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Raising the Bar

for Productive Cities in Latin America and the Caribbean

María Marta Ferreyra and Mark Roberts, editors

Overview

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OVERVIEW

MARÍA MARTA FERREYRA AND MARK ROBERTS, EDITORS

WORLD BANK GROUP

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Foreword

Since the early days of civilization, human beings have come together in cities. Cities (from the Latin *civitas*) and civilization (from the Latin *civilis*) are inextricably linked. Throughout human history, cities have been centers of civilization, culture, and human achievement. They have also been powerful hubs of economic activity, entrepreneurship, and innovation. As firms and workers gather in cities, opportunities emerge for employment and business. As cities within a country become better connected, further opportunities emerge for production and trade among cities.

These opportunities, however, do not always come to full realization. Such is the case when cities are overwhelmed by congestion, or when people, goods, and services do not flow freely across cities. Cities can only realize their potential and their contribution to national productivity when policy makers implement an enabling environment through a combination of policies at the local, state, and national level.

These issues are critical for the Latin America and the Caribbean (LAC) region today. Since almost three-quarters of LAC's population lives in cities, LAC countries cannot be productive unless their cities are also productive. Further, the region is in need of greater productivity, as the high growth rates of the first decade of the new millennium have given way to low and uneven growth rates. Reviving growth is thus at the top of policy makers' agenda.

Despite the importance of LAC cities' productivity, surprisingly little is known about it. The novel research conducted for this report tells us that while the productivity of LAC cities is on par with the world's average, it lags the world's frontier, which is where LAC policy makers would wish to be. Not only does the region lag other countries, but some cities lag others within the same country. While human capital makes key contributions to cities' productivity, other mechanisms, such as access to a larger market, seem rather muted. Closing these productivity gaps calls for an enabling environment of adequate infrastructure, urban planning, public services, and metropolitan governance. It also requires further investments in human capital and an economy that facilitates the flow of people, goods, and services across cities.

In its quest for greater productivity, LAC must seek to develop the full potential of its cities. We hope that the research presented in this report will enhance our knowledge and stimulate the type of insights and food for thought that leads to sound and progressive policy making.

Jorge Familiar, Vice President
Carlos Végh, Chief Economist
Latin America and the Caribbean Region
The World Bank Group

Preface

This book investigates the contribution of cities to productivity in Latin America and the Caribbean (LAC), a topic about which surprisingly little is known. The rapid economic growth that prevailed in the region during the first decade of the new millennium has, since the collapse of global commodity prices, given way to low, uneven growth in recent years. In this context, boosting productivity is critical to reviving economic growth in the region. And the potential of that great engine of growth—cities—cannot be left untapped.

The book has two parts. Part I documents overall urbanization patterns across the LAC region and their relationship to productivity outcomes at the national and subnational levels, compared with the rest of the world. Part II conducts a deeper, more rigorous analysis of the underlying determinants of productivity differences across LAC cities focusing on three key factors: city form, skills, and access to markets through transportation networks.

Acknowledgments

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Preparation of the book was informed by a series of background papers. Authors of these background papers who have not already been named include Jorge Balat, Paulo Bastos, Brian Blankespoor, Theophile Bougna, Maria Camila Casas, Chandan Deuskar, Juan Carlos Duque, Lin Fan, Rafael Garduno, Jorge Patino, Luis Quintero, Daniel Reyes, Benjamin Stewart, Christopher Timmins, and Lixin C. Xu. Empirical work for the book was underpinned by an extensive geospatial database for LAC that was developed in collaboration with a research team at the University of Southampton's GeoData Center led by Julia Branson and Chris Hill. Further support on data was generously provided by the World Bank's Geospatial Operations Support Team, as well as by Siobhan Murray.

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About the Authors

María Marta Ferreyra is a senior economist in the Office of the Chief Economist for Latin America and the Caribbean of the World Bank. Her research specializes in the economics of education, with special emphasis on the effects of large-scale reforms. She has conducted research on charter schools, private school vouchers, public school accountability, and school finance reform for primary and secondary education in the United States and on higher education in Latin America and the Caribbean. Her research has been published in journals such as the *American Economic Review*, the *Journal of Public Economics*, and the *American Economic Journal: Economic Policy*. She was the lead author of *At a Crossroads: Higher Education in Latin America and the Caribbean*. Before joining the World Bank, she served as a faculty member at the Tepper School of Business at Carnegie Mellon University. She holds a PhD in economics from the University of Wisconsin–Madison.

Mark Roberts is a senior urban economist in the Social, Urban, Rural, and Resilience Global Practice of the World Bank, where his work primarily focuses on the East Asia and Pacific, and Latin America and the Caribbean regions. Before joining the World Bank, Mark was a lecturer in spatial economics at the University of Cambridge and a Fellow of Murray Edwards College in Cambridge, United Kingdom. Mark has published widely in leading peer-reviewed journals on spatial economic development and is a former coeditor of the journal *Spatial Economic Analysis*. He is the coauthor of the World Bank's South Asia region's flagship report, *Leveraging Urbanization in South Asia*, and the Latin America and the Caribbean region's flagship report, *Raising the Bar for Productive Cities in Latin America and the Caribbean*. He is also currently leading the World Bank's Indonesia flagship report on urbanization. Mark holds a PhD in land economy and an MA in economics from the University of Cambridge, United Kingdom, as well as an MSc in economics from Warwick University, United Kingdom.

Grace Cineas is a consultant in the Urban, Rural, Resilience, and Social Global Practice of the World Bank. Within GSURR, her work has focused primarily on urban development and resilience in Europe and Central Asia. She has also contributed to work in Latin America and Sub-Saharan Africa. Grace holds a master of international economics and international relations from The Johns Hopkins University School of Advanced International Studies.

Harris Selod is a senior economist in the Development Research Group of the World Bank. His research focuses on the role of transport, property rights, and land markets on economic development. His papers have been published in academic journals such as the *American Economic Journal: Economic Policy*, the *Economic Journal*, the *Journal of Development Economics*, the *Journal of Public Economics*, and the *Journal of Urban Economics*. He currently coordinates the World Bank's research program on Transport Policies for Sustainable Growth and Poverty Reduction and is the co-organizer of the annual World Bank/George Washington University Urbanization and Poverty Reduction Research Conference. Before joining the World Bank, he served as an associate professor at the Paris School of Economics and as a researcher at the French National Institute for Agricultural Research (Institut national de la recherche agronomique, or INRA). He holds a PhD in economics from Sorbonne University, an MSc in statistics from the Paris Graduate School of Economics, Statistics, and Finance (École nationale de la statistique et de l'administration économique, or ENSAE), and an MBA from ESCP Europe (École supérieure de commerce de Paris).

Nancy Lozano Gracia is a senior economist in the Urban, Rural, and Social Global Practice of the World Bank, where she has worked extensively on designing and using diagnostic tools to improve the understanding of the challenges of rapid urbanization and city development and to help identify priorities for action. As part of these efforts, she has led work using innovative data collection methods such as satellite imagery, new survey designs, and big data approaches, to build a better understanding of within-city challenges. As a core member of the Global Solutions Group on Territorial Development, her work has recently focused on using spatial analysis to identify priorities for action in lagging regions. She holds a doctorate in applied economics from University of Illinois, where she worked on models for measuring capitalization of the value of local amenities into housing prices. Her areas of work include urban and regional economics, spatial economic analysis, and spatial econometric applications.

Paula Restrepo Cadavid is a senior urban economist in the Urban, Rural, and Resilience Global Practice of the World Bank, where her work has primarily focused on the Eastern Europe and Central Asia and Latin America and the Caribbean regions. At the World Bank, her work focuses on areas related to urban and territorial development, municipal finance, and housing. She is the lead author of the World Bank's *Cities in Eastern Europe and Central Asia: A Story of Urban Growth and Decline*. She has also led or contributed to investment projects in Albania, Azerbaijan, Colombia, Georgia, Honduras, Kyrgyz Republic, Moldova, Peru, Tajikistan, and Uzbekistan. She holds a master's degree in environmental and development economics from Ecole Polytechnique and a PhD in economics from Ecole de Mines de Paris, where she worked on assessing the welfare effects of slum-upgrading policies. Her areas of research span from urban and regional economics to infrastructure financing and environmental economics.

Souleymane Soumahoro is an economist and consultant in the Development Research Group of the World Bank. His research focuses on the political economy of development, access to infrastructure, and public service delivery. His research has been published in peer-reviewed academic journals such as *Economic Development and Cultural Change* and *Applied Economic Letters*. Before joining the World Bank, he worked as a postdoctoral fellow at the Center for Global Development, a leading development think tank in Washington, DC. Also, he holds a PhD in economics from the University of Oklahoma and a master's degree in international economics from the University of Auvergne Clermont-Ferrand 1 in France.

Abbreviations

EAP	East Asia and the Pacific
ECA	Europe and Central Asia
GDP	gross domestic product
GIS	Geographic Information System
IPUMS	Integrated Public Use Microdata Series
LAC	Latin America and the Caribbean
MCA	multicity agglomeration
MENA	Middle East and North Africa
NAC	North America
NTL	nighttime lights
PPP	purchasing power parity
SA	South Asia
SEDLAC	Socio-Economic Database for Latin America and the Caribbean
SSA	Sub-Saharan Africa
TFP	total factor productivity
VIIRS	Visible Infrared Imaging Radiometer Suite
WDI	World Bank World Development Indicators

Overview

In modern economies, cities can be formidable engines of productivity and economic growth. By bringing people and firms together in close geographic proximity, cities facilitate production, innovation, and trade. Historically, urbanization has accompanied the productive transformation of economies—with the decline in low-productivity agricultural employment and the rise of high-productivity manufacturing and services. Falling transportation costs—by facilitating trade by cities, both with one another and with rural areas—have accelerated this process, further stimulating both urbanization and development.

Today, almost three-quarters of the population of Latin America and the Caribbean (LAC)—or 433 million people—live in the region's 7,197 cities.[1] Some are mega-cities, such as São Paulo and Mexico City, each boasting populations of about 20 million.[2] Others are small settlements in the gray area between urban and rural. Some cities date back to precolonial times (Bogotá, Cuzco, Mexico City). Others were established by Spanish and Portuguese *conquistadores* during colonial times (Asunción, Buenos Aires, São Paulo) or by the newly independent countries in postcolonial times (La Plata). Still others were established a few decades ago (Brasilia, Puerto Ordaz).

The productivity of LAC cities is on par with the world average but lags the world productivity frontier, where LAC policy makers want their cities to be. What accounts for the failure of LAC cities to reach the global frontier? First, although LAC cities benefit from strong positive agglomeration effects associated with skills, they may lack the "enabling environment" needed to fully leverage the wider benefits of agglomeration and mitigate congestion costs. Thus, urban infrastructure management and urban planning may not be adequate to curb the congestion of roads, basic urban services, and land and housing markets associated with the high urban density in most LAC countries. Included in this is inadequate coordination across local governments within fragmented metropolitan areas. Second, a lack of integration among cities within countries is associated with underinvestment in national transport networks, opening wide productivity gaps across cities and undermining the aggregate contribution of cities to national productivity.

The evidence also shows that human capital is a bedrock source of productivity across cities throughout LAC, but that the skilled—who form a smaller share of the workforce than in, say, the United States—are also heavily concentrated in the largest cities. This makes it a priority to close the region's shortfall of skills relative to the most developed countries, and to ensure that both small and large cities can be attractive places for the skilled to live and work. Investing in

infrastructure, transport, and human capital in cities of all sizes, as well as developing efficient local governance institutions, will thus prove crucial to raising the bar for productivity in the region's cities—and ultimately in the region's countries as well.

The proximity of people and firms in cities can give rise to many benefits. The concentration of individuals, particularly the skilled, can facilitate the exchange of ideas and the sharing of knowledge, boosting innovation and productivity. Firms located in a city enjoy the privilege of having access to a large local market, which may also be well connected to the markets of nearby cities. Access to a larger market can encourage a wider variety of products and services, many of which are inputs into the production of other firms. The proximity of people and firms in cities also creates thick labor markets, which give firms access to larger and more diverse pools of workers, and workers access to a greater number and variety of potential employers, leading to better job matches. The proximity of people and firms also spreads the cost of large-scale investments in transport and infrastructure for basic services over many individuals. Cities thus generate productivity-enhancing agglomeration effects.

But cities also give rise to negative congestion effects. As the number of people and firms within a city grows, so does the demand for land, housing, and labor, raising the costs of living and conducting business. Without additional investments in infrastructure, or improvements in urban policy and management, the city becomes more congested, roads and other public infrastructure more crowded, and crime and grime more prevalent.

