REDEFINING GLOBAL CITIES

THE SEVEN TYPES OF GLOBAL METRO ECONOMIES

GLOBAL CITIES INITIATIVE
A Joint Project of Brookings and JPMorgan Chase

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THE BROOKINGS INSTITUTION | METROPOLITAN POLICY PROGRAM | 2016

EXECUTIVE SUMMARY

With more than half the world's population now living in urban areas, cities are the critical drivers of global economic growth and prosperity. The world's 123 largest metro areas contain a little more than one-eighth of global population, but generate nearly one-third of global economic output.

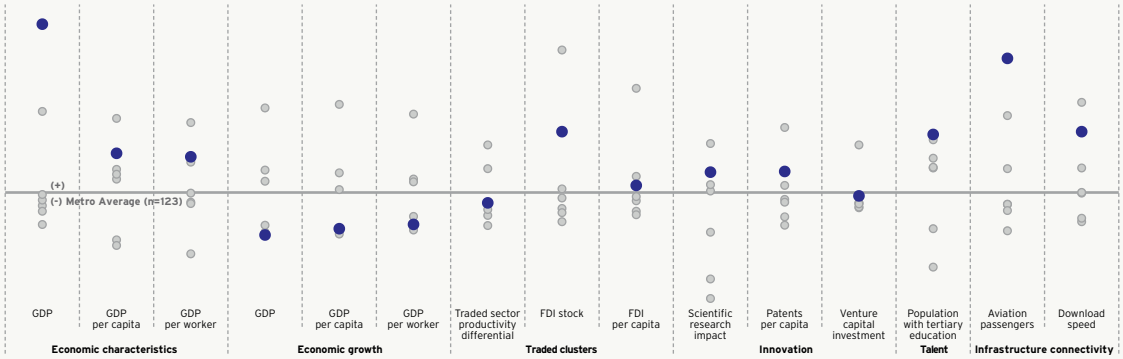
As societies and economies around the world have urbanized, they have upended the classic notion of a global city. No longer is the global economy driven by a select few major financial centers like New York, London, and Tokyo. Today, members of a vast and complex network of cities participate in international flows of goods, services, people, capital, and ideas, and thus make distinctive contributions to global growth and opportunity. And as the global economy continues to suffer from what the IMF terms "too slow growth for too long," efforts to understand and enhance cities' contributions to growth and prosperity become even more important.

In view of these trends and challenges, this report redefines global cities. It introduces a new typology that builds from a first-of-its-kind database of dozens of indicators, standardized across the world's 123 largest metro economies, to examine global city economic characteristics, industrial structure, and key competitiveness factors: tradable clusters, innovation, talent, and infrastructure connectivity.

The typology reveals that, indeed, there is no one way to be a global city. Grouped into seven metropolitan clusters, the distinct competitive positions of the world's largest metro economies become sharper, as do the peers metropolitan areas can look to for common solutions and investments to enhance economic growth:

- **GLOBAL GIANTS** are the largest cities in the United States (New York and Los Angeles), Japan (Tokyo and Osaka-Kobe), France (Paris), and the United Kingdom (London). These extremely large, wealthy metro areas are hubs for financial markets or major corporations, and they serve as key nodes in global capital and talent flows.

Figure I. Global Giant indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

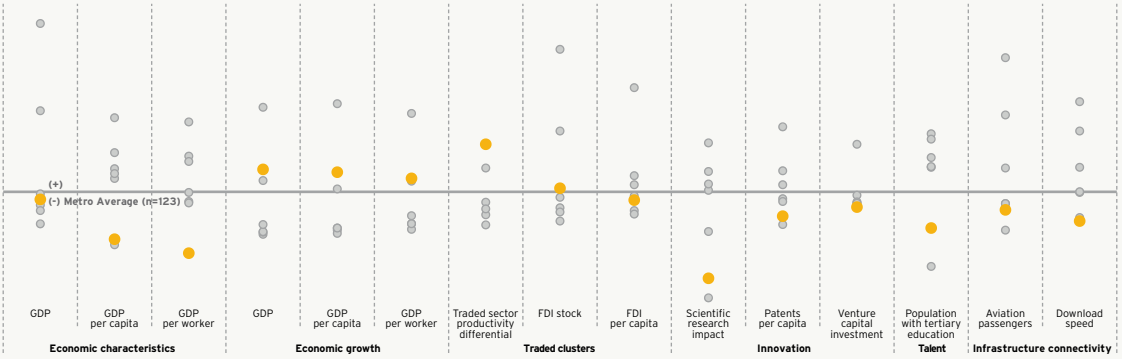
➤ **ASIAN ANCHORS** include five Pacific-facing metro areas—Beijing, Hong Kong, Seoul-Incheon, Shanghai, and Singapore—and a sixth major emerging market metro, Moscow. Asian Anchors are not as wealthy as their Global Giant counterparts, but they play a similar role as command centers in fast-growing Asia by drawing on their infrastructure connectivity and talented workforces to attract the most foreign direct investment (FDI) of any metro grouping.

Figure II. Asian Anchors indicators, 2015 or most recent year available

Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

➤ **EMERGING GATEWAYS** are 28 large business and transportation entry points for major national and regional markets in Africa (e.g., Johannesburg), Asia (e.g., Mumbai), Latin America (e.g., São Paulo), and the Middle East (e.g., Istanbul). These metros have grown healthily to reach middle-income status, but they lag on many key competitiveness factors compared to their global peers.

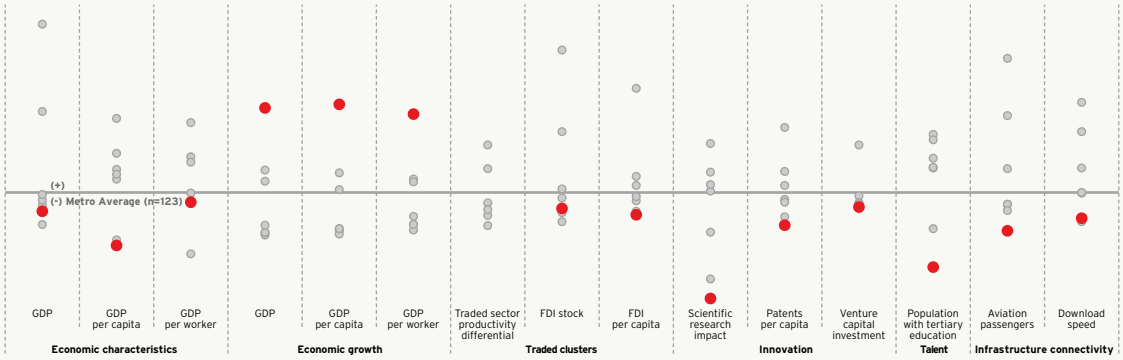
Figure III. Emerging Gateways indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

➤ **FACTORY CHINA** includes 22 second- and third-tier Chinese cities reliant on export-intensive manufacturing to power economic growth and global engagement. Factory China grew faster than every other metro grouping since 2000, but these cities are still quite poor compared to other global cities, and now must upgrade their human capital to effect a transition to a more balanced, services-oriented industrial structure.

Figure IV. Factory China indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

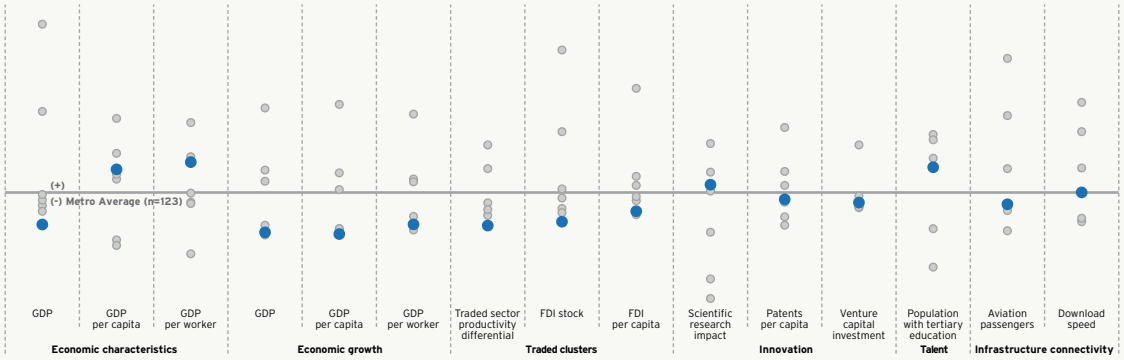
➤ **KNOWLEDGE CAPITALS** are 19 mid-sized, highly productive innovation centers in the United States (e.g., Boston, Dallas, San Jose, and Seattle) and Europe (e.g., Amsterdam and Zurich) with talented workforces and elite research universities. These regions are at the world's innovation frontier, and thus they are challenged constantly to generate new knowledge and ideas to sustain growth.

Figure V. Knowledge Capitals indicators, 2015 or most recent year available

Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

➤ **AMERICAN MIDDLEWEIGHTS** are 16 mid-sized U.S. metro areas, including places like Indianapolis, Miami, and St. Louis, that are relatively wealthy and house strong universities and other anchor institutions. But relatively low traded-sector productivity and FDI levels suggest they must continue to strategically align their existing assets to improve traded-sector competitiveness.

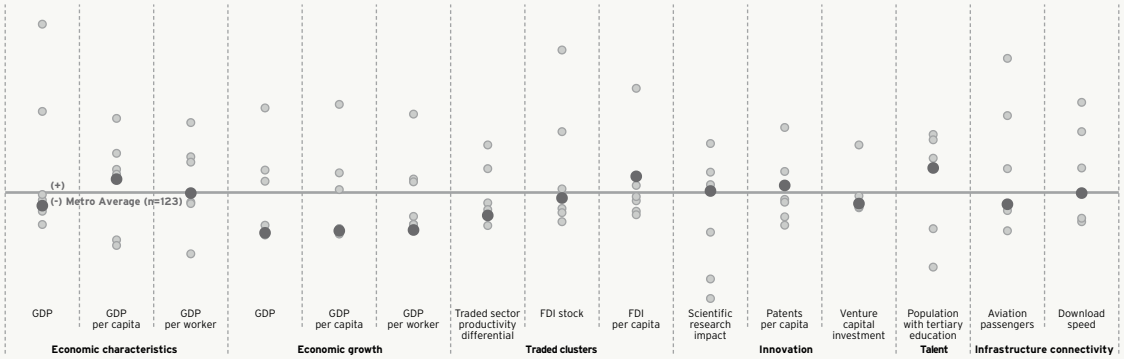
Figure VI. American Middleweights indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

➤ **INTERNATIONAL MIDDLEWEIGHTS** include 26 mid-sized cities in Australia (Melbourne and Sydney), Canada (Montreal and Toronto), and Europe (several German metros) globally connected by people and investment flows but still experiencing lagging growth since the financial crisis. Like their American middleweight peers, they are striving for a post-recession niche in the global economy, to varying degrees of success.

