities in the global sample (63%) were larger than their areas in 1990. In 20 cities in the global sample (10%), new urban peripheries were more than 10 times larger than their areas in 1990.

From an urban planning perspective, this suggests that, given their relative size—which is considerably larger than expected by most planning professionals—more attention should be given to the new urban peripheries. In other words, had we known in 1990 that cities will, on average, double their areas and that some cities will increase their areas more than 10-fold by 2014, we could have better prepared for that expansion, say by laying out arterial road grids and street grids before peripheral lands were occupied. Generally speaking, we did not, and that was a mistake. Needless to say, we do not have to repeat that mistake again.

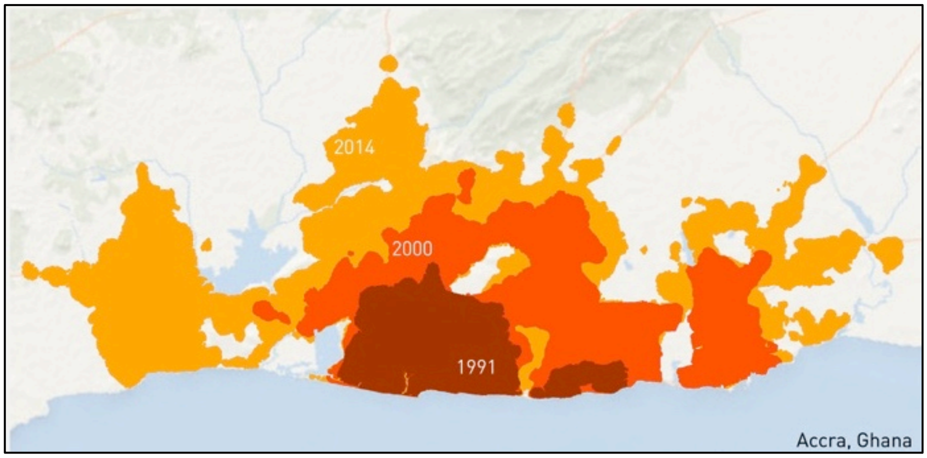


Figure 10: The urban peripheries of Accra, Ghana, areas added to the city between 1991 and 2014, was 5.5 the area of the city built before 1991.

2. New urban peripheries in more-developed and less-developed countries

There were substantial differences in the expansion of new urban peripheries in more developed and less developed countries. During the 24-year period between 1990 and 2014, the total area occupied by cities in the universe of cities in the more developed countries grew by 55%; in other words, it grew by a half. In parallel, the total urban extents of the cities in the less developed countries grew by 176%; in other words, it almost tripled. *New urban peripheries in cities in less developed countries were almost twice as large as their areas built before 1990.* Indeed, almost three quarters (71%) of the total land area of new urban peripheries created in the 1990-2014 period in the world at large was in cities in less developed countries.

Given current U.N. population projections (UN DESA, 2018)—projections that suggest that, between 2015 and 2050, 18 people will be added to urban populations in less developed countries for every person added to the urban populations in more developed countries—focusing on the new urban peripheries of the future will mean focusing more and more on the peripheries of cities in less developed countries. And the challenge here, it should be noted, is quite different: Preparing new urban peripheries for occupation will often take place in cities with weaker rule of law, weaker adherence to land use and land subdivision regulations, smaller municipal infrastructure budgets and reduced access to infrastructure finance, higher levels of corruption and greater control of private developers over the planning process. More often than not, lessons learned in planning urban peripheries in more developed countries—relying on elaborate yet enforceable master plans, to take one example—do not travel well to less-developed ones.

3. The rate of urban expansion compared to the rate of population growth

During the 24-year period between 1990 and 2014, the total population of the universe of cities grew by 53%—from 1.6 billion to 2.5 billion—while the area occupied by these cities grew by 105%—from 275,000km^2 to 570,000km^2. There is no doubt that cities are now expanding at a faster rate than their population growth rate. At current rates, when the population of a city doubles, its urban extent triples. Interestingly enough, the growth rates of both the population and area of cities were found to be statistically independent of city size: On the whole, small, large, and very large cities grew in population and expanded in area at roughly the same rates. On average, the annual population growth rate for cities large and small in the universe of cities was 3.8%; the rate of urban expansion was 5.6%. The difference between them, 1.8±0.4%, was statistically significant. Similar differences were detected in cities in more developed and less developed countries. In more developed countries, the average annual rates of population growth and urban expansion were 1.1% and 2.4% respectively and the difference between them was statistically significant. In less developed countries, the average annual rates of population growth and urban expansion were 4.7% and 6.7% respectively, and the difference between them was statistically significant as well.

This amounts to saying that average densities in cities—the ratios of the populations of their urban extents to the areas of their urban extents—are in significant decline. Indeed, between 1990 and 2014, average densities in the universe of cities declined significantly, from 90±11 to 52±5 persons per hectare; in cities in more developed countries, they declined from 31±5 to 22±3; and in cities in less developed countries, the declined from 111±13 to 66±6.