All cities are subject to the opposing forces of agglomeration and congestion, but their net outcomes depend, at least in part, on a city's enabling environment for spurring beneficial agglomeration effects and mitigating negative congestion effects. The enabling environment depends, in turn, on the extent and quality of infrastructure provision within cities (such as roads, bridges, and utility and communications networks), on urban planning and management, and on policies that influence the quality of the local business environment, including protection from crime.

Because no city exists in isolation, its productivity is related to that of other cities in the country. Any one city is part of a country's system of cities, where cities are connected by transport and other networks. So policies that affect the productivity of one city will also have repercussions on other cities. The easier the flow of goods, resources, and people across cities, the greater the contribution of cities to national productivity. That is why maximizing the contribution of cities to a country's productivity and growth requires taking the whole system of cities into account.

The Productivity of LAC Cities is Slightly Above Average but Below the Global Frontier

To compare LAC cities with those in the rest of the world, an important complication is that countries differ in defining "urban." Overcoming this complication is critical for cross-country comparisons. One crucial contribution of this book is to apply an algorithm (the "cluster algorithm") that allows for a globally consistent definition of urban areas. Rather than define urban areas on the basis of their official administrative boundaries, which often fail to accurately delineate the actual extent of a city, this algorithm identifies cities as spatially contiguous dense clusters of population, whose total population surpasses a well-defined threshold.[3] With this definition, we calculate a variety of country-level urbanization metrics, the most basic of which is a country's urban share (the percent of its population that lives in cities). We also use the individual cities as units of observation in their own right, which allows us to benchmark the productivity of LAC cities against those in the rest of the world.

The story of productivity in LAC cities in relation to the rest of the world has good news and bad. Historically, the joint processes of economic development and urbanization have

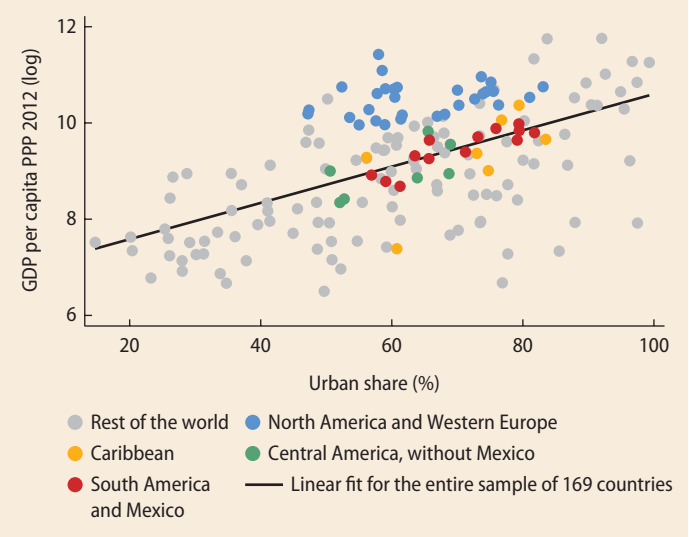
given rise to a positive association between a country's aggregate productivity (measured by gross domestic product [GDP] per capita) and the share of its population that lives in urban areas (its urban share).[4] Across countries in the world, a 1 percentage point increase in the urban share is associated with a 3.8 percent increase in GDP per capita. Without implying causality, this relationship, shown by the solid line in figure 1, establishes a country's expected productivity given its urban share. A country falling below the solid line underperforms, given its urban share, and a country above it overperforms.

As it turns out, LAC countries (indicated by the orange, green, and red markers) on average perform as expected given their urban shares. This is true for the region, and for the South America, Central America, and Caribbean subregions. Nonetheless, LAC countries underperform relative to countries in North America and Western Europe (blue markers). The good news, then, is that LAC countries perform as predicted given their urban shares; the bad news is that they are below the global productivity frontier.[5]

A similar conclusion emerges from using city-level productivity measures. Figure 2 depicts the global relationship between a city's level of economic activity—as proxied by the intensity of the light it emits at night—and its level of population. As it turns out, LAC cities overall perform above the global average—in other words, they are more productive than expected given their populations.[6] This result is driven by South American and Mexican cities (red markers); cities in the rest of the region tend to perform around the global average. Yet, once again, LAC cities fail to reach the global frontier, given by the outer envelope of points in the figure, representing mainly North American and Western European cities (blue markers).

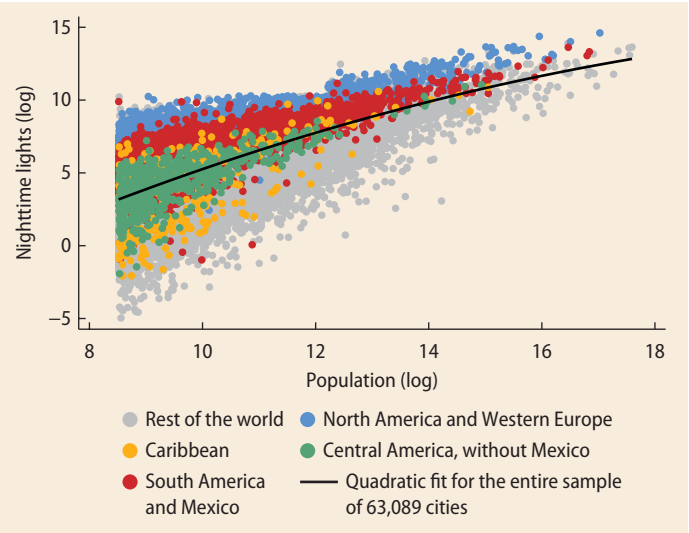
To summarize, LAC cities perform at or above the global average, but they perform below the global frontier. To provide insights into why LAC cities lag the global frontier, we examine the distinctive features of LAC cities relative to others in the world, and the role of

FIGURE 1 LAC Countries Exhibit Average Productivity Given Their Urbanization Levels



Source: Calculations based on World Development Indicators data and cities defined using the cluster algorithm of Dijkstra and Poelman (2014), as applied to Landscan 2012 gridded population data.
Note: GDP per capita is measured in constant international dollars at 2012 PPP exchange rates. It is expressed in natural logs on the vertical axis. GDP = gross domestic product; LAC = Latin America and the Caribbean; PPP = purchasing power parity.

FIGURE 2 Productivity of LAC Cities Is above Average, but Lags the Global Frontier



Source: Calculations based on nighttime lights data from the 2015 VIIRS (Visible Infrared Imaging Radiometer Suite) annual composite product (https://ngdc.noaa.gov/eog/viirs/download_dnb_composites.html). Cities are defined using the cluster algorithm of Dijkstra and Poelman (2014), as applied to Landscan 2012 gridded population data.
Note: Nighttime lights on the vertical axis is the sum of nighttime lights luminosity values within a given city. LAC = Latin America and the Caribbean.

three critical, proximate determinants of city productivity—form, skill, and access.

Distinctive Features of LAC Cities

Several features distinguish LAC cities from others in the world—and can help in understanding why they perform below the global frontier.

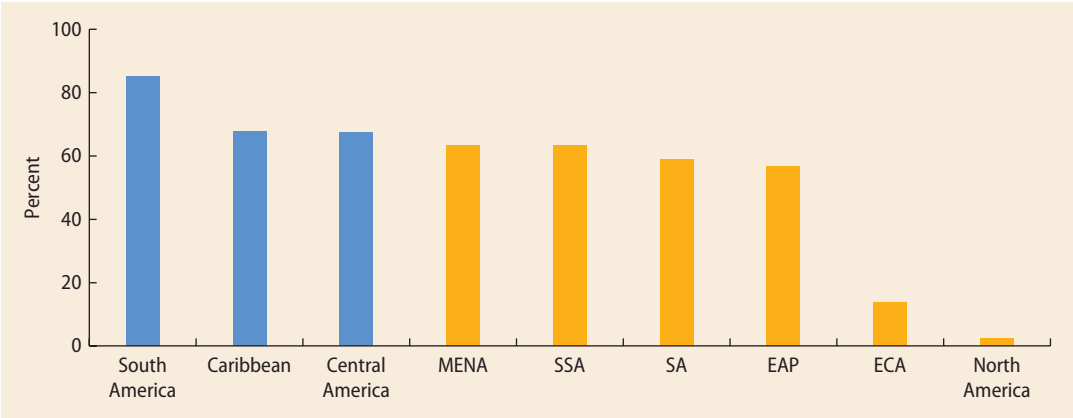
Feature 1. LAC cities are relatively dense. In Bogotá, Colombia, almost 13,500 people occupy each square kilometer of land, while in Lima, Peru, nearly 9,000 people populate each square kilometer. More generally, with an average density of almost 2,400 people per square kilometer across all 7,197 of its cities, LAC exhibits urban densities that are well above the world average of just over 1,500. Although density is highest in South American cities, followed by Central American and Caribbean cities, it is high by international standards in all three subregions. Further, 80 percent of LAC cities have a population density above the global median, well above the percentage in regions such as Europe and Central Asia (ECA) and North America (NAC) (figure 3).[7]

Two factors can contribute to a city's high density. The first is a large population relative to the geographic area. The second is a small area relative to the population size. In relation to the rest of the world, LAC cities are dense not because their populations are large but because their geographic areas are small, particularly compared with cities in ECA and NAC (figure 4). Given its potential to generate strong positive agglomeration effects, high density can be a blessing. However, in the absence of an adequate enabling environment to help manage congestion costs and foster these agglomeration effects, this blessing can become a curse—which may help explain why LAC cities lag the global productivity frontier.[8]

Feature 2. Multicity agglomerations are unusually prevalent. The administrative definition of a city can differ quite radically from the "true" urban extent of a city using the cluster algorithm. Indeed, a city as defined in this book can span multiple "cities" as defined from an administrative or jurisdictional viewpoint. We refer to such areas as multicity agglomerations (MCAs).[9] By definition, MCAs span multiple local government jurisdictions. Take Mexico City and Santo Domingo: Mexico City's urban area encompasses 34 municipalities, and Santo Domingo's covers 19 (map 1).[10]

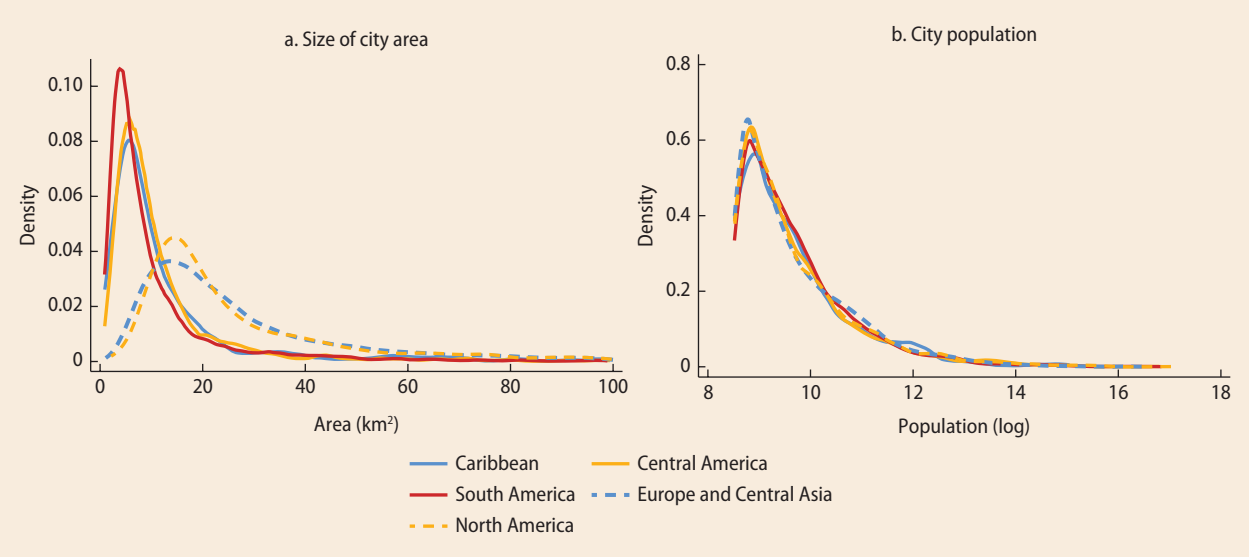
Of the world's 295 MCAs, 54 are in LAC, second only to East Asia and the Pacific (EAP).