Figure VII. International Middleweights indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

This urban century demands a more informed, bottom-up approach to solving our global economic challenges. Local and national leaders, in turn, must govern in ways that deliver sustainable and inclusive growth, but must often make choices about policies and investments devoid of much-needed data. This report—and its accompanying online interactive—seek to help decision makers in global cities enhance the local assets that matter most for economic competitiveness, benchmark their performance against peer cities, and identify the global innovations most relevant to securing local growth and prosperity.

I. INTRODUCTION

As the global economy has become more integrated and urbanized, fueled in large part by technology, major cities and metropolitan areas have become key engines of economic growth. The 123 largest metro areas in the world generate nearly one third of global output with only 13 percent of the world's population.

In this urban-centered world, the classic notion of a global city has been upended. This report introduces a redefined map of global cities, drawing on a new typology that demonstrates how metro areas vary in the ways they attract and amass economic drivers and contribute to global economic growth in distinct ways. New concerns about economic stagnation—in both developing and developed economies—add urgency to mapping the role of the world's cities and the extent to which they are well-positioned to deliver the next round of global growth.[1]

Instead of a ranking or indexed score, which many prior cities indices and reports have capably delivered,[2] this analysis differentiates the assets and challenges faced by seven types of global cities. This perspective reveals that all major cities are indeed global; they participate as critical nodes in an integrated marketplace and are shaped by global currents. But cities also operate from much different starting points and experience diverse economic trajectories. Concerns about global growth, productivity, and wages are not monolithic, and so this typology can inform the variety of paths cities take to address these challenges. For metro leaders, this typology can also ensure better application of peer comparisons, enable the identification of more relevant global innovations to local challenges, and reinforce a city-region's relative role and performance to inform economic strategies that ensure ongoing prosperity.

This report proceeds in four parts. In the following section, Part II, we explore the three global forces of urbanization, globalization, and technological change, and how together they are demanding that city-regions focus on five core factors—traded clusters, innovation, talent, infrastructure connectivity, and governance—to bolster their economic competitiveness. Building on these factors, Part III outlines the data and methods deployed to create the metropolitan typology. Part IV explores the collective economic clout of the metro areas in our sample and introduces the new typology of global cities. Finally, Part V explores the future investments, policies, and strategies required for each grouping of metro areas. Within the typology framework, we explore the priorities for action going forward, including the implications for governance.

II. GLOBAL MEGATRENDS AND CITIES

Three significant forces—urbanization, global integration, and technological change—are reshaping the international economy.[3] We focus on these three forces because they are distinctly positioning cities as the world's competitive economic units while simultaneously redefining what it takes for them to excel in today's economy.

URBANIZATION

The world is becoming more urban, placing cities at the center of global economic development. The share of global population in metropolitan areas has grown from 29 percent in 1950 to well over half today, and it is predicted to reach 66 percent by mid-century.[4]

History indicates that urbanization both accompanies and facilitates economic transition from agriculture to manufacturing and services, activities that tend to demand clusters of labor and capital as well as the proximity to other firms that cities provide. Urbanization and industrialization, therefore, tend to occur in concert. These twin forces, which revolutionized Europe and North America in the late 19th century and early 20th century, have now touched Asia and Latin America. However, this process is not preordained. Africa's urbanization, for instance, has not been accompanied by widespread industrialization.[5] Notwithstanding Africa's challenges, millions of rural residents each week flock to urban regions in the Global South in search of the living standards that new production and service jobs provide. Since 2010 annual urban populations have grown fastest in Africa (3.55 percent) and Asia (2.50 percent), greatly exceeding the pace of urban growth in North America (1.04 percent) and Europe (0.33 percent).[6]

The pressures and opportunities accompanying urbanization will be felt most intensely and directly in the Global South, but the knock-on effects will be worldwide. Urbanization in developing economies has resulted in a much greater number of urban areas in which firms and workers can thrive. In technical terms, agglomeration externalities—the benefits that accrue to firms, workers, and local economies from clustering—now exist in many more parts of the world.[7] As a result, along with their growing human footprint, metro areas are flexing even greater economic muscle on the world stage. Overall, the 50 percent of the world's population that lives in urban

areas produces roughly 80 percent of the world's total output.[8]

Urbanization, however, comes with risks if it is unmanaged. Rapid population influxes in the megacities of Africa, Latin America, and Southeast Asia are straining the ability of local governments to provide basic housing, transportation, energy, water, and sewage infrastructure.[9] The world will need to invest $57 trillion in new infrastructure by 2030 to keep pace with expected growth, the bulk of which will occur in the developing world.[10] If the negative externalities of congestion, insecurity, and health risks overwhelm the positive agglomeration externalities that cities provide, countries run the risk of urbanizing without growth.[11]

The rise of developing metro areas creates both challenges and opportunities for developed world cities. There is now more direct competition for firms and talent, but metro areas in developed markets can also look to developing metros with expanding populations and wealth for new sources of demand. Brookings' Homi Kharas and Geoffrey Gertz project that China and India, which account for only 5 percent of global middle-class consumption today, could together account for nearly half of that consumption by 2050, with most of it occurring in their cities.[12]

GLOBALIZATION

Global integration, a defining trend of the postwar era, is intensifying.[13] The volume of goods, services, and investments between countries increased from $5 trillion in 1990 to $30 trillion in 2014, or from 24 percent to 39 percent of global gross domestic product (GDP).[14] Moreover, the nature of global exchange seems to be shifting. While goods trade has stagnated in recent years, cross-border flows of data and information have grown robustly.[15]

Broadly measured, these connections matter. Countries that are more internationally connected can expect to increase GDP growth by up to 40 percent more than less-connected countries.[16] These findings affirm a wide array of economic literature citing the benefits of participating in global flows of trade, investment, and talent. Much of these benefits stem from the presence of globally-engaged firms. Local companies that embed themselves in global value chains gain access to high-quality imports, lowering their overall costs and allowing them to become more globally competitive. This process tends to boost productivity and wages.[17] Firms selling internationally inject new wealth from abroad that, when spent locally, creates a multiplier effect in the regional economy, spurring new jobs, growth, and further tax revenue to be reinvested locally.[18] Households living in metro areas open to trade are able to access a greater diversity of goods made elsewhere.[19] Furthermore, global exchange is how regions with fewer industrial capabilities often obtain the knowledge required to move up the economic ladder, create new jobs, and boost productivity.[20]

But cities also bear the brunt of the dislocations caused by global integration. For instance, China's insertion into the global trading system resulted in significant job losses in U.S. labor markets that specialize in manufacturing.[21] In the developing world, there is an argument to be made that the globalization of labor, trade, and capital markets, along with bringing new knowledge and technologies, has contributed to economic instability and rising inequities within nations.[22]

Indeed, even those cities that have thrived in a more globally integrated world are experiencing challenges of unevenly shared prosperity. As Saskia Sassen has argued, the rise of the globally integrated city has coincided with the rise of the unequal city, across both developed and developing countries.[23] Indeed, the Organization for Economic Cooperation and Development (OECD) has found that inequality tends to be higher and rising more quickly in large cities than in their surrounding nations due to skills' distribution and the rise of high earners.[24] Inequality may limit upward mobility and overall economic growth if it hinders investments in education and skills among earners at the bottom of the income distribution.[25] Recognizing these costs is an important and urgent matter for public policy. But barring adoption of severe isolationist policies, global integration will continue apace, and all cities must respond accordingly.

TECHNOLOGICAL CHANGE

The information technology revolution, digitization, and labor-saving automation are altering modes of communication, the processes firms use to create and deliver products and services, and the very nature of work itself.[26]

The scale of these technological changes is significant and the pace of change has been relentless. The McKinsey Global Institute predicts that 12 emerging technologies will generate an annual economic impact of up to $33 trillion by 2025.[27] A recent Brookings study found that many of these technologies will be developed and deployed within a set of 50 "advanced" industries, characterized by a reliance on high levels of research and development (R&D) and significant numbers of science, technology, engineering, and mathematics (STEM) workers.[28]

Advanced industries matter because they drive productivity growth in an environment in which overall productivity growth has been lackluster.[29] The average worker in advanced industries is twice as productive as the average worker outside the sector, due to these firms' unique abilities to productively utilize new technologies and platforms. This productivity differential matters because it allows workers within the sector to earn wages double those of workers outside of it.[30] Cities that can foster environments in which highly productive firms and workers can thrive enjoy the associated wage benefits.

Risks accompany these high-tech breakthroughs, however. In the United States, a useful proxy for other advanced economies, already demonstrated technologies have the potential to automate 45 percent of work activities in the United States.[31] Indicative of the deployment by advanced industries of labor-saving technology, employment in advanced industries in U.S. cities has been flat since 1980, even while the sector's value-added growth has soared. And technology-induced labor market changes are not a challenge just for the developed world. Increased automation in manufacturing is one reason why developing countries are deindustrializing at much lower levels of income. This trend suggests that manufacturing may not provide the same on-ramp for lower-income countries going forward, and the economic and political consequences of this shift may be significant.[32]

Especially as populations age and workforces retire, productivity growth, rather than labor force growth, will have to do the heavy lifting to maintain overall economic growth, especially in developed metro areas. In a study of 20 large national economies, the McKinsey Global Institute estimates that, to achieve global growth rates comparable to those experienced over the last 50 years, productivity growth will need to be 80 percent faster to compensate for slowing employment growth.[33] Since technology appears to be such a critical input to worker, firm, and industry-level productivity, cities must understand and adapt to its impact.

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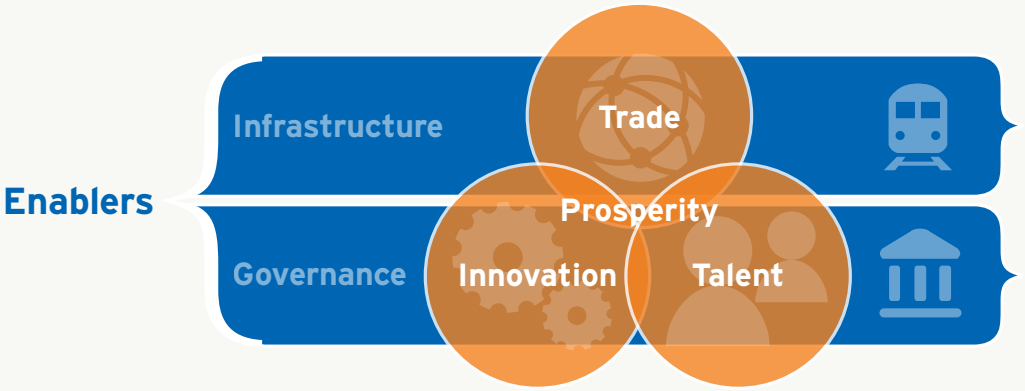
These three trends underscore a new economic reality for cities. For starters, urbanization has placed developing metro areas alongside their more developed peers as the main sites for economic growth and development. This shift means that understanding global market currents requires an understanding of the economic dynamics playing out in the world's cities. The opportunities and pressures of global integration mean that, to deliver prosperity for their residents, cities must proactively adapt and position workers, industries, and communities for the upsides of global engagement by **investing in a competitive traded sector, maintaining infrastructure connectivity, and being open to global flows of capital and talent**. To manage technological change and reap the productivity gains that will improve living standards, cities must cultivate **innovation systems, skilled workforces, and digital infrastructure.** All of these competitiveness assets must be stewarded by good governance and a stable business environment.[34]

DEFINING AND MEASURING COMPETITIVENESS FACTORS

Given this global environment, this report focuses on the assets that matter for a metro economy's competitiveness. We draw on the Harvard Business School definition of a competitive market as one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households.[35] Competitive regions are, by this definition, supportive environments for both companies and people.