These findings suggest that urban planning efforts to contain urban expansion through green belts, urban growth boundaries, and other zoning and land use regulations—efforts that have been in place for the past three decades—have so far not borne fruit. There are anecdotal data to suggest that higher urban densities are associated with lower greenhouse gas emissions, shorter travel distances, and shorter infrastructure network lengths. It stands to reason, therefore, that cities should aim at slowing down their rates of urban expansion—at the very least to match their rates of population growth—so as to keep their average densities from declining, but so far that goal has proven to be quite elusive: Urban expansion continues to outpace urban population growth in the great majority of cities the world over. Refusing to acknowledge the pace of urban expansion and to prepare for it properly—simply because it is perceived as undesirable—is tantamount to shirking our responsibilities for ensuring that cities expand into their peripheries in an orderly manner, one that fosters their productivity, their inclusiveness, their sustainability, and their resilience.

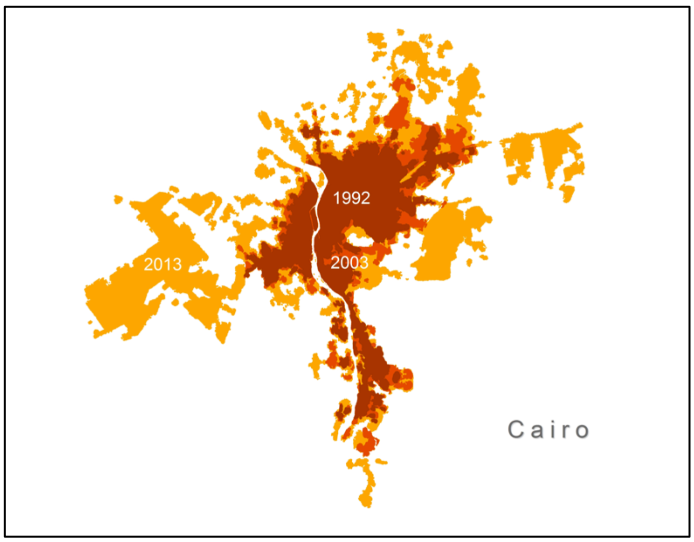
4. Densification vs. Expansion

It is generally understood and conceded that the density of urban neighborhoods is not simply determined by public policy. Urban densities are oftentimes the outcome of supply and demand pressures for residential living space. They may also be the outcome of consumer preferences for larger suburban homes further away or for smaller apartments closer to bustling urban centers. Still, there is an ongoing policy debate on the merits of accommodating urban population growth through urban densification as against through urban expansion. Those engaged in this debate claim that public intervention in the matter is needed to ensure that cities grow in a productive, inclusive, and sustainable manner. Densification is typically the preferred course for those concerned with energy conservation, with global warming, and with excessive public infrastructure costs. It is typically resisted by existing communities that prefer the status quo and by established planning regulations that limit what can be built where. Indeed, community resistance to densification, or the inability to reform planning regulations that prohibit it, may limit densification and accelerate expansion. Expansion is typically the preferred course for those concerned with overcrowding or with land supply bottlenecks that may lead to unaffordable housing. It is typically resisted by homeowners lest it depress property values, by municipal authorities reluctant to extend infrastructure services, and by concerned citizens who want to protect green spaces on the urban periphery. That resistance to urban expansion may compromise preparing for it at the proper scale, by failing to put in place adequate public works in advance of development, for example.

What is typically missing in this debate is the evidence on the relative share of the population added to cities in a given time period that was accommodated through the densification of their existing urban footprints as against the share of the population added to these cities that was accommodated in their new urban peripheries. We have obtained data on these relative shares, as well as additional data on the densification and saturation of existing urban footprints and new urban peripheries, in a representative group of 10 cities for the 1990-2014 period. The cities were Bangkok (Thailand), Bogotá (Colombia), Baku (Azerbaijan), Cairo (Egypt), Dhaka (Bangladesh), Hong Kong (China), Wuhan (China), Kinshasa (Democratic Republic of Congo), Madrid (Spain), and Minneapolis (USA).

Before reporting on these results and their implications, let us look at Cairo to get an overall understanding of the parameters used in our analysis (see figure 11 below). The map on the left of the figure shows the urban extent of Cairo in 1992 and its new urban periphery: The areas built between 1992 and 2013. The population of Cairo in 1992 was 9.6 million and it grew to 15.7 million by 2013. Of the 6.1 million people added to the city during the 1992-2013 period, 0.7 million (12%) were accommodated in the pre-1992 urban extent, while 5.4 million (88%) were accommodated in the new urban periphery.

The added population to Cairo's 1992 urban extent increased its saturation (Saturation = total built-up area ÷ total urban extent) from 72% to 94%. At the same time, despite the increase in its population, its built-up area density (Built-up area density = total population ÷ total built-up area) declined from 324 to 268 persons per hectare. The area occupied between 1992 and 2003 had a 44% saturation level by 2003 and this level increased to 72% by 2013. The area occupied between 2003 and 2013 has a saturation level of 47% by 2013. In short, most of the added population to the 1992 urban extent of Cairo was absorbed through increased saturation—occupying urbanized open spaces that were previously vacant—and not through increasing the density of its built-up areas. The new urban periphery became more saturated over time. It also became denser: By 2013, the overall density in the area built between 1992 and 2003, for example, increased from 55 to 100 persons per hectare. Most likely, new construction in this expansion area was added at higher densities than the original construction that took place between 1992 and 2003. We repeated this analysis for the remaining nine cities. We report briefly on these results below.