FIGURE 3 A High Percentage of LAC Cities Have Population Densities above the Global Median



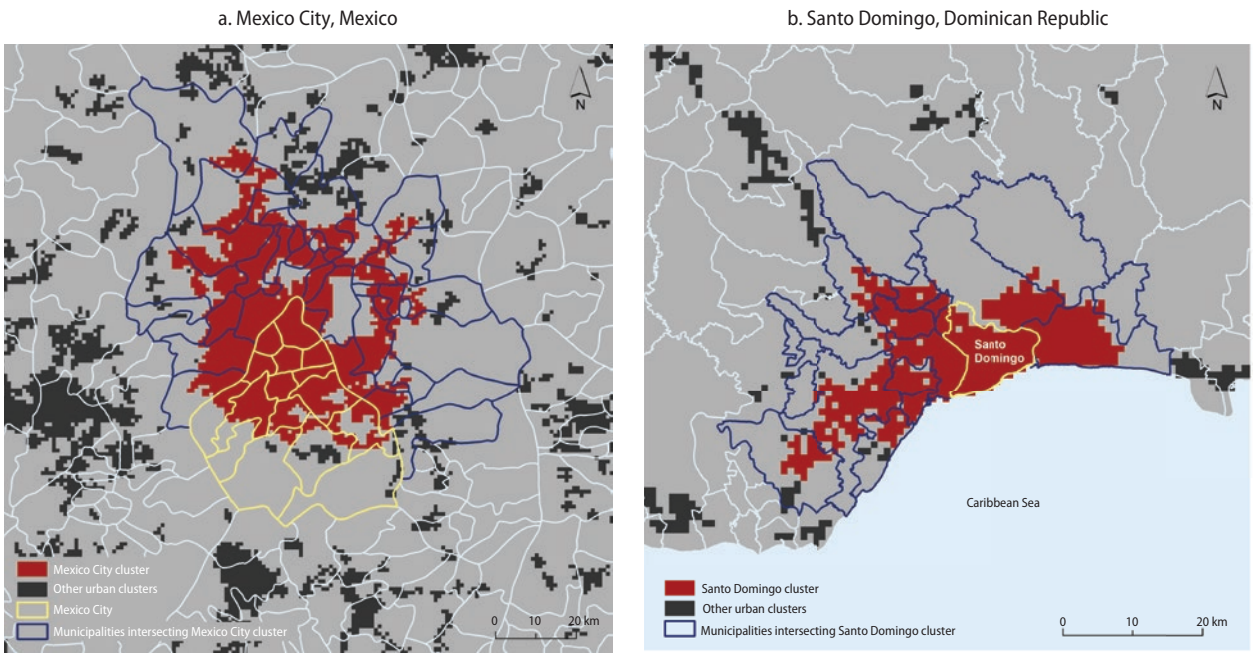
Source: Calculations based on an analysis of cities defined using the cluster algorithm of Dijkstra and Poelman (2014), as applied to Landscan 2012 gridded population data.
Note: A city is classified as dense if its mean population density exceeds the global median of 1,180 people per km^2. Central America includes Mexico. EAP = East Asia and the Pacific; ECA = Europe and Central Asia; LAC = Latin America and the Caribbean; MENA = Middle East and North Africa; SAR = South Asia; SSA = Sub-Saharan Africa.

FIGURE 4 LAC Cities Are Dense Because Their Areas Are Small



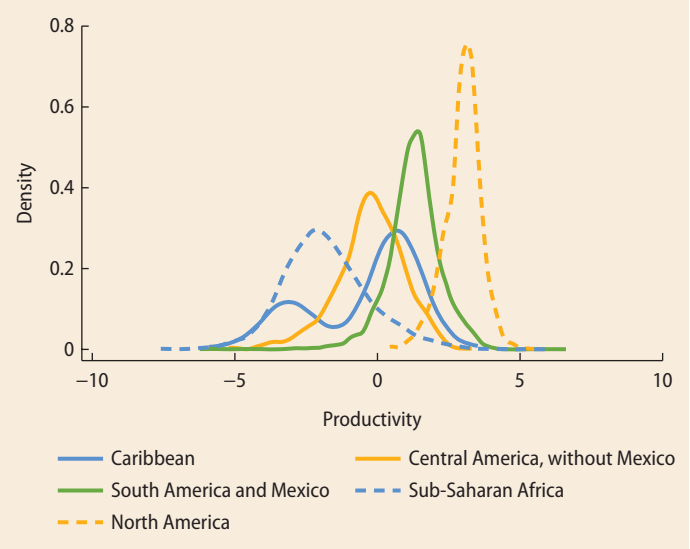
Source: Calculations based on analysis of cities defined using the cluster algorithm of Dijkstra and Poelman (2014), as applied to Landscan 2012 gridded population data.
Note: Panels a and b show, for different regions, the distribution of area (in km²) and (log) population, respectively, of cities using an Epanechnikov kernel. For expositional purposes, the distributions of area are trimmed at 100 km². Central America includes Mexico. LAC = Latin America and the Caribbean.

MAP 1 Multicity Agglomerations in Latin America and the Caribbean Span Multiple Municipalities



Source: Calculations using Geographic Information Systems (GIS) software and administrative boundary data from the LAC Geospatial Database (Branson et al. 2016).
Note: In the maps, the red areas correspond to cities as defined using the cluster algorithm of Dijkstra and Poelman (2014), as applied to Landscan 2012 gridded population data. The yellow lines represent subnational administrative boundaries at the municipality level that belong to a city as officially defined. The blue lines represent the boundaries of municipalities that intersect with the city but that do not belong to the officially defined city. In the case of Mexico City, the officially defined city comprises several municipalities. LAC = Latin America and the Caribbean.

FIGURE 5 Productivity Varies Widely across Cities and Countries in Latin America and the Caribbean



Source: Calculations based on nighttime lights data from the 2015 VIIRS (Visible Infrared Imaging Radiometer Suite) annual composite product (https://ngdc.noaa.gov/eog/viirs/download_dnb_composites.html).
Note: The figure shows density plots of the residuals from a regression at the city level where the dependent variable is the sum of nighttime lights (in logs) and the independent variable is the population (in logs). These residuals measure city-level productivity; cities have been identified by applying the cluster algorithm of Dijkstra and Poelman (2014) to Landscan 2012 gridded population data.

About 40 percent of LAC's urban population resides in MCAs, compared with a third of the world's urban population. Thus, LAC cities may be particularly vulnerable to the shortcomings of MCAs, which arise when their local jurisdictions fail to coordinate governance and the provision of public goods and services.

Feature 3. Within countries, productivity varies widely across cities. City labor productivity, measured by the (log) intensity of nighttime lights net of population, varies widely across LAC cities (figure 5). LAC's most productive cities rival many North American cities, but the least productive are close to the top-performing African cities.

Within countries, productivity is widely dispersed across cities. In a well-integrated system of cities, the flow of goods, people, and resources across cities closes productivity gaps among cities and maximizes the contribution of the system of cities. Compare the productivity dispersion in LAC countries with that of high-income countries. For each LAC country, the within-country productivity dispersion is relatively high (figure 6). So LAC systems of cities are not well integrated and thus not fully productive.[11]

Feature 4. Within countries, the skilled are unusually concentrated in large cities. Skilled people tend to sort into larger cities (figure 7).[12,13] This sorting takes place in the United States as well but is stronger in LAC. In the United States, a 10 percent increase in a city's population is associated with a 1.2 percent increase in the share of the city's population that is skilled (Behrens and Robert-Nicoud 2015), but with a 2.9 percent increase in LAC.[14] This indicates that, compared with the United States, skilled people are relatively more concentrated in a few large cities. This concentration of skills may help to explain, at least partly, the high productivity dispersion across cities in LAC countries.

Feature 5. Inequality in LAC cities is unusually high. Not only are large LAC cities more skilled but they are also more unequal. On average in LAC, a 10 percent increase in city population is associated with a 0.29 percent increase in income inequality, measured by the Gini coefficient.[15] The corresponding increase in the United States is lower (0.12 percent), indicating a stronger tendency toward income inequality in large LAC cities.

Of the greater income inequality in LAC's larger cities, 43 percent is due to skills. Put differently, relative to smaller cities, large cities are more unequal because they are more skilled and have a greater share of high-earning individuals.[16] A similar, yet weaker, finding holds for the United States, where skills explain only 25 percent of the association between city population and income inequality.[17]

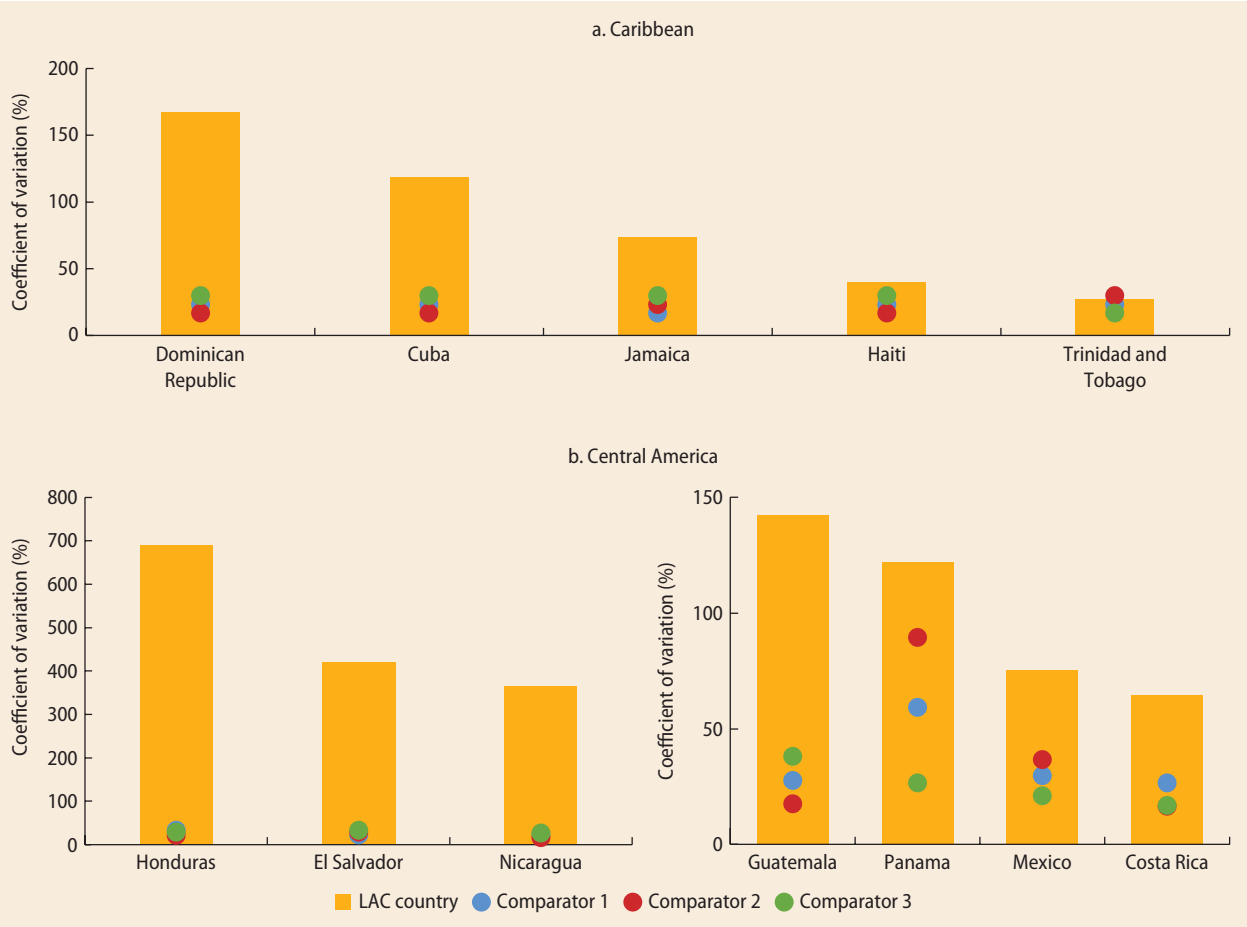
That city population, skills, and inequality are more strongly associated in LAC than in the United States may reflect LAC's scarcity of skills. For example, the share of individuals with some higher education in the average LAC country (18 percent) is

roughly one-third of that in the United States (59 percent), and returns to higher education are concomitantly higher (104 percent for the average LAC country, and more than twice that in the United States).[18,19] The stronger associations in LAC may also reflect a more unequal distribution of amenities and public services—which serve to attract skilled people—across cities in LAC than in the United States.

Feature 6. National transport networks remain quite undeveloped. In NAC, Asia Pacific, and Europe, about 40 percent or more of surface freight is shipped by rail, reflecting well-developed and well-used national rail networks. But, in Latin America, rail captures only 22 percent of surface freight, close to the 19 percent captured by rail in Africa (figure 8).