This report draws on a five-factor competitiveness framework—tradable clusters, innovation, talent, infrastructure, and governance. Globally competitive traded sectors, innovation ecosystems, and skilled labor are the key drivers of overall productivity, employment creation, and income growth. "Enablers" support these drivers: well-connected infrastructure and reliable governance, public services, and the business environment (see box).[36] Focusing on these fundamentals positions metropolitan economies to compete based on the distinct long-term value their industries and people can provide, and avoids economic strategies that attract firms through "race-to-the-bottom" techniques that compete via one-time tax breaks or low wages.

A framework for regional competitiveness



Source: Brookings Institution, RW Ventures, and McKinsey and Company.

Measuring competitiveness factors

Tradable clusters: Tradable industries are a critical driver of prosperity and competitiveness. These industries are typically anchored by globally engaged firms, which have valuable spillovers for local economies. The traded sector can be measured in several ways. We measure tradable industries using data on greenfield foreign direct investment (i.e., investments that bring new plants or offices), which is inextricably bound up with traded industry clusters, and the productivity differential (measured as output per worker) between a metro area's traded sector and that traded sector nationwide.[37] Due to data limitations at the metropolitan scale, we are unable to standardize and measure domestic investments across industries or include data on global trade flows.

Innovation: A region's innovative capacity and levels of entrepreneurship both have implications for its ability to develop and deploy commercial applications, start new businesses, and maintain industrial competitiveness in the face of disruptive technological change.[38] We measure innovation through patenting, venture capital flows, and the scientific impact of research universities.[39]

Talent: Human capital—the stock of knowledge, skills, expertise, and capacities embedded in the labor force—is of critical importance to enhancing productivity, raising incomes, and driving economic growth. We measure talent through the share of population with tertiary education.[40]

Infrastructure connectivity: Infrastructure connectivity matters for regional competitiveness because firms rely upon global access, both physically and digitally, to participate in the efficiencies of global value chains. We measure infrastructure connectivity through aviation passenger flows and internet download speeds.[41] Due to data limitations we are unable to utilize standardized indicators on other important infrastructure metrics such as the quality of freight and logistics systems, roads, and public transit.

Governance: Governance matters for competitiveness because proactive government, public, and civic groups can marshal investment from a variety of domestic and international sources to enable new growth strategies. Similarly, the efficiency with which government can deliver services and investments matters; highly fragmented metro areas tend to be less productive than their more cohesive counterparts. Central, provincial, and municipal governments also have unique and complementary roles to play in enabling firms and their wider regions to succeed in global markets.[42] However, data limitations limit our ability to quantitatively measure governance in this report.

SELECTION AND DEFINITION OF METROPOLITAN AREAS

We deploy new, standardized metropolitan-level data to measure these factors for 123 large metro areas. This sample constitutes the largest metropolitan economies in the world in 2015 at purchasing power parity (PPP) rates for which data on these factors were available.[43] With a few exceptions, these metro areas all tend to have economies larger than $100 billion in nominal terms. The sample's average population is 7.6 million. As previous studies have shown, including Brookings' own Global MetroMonitor and those by the McKinsey Global Institute and the World Bank, global growth is not solely powered by these large metro economies; in fact, small and mid-sized cities matter greatly.[44] Data limitations, however, prevent us from analyzing a larger sample of economies

on all these factors. Given these limitations, we focus on the largest city-regions because they uniquely concentrate the assets that undergird global growth. They are the main infrastructure connection points to second- and third-tier cities. They cluster universities, skilled workers, and other innovation assets that yield the positive externalities and knowledge spillovers that generate endogenous growth.[45]

This study uses the general definition of a metropolitan area as an economic region comprising one or more cities and their surrounding areas, all linked by economic and commuting ties (see Appendix A). These definitions are the same as those used in previous versions of Brookings' Global MetroMonitor. We use the terms city, city-region, metro, metro area, and metro economy interchangeably to describe economic regions.

METROPOLITAN TYPOLOGY

A significant body of research has sought to classify global cities and measure their economic competitiveness. This literature began with the seminal work of scholars like Peter Hall, John Friedmann and, most famously, Saskia Sassen, each of whom documented the unique role of a select handful of cities as the command and control centers of global finance.[46] That work has since been extended. Perhaps the most commonly known classification of global cities comes from the research group Globalization and World Cities (GaWC), which has provided a rich theoretical and analytical understanding of how cities engage in the global economy through their unique concentrations of advanced services firms.[47] In their capacity as analysts and investors, multilateral institutions like OECD and the World Bank offer valuable, rigorous assessments of growth and competitiveness in global metro areas. Greg Clark and Tim Moonen have found more than 200 indexes that have a global cities focus.[48]

In a summary of global city rankings, the Chicago Council on Global Affairs notes "how methodologies, definitions, data use, and conclusions vary wildly from ranking to ranking." It also notes "biases and challenges common to many indexes, including the author's perspective, lack of reliable and internationally comparable data, and the routine presence of lagging indicators."[49] That report concludes that city officials and policymakers seek out assessments based on standardized data, look beyond topline rankings, and uncover comparative strengths and weaknesses using relevant peers as a baseline comparison.

Against the backdrop of these previous efforts, we develop a metropolitan typology based on regional economic characteristics and competitiveness factors. Classifying and identifying peers allows policymakers and stakeholders to better understand the position of their economies in a globalized context as well as to conduct constructive benchmarking. To select peers we utilized a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering.[50] These commonly used data science techniques allowed us to group metro areas with their closest peers given a set of economic and competitiveness indicators. We used 35 variables in the PCA analysis (see Table 1). We do not include change-over-time metrics in the clustering algorithm, but analyze change variables within and across metropolitan groupings to summarize key trends. For more details, see Appendix A.

This report creates metropolitan groupings based on these factors, summarizes the distinguishing characteristics of each group, and then examines trends within each using a range of indicators. It is important to clarify the two ways in which we use these data. First, we use point-in-time data to create the metropolitan typology. Those indicators and their vintage are outlined in Table 1. Second, we examine change-over-time trends for these same indicators within the analysis. The variables used to measure competitiveness factors come from a variety of sources, including public and private datasets, and as a result the periods for which we can measure key characteristics vary considerably. The analysis of economic and industrial characteristics looks at data between 2000 and 2015; for flows of greenfield FDI we use data corresponding to 2009-2015; for venture capital flows we use data for 2006-2015; for patents we look at stock of patents between 2008 and 2012;

Table 1. Indicators used in the clustering algorithm, 2015 or most recent year available

Dimension	Indicator	Source
Economic and Industrial Characteristics	Population, 2015	Oxford Economics, U.S. Census Bureau
	Gross domestic product, 2015	Oxford Economics, Moody's Analytics
	Gross domestic product per capita, 2015	Oxford Economics, Moody's Analytics, U.S. Census Bureau
	Output per worker, 2015	Oxford Economics, Moody's Analytics
	Industry share of overall output, 2015	Oxford Economics, Moody's Analytics
	Industry output per worker, 2015	Oxford Economics, Moody's Analytics
Traded Clusters	Greenfield foreign direct investment, 2009-2015	fDi Intelligence data
	Greenfield foreign direct investment per capita, 2009-2015	
	Greenfield foreign direct investment jobs created, 2009-2015	
Innovation	Share of total publications in top 10 percent cited papers, 2010-2013	Centre for Science and Technology Studies (CWTS) and Leiden University data
	Share of total publications done with industry, 2010-2013	
	Total patents, 2008-2012	REGPAT
	Total patents per capita, 2008-2012	
	Venture capital investments, millions of dollars per 1,000 inhabitants, 2006-2015	Pitchbook
	Venture capital investments, millions of dollars, 2006-2015	
Talent	Share of population 15+ with tertiary education, 2014 or latest year available	Oxford Economics, U.S. Census Bureau
Infrastructure Connectivity	Total aviation passengers, 2014	SABRE
	Total aviation passengers per capita, 2014	
	Average internet download speed, 2015	Net Index
Governance	Data not available across all metro areas	N/A

Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

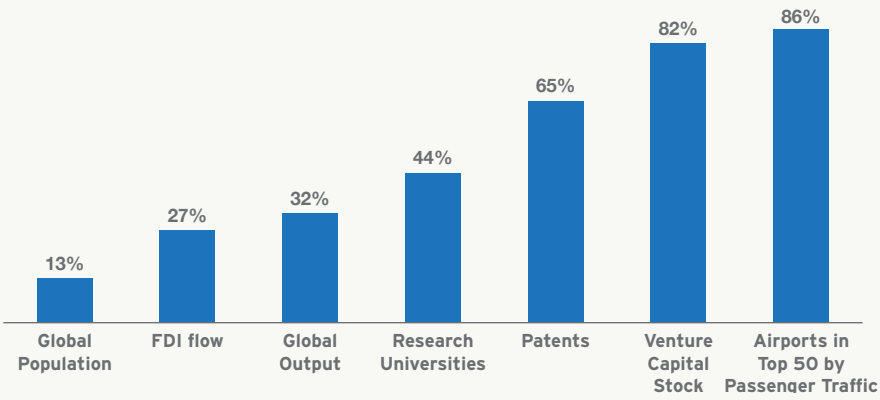
to measure impact of university research we use the 2010-2013 period; the analysis of population with tertiary education corresponds to 2014 or latest year available; aviation passengers uses data for 2004 and 2014; and internet average download speed corresponds to the 2008- 2015 period. For a more detailed description of the data sources please see Appendix A.

The world's large metropolitan areas are notable in their economic primacy. With about 13 percent of the world's people, 123 large metro economies generate nearly one-third of global economic output. Nearly all of the 123 largest metro economies studied in our analysis generate more than $100 billion in annual economic output (in nominal terms), led by Tokyo ($1.6 trillion) and New York ($1.5 trillion).[51]

These metros concentrate economic activity because they house the competitiveness assets required to drive global growth. They have attracted more than $5.4 trillion in greenfield FDI since 2009, more than one-quarter of the global total; six of the top 10 largest inflows were destined for the Asian metros of Singapore, Shanghai, Hong Kong, Beijing, Suzhou, and Chongqing. When controlling for population size, FDI concentrations are still greatest in many of these Asian metros, but smaller metro economies in North America (Austin and Vancouver), Europe (Birmingham and Barcelona), and Australia (Sydney) also join the top 10.