Metric	Area Occupied before 1992	Area Occupied 1992-2003	Area Occupied 2003-2013
Extent (hectares)			
1992	41,203	-	-
2003	41,203	16,989	-
2013	41,203	16,989	78,224
Population (Thousands)			
1992	9,622	-	-
2003	10,995	933	-
2013	10,346	1,859	3,530
Overall Density (Persons per Hectare of Urban Extent)			
1992	234	-	-
2003	267	55	-
2013	251	110	45
Built-up Area (Hectares)			
1992	29,717	-	-
2003	35,191	7,490	-
2013	38,670	12,295	37,088
Saturation (Built-up Area/Urban Extent)			
1992	72%	-	-
2003	85%	44%	-
2013	94%	72%	47%
Built-up Area Density (Persons per Hectares of uilt-up Area)			
1992	324	-	-
2003	312	125	-
2013	268	151	95

Figure 11: The area of Cairo, Egypt, built before 1992 (red), and its new urban peripheries, areas built during the 1992-2003 period (dark orange), and areas built during the 2003-2013 period (yellow). Statistics on densification and saturation are given in the table on the right.

The shares of the populations added to the ten cities studied between 1990 and 2014 that were accommodated in their pre-1990 areas varied greatly: From 12% in Cairo to 90% in Bogotá (see figure 12 below). The very high value for Bogotá can be attributed to the deteriorated security on its suburban fringe and the high threat of kidnapping on suburban roads during this period (Gaviria et al., 2018). While it is difficult to draw conclusions about the universe of cities as a whole from such a small representative group, we note that, on average, 39±17% of the added populations between 1990 and 2014 were settled in the pre-1990 areas of cities, while the rest, 61±17%, were settled in the new urban peripheries of these cities, areas occupied between 1990 and 2014.

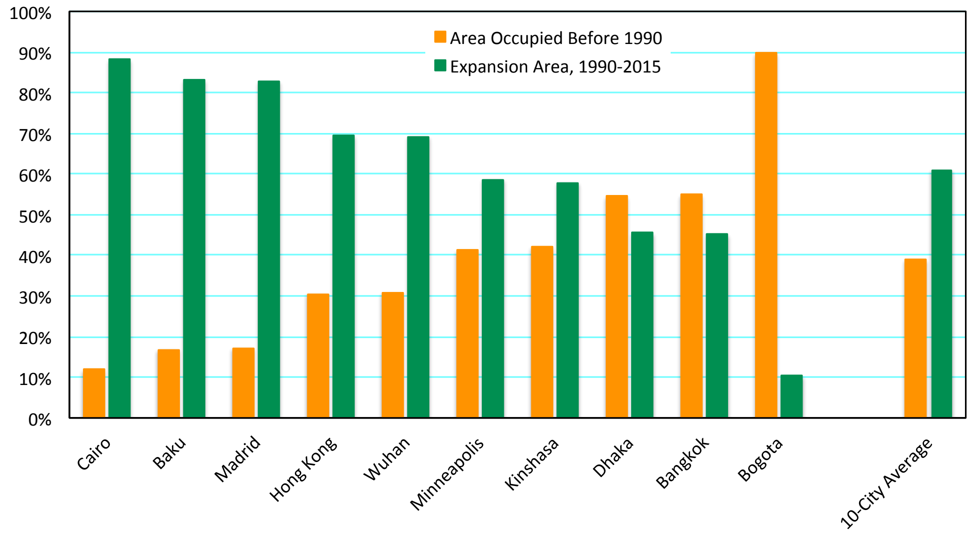


Figure 12: In the ten representative cities, the share of the population added between 1990 and 2014 that were accommodated in the pre-1990 urban footprint varied from as little at 12% in Cairo to a maximum of 88% in Bogotá, with an average of 39%.

If any populations at all were added to the pre-1990 footprints of these 10 cities, it clearly densified them because their densities are simply ratios of their populations and their areas and their areas remained fixed. Even for as small a sample of 10 cities, average overall densities in the pre-1990 areas in these 10 cities increased by a factor of 1.5±0.3, a statistically significant increase at the 95% confidence level. That increase in density could take place in two distinct ways: By increasing the saturation of the pre-1990 footprints or by increasing the built-up area density (population ÷ built-up area) within these footprints. Figure 13 below shows the increase in saturation (built-up area ÷ total area) within the pre-1990 urban footprints of the ten cities. There is no doubt that the added population to the pre-1990 urban footprints of these ten cities significantly increased the level of saturation within these footprints: The 10-city average saturation level increased from 61±6% in 1990 to 83±6%. In three cities—Cairo, Kinshasa, and Wuhan—saturation levels reached 90% or more, leaving little open space—either public or private— within their urban extents. Saturation, no doubt, clearly has its limits.