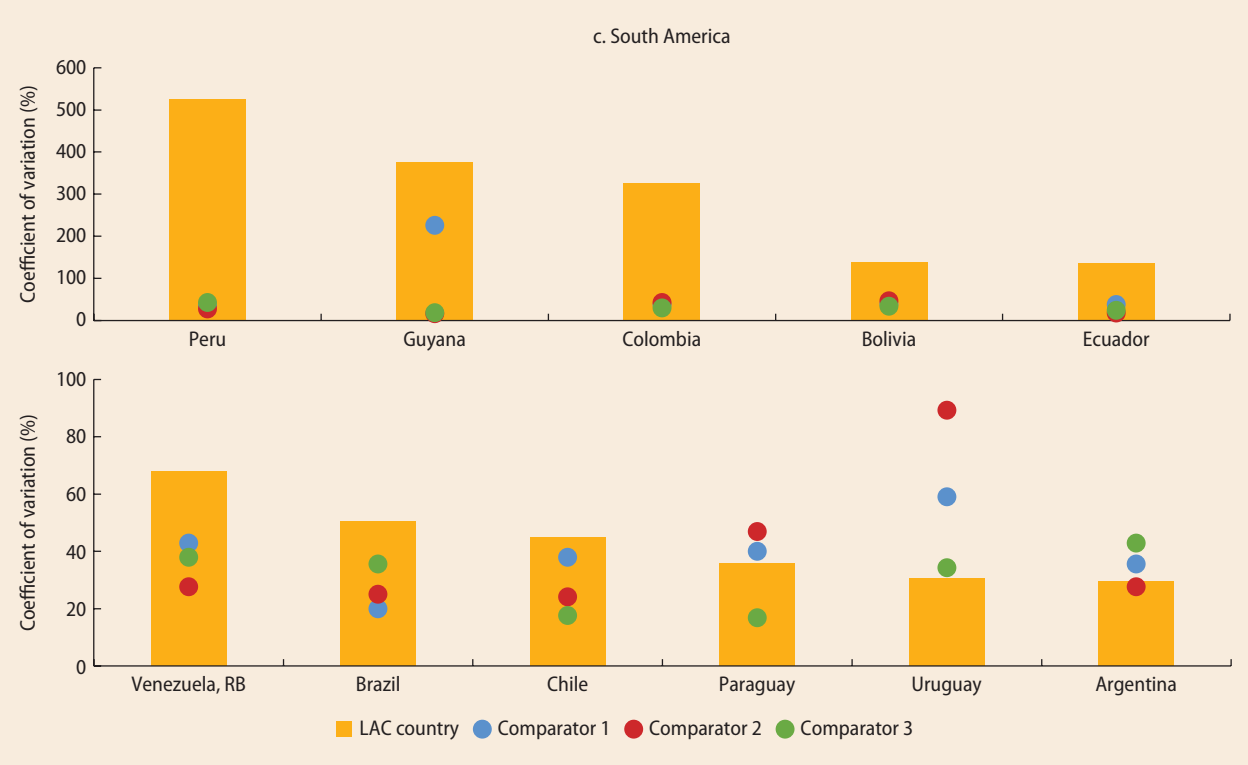
A low share of freight shipped by rail would not be problematic if national road networks were of high quality. But LAC roads are not, and the paved road density has been rather stagnant in LAC for four decades (figure 9). Although paved road density in South Asia was only slightly above LAC's in the early 1960s, it is now much higher. And, although EAP, and the Middle East and North Africa (MENA) started at virtually the same level as LAC, they too are ahead of LAC today.

FIGURE 6 Within-Country Productivity Dispersions Are High in LAC Countries



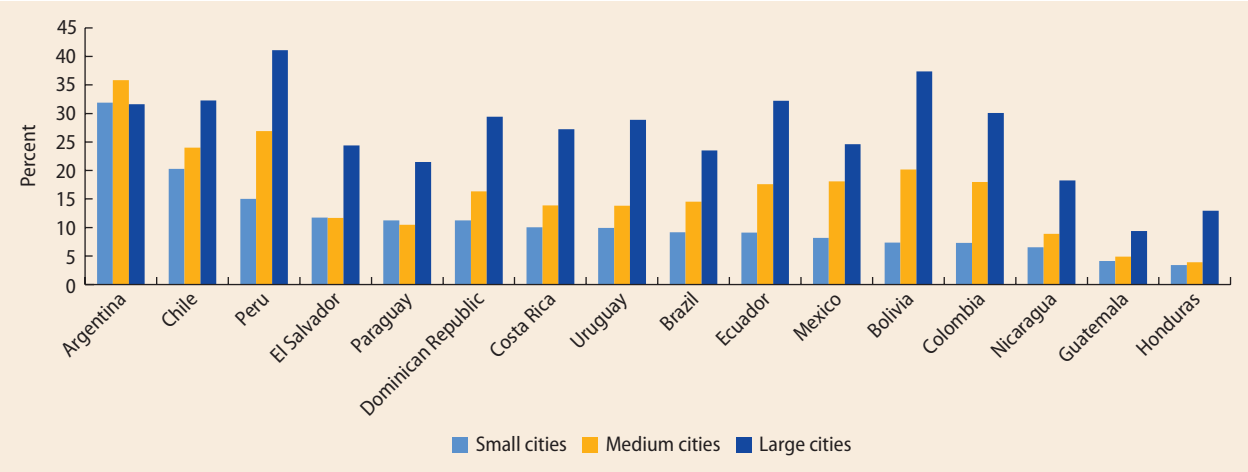
(continued)

FIGURE 6 Within-country Productivity Dispersions Are High in LAC Countries *(continued)*



Source: Calculations based on nighttime lights data from the 2015 VIIRS (Visible Infrared Imaging Radiometer Suite) annual composite product (https://ngdc.noaa.gov/eog/viirs/download_dnb_composites.html).
Note: City productivity is measured using the residuals from a regression at the city level where the dependent variable is the sum of nighttime lights (in logs) and the independent variable is the population (in logs). Productivity dispersion across a country's cities is measured by the coefficient of variation (in percent). Comparators for each LAC country are restricted to high-income countries, but with no restrictions on the regions their comparators are drawn from. The methodology for selecting comparators is described in detail in box 2.1 in chapter 2 of the full book. A full list of comparators for each LAC country is in annex 2A in chapter 2 of the full book. LAC = Latin America and the Caribbean.

FIGURE 7 More Populous LAC Cities Have Higher Shares of Skilled Labor

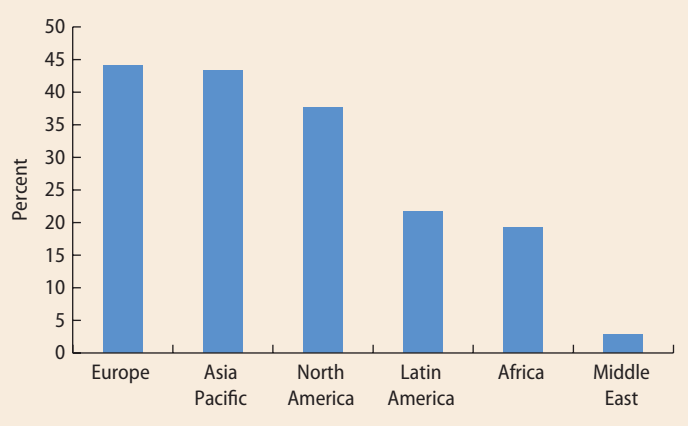


Source: Calculations using Socio-Economic Database for Latin America and the Caribbean (SEDLAC) for countries other than Brazil and IPUMS International for Brazil.
Note: The figure shows the average percentage of adult population (ages 25–64 years) with some higher education, by area size. The area size classification follows country-specific population thresholds, as explained in annex 5A of chapter 5 of the full book. LAC = Latin America and the Caribbean.

The underdevelopment of national transport networks in LAC reflects the lack of integration among cities within LAC countries. Together with the unusually high concentration of skills in large cities, this underdevelopment may contribute to the wide dispersion of productivity across cities within LAC countries.[20]

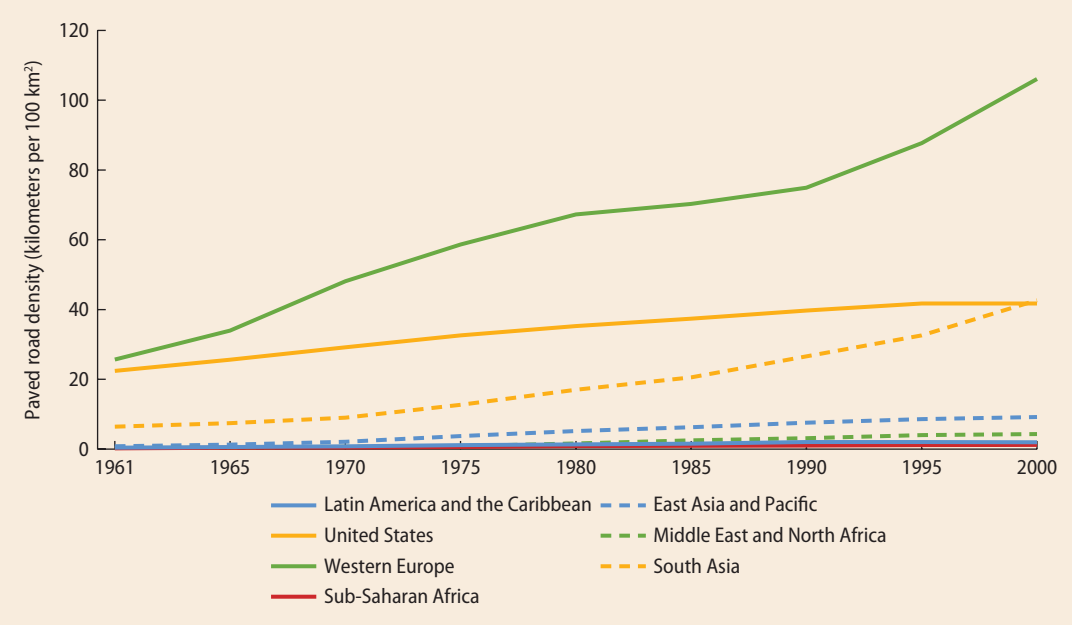
To summarize, LAC cities have distinctive features. They are relatively dense, perhaps exacerbating congestion forces given prevailing infrastructure and policies. MCAs, with their potential coordination and governance problems, are unusually prevalent. Skilled human capital is highly concentrated in large cities. Productivity dispersions across cities in LAC countries are very high, indicating that their systems of cities are not efficient. Such dispersions may be linked to the underdevelopment of national transport networks. The spatial concentration of skills also means that two issues—a deficit of skills in small cities, and inequality in large cities—may be particularly acute in LAC. These distinctive features of LAC cities help explain why these cities lag the global productivity frontier. To further expand our understanding of this question, we turn to empirical evidence on the proximate determinants of city productivity in LAC.

FIGURE 8 Rail Is Not Prevalent in Latin America



Source: International Transport Forum 2017.
Note: The figure shows the percentage of goods transported by rail (as opposed to road).

FIGURE 9 Paved Road Density Has Been Stagnant in Latin America and the Caribbean



Source: Calculations based on data from the World Bank's World Development Indicators.

The Role of Form, Skill, and Access in the Productivity of LAC Cities

A city may be more productive than others because of sorting, as skilled and talented people gravitate toward it. But its greater productivity can also be due to agglomeration effects, which operate through various mechanisms enabled by the proximity of firms and individuals. For example, the greater number of firms and workers that characterize cities can generate better matches between them. The greater number of customers and firms can support a large and diversified array of suppliers of final and intermediate goods and services, an effect facilitated by connections to other cities and the markets they provide. It can also spread the cost of large-scale investments in transport and infrastructure that underlie the supply of basic services. And the interaction of workers within and across firms can contribute to knowledge spillovers and allow all workers to learn from the most skilled ones.

As a result of these mechanisms, agglomeration effects are associated with city form, skill, and access (box 1). Form refers to the size and configuration of a city, skill to how skilled individuals contribute to the productivity of others, and access to a city's connectedness to other cities in the country through the transportation network. Figure 10 shows that, if we look at form alone (measured by population density), LAC cities experience positive agglomeration effects.[21] Controlling for features of a city's physical geography, a 1 percent increase in population density is associated with a 0.049 percent increase in productivity (and nominal wages).[22] This "unconditional" estimate is close to that for the United States (0.046 percent), using a comparable regression specification, but far

BOX 1 Form, Skill, and Access

As the net outcome of the tussle between agglomeration and congestion forces, a city's productivity depends on form, skill, and access.

Form refers to the size and configuration of a city. A city's size (usually measured by population or density) influences the likelihood of interactions among individuals and firms. These interactions can stimulate a wide array of positive, productivity-enhancing agglomeration effects. But they can also generate negative congestion effects, such as increased crime and a heightened probability of spreading communicable diseases. In the absence of offsetting investments and policies, density also brings other negative congestion effects as markets and infrastructure become crowded.