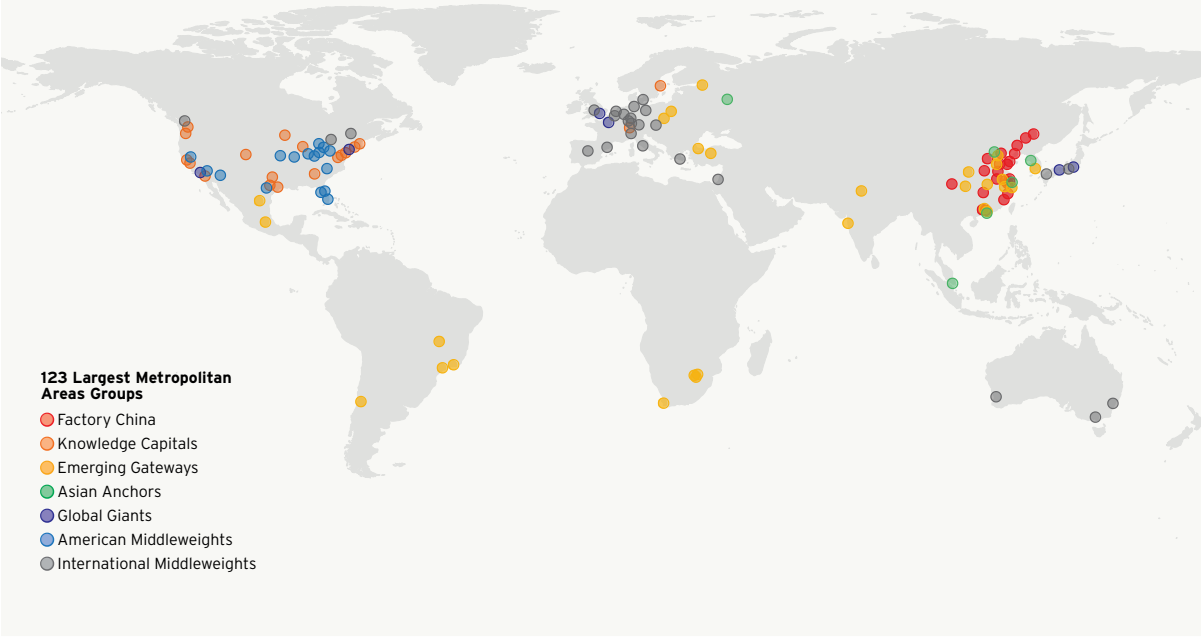
The top 123 metro economies are critical generators of new scientific research and innovation. Together, they account for 44 percent of the world's most scientifically impactful research universities, generate 65 percent of all patents, and attract 82 percent of all venture capital. The largest patent-producing metros are among the largest economies in the world, including Tokyo, Seoul-Incheon, Shenzhen, Osaka, and San Jose. However, in terms of patents per capita a smaller set of highly innovative cities rises to the top: San Jose, San Diego, San Francisco, Boston, and Stuttgart. Many of these metro areas

Figure 1. Global share of competitiveness factors, 123 largest metros, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, and Pitchbook.

Map 1. Seven Types of Global Cities, 2015



are also among the most educated in the world. San Jose, San Francisco, and Boston join Singapore, London, Washington, and Madrid as the metros with the highest shares of their populations with tertiary education.

These metros also concentrate much of the world's critical infrastructure. In 2014, airports in these metro areas transported more than 4.9 billion air passengers. The largest metro economies in the world, which house multiple large airports, move the most aviation passengers. New York, London, Shanghai, Los Angeles, Tokyo, Beijing, Chicago, and Atlanta had the highest passenger volumes in 2014. The 123-metro sample contains 86 percent of the world's 50 busiest international airports.

THE SEVEN TYPES OF GLOBAL CITIES

This collective economic clout, however, masks the significant variation in which competiveness factors are distributed across these cities. While each metropolitan economy in our sample possesses a unique trade, innovation, talent, and infrastructure connectivity profile, the distribution of these assets reveals a clear typology of places. We used advanced statistical techniques to cluster metro economies based on their size, industrial structure, and competitiveness factors. In some cases, these groupings align to specific regions, like in China or the United States. But just as often the groupings unite metro economies from different parts of the world, showcasing that they share more in common with far-flung counterparts than with their regional neighbors. And while we include only point-in-time measures in the clustering algorithm, the resulting groupings perform quite similarly on growth metrics.

When grouped into seven metropolitan categories, the distinct competitive positions of the world's largest metro economies become sharper, and the result is a resource that peer metropolitan areas can utilize for common solutions and investments to enhance economic growth:

- **Global Giants:** six large, wealthy hubs with concentrations of corporate headquarters; they serve as the command and control centers for the world's largest advanced economies.
- **Asian Anchors:** five large, business and financial nodes anchoring inward investment into the Asia-Pacific and Russia.
- **Emerging Gateways:** 28 large business and transportation entry points for major national and regional emerging markets in Africa, Asia, Eastern Europe, and Latin America.
- **Factory China:** 22 second- and third-tier Chinese cities distinctly reliant on export-intensive manufacturing to power economic growth and global engagement.
- **Knowledge Capitals:** 19 mid-sized, highly productive knowledge creation centers in the United States and Europe with talented workforces and elite research universities.
- **American Middleweights:** 16 mid-sized U.S. metro areas striving for a post-recession niche in the global economy.
- **International Middleweights:** 26 mid-sized cities in Australia, Canada, and Europe globally connected by people and investment flows, but where growth has lagged after the financial crisis.

Table 2. Seven types of global cities, 2015

Group name	Metro areas	Number of observations
Global Giants	London, Los Angeles, New York, Osaka-Kobe, Paris, and Tokyo	6
Asian Anchors	Beijing, Hong Kong, Moscow, Seoul-Incheon, Shanghai, and Singapore	6
Emerging Gateways	Ankara, Brasilia, Busan-Ulsan, Cape Town, Chongqing, Delhi, East Rand, Guangzhou, Hangzhou, Istanbul, Jinan, Johannesburg, Katowice-Ostrava, Mexico City, Monterrey, Mumbai, Nanjing, Ningbo, Pretoria, Rio de Janeiro, Saint Petersburg, Santiago, Sao Paulo, Shenzhen, Tianjin, Warsaw, Wuhan, and Xi'an.	28
Factory China	Changchun, Changsha, Changzhou, Chengdu, Dalian, Dongguan, Foshan, Fuzhou, Haerbin, Hefei, Nantong, Qingdao, Shenyang, Shijiazhuang, Suzhou, Tangshan, Wenzhou, Wuxi, Xuzhou, Yantai, Zhengzhou, and Zibo	22
Knowledge Capitals	Atlanta, Austin, Baltimore, Boston, Chicago, Dallas, Denver, Hartford, Houston, Minneapolis, Philadelphia, Portland, San Diego, San Francisco, San Jose, Seattle, Stockholm, Washington DC, and Zurich	19
American Middleweights	Charlotte, Cincinnati, Cleveland, Columbus, Detroit, Indianapolis, Kansas City, Miami, Orlando, Phoenix, Pittsburgh, Riverside, Sacramento, San Antonio, St. Louis, and Tampa	16
International Middleweights	Brussels, Copenhagen-Malmö, Frankfurt, Hamburg, Karlsruhe, Köln-Düsseldorf, Milan, Munich, Nagoya, Rome, Rotterdam-Amsterdam, Stuttgart, Vienna-Bratislava, Athens, Barcelona, Berlin, Birmingham, (UK), Kitakyushu-Fukuoka, Madrid, Melbourne, Montreal, Perth, Sydney, Tel Aviv, Toronto, and Vancouver	26

GLOBAL GIANTS

Global Giants serve as the command and control centers of the world's largest advanced nations. This group includes the largest cities in the United States (New York and Los Angeles), Japan (Tokyo and Osaka-Kobe), France (Paris), and the United Kingdom (London). These metro areas not only serve as the main entry points for their extremely powerful nations, but as the world's most significant concentrations of wealth, corporate decision making, and international exchange.

The first characteristic that binds these metro areas together is their size. On average, Global Giants house 19.4 million residents and generate over $1 trillion in real output, three times more than the next largest set of economies, the Asian Anchors. If they were a single country, they would be the world's third largest economy. Beyond their overall economic clout, these metro economies are highly productive and generate enormous wealth. They have the second highest average nominal GDP per person ($58,000) and GDP per worker ($116,000) among the metro groups, behind only the Knowledge Capitals.

These wealth levels stem from the concentration of financial and business services, which generate 41 percent of gross value added (GVA), on average, in this group. About 20 percent of the Forbes Global

Map 2. Global Giants, 2015

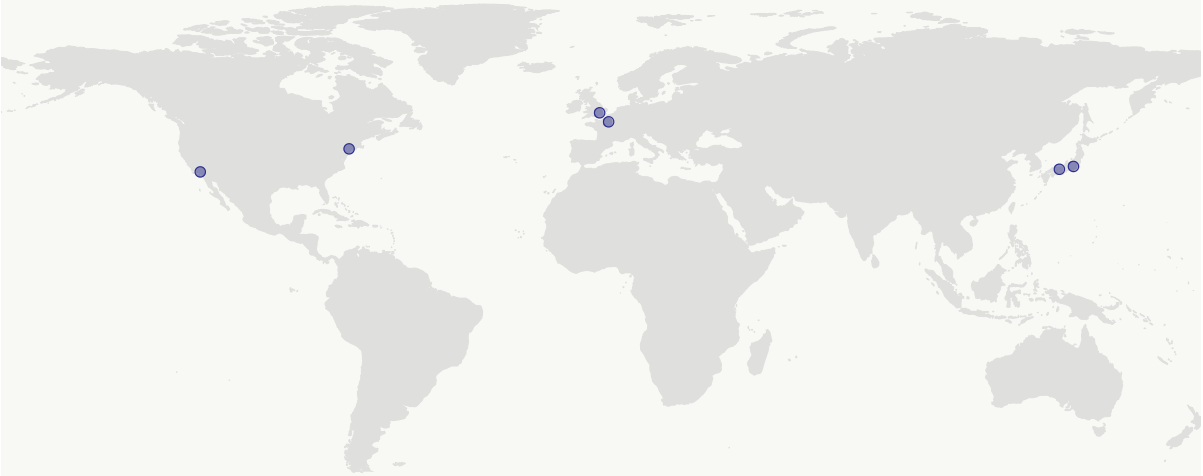
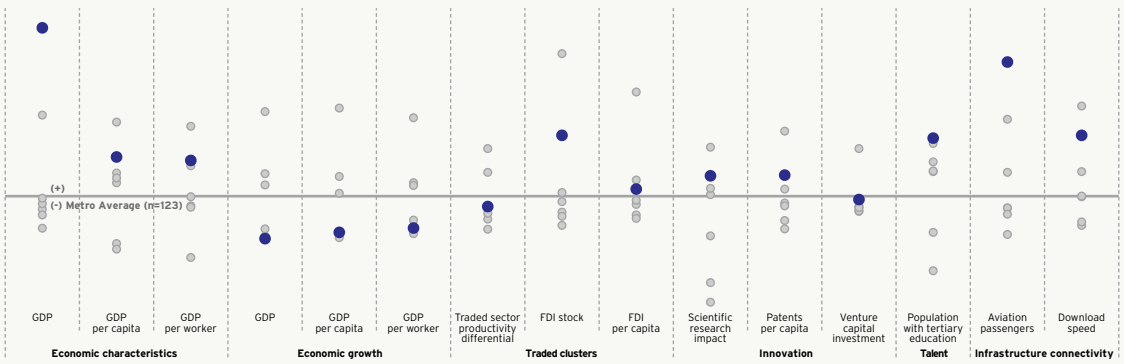