In contrast to the clear pattern detected in increased saturation levels, the densification of built-up areas within the pre-1990 urban extents of the ten cities studied here presents a more varied pattern. It increased substantially in some cities, e.g. Dhaka and Bogotá, and it decreased substantially in others, e.g. Hong Kong. On average, the built-up area densities in these 10 representative cities did not change substantially over the 1990-2014 period (see figure 14). There is no natural limit to the densification of the built-up areas of cities, but it is difficult to undertake in practice. It may require smaller apartments, lower vacancy rates, taller buildings, higher plot coverage, or a greater share of land in residential use.

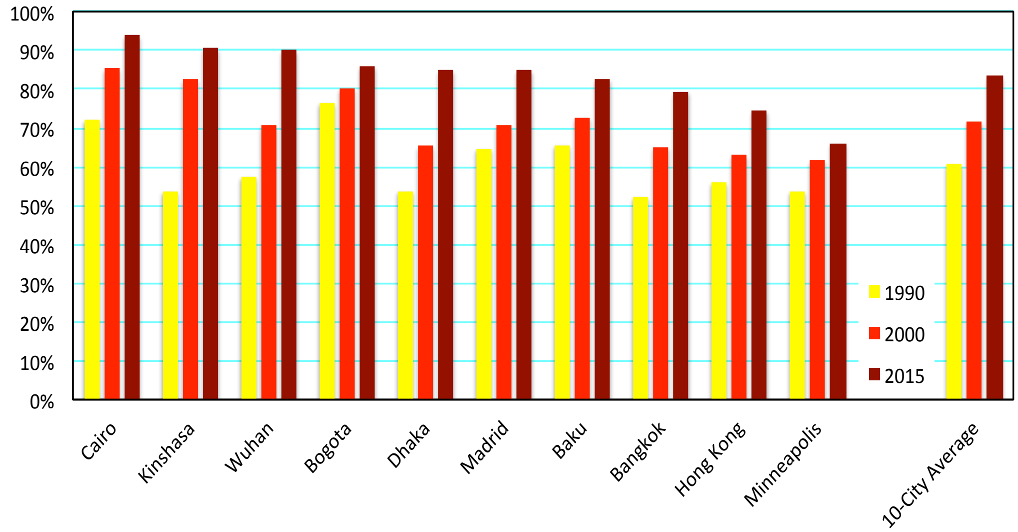


Figure 13: Average levels of saturation (built-up area ÷ total area) increased significantly between 1990 and 2000 and between 2000 and 2014 in the ten representative cities.

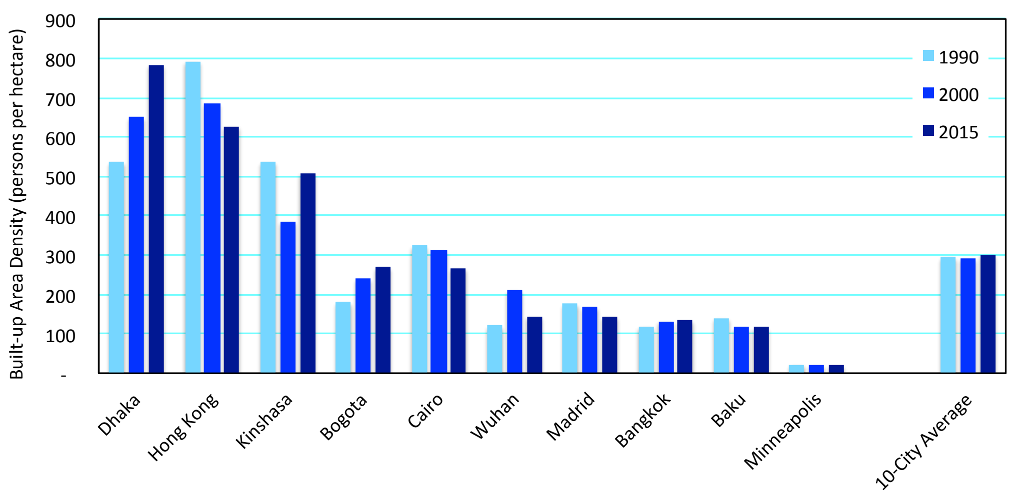


Figure 14: Average built-up area densities (total population ÷ total built-up area) did not change significantly between 1990 and 2000 and between 2000 and 2014 in the ten representative cities.