A city's configuration, meanwhile, encompasses several dimensions. The first dimension is whether a city is, in fact, a broader metropolitan area or multicity agglomeration. In an agglomeration, the boundaries between one administratively defined "city" and another blur to such an extent that it becomes difficult to tell where one ends and the other begins. A distinctive aspect of multicity agglomerations is the governance challenges that they face in coordinating the provision of infrastructure and basic services in a space fragmented by local government administrative boundaries.

The second dimension is geometric shape. For example, in a perfectly circular city, the average distance between two locations is lower than in an elongated city of the same area. All else being equal, therefore, interactions take place more easily in a circular city than in an elongated city.

The third dimension of form is internal structure, which depends on a city's road network among other things. For example, mobility is easier in cities with well-planned road networks that follow a regular pattern, such as a grid, than in cities with more haphazard networks.

The fourth dimension is land use. For example, building restrictions may favor sprawl, which in turn can increase the journey to work as well as other travel times. Similarly, although land zoning is necessary—for example, to keep a chemical plant from locating in a residential area—overly stringent zoning requirements may create unnecessary

(continued)

BOX 1 Form, Skill, and Access *(continued)*

distance between the places where people live and the places where they work.

Skill refers to a city's aggregate stock of human capital, or aggregate skill. When individuals choose where to live in a country, they compare locations on the basis of such attributes as wages, job opportunities, housing values, natural amenities, manmade amenities—including, for example, cultural attractions—and the demographic composition of the population. Given their preferences and personal characteristics (such as age, education, and place of birth)—they thus sort into different cities. A city that attracts more skilled individuals could be more productive simply because its residents are on average more productive—yet this is not the meaning of "skill" as it relates to city productivity.

Instead, skill refers here to the productivity contribution of skilled individuals above and beyond their own productivities. This contribution arises because a person's human capital benefits not only her but others in the city as well. For example, workers in a city with a higher share of college-educated individuals will likely be more productive because they will have greater opportunity to interact with such individuals and learn from them, regardless of their own skill level.

Access refers to a city's connectedness to other cities through the transportation network.[a] When a city is well connected to others, transporting people or goods to and from other cities is not costly. In such a city, firms have access to markets that extend beyond that of the city itself. By promoting trade with other cities both domestically and internationally, this allows firms in a city to expand, become more specialized, and benefit from economies of scale. And, when firms and workers become freer to move between cities, they flock to more productive cities. In a system of well-connected cities, the dispersion of productivity across cities is minimized, and cities maximize their overall contribution to national productivity.

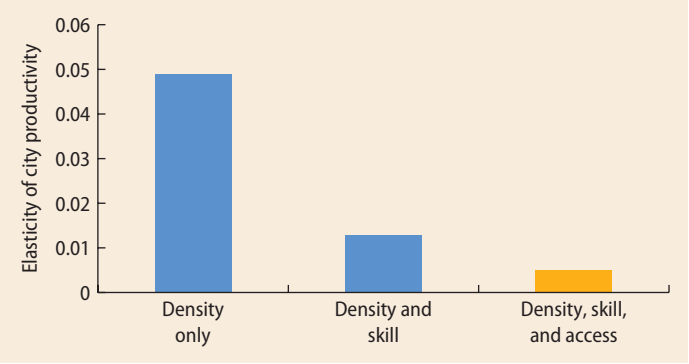
a. In this book, we focus mainly on access to other cities and areas in the same country. Hence, the results in figures 10 and 11 are based on a measure of *domestic* market access. Some discussion of the importance of international market access through ports and airports, as well as the road and rail networks that connect cities to them, is contained in chapter 4 of the full book.

weaker than that for China (0.192 percent) or India (0.076 percent).[23]

However, both skill and access are positively correlated with population density because more densely populated cities tend to have higher average levels of human capital and better access to other cities' markets through transportation networks. Figure 10 shows "conditional" estimates of agglomeration effects. When we control for skill (measured by average years of schooling), the estimated agglomeration effect shrinks to 0.013 percent. When we control for access (measured by a market access index) as well as skill, it becomes almost zero.[24]

Comparing "conditional" agglomeration effects for LAC and other regions is difficult because conditional estimates for other regions do not control for both skill and market access. Yet those that control for skill (measured by percent of the working-age population with higher education), without controlling for access, paint a similar picture because the estimated agglomeration effect

FIGURE 10 Unconditional and Conditional Effects of Density on Productivity Provide Insights into the Mechanisms for Agglomeration Effects



Source: Quintero and Roberts 2017.
Note: The figure shows the sensitivity (elasticity) of city productivity to population density for different regression specifications in which cities from 16 LAC countries are pooled. Productivity is measured as (log) city average nominal wage, controlling for worker characteristics. The first bar ("Density only") shows the effect of population density on city productivity without controlling for skill and access; the second bar ("Density and skill") the effect of population density on city productivity when controlling for skill, but not access; the third bar ("Density, skill, and access") the effect of population density on city productivity when controlling for both skill and access. Skill is measured as log average years of schooling. All three regression specifications control for features of a city's physical geography (mean air temperature, terrain ruggedness, and total precipitation) and include country fixed effects. The orange bar represents coefficients that are not significantly different from zero at the 10 percent level.

for LAC (0.023 percent) is similar to that of the United States (0.024 percent), but lower than that for China (0.112 percent) or India (0.052 percent). The LAC effect is, however, less precisely estimated than that for China, India, or the United States.[25]

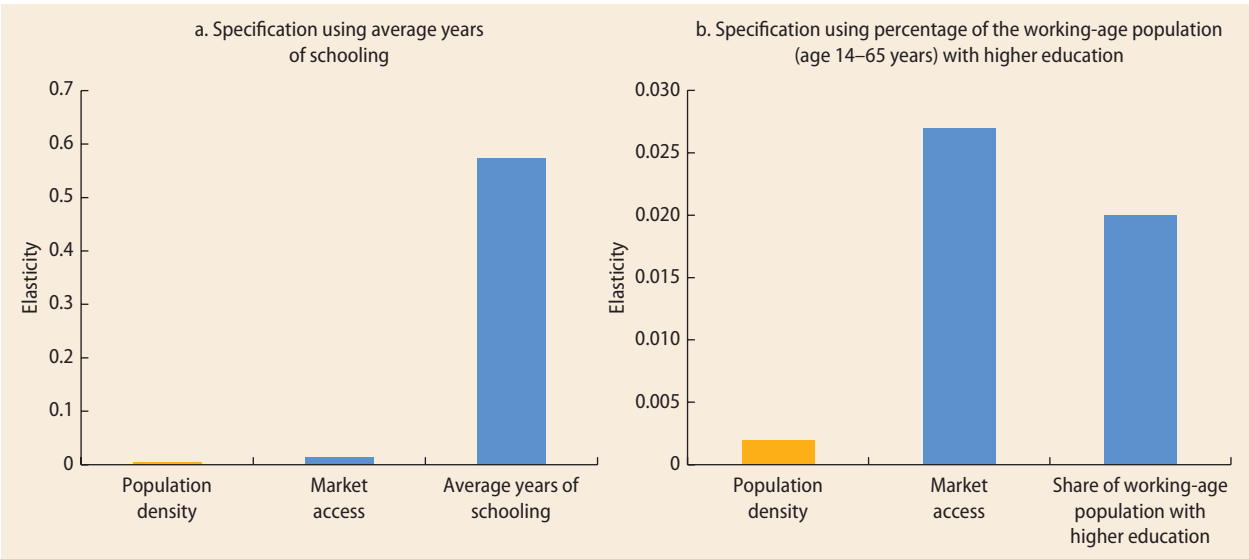
This analysis indicates that agglomeration effects in LAC operate mainly through skill (as workers in a city learn from skilled workers), and much less through access (as cities gain access to the markets of other cities). By contrast, other positive agglomeration effects in LAC cities that might be associated with population density seem to be largely absent—such as those that might arise from better job matches, the growth of a large and local diversified array of specialized suppliers, spreading costs of large investments in infrastructure and transport, and more general knowledge spillovers beyond those associated with skilled workers.

To gain insight into the relative importance of form, skill, and access, figure 11 shows the sensitivity of productivity to form (density), skill, and access when all three are included in the same regression specification (along with features of a city's physical geography).

Form. Holding skill and access constant, density has, at best, no impact on productivity; at worst, it has a negative impact. An increase in density is associated with almost no change in city productivity. The response of productivity to density varies across countries, but its effect is significantly positive only for Brazil, Dominican Republic, Ecuador, and Peru. For Chile and Nicaragua, the effect of density on productivity is significant but negative (figure 12).

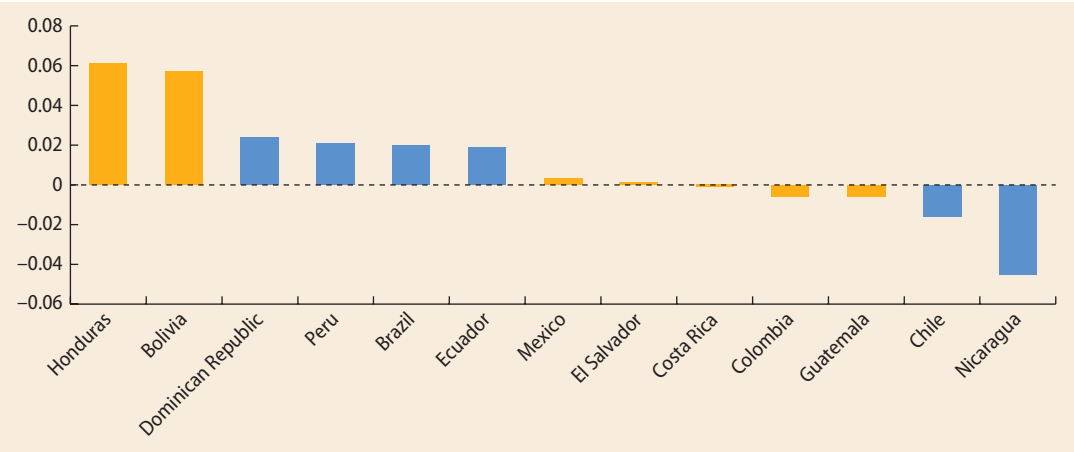
Other findings are also consistent with the notion that, under current infrastructure and

FIGURE 11 The Effects of Form, Skill, and Access on Productivity



Source: Quintero and Roberts 2017.
Note: The figure shows the sensitivity (elasticity) of city productivity to density, skill, and access when all three are included in the same regression specification in which cities from 16 LAC countries are pooled. Productivity is measured as the (log) city average nominal wage, controlling for worker characteristics. Density, market access, and average years of schooling are in logs. For example, an increase in average years of schooling equal to 1 percent raises productivity (and thus wages) by 0.57 percent. The regression specification controls for features of a city's physical geography (mean air temperature, terrain ruggedness, and total precipitation) and also includes country fixed effects. Orange represents coefficients that are not significantly different from zero at the 10 percent level. Panel a shows coefficients using average years of schooling as a measure of aggregate skill; in panel b, aggregate skill is measured through the percentage of the working-age population with higher education.

FIGURE 12 In Most Countries, a City's Population Density Does Not Have a Positive Significant Effect on Its Productivity



Source: Quintero and Roberts 2017, background paper for this book.
Note: The figure show the estimated elasticities to population density for each country derived from regressing, in country-level regressions, estimates of city productivity (measured in natural logs) on the following variables, expressed in natural logs: population density, average years of schooling, market access, mean air temperature, terrain ruggedness, and total precipitation. Productivity is measured as (log) city average nominal wage, controlling for worker characteristics. The orange bars represent coefficients that are not significantly different from zero at the 10 percent level. This figure excludes Argentina, Panama, and Uruguay because these countries lack a sufficient number of subnational locations (that is, observations for the regressions) to permit reliable estimation.

policy conditions, density does not contribute to city productivity in LAC. A study for this book finds that, opposite to what is found for the rest of the world, LAC's labor productivity is lower in large cities than in its smaller cities, after controlling for elements of a city's business environment and firm characteristics such as industry, size and ownership structure, age, and whether the firm is an exporter (Reyes, Roberts, and Xu 2017).[26] And, when considering all countries in the world, there is either no association, or a negative one, between national levels of productivity, measured by GDP per capita, and density.[27]

As mentioned above, the weak (or even negative) contribution of density to city productivity in LAC suggests the absence of positive agglomeration effects beyond those associated with skill and access. Because the region has relatively dense cities, they may be suffering from negative congestion effects, which more than offset positive agglomeration benefits. Congestion, in turn, may be aggravated by an inadequate enabling environment associated with a lack of infrastructure investment, poor planning, and more generally poor urban management within cities. For example, even if they have the same density, cities with fewer vehicles on the road (perhaps because of better public transportation) or with better traffic management systems will be less congested. Indeed, four LAC cities—Buenos Aires, Mexico City, Rio de Janeiro, and Santiago de Chile—are among the world's most congested, and Mexico City tops the chart.[28]

Congestion effects in the form of crime might also be aggravated by there being little basic protection from theft, kidnapping, and other criminal activity. Across the world, labor productivity and firm total factor productivity (TFP) are lower in cities with higher private security costs, perhaps because firms must pay for private security to fill the void left by local police (Reyes, Roberts, and Xu 2017). A case study of Colombia for this book finds that high levels of crime and violence have large, negative, and statistically significant effects on

firm TFP, with large productivity losses associated with the presence of paramilitary and drug-trafficking groups within a city (Balat and Casas 2017).