Figure 2. Global Giant indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

Table 3. Global Giants economic indicators, 2015

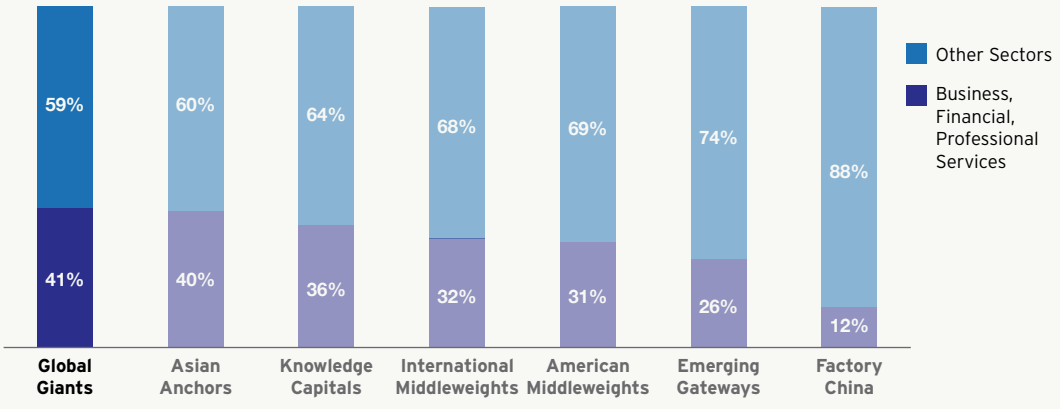
Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Tokyo	37,004	1,623,904	43,884
New York	20,182	1,492,242	73,938
Los Angeles	13,340	927,562	69,532
London	14,855	831,100	55,947
Paris	12,524	818,522	65,354
Osaka-Kobe	18,640	680,997	36,535
Global Giants Average	**19,424**	**1,062,388**	**57,532**

Source: Oxford Economics, U.S. Census Bureau, and Moody's Analytics.

Figure 3. Average metropolitan gross domestic product, 2015

Source: Oxford Economics and Moody's Analytics.

Figure 4. Gross value added by type of service, 2015



Source: Oxford Economics, U.S. Census Bureau, and Moody's Analytics.

2000 and 18 percent of global firms with more than $1 billion in revenue, plus five of the world's seven largest stock exchanges by market capitalization, are headquartered in these six markets. Dense clusters of advanced-producer-services firms in law, accounting, management consulting, and advertising have formed to support the complex decision making occurring in the financial markets and board rooms of multinational firms.[53]

These are also the world's major nodes for flows of people, capital, and knowledge. In 2014, over 800 million aviation passengers traveled through these markets, by far the highest total of any grouping. Global travelers often stay to live and work; a little under one in six residents of a Global Giant is foreign born.[54] Capital flows seamlessly through Global Giants. Foreign investors parked an average of $25 billion in these markets between 2009 and 2015, the second highest after the Asian Anchors. Finally, knowledge creation is increasingly a major function of these metro economies. Among the seven types of metro areas, Global Giants have the highest education levels, the second highest patenting rates, and the second highest share of high-impact scientific publications in their universities. Every metro area except Osaka is among the top 15 globally in terms of digital data flows.[55] And venture capital investment data reveal that they are also sites for budding entrepreneurship, especially London and New York.[56]

By nearly every measure these cities are globally integrated and fluent. Saskia Sassen mainstreamed the phrase "global city" in her 1991 book about London, New York, and Tokyo. The world's mobile talent and capital seek them out, and they have benefited from multiple cycles of high demand.[57] Paris is regularly cited in this class of global city, but Los Angeles and Osaka may be more surprising additions given that they are not generally considered among the world's leading financial hubs. However, they loom large on the global stage by dint of their shear economic weight—Los Angeles and Osaka are the fifth and sixth largest metro economies in the world, respectively.

ASIAN ANCHORS

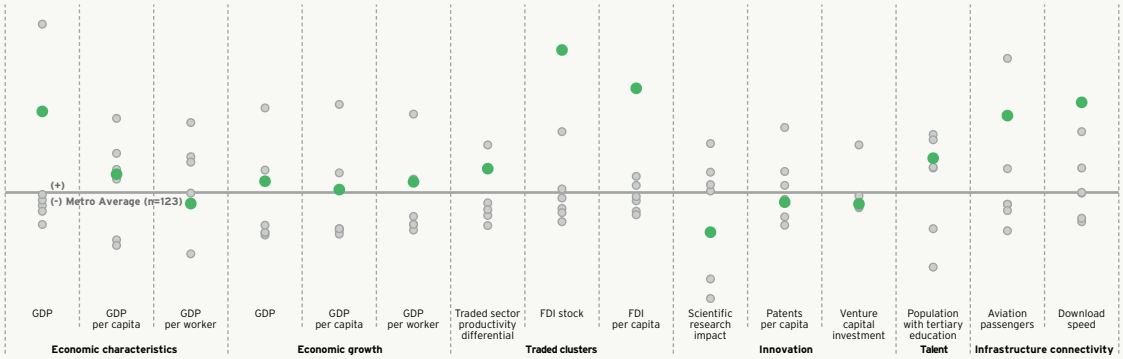
Asian Anchors include five Pacific-facing metro areas—Beijing, Hong Kong, Seoul-Incheon, Shanghai, and Singapore— as well as Moscow, which, while more aligned with Europe, falls in this group due to its similarity in size, wealth, and reliance on business and financial services with many of these Asian metro economies.[58] Asian Anchors have many of the same characteristics as their established counterparts in Europe, Japan, and the United States, but are not yet as wealthy and globally connected.

The rise of the metros in this group has everything to do with the rise of Asia. The ascent of the Asian Tiger economies followed by the gradual liberalization of China and Russia positioned these cities as the gateways between the global investment community and their fast-growing nations. Those foreign investment streams brought new industries and capabilities to many of these cities, which have since been bolstered by local investments in infrastructure and skills.

Asian Anchors are now among the cities with the largest concentrations of people and market activity in the

Map 3. Asian Anchors, 2015

Figure 5. Asian Anchors indicators, 2015 or most recent year available



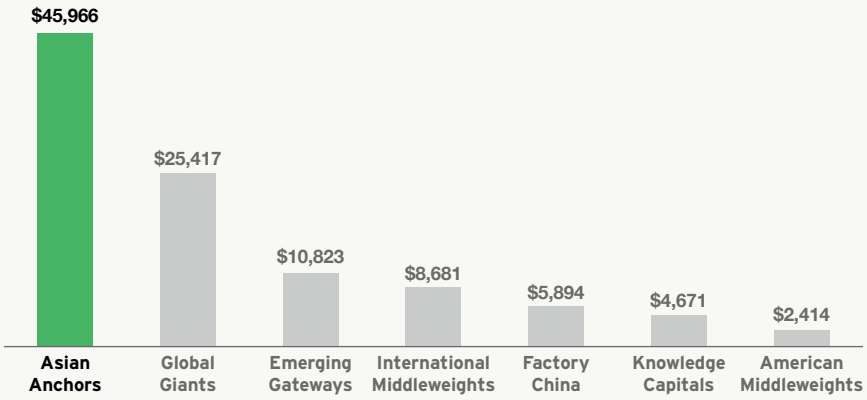
Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

Table 4. Asian Anchors economic indicators, 2015

Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Seoul-Incheon	25,095	903,466	36,002
Shanghai	24,768	809,507	32,684
Moscow	12,194	749,686	61,482
Beijing	21,876	663,590	30,335
Singapore	5,546	468,087	84,399
Hong Kong	7,295	413,999	56,751
Asian Anchors Average	**16,129**	**668,056**	**50,276**

Source: Oxford Economics.

Figure 6. Greenfield foreign direct investment in metropolitan groups (millions of $US), 2009-2015



Source: Brookings analysis of fDi Intelligence and Oxford Economics data.

world. These metros have an average population of 16.1 million residents and an average GDP of $668 billion, the second largest figures among the seven groups. GDP per capita in these regions has grown by a robust 4.2 percent per year since 2000. On average residents of the Asian Anchors are now firmly rooted in the global middle class. Interestingly, this average masks significant differences in nominal GDP per capita among the wealthiest metros in this group, Singapore ($84,000) and Hong Kong ($57,000), and the lowest-income metros, Shanghai ($33,000) and Beijing ($30,000). In line with convergence theory, the lower-income city-regions in this group have seen the fastest income growth since 2000.

Despite their disparities in wealth, several characteristics bind this group, especially the five Asian metro areas. First, the generous inflows of FDI distinguish these regions from the rest of the world. On average, $46 billion in greenfield FDI entered each of these markets between 2009 and 2015, nearly double the average of the next highest grouping. No metro areas in the world attracted more FDI than Hong Kong and Singapore during this period, and Beijing and Shanghai were not far behind. These cities provide a distinct value proposition for foreign investment: they afford access to a rapidly growing Asian consumer market; they provide strong infrastructure connectivity—Asian Anchors rank second in total aviation

passengers, behind Global Giants, and first in average internet download speed and relatively well-educated workforces; and they offer a more conducive regulatory and political environment than many peers in the region.[59] It is notable that Moscow has not kept pace with the other Asian metros in this category in regard to FDI attraction.

These metro areas, along with Tokyo and Osaka-Kobe, are where Asia's business gets done. About 32 percent of gross value added in these six metros is generated by financial and business services, 10 percent of Global 2000 firms are headquartered in these markets, and major stock exchanges are located in Shanghai, Hong Kong, and Seoul. Singapore is a significant financial trading hub in its own right. And 41 percent of Moscow's GVA is in financial and business services.

Yet, labor productivity in this sector is only about one-third as high as in Global Giants, revealing that much work needs to be done to move further up the value-added chain. These metro areas are not yet on par with their Western counterparts in terms of patenting intensity or the scientific impact of their universities, although they can be considered the innovation hubs of their respective countries. Beijing and Shanghai together generate 23 percent of China's patents, Moscow generates 55 percent of Russia's, and Seoul-Incheon generates 67 percent of South Korea's. Patents per capita increased by 78 percent across Asian Anchors between 2007 and 2012. And the share of scientific publications generated in these markets that can be considered high-impact increased by 18 percent between 2009 and 2013, the second fastest increase among the seven groupings.