Our position in the debate on the merits of densification vs. expansion takes the middle road, seeking proper balance between the two by promoting both acceptable densification and orderly urban expansion. We have no issue with either densification or expansion and we are fully aware that they are substitutes. Both can and do accommodate population growth. It is important to keep in mind, however, that in the presence of inevitable urban population growth one cannot be both against densification and against expansion. Strict adherence to the status quo and uncompromising Nimbyism in the presence of urban population growth must be delegitimized and actively resisted. Densification vs. expansion, or the relative importance we attach to one vis-à-vis the other, present a choice we must make, a choice that cannot be avoided. Neither densification nor expansion is simple or easy to implement. Both require strong leadership and public support and, more often than not, regulatory reform. What is of greatest importance in the context of this paper is that hoping against hope that strict containment of existing urban footprints can relieve cities from their need to expand into new urban peripheries is counterproductive. Containment might, if successful, lead to land supply bottlenecks and consequently to higher land and housing prices; and, if it fails, to unplanned and disorderly expansion.

The densification of the urban extents of cities is easier to accomplish by the infill of urbanized open spaces, many of them still vacant, and much more difficult to accomplish by increasing density in situ in already built-up areas, either by subdividing units into smaller ones, by adding units to existing structures, or by tearing them down and building higher structures in their stead. It should not come as a surprise, therefore, that in the 10 representative cities we found significant infill between 1990 and 2014 in the pre-1990 urban extents, but no significant increase in the average densities of built-up areas there. And while densification in situ, at least in theory, has no upper limit, saturation of urbanized open spaces does: Sooner or later the remaining stock of vacant land is exhausted. In the face of population and income pressures on housing demand, limitations on infill or on in-situ densification of built-up areas intensify pressures for urban expansion. Lest they fall prey to wishful thinking, urban planners that need to confront these pressures on housing demand, with the objective of ensuring the adequate supply of residential land and housing so as not to render housing unaffordable, must correctly estimate how much of that demand can be accommodated within existing urban footprints and how much will need to be accommodated by urban expansion, while keeping an eye on land price movements on the urban periphery. Anecdotal evidence, from Santiago, Chile, for example, suggests that if land supply bottlenecks—often accentuated by infrastructure shortages on the urban periphery—allow land price to increase, they tend to remain high, particularly when there are no pressures on peripheral landowners to dispose of their lands.

5. The quality of the urban fabric in the new urban peripheries

It is important to know if the quality of the urban fabric—measured, say, by the share of the built up area occupied by roads, average block size, 4-way intersection density, access to arterial roads, or proper residential land subdivision—in new urban peripheries built in the 1990-2014 period improved or deteriorated in comparison to areas built before 1990. The default answer to this question—the null hypothesis, so to speak—is that the quality of the urban fabric in the new urban peripheries of cities remained the same over time. One would hope, however, that in parallel with economic development and social progress along a number of dimensions over the last 25 years, it has improved. There would be less cause for worry if the urban fabrics in the new urban peripheries were of similar, or preferably better quality than those found in areas built before 1990.

Our findings show that the opposite is true, leading us to believe that drawing attention to preparing new urban peripheries for human settlement—the most basic and the most established task of traditional urban planning—is now one of the most critical task confronting the rapidly growing cities in less developed countries. We find that, on the whole, new urban peripheries were less prepared on a number of critical dimensions for urban settlement than areas of cities built before 1990.

That said, along one important dimension—the share of the built-up area occupied by streets and roads—there has been no change, whether for the better or for the worse. The share of the built-up area occupied by roads was 21±1%, on average, in the areas of cities built before 1990; it was 21±1%, on average, in the new urban peripheries of these cities, areas built during the 1990-2014 period. There was no significant statistical difference between the two. Median values in the two areas were not that different either. There were numerous cities, however, both in more developed and in less developed countries that had considerably lower values in their expansion areas: The new urban peripheries of London and New York had only 10% and 13% of their built-up areas, on average, dedicated to streets respectively. Similarly, The new urban peripheries of Kolkata and Dhaka had only 10% and 12% of their built-up areas, on average, dedicated to streets respectively.

Interestingly, the share of roads that were less than 4-meters in wide increased significantly, from 20±2% in the areas of cities built before 1990 to 28±2% in areas built in the 1990-2018 period. The share of roads less than 4-meters wide was only 18% and 14% in London and New York respectively, by as high as 60% and 56% in Kolkata and Dhaka respectively. There are good reasons to believe that in the new peripheries of many cities not enough land was dedicated to roads, but we cannot say that, in general, less area was dedicated to roads in the post-1990 period than in the pre-1990 period.

On a number of other dimensions, instead of seeing progress over time, we saw regress. We can definitely say that about average block size, a key metric in evaluating the walkability of urban areas: The larger the block size, the longer the walking distance between two random locations in comparison with their beeline distance. Average block size increased significantly in urban areas built after 1990 in the universe of cities in comparison to areas built before 1990: It increased from an average of 3.4±0.2 hectares in the former to an average of 5.4±0.4 hectares in the latter in the universe of cities as a whole, and the increase was significant in all world regions.