Beyond density, other dimensions of a city's form also bear on productivity. Most salient is the presence of MCAs. Although the association between country productivity (measured by log GDP per capita) and the share of a country's population that lives in MCAs is positive in North American and Western European countries, it is virtually zero in LAC countries. This suggests that LAC countries may not handle effectively the difficult coordination challenges that MCAs pose. Evidence from 73 large metropolitan areas in LAC indicates that, although half of them have a metropolitan-level governance body, the mere existence of such a body does not yield productivity gains, pointing to the need for better institutional arrangements.

Lower productivity is also a feature of LAC cities with a long irregular shape (as opposed, say, to "round" cities). And it is a feature of cities where segments of the street network are poorly connected (due, say, to dead ends, circular streets, and few street intersections).

Skill. In the productivity race between density, skill, and access, skill emerges as the clear winner. Holding density and access constant, a 1 percent increase in skill (measured as average years of schooling) is associated with a 0.57 percent increase in city productivity, much higher than the associated increase for density or access (figure 11, panel a). While the contribution of skill to productivity varies across countries, it is significantly different from zero[29] and positive for all of them, which is not the case for density or access.

To understand the responsiveness of productivity to skill, note that, when a LAC worker acquires an additional year of schooling, his or her salary rises by 8.9 percent on average;[30] when a city's average years of schooling rises by one year, salaries in the city rise by 9.2 percent on average. This means that, if all people within a city were to acquire an extra year of education, this would (approximately) raise their salaries by a remarkable 20 percent, coming in equal parts from own and aggregate human capital.

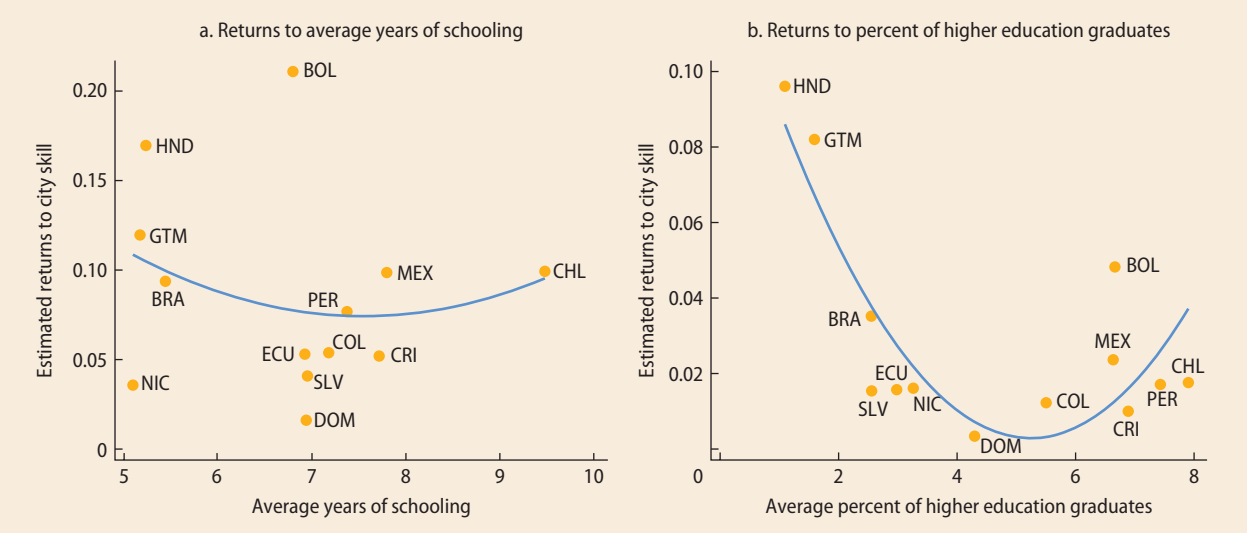
Returns are not as high when skill is measured by the share of higher education graduates in a city's population, with productivity rising by 2 percent for every 1 percentage point rise in share of graduates (figure 11, panel b).

Regardless of the metric, returns to skill in cities are relatively high in LAC by international standards. Although in other parts of the world they are equal to 50–100 percent of the private returns, in LAC they are equal to 100 percent or more, reflecting the region's scarcity of skills (Duranton 2014).

Although returns to skill in cities are positive for all LAC countries, they vary across countries depending on average skill in the average city. The relationship is U-shaped, indicating that, when a country's cities have a low average skill level, returns fall as average skill rises yet increase after the cities reach a critical skill level (figure 13).

Returns to city skill are also U-shaped for an individual's own level of education (figure 14), indicating that, as an individual's skill rises, the return she or he enjoys from city skill first falls and then rises. This pattern likely reflects the interplay between the two sources of social returns to human capital: complementarities and human capital externalities. Complementarities arise when skilled workers in a firm raise the productivity of other workers (usually unskilled ones) and are paid for it. For example, skilled workers in a firm may streamline the production process and thus enhance the productivity of the firm's unskilled workers. Complementarities also arise when the greater presence of skilled individuals in a city raises demand for unskilled workers (who work at restaurants and drive cabs, for example). In contrast, human capital externalities arise when skilled workers in a firm raise the productivity of workers, perhaps in other firms, but are not paid for it. For example, skilled workers may exchange knowledge and ideas with workers from

FIGURE 13 Across Countries, Returns to Skill Are U-Shaped in Average City Skill



Source: Calculations using Socio-Economic Database for Latin America and the Caribbean (SEDLAC) for countries other than Brazil and IPUMS International for Brazil. Sample covers 2000–2014.
Note: The vertical axis shows, for each country, the estimated returns to city skill. The horizontal axis shows, for each country, the average of the corresponding variable; the average is calculated over the country's cities. Average years of schooling, and percent of higher education graduates, correspond to individuals ages 14-65. Returns can be expressed in percent if multiplied by 100. To obtain these returns, for each country we regress city-level productivity on the corresponding measure of city skill. These regressions control for area density, market access, air temperature, terrain ruggedness, and precipitation. City-level productivities are estimated by regressing, for each country, log wages on individual-level characteristics (age, age squared, years of schooling, gender, and marital status) and year fixed effects. We do not run these regressions for Argentina, Panama, and Uruguay because of their low number of cities. Coefficients from the quadratic specification in panel b are significantly different from zero. Coefficients from the quadratic specification in panel a are not significantly different from zero. BOL = Bolivia; BRA = Brazil; CHL = Chile; COL = Colombia; CRI = Costa Rica; DOM = Dominican Republic; ECU = Ecuador; GTM = Guatemala; HND = Honduras; MEX = Mexico; NIC = Nicaragua; PER = Peru; SLV = El Salvador.

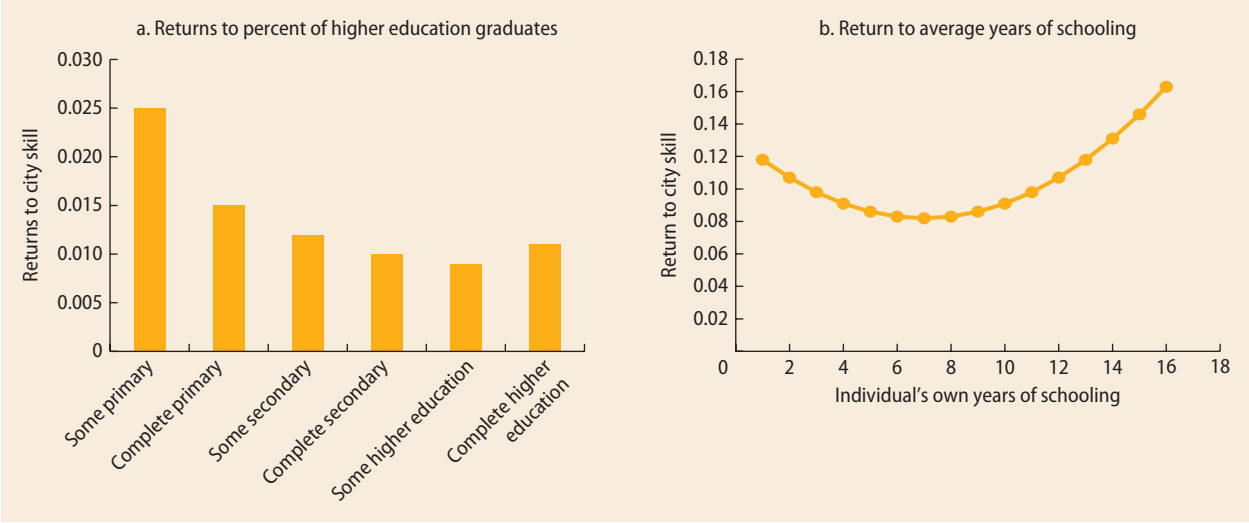
other firms, either in formal settings such as conferences and public presentations or in informal settings such as school meetings, civic associations, or neighborhood interactions.

In general, an increase in city skill will raise salaries for unskilled workers because of both complementarities and human capital externalities, yet it will have two opposing effects on the salaries of skilled individuals: a negative effect due to greater relative supply of skilled individuals, and a positive effect due to human capital externalities. So an increase in city skill that leads to higher salaries *for skilled workers* can be regarded as evidence of human capital externalities.

The U-shaped pattern in figure 14, panel a, provides evidence of human capital externalities. The positive return to the share of higher education graduates among individuals with complete higher education suggests the existence of human capital externalities. Meanwhile, the least educated individuals enjoy the highest returns to the share of college graduates because, in addition to human capital externalities, they may benefit from complementarities as well.

The U-shaped pattern in figure 14, panel b, likely reflects a different balance of complementarities and human capital externalities. Because average years of schooling is about seven years (close to where returns reach a minimum in the figure) for the average LAC city, the average worker in this city is unskilled. Thus, his or her impact on the productivity of others is more likely to come from complementarities than from externalities. Additional schooling for the average worker may hurt individuals with the least amount of schooling, with whom he or she competes. However, it may benefit individuals with more schooling, by allowing them, for example, to specialize in more complex tasks and leave other tasks to the average worker.

FIGURE 14 Individual Returns to Skill Fall and Then Rise with Own Education



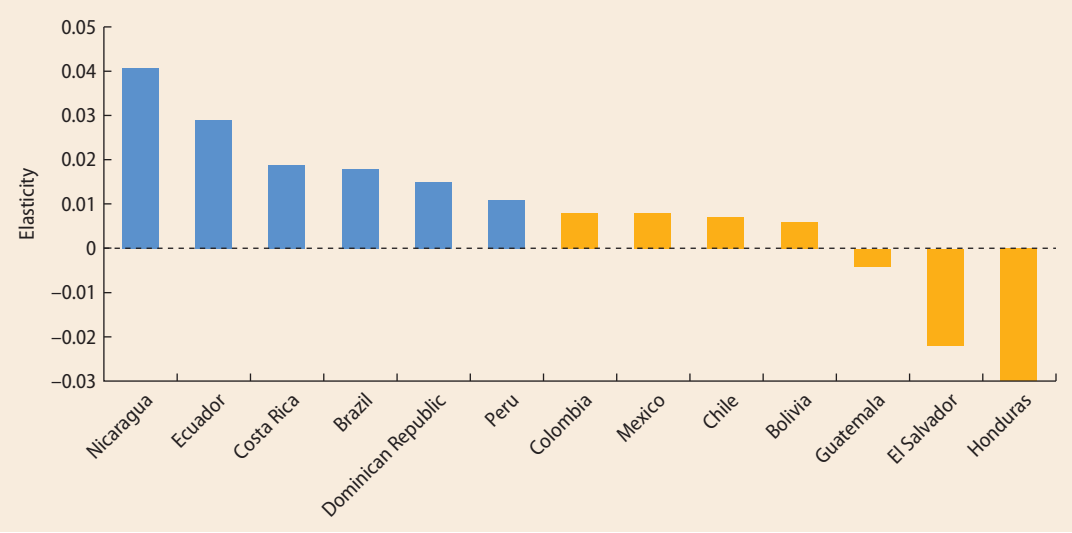
Source: Calculations using Socio-Economic Database for Latin America and the Caribbean (SEDLAC) for countries other than Brazil and IPUMS International for Brazil. Sample is the same as that used by Quintero and Roberts (2017), covering 2000–14.
Note: To construct panel a, we pool data from all countries and regress log wages on individual characteristics (age, age squared, indicators of educational attainment, gender, and marital status) interacted with country dummies, city-level characteristics (density, share of college graduates, market access, air temperature, terrain ruggedness, and precipitation), country-year fixed effects, and the interaction between indicators of individual educational attainment and the city share of college graduates. Individuals with complete primary (secondary) have not started secondary (higher) education. To construct panel b, we pool data from all countries and regress log wages on individual characteristics (age, age squared, years of schooling, years of schooling squared, gender, and marital status) interacted with country dummies, city-level characteristics (density, average years of schooling, market access, air temperature, terrain ruggedness, and precipitation), country-year fixed effects, the interaction between own years of schooling and average years of schooling, and the interaction between own years of schooling squared and average years of schooling. All relevant coefficients for these panels are significantly different from zero.