EMERGING GATEWAYS

Emerging Gateways are 28 large metropolitan areas from developing economies that serve as the business, transportation, and oftentimes political centers of their countries and regions. Nearly one-third of the cities in this group are the official capital of their respective countries (e.g., Ankara, Brasilia, Cape Town, Mexico City, Pretoria, Santiago, and Warsaw). In fact, eight of the metropolitan areas in this group serve as the financial centers of their countries and house the largest national stock exchange. Many of these cities served as the focal point of their national economies as the countries liberalized their markets for flows of trade, investment, and people at the end of the 20th century.[60] Additionally some of these cities also serve as gateways for entire regions, as is the case for São Paulo in financial and business services within South America[61]; Istanbul connecting the Middle East and Europe; Johannesburg as the business hub of sub-Saharan Africa; and Shenzhen as a major complementary business hub in China to Beijing, Hong Kong, and Shanghai.[62]

Map 4. Emerging Gateways, 2015

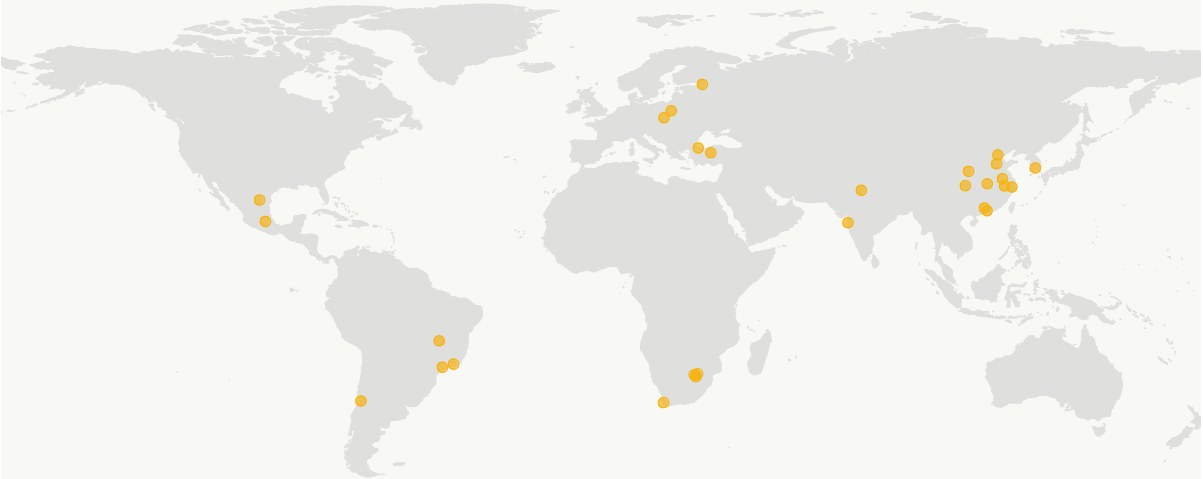
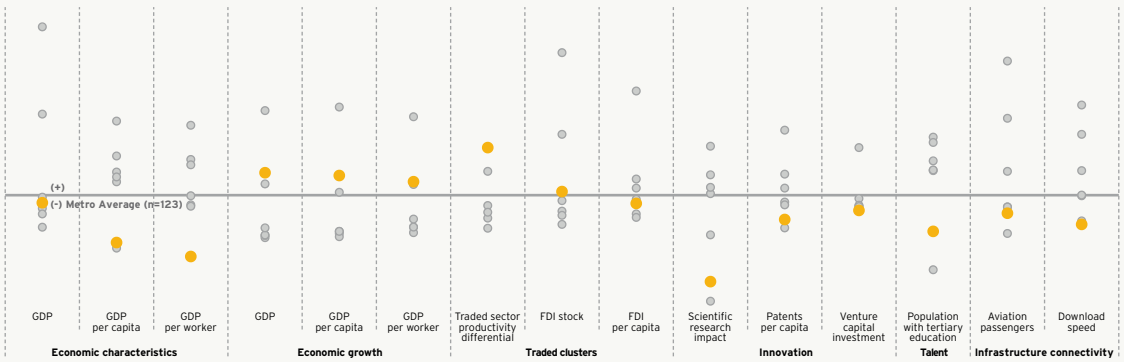


Figure 7. Emerging Gateways indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

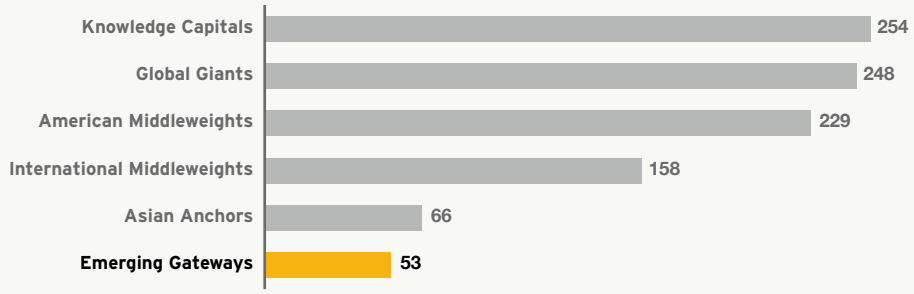
Table 5. Emerging Gateways economic indicators, 2015

Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Sao Paulo	21,175	579,473	27,366
Guangzhou	13,155	523,554	39,800
Shenzhen	10,816	490,761	45,374
Mexico City	21,099	485,621	23,017
Tianjin	15,646	477,808	30,538
Istanbul	14,627	449,388	30,723
Chongqing	30,159	425,472	14,108
Delhi	23,513	396,449	16,861
Wuhan	10,261	323,517	31,529
Busan-Ulsan	7,812	305,931	39,160
Hangzhou	8,922	274,969	30,820
Nanjing	8,245	271,934	32,983
Rio de Janeiro	12,172	233,238	19,162
Ningbo	7,724	233,000	30,166
Mumbai	21,799	221,192	10,147
Santiago	7,300	213,908	29,303
Jinan	7,066	174,317	24,671
Warsaw	2,901	164,068	56,564
Xi'an	8,606	160,578	18,658
Brasilia	4,076	159,587	39,150
Saint Petersburg	5,190	158,084	30,459
Monterrey	4,404	140,512	31,906
Katowice-Ostrava	5,008	136,218	27,200
Ankara	5,226	133,934	25,630
Johannesburg	4,725	94,096	19,913
Cape Town	3,976	66,599	16,750
East Rand	3,306	62,492	18,904
Pretoria	3,200	61,240	19,141
Emerging Gateways Average	**10,432**	**264,926**	**27,857**

Source: Oxford Economics.

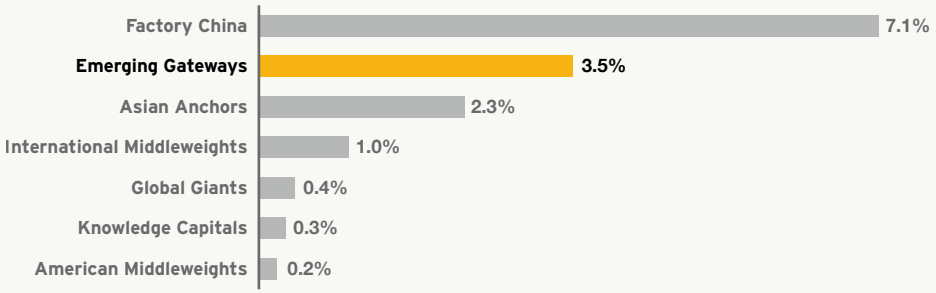
Metropolitan areas in this group house on average 10 million inhabitants and have an average GDP of $265 billion, with some megacities boasting economies of more than $400 billion (São Paulo, Guangzhou, Shenzhen, Mexico City, Tianjin, Istanbul, and Chongqing). The average inhabitant of these metro areas entered the global middle class over the past 15 years. Real GDP per capita in Emerging Gateways has grown 5.5 percent annually since 2000 (second fastest after Factory China metros). Nominal GDP per capita now stands at around $28,000. Asian metro areas in this group experienced greater GDP per capita gains (8.1 percent annually) between 2000 and 2015 than did their Latin American (3.2 percent) and African counterparts (3.6 percent).

Figure 8. Output per worker in business, financial, and professional services in metropolitan groups, (thousands of real USD), 2015[63]



Source: Brookings analysis of Oxford Economics data.

Figure 9. Aviation passengers compound annual growth in metropolitan groups, 2004-2014



Source: Brookings analysis of SABRE data.

These regions disproportionately concentrate their nation's competitiveness assets. All the cities in this group have a higher share of their working-age population with tertiary education compared to their national economies. Many are home to their nation's only globally relevant research universities. Cities like Istanbul, Santiago, São Paulo, and Shenzhen account for more than 40 percent of all the patents produced in their countries. Business, professional, and technical services accounted for 25 percent of total output in these metro areas. However, the productivity of the average worker in this sector is one fifth that of their peer metros in the Knowledge Capitals, Global Giants, and American Middleweight group.

Emerging Gateways are the entry points for global flows of people and capital. They typically house the best-connected international airports of their nations. In 2014 all the airports in these metropolitan areas transported 800 million passengers, up from the 273 million in 2004. In fact, the average metro, which in 2014 transported 28 million passengers per year, up from 9 million passengers in 2004, registered the second fastest annual passenger growth rate—3.5 percent—among all groups, behind only Factory China. Metropolitan areas in this group received FDI flows of $58 billion between 2009 and 2015, but on a per capita basis these investment flows trail most of the other metro groups. They are not yet on par with the Global Giants in terms of international business or with Knowledge Capitals in terms of global innovation, although their prominence is growing quickly. FDI flows doubled between 2011 and 2015, and the stock of venture capital investment grew by 300 percent, from $4.3 billion in 2010 to $14.1 billion in 2015.

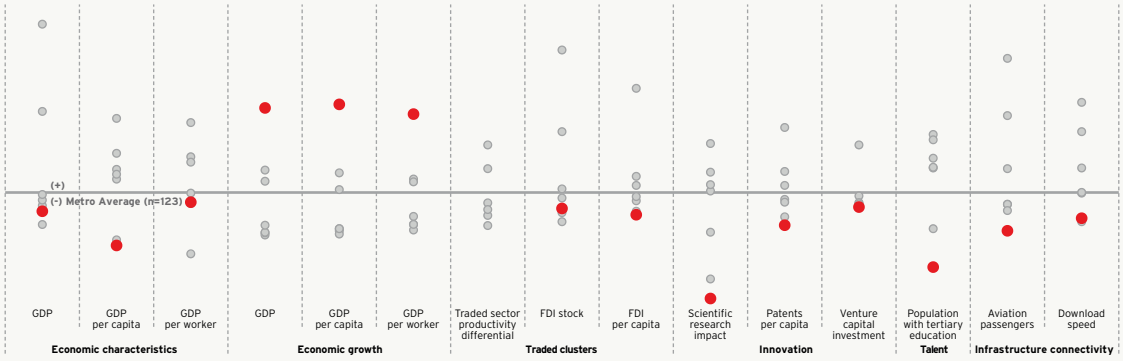
FACTORY CHINA

Factory China comprises Chinese manufacturing hubs, and the 22 cities are a good representation of the geographic diversity of China's industrial revolution. Factory China includes metros on China's east coast (Hefei and Nantong), inland regions (Chengdu and Zibo), and the Pearl River Delta (Foshan and Dongguan).[64]

The metro areas in Factory China are second- and third-tier population centers that are growing quickly. The typical city in this group has an average population of 8 million and a nominal GDP of $205 billion. Output and employment have grown in these metros by an outstanding 12.6 and 4.7 percent annually between 2000 and 2015, the fastest pace among our seven groups. Real GDP per capita has expanded fivefold since 2000, from $2,500 to $12,000, rooting these metros firmly in the global middle class.