What was true for average block size was also true for the share of road intersections that were 4-way road intersections, another common measure of walkability. 4-way road intersections define blocks; they also make for increasing the number of alternative routes between urban locations, thus reducing the prevalence of bottlenecks and distributing traffic flow more evenly among city streets. The average share of road intersections that were 4-way in the pre-1990 areas in the universe of cities was 14±1%; it decreased to 10±1% in the areas of cities built between 1990 and 2014, and it decreased significantly in all world regions except in Europe and Japan. This is indeed a worrisome development: Nine out of ten intersections in new urban peripheries in the universe of cities are, on average, 3-way intersections. Indeed, narrow road networks with 3-way intersections can, and most often do, ensure road access to every plot—a key requirement for making the plot salable—but that it all they can do. They hamper walkability and they present difficult obstacles for the smooth flow of traffic within as well as across territories that have predominantly 3-way intersections.

Urban and metropolitan labor markets thrive when all workers have access to all jobs, because that ensures that firms can hire the best workers and workers can find the best jobs. Labor markets are integrated when all locations are connected by inter-city arterial roads that allow workers to reach their workplaces all over the urban area rapidly and efficiently. The presence of an arterial road, preferably one that carries public transport, within walking distance of a residence greatly facilitates access to jobs throughout the urban area. We can legitimately inquire, therefore, whether the average walking distance to an arterial road in new urban peripheries built between 1990 and 2014 increased or decreased significantly from the average distance to arterial roads in the areas of cities built before 1990. There is no question that for cities in the universe it increased significantly, from 431±48 meters, on average, in pre-1990 areas to 601±50, on average, in the new urban peripheries developed in the 1990-2014 period. It increased significantly in cities in all world regions, except Europe and Japan, Land-Rich Developed Countries (U.S., Canada, Australia and New Zealand), and South and Central Asia.

The left map in figure 15 below shows the scarcity of arterial roads in a northeastern section of Bangkok in the 1980s: Arterial roads were 8 kilometers apart and carried all intra-city traffic. As a result people could not walk to arterial roads and arterial roads were highly congested. The map on the right shows the public transit network on the arterial road grid in Toronto circa 2010. The density of the arterial road grid allowed almost everyone to be within walking distance of arterial roads and hence from public transit. The global increase in distance to arterial roads during the 1990-2014 period is also a worrisome development. To function as integral parts of urban labor markets, new urban peripheries must be connected to the overall network of arterial roads that connect workers to jobs throughout cities. The productivity and inclusiveness of cities is impaired when job markets become fragmented and cities cannot function as integrated labor markets.

Figure 15: Arterial roads in a northeastern section of Bangkok (left) are 8 kilometers apart. Most arterial roads in Toronto (right) carry public transit.

Anecdotal evidence suggests that laying out residential areas in an orderly manner before they are occupied —i.e. subdividing land into regular plots and arranging these plots along a regular network of streets—has economic and social benefits that far exceed its costs. First, regular layouts facilitate the provision of infrastructure and reduce the expenditures associated with it. Second, introducing roads into fully built irregular settlements (see figure 16, left) has proved both costly and inefficient (Abiko 2007). Third, regular layouts accelerate the transition of informal settlements away from being perceived as "slums", as has been the case of the gridded squatter settlements on the periphery of Lima, Peru (see figure 16, right). Fourth, settlements with orderly layouts increase in economic value over time more rapidly than atomistic development. Michaels *et al* (2018)

> [S]tudied 'Sites and Services' projects implemented in seven Tanzanian cities during the 1970s and 1980s, half of which provided infrastructure in previously unpopulated areas (de novo neighborhoods), while the other half upgraded squatter settlements. Using satellite images and surveys from the 2010s, [they found] that de novo neighborhoods developed better housing than adjacent residential areas (control areas) that were also initially unpopulated. Specifically, de novo neighborhoods are more orderly and their buildings have larger footprint areas and are more likely to have multiple stories, as well as connections to electricity and water, basic sanitation and access to roads… While we have no natural counterfactual for the upgrading areas, descriptive evidence suggests that they are if anything worse than the control areas… the mean land value in [Dar e Salaam's] de novo neighborhoods is in the range of $160-220 per square meter, while in its upgrading neighborhoods it is about US$30-40 per square meter.

(Michaels e*t al*, 2018, 1 and 26)

Figure 16: The cost of providing residential infrastructure in the Matinha favela in Rio (left) was 6-9 times the cost of providing it in a new land subdivision; Some houses in Comas, a properly laid out former squatter settlements in Lima, Peru (right) are now selling for $180,000.

Given the importance of orderly land subdivision, we can ask whether land subdivision practices are gaining in importance in the new urban peripheries or whether they are losing ground. Unfortunately, evidence from the universe of cities is by no means encouraging. We examined the shares of residential areas within randomly selected 10-hectare locale in the global sample of cities and divided them into four categories: (1) atomistic, where houses were added one by one without any layout; (2) informal land subdivisions, where there was a more or less regular layout but roads remained unpaved; (3) formal land subdivisions, where there was a regular layout and roads were paved; and (4) housing projects, where there was a regular layout and a repetitive house design. We generalized our findings to the universe of cities as a whole.

In the universe of cities as a whole, the share of residential areas that were not laid out before they were occupied—i.e. those with atomistic housing—increased significantly, from 22±4% in the areas of cities built before 1990 to 32±4% in the new urban peripheries built during the 1990-2014 period. That increase was significant in all world regions as well, except in South and Central Asia. Globally, we are seeing a large increase in unplanned urban expansion, an expansion that will make it difficult for many people to obtain infrastructure services and to see their settlements transform from "slums" into regular urban neighborhoods.