Access. Access to the markets of other cities in the same country through transportation networks has a statistically significant association with city productivity. Holding density and skill constant, a 1 percent increase in access is associated with a 0.015–0.020 percent increase in productivity, well below the increase associated with skill but above the increase associated with density. The responsiveness of productivity to access varies among countries and is significantly different from zero in 6 out of 13 countries (figure 15).

Multiple factors may explain the low impact of access on the productivity of LAC cities. First, our estimate of access impact may be biased downward. This may be the case, for example, if transport investments have targeted cities in lagging regions, with low economic potential. Indeed, a case study of Mexico for this book finds a stronger effect of market access on city productivity when adopting an estimation strategy that controls for this potential bias (Blankespoor et al. 2017).[31] It also finds that Mexico's road investment in recent decades was associated with local job growth and output, and with increasing specialization among manufacturing firms. In other words, market access holds the promise of raising city productivity.

Second, even if cities have access to other cities through the transportation network, using the network may be costly in money (due, say, to high toll prices, or to a noncompetitive transportation sector that limits supply and raises prices) or in difficulty (due, for example, to low road safety or to frequent traffic disruptions created by protests).

FIGURE 15 Market Access Is Associated with City Productivity in Some Countries

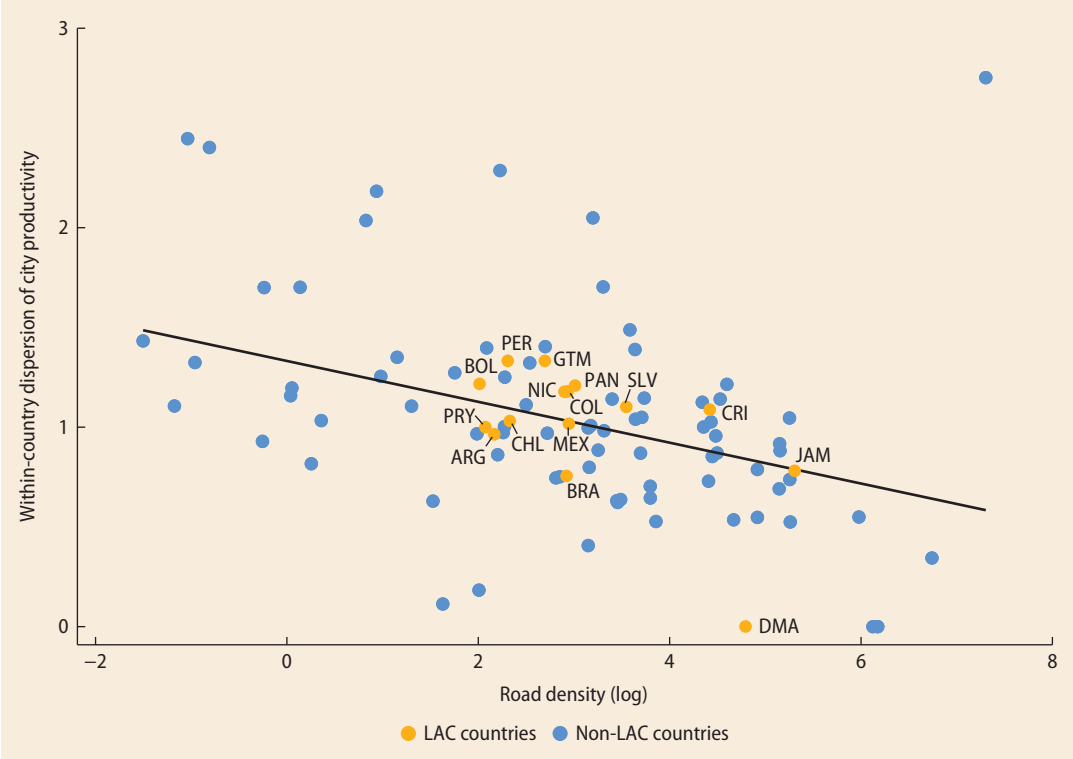


Source: Quintero and Roberts 2017.
Note: Figures show the estimated elasticities to market access for each country derived from regressing—in country-level regressions—estimated city productivity (measured in natural logs) on the following variables, measured in natural logs: population density, average years of schooling, market access, mean air temperature, terrain ruggedness, and total precipitation. Productivity is measured as (log) city average nominal wage, controlling for worker characteristics. The orange bars represent coefficients not significant at the 10 percent level. This figure excludes Argentina, Panama, and Uruguay because these countries lack a sufficient number of cities (that is, observations for the regressions) to permit reliable estimation.

Access holds the promise of raising the productivity not only of individual cities but also of the whole system of cities. Indeed, improvements in national transport networks can help create a more integrated system of cities—with lower productivity dispersion across cities and with a higher contribution to national productivity. Evidence from countries throughout the world shows that the within-country productivity dispersion across cities is lower in countries with higher road density (figure 16).

To summarize, agglomeration effects driven by skill—and, to much less extent, by access—are strong in LAC cities. Skill, which has a positive effect in all countries, operates through complementarity between skilled and unskilled workers, and through human capital externalities, mostly from skilled workers. Market access has a small estimated positive impact, driven by only some of the countries, although its estimated effect may be biased. These results suggest that other types of agglomeration effects associated with population density are largely absent in LAC cities, which may not have the necessary enabling environment. For example, current levels of infrastructure, urban management practices, and transportation policies may not adequately support LAC cities' relatively high densities, resulting in congestion forces that overwhelm positive agglomeration effects. Institutional weaknesses that limit coordination across local governments within metropolitan areas may also dampen agglomeration effects. And the high within-country productivity dispersion indicates that LAC city systems are not efficient and do not maximize their contribution to national productivity, likely because of poor intercity connectivity through the transportation network.

FIGURE 16 Countries with Better Road Coverage Have More Efficient Systems of Cities



Source: Calculations based on nighttime lights data from the 2015 VIIRS (Visible Infrared Imaging Radiometer Suite) annual composite product (downloadable from: https://ngdc.noaa.gov/eog/viirs/download_dnb_composites.html) and road density data from the World Bank's World Development Indicators (WDI) database (http://data.worldbank.org/data-catalog/world-development-indicators).
Note: Productivity is measured using the residuals from a regression at the city level where the dependent variable is the sum of nighttime lights (in logs) and the independent variable is the population (in logs). Productivity dispersion across a country's cities is measured by the interquartile range of the distribution of productivity. Road density is the ratio of the length of the country's total road network to the country's land area and is measured in km per 100 km^2 of land area. ARG = Argentina; BOL = Bolivia; BRA = Brazil; CHL = Chile; COL = Colombia; CRI = Costa Rica; DMA = Dominica; GTM = Guatemala; JAM = Jamaica; LAC = Latin America and the Caribbean; MEX = Mexico; NIC = Nicaragua; PAN = Panama; PER = Peru; PRY = Paraguay; SLV = El Salvador.

What These Findings Might Mean for Policy

Although this book is intended primarily as a research piece, its rich results can provide food for thought for policy makers. As with any piece of applied research that makes use of diverse data sets and a variety of methods, extracting this food for thought is not necessarily straightforward. As might be expected, not all results are consistent across the different methods and data sets. Even when methods and data are consistent, not all results apply to all countries. But, in stepping back and viewing the body of research presented in this book as a totality, several policy-relevant insights emerge.

That LAC cities lag the world's productivity frontier might be due not only to market failures, but also to policy failures.[32] For example, although LAC cities benefit from positive agglomeration effects, these effects are mainly associated with city skill—with complementarities between skilled and unskilled workers, as well as with spillovers of knowledge from skilled workers. By contrast, LAC cities largely lack other positive agglomeration effects—such as those that might arise from good job matches, a large and diversified array of local suppliers of intermediate inputs, the cost-sharing of large-scale infrastructure and transport, and other knowledge spillovers. Policy makers may thus need to improve the enabling environment

for these broader agglomeration effects. Improvements may include carefully planned infrastructure and public services to mitigate the congestion created by current density. They may also include stronger coordination among municipalities in large metropolitan areas or MCAs, as well as effective policies for deterring crime and improving security.

LAC systems of cities do not seem to operate efficiently. Within countries, cities seem to be poorly integrated, and resources do not seem to flow to their most productive uses. Skilled people are strongly concentrated in the largest cities—even more than in the United States. The concentration is in part due to a relative shortage of skilled people at the national level, which makes investing in human capital across the board a priority. But it may also be due to an unequal distribution of basic services across areas that disproportionately favors large cities. Although improving this distribution would help in principle, great care must be exercised in the design of relevant programs aiming to do so—to make sure that gains for one city do not merely come at the expense of others.[33]

The inefficiency of city systems also appears related to the underdevelopment of national transport networks and to barriers to mobility across cities. Expanding transportation networks, and lowering the pecuniary and nonpecuniary costs of their use, would in principle raise cities' productivity. Eliminating obstacles that might constrain people from moving to the cities where they would be most productive might also help. For example, a city's inelastic housing supply can mean that, as the city grows, housing prices rise rapidly but the housing stock does not, which limits people's ability to move to the city even if they would be more productive there than in other places. Similarly, a city's high crime rates might discourage people from moving to that city, even if they would be more productive there.[34]

Whereas almost all skilled individuals in the region live in cities, many unskilled individuals do not. Going forward, any additional urbanization that LAC may experience will most likely be driven by the migration of the unskilled to cities. Because migration will increase the population (and probably density) of cities, it may also increase their congestion. It is all the more critical, then, for cities to create an enabling environment for strong agglomeration effects.

At the same time, unskilled populations in cities mostly work in low-productivity, often local, services such as retail, hotels, and restaurants.[35] Under prevailing conditions, further urbanization of unskilled workers may just continue shifting workers from agriculture and manufacturing into low-productivity sectors. A better enabling environment for agglomeration effects, which operate more strongly for the formal sector, and for tradable goods and services may reduce that effect.[36] To be productive, cities also need the enabling environment of sound macroeconomic policies and efficient markets for goods and services, which are critical to the existence of productive firms, good jobs, and high national productivity. Without this wider enabling environment, LAC cities are not likely to reach the world's productivity frontier.

Cities thus are lenses to consider a whole host of policies, including education, infrastructure, transportation, and urban planning. Cities are the immediate context in which people live and work. And, because almost three-quarters of the LAC population live and work in this context, raising the bar for the productivity of LAC cities is crucial. Although this book cannot provide all the policy answers, we hope that, by taking a stride forward in our knowledge of the determinants of productivity in LAC cities, the book can raise the bar for productive cities in the region.

Annex 1: Productivity Measures Used in the Book to Assess LAC Cities

- Per capita GDP at the national level proxies average labor productivity at the national level and is relevant to the aggregate

contribution of urbanization and cities to national productivity.

- Nighttime lights (NTL) at the city level measures output at the city level. Because city-level GDP is typically not available, researchers have used the intensity of an area's NTL as a proxy for its level of economic activity.[37]
- NTL net of (log) population at the city level measures average labor productivity at the city level.
- Average nominal wages at the city level is a commonly used measure of a worker's productivity in the urban economics literature, especially in literature that estimates the strength of agglomeration economies (for example, see Duranton 2016 and Chauvin et al. 2017). All other things equal, a city that pays a higher average nominal wage can be considered to have a higher average level of labor productivity.
- Average nominal wages net of individual worker characteristics at the city level measures a city's labor productivity, having controlled for differences in the composition of its workforce. If workers with the same observable characteristics (such as age, education, marital status, and gender) who live in different cities within a country earn different wages, it must be because their cities have different productivity levels.[38]
- TFP at the firm (establishment) level captures firm productivity, net of the capital, labor, and intermediate inputs used in the production process.