Map 5. Factory China, 2015

Figure 10. Factory China indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

Table 6. Factory China economic indicators, 2015

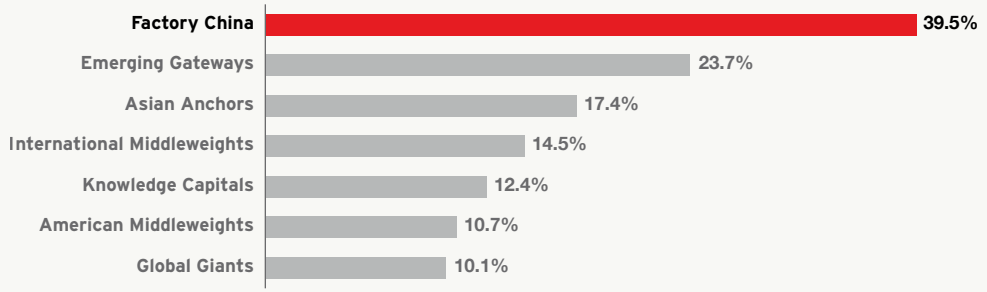
Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Suzhou	10,658	440,255	41,306
Chengdu	14,407	306,458	21,272
Wuxi	6,526	269,957	41,368
Qingdao	9,054	265,789	29,357
Changsha	7,308	245,571	33,604
Dalian	6,942	245,161	35,317
Foshan	7,424	234,737	31,620
Shenyang	8,257	230,103	27,869
Zhengzhou	9,203	209,690	22,784
Tangshan	7,803	190,743	24,446
Dongguan	8,466	186,042	21,976
Yantai	7,057	183,501	26,003
Nantong	7,357	169,781	23,079
Changchun	7,601	162,933	21,435
Fuzhou	7,444	159,572	21,437
Haerbin	10,669	159,238	14,926
Hefei	6,043	156,989	25,979
Shijiazhuang	10,644	156,264	14,681
Xuzhou	8,660	149,682	17,284
Changzhou	4,727	147,281	31,155
Wenzhou	9,275	131,441	14,172
Zibo	4,633	123,273	26,608
Factory China Average	**8,189**	**205,657**	**25,804**

Source: Oxford Economics.

The most salient feature of this group is the extreme reliance on manufacturing, which accounts for nearly 40 percent of total output in the typical Factory China city, the highest among all groups. In fact, Factory China cities were more manufacturing-intensive in 2015 than they were in 2000, when manufacturing accounted only for 30 percent of their GDP. With only 25 percent of national population, Factory China metros generate one-third ($800 billion) of China's total manufacturing value added.

Factory China metro areas plug into the global economy as nodes in international manufacturing supply chains, typically providing goods to wealthier consumer markets in advanced economies. Multinational corporations like Unilever (operating in Hefei), Goodyear (Dalian), Samsung (Dongguan), DuPont (Dongguan and Changshu), Intel (Dalian), Pfizer (Dalian and Hangzhou), and Dell (Chengdu) anchor manufacturing operations in Factory China.[65] This specialization has proved effective in building wealth and moving millions of Chinese households into the global middle class. But growth has come with significant environmental costs. The heavy industrial

Figure 11. Manufacturing share of real gross value added in metropolitan groups, 2015



Source: Brookings analysis of Oxford Economics and Moody's Analytics data.

activity has resulted in pollutant levels that are 40 times above what the World Health Organization recommends, and 40 percent of China's rivers are polluted.[66]

Currently, business, financial, and professional services—economic activities typically associated with urban agglomeration—account for only 12 percent of total output in this group, well below the average of 32 percent for the other groups. The lack of economic diversification partly explains why cities in this cluster rank last in flows of FDI, venture capital attraction, and international passengers. Additionally, only 13 of the cities in this group house a top-ranked research university. Factory China metros file only 0.03 patents per 10,000 employees, and less than 10 percent of the population 15 years or older has tertiary education.

"Factory China metro areas plug into the global economy as nodes in international manufacturing supply chains, typically providing goods to wealthier consumer markets in advanced economies."

KNOWLEDGE CAPITALS

Knowledge Capitals tend to be mid-sized population centers that are among the wealthiest and most productive in the world. This group of 19 metropolitan economies has an average population of 4.2 million, the second smallest group by population. But because they are so productive, these metro areas have the third highest average economic output ($283 billion) and the highest nominal GDP per capita ($69,000) and GDP per worker ($136,000) of any group.

Map 6. Knowledge Capitals, 2015

Figure 12. Knowledge Capitals indicators, 2015 or most recent year available

Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

Table 7. Knowledge Capitals economic indicators, 2015

Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Chicago	9,551	582,496	60,988
Houston	6,657	505,218	75,893
Dallas	7,103	458,043	64,488
Washington	6,098	454,088	74,469
San Francisco	4,656	375,055	80,551
Boston	4,774	370,731	77,651
Philadelphia	6,070	363,644	59,910
Atlanta	5,711	310,822	54,427
Seattle	3,734	285,634	76,504
Minneapolis	3,525	227,417	64,523
San Diego	3,300	217,562	65,938
San Jose	1,977	180,757	91,437
Denver	2,814	179,882	63,916
Baltimore	2,797	178,121	63,673
Stockholm	2,615	167,911	64,223
Portland, Ore.	2,389	159,219	66,640
Zurich	1,972	135,596	68,761
Austin	2,001	119,234	59,591
Hartford	1,211	101,787	84,029
Knowledge Capitals	**4,155**	**282,801**	**69,348**

Source: Oxford Economics, U.S. Census Bureau, and Moody's Analytics.

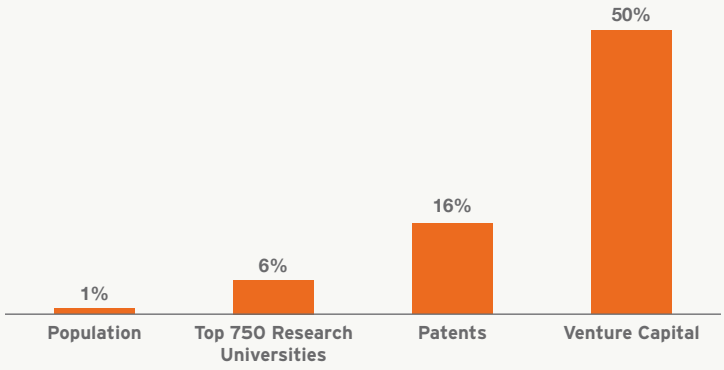
Knowledge Capitals are the world's leading knowledge creation centers. They compete in the highest value-added segments of the economy, relying on their significant stock of human capital, innovative universities and entrepreneurs, and relatively sound infrastructure connectivity.

These places are supremely well educated: 41 percent of their 15-and-over population has obtained a college degree. Many of these are graduates from the elite research universities that anchor these metro economies' distinct positions in science and technology. Universities in this group boast the largest share of highly cited scientific publications. Of the 100 most scientifically impactful universities in the world, 20 are located in these cities.

Scientific research tends to translate to new inventions in these regions, which have the highest average rates of patenting in the world. With only about 1 percent of the world's population, Knowledge Capitals generated 16 percent of global patents between 2008 and 2012; shares were even higher in information technology (22 percent) and life sciences (19 percent). Led by San Jose, San Francisco, and Boston, Knowledge Capitals also have, by far, the highest venture capital investment rates per capita in the world. More than half of all global venture capital funding flowed to these 19 markets over the past decade.

Finally, controlling for their population size, these metro economies have the greatest volume of aviation passengers in the world, signifying the substantial flows of business and leisure travelers flocking

Figure 13. Global Share of innovation assets in Knowledge Capital metros, 2015 or most recent year available



Source: Brookings analysis of Oxford Economics, U.S. Census Bureau, Centre for Science and Technology Studies (CWTS) and Leiden University, REGPAT, and Pitchbook.

to these places. However, foreign direct investment inflows are not as substantial as in other groupings, revealing that, for all their assets, many of these mid-sized metros must proactively assert their visibility in the global marketplace.

Knowledge Capitals overwhelmingly are located in the United States. All but two (Stockholm and Zurich) are U.S. cities, including well-known coastal innovation hubs like Boston, San Francisco, San Jose, and Seattle. But they also include metro economies in the Midwest (Chicago, Minneapolis-St. Paul) and the South (Atlanta, Austin, Dallas, Houston), which now tend to compete in technology-intensive advanced industries across both manufacturing and services.[67] Stockholm and Zurich represent two of Europe's wealthiest and most productive economies, specializing in professional, scientific, and technical services; finance; and information technology. Overall, output per worker in these metro areas is 9 percent higher than in the next most productive metro grouping.

Not only are Knowledge Capitals more productive than the rest of their advanced economy peers, but the gap is widening. Between 2000 and 2015, growth in annual GDP per capita and GDP per worker averaged 0.9 and 1.4 percent, respectively, in Knowledge Capitals. This is by no means a blistering pace, but these growth rates are 37 percent and 69 percent faster, respectively, then average growth rates across the other three developed-economy groupings.

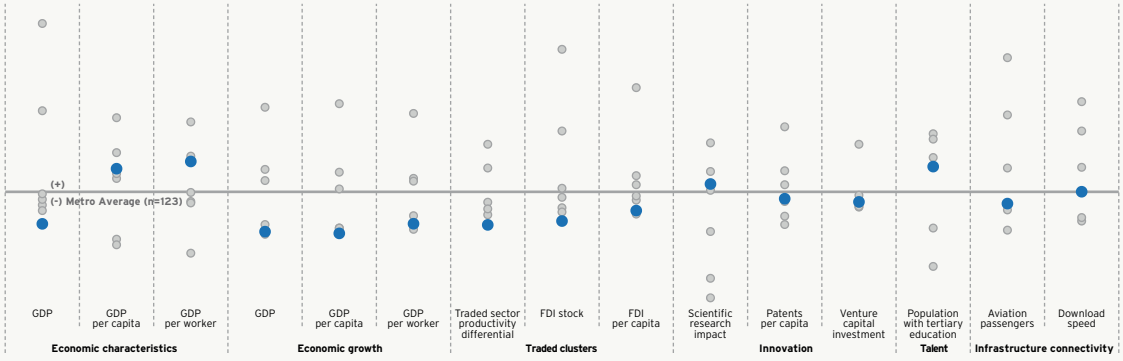
"Knowledge Capitals are the world's leading knowledge creation centers. They compete in the highest value-added segments of the economy, relying on their significant stock of human capital, innovative universities and entrepreneurs, and relatively sound infrastructure connectivity."