In parallel with the increased share of atomistic layouts, we also observed an increased share of informal land subdivisions coupled with a decreased share of formal ones. The share of informal land subdivisions in the universe of cities increased significantly, from

20±4% in the areas of cities built before 1990 to 32±4% in the new urban peripheries built during the 1990-2014 period. In parallel, the share of formal land subdivisions in the universe of cities decreased significantly, from 47±4% in the areas of cities built before 1990 to 24±4% in the new urban peripheries built during the 1990-2014 period. The share of residential areas in housing projects did not change significantly. The absence of formal layouts is especially critical in Sub-Saharan Africa, where the share of atomistic residential development increased from 26±13% in pre-1990 areas to 43±14% in new urban peripheries, while the share of informal land subdivision decreased insignificantly, from 50±15% in pre-1990 areas to 43±14% in the new urban peripheries built during the 1990-2014 period.

Municipalities in rapidly growing cities are often reluctant to engage informal developers because they do not conform to municipal land subdivision regulations, regulations that often require the provision of a full complement of infrastructure services before the construction of houses can begin. Informal developers, on their part, sell unserviced land with the promise of services to be provided later, typically by pressuring municipalities to provide them. Still, engaging informal developers with a view of assisting them or encouraging them to generate better layouts with regular plots and more land allocated to streets, can yield great benefits to all: Developers would end up with smaller amounts of salable land, but would sell it at a higher price; buyers would obtain plots that will increase faster in value; and municipalities could upgrade infrastructure at lower cost. Urban planners must work to ensure that new urban neighborhoods on the urban periphery are laid out in an orderly fashion. That has always been their traditional role and it appears that they have been neglecting it of late, having lost interest in affecting the emerging shape of their cities on the ground. Too little is known about informal land developers on the new peripheries of rapidly growing cities, especially the poorer ones, and too little is being done to engage them.

To conclude, along a number of important dimensions we can determine without doubt that the urban fabric in the new urban peripheries of cities is of a lower, rather than a higher, quality than the urban fabric in areas of cities built earlier. This suggests a serious failure on the part of urban planners entrusted with ensuring that essential public works, as well as essential public open spaces, are put in place before cities get built. The concluding section of this essay outlines a pragmatic set of practical interventions that can repair and correct past failures and ensure a modicum of order in new urban peripheries to be built in the decades to come.

IV Conclusion: Preparing Future Urban Peripheries

The most important conclusion of this essay is that urban planners and policy makers must stop neglecting the peripheries of cities. Instead, they must direct both attention and resources to learning more about urban peripheries, to understanding the processes now guiding their formation, to becoming more involved in these processes, and to take a few basic actions that can help shape new urban peripheries so as to make them more productive, more inclusive, more sustainable, and more resilient. All of this can be done at modest cost and with modest changes to current practices, while yielding economic and social benefits that far outweigh these costs.

More particularly, urban planners and policy makers would do well to engage in the long-term planning of new urban peripheries, preferably preparing now for the expansion of cities in the next three decades, with the year 2050 as a realistic time horizon. Preparing for urban expansion in advance indeed requires a long time horizon: It is considerably cheaper to engage in planning, as well as in land acquisition, in areas of expansion far away from the existing edge of cities than in areas close by. Looking far into the future while acting now reduces present outlays while vastly multiplying future benefits.

We now know the orders of magnitude of the lands that cities will need for their future expansion in the coming thirty years. Each city can now determine its urban extent and use more precise statistical tools to project it into the future. These projections need to be done realistically, shying away from tendencies to underestimate urban expansion in the hope that it never occurs. Projections must take into account both population and income growth, remaining alert to the fact that cities typically expand at a faster rate than the rate of growth of their populations. They must also take into account the potential for the densification of the areas of cities that are already built. In fact, estimating the areas needed for urban expansion must go hand in hand with estimating the shares of the population that will need to be settled in new urban peripheries as against the shares that can be accommodated in already built areas.

That said, there is good reason to prepare more lands for expansion that predictions call for: As long as investments in expansion areas are small, there is no great loss if expansion does not occur at full scale. There are heavy penalties, however, for not preparing adequate areas for expansion: Cities may then expand in a disorderly and thus costly manner or, if not allowed to expand, create land supply bottlenecks that may result in unaffordable housing. Planners must also understand that the urban peripheries of cities cannot be built at high densities. Density levels typically decline with distance from city centers but increase over time as cities expand outwards. Hoping to densify cities and limit their footprint by building dense settlements on the urban periphery, while certainly possible here and there, is unlikely to change this overall pattern, a pattern that has been observed everywhere.