Annex 2: The Need for Policy

Cities represent potential engines of productivity and growth. But, if cities are left to markets alone, this potential cannot be realized—for several reasons.

Externalities arise when a decision by an economic agent, such as a worker or firm, has consequences for other agents, yet the agent's decision does not take such consequences into account. In these cases, what is best for the individual is not best for society as a whole. Externalities are pervasive in cities. Some of these are positive, whereas many others are negative. Aggregate skill, for example, is subject to positive externalities. Although many workers in a city gain when aggregate skill rises, any one worker regards his or her contribution to the aggregate skill level as negligible. Thus, when deciding whether to acquire more skill, individuals do not consider the benefit of their actions for the whole city and are thus less likely to acquire additional skill. As a result, aggregate skill in the city is below the socially optimal level. Meanwhile, traffic congestion and pollution externalities represent classic textbook cases of congestion effects that are negative externalities.

Cities are also notorious for their *public good* problems. Cities typically contain infrastructure (such as bridges and roads) and public spaces (such as parks and town squares) that can be enjoyed by many individuals at once, without an easy mechanism to exclude users. No individual is willing to pay for public goods because all have an incentive to free ride by letting others pay. As a result, no private firm is willing to provide public goods.

Cities also suffer from *coordination failures*. Within a city, individual firms and workers may fail to coordinate. For example, although all individuals may desire clean air, which could be more easily accomplished if more of them used public transportation rather than driving their own vehicles, many individuals may find it more convenient to drive. Given the practical difficulties of coordinating among themselves, individuals may end up driving, thus raising pollution above the socially optimal level. Similarly, many firms might benefit from moving to a given location within the city if a sufficiently large group of them moves there, yet no individual firm might gain from moving alone. In the absence of a mechanism to coordinate their actions, firms might remain where they are, and might all be worse off.

Cities may fail to coordinate as well. The cities of an MCA can fail to coordinate, as discussed in the main text. More broadly, the cities in a system can fail to coordinate. They may not have incentives to invest in

human capital when workers are mobile across cities, because they may not reap the return to their investment if the workers move. And, if a public transit link benefits two cities, neither city has an incentive to invest in the link because the other city will benefit as well.

More broadly, systems of cities can suffer from *barriers to mobility* that raise the cost of moving resources across cities. Whereas some of these barriers can be natural (a mountain range), others arise from policy regulations (overly restrictive building and planning regulations), or from coordination failures among cities (the two cities that could benefit from a connecting transport link).

Such market failures justify policy intervention, both for cities and for systems of cities.

Notes

1. These figures are based on the globally consistent definition of urban areas that we introduce in chapter 1 of the full book. They differ from corresponding figures based on official national definitions of urban areas, which, as discussed in detail in chapter 1 of the full book, vary widely not only across countries within LAC but also across countries globally. On the basis of national definitions of urban areas, the share of LAC's total population living in cities in 2016 was 80.1 percent.
2. A mega-city is generally defined as a city that has a population in excess of 10 million.
3. The algorithm that we use is from Dijkstra and Poelman (2014). In total, we identify almost 64,000 urban areas globally, of which just under 7,200 belong to LAC. For ease of exposition, we refer to urban areas as "cities" throughout this overview, even though the smaller and less densely populated urban areas may perhaps be more aptly referred to as "towns." To be classified as an urban area, a cluster must have a minimum density of 300 people per square km, and the cluster's total population must be at least 5,000.
4. Multiple measures of productivity are used in this book. See annex 1 for a list of such measures.
5. The concept of a global productivity frontier, as presented here, is a purely empirical one in which the frontier is implicitly defined by the set of countries that exhibit the highest levels of GDP per capita at given levels of urbanization. Similar comments apply to figure 2, where the frontier is defined by the set of cities that exhibit the highest levels of economic activity at given levels of population.
6. This statement is based on the average performance of LAC cities—so LAC cities, on average, exhibit higher output than we would expect based on their populations. However, as also shown in figure 2, LAC cities show considerable variation around the average, with some exhibiting levels of output much lower than we would expect based on their populations. We discuss the dispersion of productivity levels across LAC cities later in the overview.
7. Argentina, Barbados, and Grenada provide the most notable exceptions to the finding that LAC countries have unusually dense cities. Antigua and Barbuda, the Bahamas, Guyana, Jamaica, and St. Kitts and Nevis all have a roughly 50:50 split between dense and not dense cities.
8. Just as important as a city's average density from the perspective of fostering positive agglomeration effects and mitigating congestion is likely to be how that density is organized. This is discussed more in chapter 6 of the full book.
9. In this book, MCAs are defined as urban areas identified by the cluster algorithm that encompass two or more cities as given by countries' own definitions. Each component city must have at least 100,000 people. Nevertheless, as discussed in chapter 2 of the full book, our main regression results relating national productivity and the share of population in MCAs also hold when allowing for smaller component cities.
10. In the case of Mexico City, several of the municipalities in the officially defined city (shown in map 1 by the yellow lines) only overlap partially with its "true" urban extent.
11. Within-country productivity dispersion does not necessarily indicate inefficiency in the system of cities; it could also indicate a disparity in the presence of amenities. For example, some individuals may choose to live and work in a city where they do not maximize productivity or wages simply because the city is close to the beach. In these cases, productivity in the country is not maximized, yet welfare is. However, assuming that the disparity in

amenities accounts for a similar fraction of productivity dispersion in LAC countries and their comparators, we can view the high productivity dispersion within LAC countries (relative to their comparators) as indicative of inefficient systems of cities in LAC.

12. An individual is defined as skilled who has at least some higher education.
13. From figure 7, Argentina is an exception to this pattern.
14. We obtain this result by regressing (log) share of the city population that is skilled on (log) city population, pooling data for all LAC countries. Results are very similar when country fixed effects are included, or when we run a separate regression per country and average the country-specific coefficients.
15. The Gini coefficient is a measure of inequality in the income distribution. It ranges between zero and 1. The larger the coefficient, the greater the inequality. We obtain the LAC elasticity (equal to 0.029) by regressing (log) city Gini coefficient on (log) city population, pooling data for all countries in LAC. When including country fixed effects, the coefficient of this regression rises from 0.029 to 0.042. The U.S. elasticity (equal to 0.012) comes from Behrens and Robert-Nicoud (2015).
16. Income inequality can be decomposed into two components: between-group and within-group inequality. These correspond to income inequality among individuals with different skill levels, and among individuals with the same skill level, respectively. Even if all individuals in a city are skilled, income might be unequally distributed if income for the skilled is dispersed. In LAC, however, the greater inequality of larger cities is driven by between-group inequality—by income inequality among individuals with different skill levels.
17. The elasticity of the Gini coefficient with respect to population falls from 0.012 to 0.009 for the United States when controlling for city education (Behrens and Robert-Nicoud 2015). On average (across countries), this elasticity in LAC falls from 0.03 to 0.017.
18. These are private returns to higher education, accruing to the individual who attains it. Percent of skilled population is calculated relative to the population ages 25–65 years in each country. Sources for LAC: SEDLAC for all countries other than Brazil; IPUMS for Brazil. Source for the United States: U.S. Census Bureau, Current Population Survey 2010. Returns to higher education correspond to complete higher education. Source for LAC is Ferreyra et al. (2017); estimates for the United States are based on Card (2001) and Heckman, Lochner, and Todd (2006).
19. Following Ferreyra et al. (2017), "higher education" encompasses both bachelor's programs (akin to the bachelor's programs in the United States) and short-cycle programs (akin to associate degree programs in the United States).
20. The high concentration of skills in large cities may itself be a symptom of the underdevelopment of national transport networks and, more generally, of a lack of integration between cities. Hence, high migration costs associated with a lack of integration may limit migration for the unskilled more than for the skilled, rendering the skilled more likely to migrate than the unskilled—as is the case in Brazil (Fan and Timmins 2017).
21. This discussion is based on the regressions, which cover subnational areas in 16 LAC countries, reported in chapter 3. These regress city productivity (in logs), as measured net of individual worker characteristics, on (log) population density, (log) mean air temperature, (log) terrain ruggedness, and (log) total precipitation.
22. To assess the role of form, skill, and access in city productivity, we measure productivity through average nominal wages, net of worker characteristics. See annex 1 for further details on productivity measures used in this book. For a discussion of why nominal wages provide an appropriate measure of productivity, see Combes and Gobillon (2015).
23. Estimates from China, India, and the United States come from Chauvin et al. (2017), who do not control for cities' physical geographic attributes (such as climate and terrain). As in our case, they use individual-level data and use density as a right-hand side variable. Using aggregate data, Ciccone and Hall (1996) and Rosenthal and Strange (2008) estimate agglomeration effects for the United States of 0.04–0.05 percent.
24. For each city, the market access index reflects the number of cities to which the city is connected through the road network, the time it takes to travel to those cities, and those cities' population. See chapters 3 and 4 of the full book for further details.

25. Although the effects for China, India, and the United States reported by Chauvin et al. (2017) are all statistically significant at the 1 percent level, the effect that we estimate for LAC is significant at only the 10 percent level.
26. A large city here is defined as one that has a population of more than 1 million or is a national capital.
27. Country-level productivity is measured by (log) GDP per capita, and average density is measured in two ways: as the weighted average of density levels across cities in a country or as the percent of the population that lives in dense cities. Findings are based on regressions that also control for a country's urban share. For further details, see chapter 2 of the full book.
28. This congestion ranking is based on TomTom data. See chapters 2 and 4 of the full book for further details.
29. At the 5 percent significance level.
30. This is the average of country-specific Mincerian returns to schooling, controlling for individual characteristics.
31. The bias associated with the endogenous placement of transport infrastructure also has the potential to go in the opposite direction. Hence, the estimated coefficient on access may be biased upward if transport investments have been targeted at better connecting cities that policy makers anticipate will grow rapidly.
32. Annex 2 describes the market failures associated with cities.
33. For example, place-based policies aiming at boosting employment or economic activities in specific areas have a mixed track record (World Bank 2009).
34. In his case study of Brazil for this book, Bastos (2017) finds that the productivity dispersion among workers in the formal sector, who made up two-thirds of the total Brazilian workforce in 2013 (Messina and Silva 2018), has fallen in recent decades. This might have been prompted by the reduction of crime rates in the most productive metropolitan areas, which has served to attract workers from other, less productive, areas. At the same time, productivity dispersion among cities in Brazil remains higher than in the United States. One possible explanation is the shortage of affordable housing in Brazil's most productive cities. On average, housing deficits have risen more in high-wage than in low-wage metropolitan areas. Although informal housing presumably filled the gap for some migrants to high-wage metro areas, the poor quality of such housing may have deterred would-be migrants, thereby keeping them "trapped" in less productive cities.
35. See chapter 5 of the full book for further details on the employment of skilled and unskilled individuals in cities. As is well known, measuring productivity in the service sector is remarkably difficult, partly because of the difficulties in measuring output.
36. Chapter 3 of the full book presents evidence that agglomeration effects are stronger in formal than in informal economic activities.
37. Among economists, the use of NTL to proxy for levels of economic activity has become widespread since the work of Henderson, Storeygard, and Weil (2011, 2012). Before this, the ability of NTL to proxy for levels of economic activity had been highlighted in the field of remote sensing by, for example, Elvidge et al. (1997).
38. Of course, the difference could also be due to systematic differences in their unobserved characteristics. We assume that controlling for our set of observed individual characteristics minimizes the role of such differences.

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With more than 70 percent of its population living in cities, Latin America and the Caribbean (LAC) is among the most urbanized regions in the world. Yet, even though LAC cities are, on average, more productive than those elsewhere in the world, their productivity lags that of North American and Western European cities. Closing this gap will help LAC countries raise their living standards and be among the world's richest countries.

Raising the Bar for Productive Cities in Latin America and the Caribbean explores the productivity of LAC cities and the factors that explain it. Using original empirical research, the book documents the relatively high population density, strong concentration of human capital in the largest cities, and other features of LAC cities that distinguish them from cities in the rest of the world.

This book also explores how three key factors—urban form, skills, and access to markets—determine productivity in LAC cities. Although these cities benefit strongly from human capital and skills, they fail to reap the wider benefits of agglomeration. This is, in part, due to an inadequate enabling environment, as well as excessive congestion forces associated with infrastructure deficiencies and lack of administrative coordination within metropolitan areas. Further, the poor integration of LAC cities within countries contributes to large performance differences across cities and undermines cities' aggregate contribution to national productivity.

Raising the Bar will be of interest to policy makers, researchers, and the public at large.

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