From the perspective of urban population growth, urban planners and policy makers the world over should come to understand that urbanization—insofar as it entails the growth of urban populations—is new essentially over in the more developed countries; it is now essentially an issue facing the less developed ones. And preparing for urban expansion in less developed countries—with weaker rule of law and limited human, fiscal, and financial resources—is a task of quite a different order than managing urban expansion in more developed countries. Emphasis on complex master plans that rely on strong compliance must give way to simpler interventions that can utilize the limited available capacities for making significant changes on the ground.

Finally, the quality of the urban fabric in new urban peripheries can be enhanced with a simple four-point action program: (1) Estimating the amount of land needed for expansion in the next thirty years, identifying the area needed for expansion, and obtaining planning jurisdiction over the entire area; (2) preparing an arterial road grid throughout the expansion area; (3) identifying and securing a hierarchy of public open spaces that need to be protected from development; and (4) improving land subdivision practices on the urban periphery.

The first involves a realistic estimate of the amount of land needed for the expansion of the city over the next three decades. This estimate must take into account global knowledge about urban expansion, current rates of expansion, population and income growth projections, and an analysis of the share of the added population that can be expected to be accommodated though the densification of the existing urban footprint. Estimates should err on the high side to account for the asymmetric risk in estimation errors: Erring on the high side does not involve high costs if there are only minimal investments in preparing for expansion. Errors on the low side do involve high costs, as they may result in disorderly expansion or in unaffordable residential land and housing. Given these estimates, sufficient buildable land needs to be identified, dry land with slopes less than 15%, while ensuring that lands of high environmental risk are protected from development. Once sufficient land has been identified, the planning jurisdiction over the entire expansion area must be secured.

The second involves creating an arterial road grid that covers the entire projected urban periphery to 2050 with the view to connecting it to all urban locations, to facilitating public transit provision, to creating natural corridors for transit-oriented development, and to shifting urban development away from lands with high environmental risk. This arterial road grid—say one with 30-meter wide road rights-of-way spaced one kilometer apart—can allow the entire expansion area to be within walking distance of arterial roads and hence from public transport. The key to success in creating such a grid hinges on acquiring the rights-of-way for the entire grid now. Our Urban Expansion Program at New York University has been assisting cities in Ethiopia and Colombia, for example, is preparing such grids and some of these cities are now in advanced stages of preparation (Lamson-Hall *et al*, 2018; Vásconez *et al*, 2015). Two cities in Colombia—Montería and Valledupar—are now planning to plant trees at 10-meter intervals along the future sidewalks of their entire new arterial road networks.

The third involves identifying a hierarchy of public open spaces, large and small, that need to be protected from development and instituting a set of pragmatic arrangements that can ensure that they remain open is the face of pressures from formal and informal developers to occupy them. Again, the key issue here is not to create a map of desired open spaces, pain them green, and hang the map in the municipal office to gather dust, but to put together a strategy for protecting a limited hierarchy of open spaces on the ground, be it by creating stronger institutional arrangements, by creating incentives, by organizing communities, and by soliciting funds. The success of such an effort must be measured by individual successes on the ground, accomplished one at a time, rather than by good intentions that are ultimately frustrated.

The fourth intervention involves the engagement of informal suppliers of residential plots in improving their land subdivision practices, especially in the rapidly growing cities in Sub-Saharan Africa and in South and Southeast Asia, where most urban expansion is expected to take place in coming decades. This will require learning more about these practices, removing the stigma associated with them, modifying regulatory practices where necessary to recognize the value of regular subdivisions that do not offer a full complement of infrastructure services at the outset, and engaging informal developers in planning and disbursing plots in more orderly land subdivisions. Espinoza and Fort, for example, have taken an important step in this direction, creating a smartphone application—"Lotizer"—for generating instant layouts, and testing it in the new urban peripheries of several cities in Sub-Saharan Africa (Espinoza and Fort, 2018).

Needless to say, all three proposed interventions—acquiring the rights-of-way for the arterial grid, protecting a hierarchy of public open spaces from development, and increasing the capacity of informal developers to engage in proper land subdivision—are much simpler, much cheaper, and much easier to implement that the complex master plans that still command the attention of local and national politicians in less developed countries, and that are still aggressively marketed in these countries by unscrupulous planning consortiums from more developed countries. Both those selling and those buying these master plans see them as ends in themselves that have no visible effect on the facts being created on the ground. In fact, there are good reasons to believe that most of those engaged in master plan transactions have never been to the urban periphery and have never sought to understand how it is now being formed.

At this point in time, as this essay has shown, the new urban peripheries of cities are growing wild. They need to be tamed and they can be tamed. They can be tamed by projecting how much land will be needed for their expansion to 2050 and where these lands would be. They can be tamed by an active initiative aimed at conserving public open spaces and protecting them from development. They can be tamed by creating a skeleton plan in the entire area of expansion, a plan that already determines the location of an arterial road grid now and that secures the right-of-way for that arterial grid, before development takes place. Finally, they can be tamed by focusing new attention on the way land is subdivided and sold on the urban periphery, with a view of getting rural landowners and informal property developers to improve their land subdivision practices. While these minimal interventions will by no means address all the myriad problems confronting rapidly growing cities in less developed countries, they offer real hope in making something of real value happen there.

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