AMERICAN MIDDLEWEIGHTS

Sixteen cities form the American Middleweights. Metropolitan areas in this group are almost evenly divided between mid-sized production centers in America's North and East (Cincinnati, Cleveland, Pittsburgh, Indianapolis, Detroit) and Southern cities that have experienced significant population growth (Miami, Phoenix, Orlando, St. Louis, Tampa, Sacramento). The average metropolitan area has 3 million inhabitants, generates $149 billion in nominal output, and has a nominal GDP per capita of $52,000. Growth in overall output (1.6 percent), GDP per capita (0.4 percent), and employment (0.7 percent) has lagged most other metro groupings between 2000 and 2015, perhaps due partly to the high concentration of non-traded clusters in their economies. American Middleweights have the highest concentration of local services (health care, real estate, education, and public services), accounting for 28 percent of output and 42 percent of employment. Moreover, their tradable industries tend to be less productive than national averages. While many of the cities in this group are still finding their global niche, they all maintain at least one globally relevant

Map 7. American Middleweights, 2015

Figure 14. American Middleweights indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

Table 8. American Middleweights economic indicators, 2015

Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Miami	6,012	282,514	46,989
Detroit	4,302	218,080	50,692
Phoenix	4,575	214,809	46,958
Riverside	4,489	167,864	37,393
St. Louis	2,812	146,024	51,937
Pittsburgh	2,353	141,339	60,066
Tampa	2,975	140,263	47,144
Charlotte	2,426	131,636	54,253
Sacramento	2,274	126,103	55,449
Orlando	2,387	125,898	52,740
Cleveland	2,061	117,493	57,013
Cincinnati	2,158	115,552	53,553
Indianapolis	1,989	114,936	57,791
San Antonio	2,384	113,910	47,779
Columbus	2,022	113,875	56,328
Kansas City	2,087	110,456	52,914
American Middleweights	**2,957**	**148,797**	**51,812**

Source: U.S. Census Bureau and Moody's Analytics.

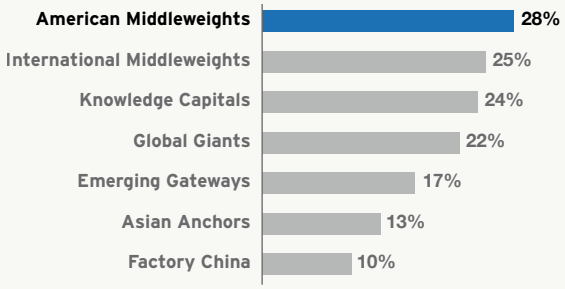
export sector. For instance, Charlotte, Detroit, and Phoenix are among the leading metro exporters of engine and power equipment, motor vehicles, and semiconductors, respectively. As a group, American Middleweights increased their exports by 1.9 percent per year between 2008 and 2014, slightly below the national average of 2.4 percent in the same period.[68]

The prevalence of local services accentuated the impact of the 2008 economic and financial crisis, particularly in Sunbelt cities that relied heavily on construction and real estate development to power economic growth.[69] Between 2008 and 2010 the construction sector shrank 11 percent per year, the highest drop among all the groups, while the average home lost 29 percent of its value between 2008 and 2012.[70] Cities like Detroit, Miami, Orlando, and Phoenix saw home price declines of more than 30 percent.

"American Middleweights have a base of educated workers, research universities and hospitals, and tradable clusters. Aligning these assets to improve export competitiveness through coordinated economic strategies will be critical if these metros are to compete in global markets."

Figure 15a. Share of output in traded sectors in metropolitan groups, 2015

Figure 15b. Share of output in local services in metropolitan groups, 2015



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

At the same time, the manufacturing sector—once the engine of export-led growth in places like Cleveland, Detroit and St. Louis—has seen its share of output and employment decline relative to other sectors of the economy.[71] Due to automation and strong competition from abroad, manufacturing employment declined 2.1 percent annually since 2000. Today, manufacturing accounts only for 7 percent of total employment in this group.

American Middleweights have assets, however. They house well-regarded research universities. Cities in this group ranked third among all other groups in the share of scientific publications in the top 10 percent of most-cited academic journals. Additionally, one-third of the working-age population in these markets boasts a tertiary degree, ranking it fourth among all groups. The combination of a highly skilled labor force and world-class research universities is also strengthened by venture capital per capita, an indicator on which American Middleweights ranked third among all their peers.

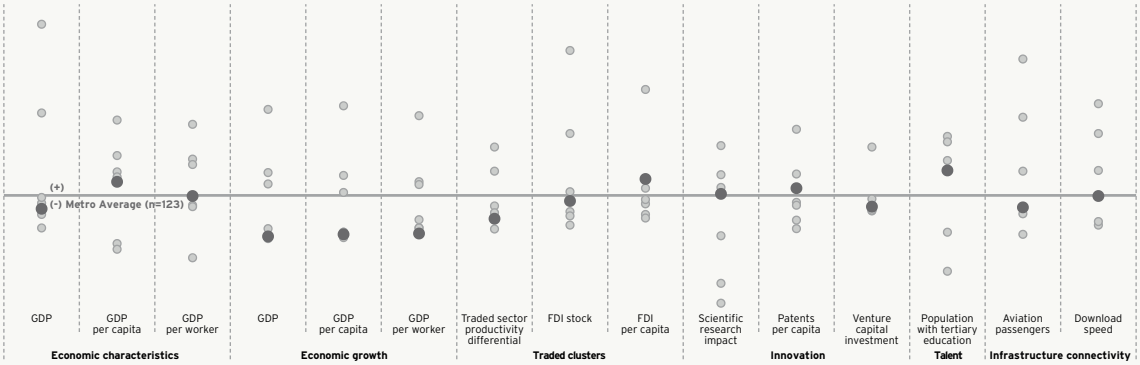
INTERNATIONAL MIDDLEWEIGHTS

International Middleweights include a diverse group of wealthy cities in Canada (Toronto, Vancouver), Europe (Brussels, Berlin, Munich, Rome, Milan, Munich), Asia (Kitakyushu-Fukuoka, Nagoya, Tel Aviv), and Australia (Sydney, Melbourne). These 26 metros have an average population of 4.8 million, output of $234 billion, and nominal GDP per capita of $49,000, fifth among our groups.

International Middleweights are the most varied group of metro economies. Cities like Toronto, Sydney, Frankfurt, Madrid, and Copenhagen play a fundamental role in the provision of business and financial services in their national and regional economies. In parallel, industrial centers such as Kitakyushu-Fukuoka, Nagoya, Stuttgart, Karlsruhe, Milan, and Barcelona generate significant levels of manufacturing value added in Japan, Germany, and Southern Europe, respectively. Most have diversified tradable sectors that tend to specialize in knowledge services, advanced manufacturing, or some combination of both.

Map 8. International Middleweights, 2015

Figure 16. International Middleweights indicators, 2015 or most recent year available



Source: Oxford Economics, U.S. Census Bureau, Moody's Analytics, fDi Intelligence data, Centre for Science and Technology Studies (CWTS) and Leiden University data, REGPAT, Pitchbook, and SABRE.

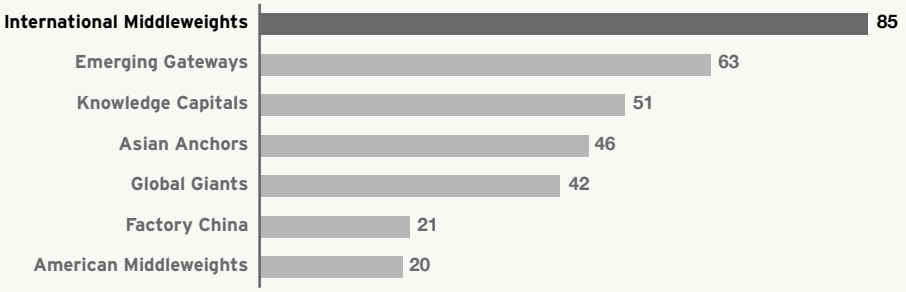
Table 9. International Middleweights economic indicators, 2015

Cities	Population 2015 (thousands)	Nominal GDP 2015 ($ millions)	Nominal GDP per capita 2015 ($)
Köln- Düsseldorf	11,488	548,379	47,735
Rotterdam-Amsterdam	7,146	397,399	55,610
Milan	7,722	380,609	49,286
Nagoya	9,049	377,075	41,672
Madrid	6,586	315,507	47,905
Toronto	6,124	292,432	47,750
Brussels	5,540	290,522	52,445
Frankfurt	4,483	270,396	60,321
Munich	3,981	265,693	66,739
Sydney	4,916	251,254	51,115
Rome	4,468	207,502	46,444
Vienna-Bratislava	3,822	200,062	52,341
Barcelona	4,711	197,889	42,010
Melbourne	4,527	197,774	43,690
Kitakyushu-Fukuoka	5,563	194,550	34,970
Stuttgart	3,166	193,143	61,013
Hamburg	3,188	186,506	58,499
Berlin	4,314	185,910	43,100
Karlsruhe	3,056	159,066	52,050
Montreal	4,058	157,734	38,872
Copenhagen-Malmö	3,045	151,041	49,610
Tel Aviv	3,699	144,875	39,162
Perth	2,080	139,282	66,959
Athens	3,844	138,715	36,082
Birmingham (UK)	3,869	132,439	34,233
Vancouver	2,502	114,447	45,738
International Middleweights Average	**4,883**	**234,238**	**48,667**

Source: Oxford Economics.

Several shared characteristics bind International Middleweights. First, they are globally connected by migration and capital flows. About 22 percent of the population in these cities is foreign born, the highest share among any cluster. Similarly, these metros boast the second highest level of foreign direct investment per capita, with almost $2,000 dollars of FDI stock per inhabitant. These metros are well-educated (33 percent of the working-age population has tertiary education), house elite universities (the highest number of research universities of any group on both an absolute and per capita basis), and generate new knowledge (third highest rate of patenting intensity).

Figure 17: Total number of world ranked research universities in metropolitan groups, 2010-2013



Source: Centre for Science and Technology Studies (CWTS) and Leiden University.

For International Middleweights, unfortunately, another characterization they share is sluggish economic growth. Between 2000 and 2015, output, GDP per capita, and employment grew 1.6, 0.7, and 1.0 percent annually, each the slowest of any group. The solid economic growth of metropolitan areas in Australia (Perth, Sidney, and Melbourne), Canada (Toronto and Vancouver), and Israel (Tel Aviv), whose metro economies posted real output growth rates of 3 percent on average, contrasts starkly with the 1.1 percent experienced by their metropolitan peers in Europe. Further, the international financial crisis of 2008-2009 divides the economic trajectory of this group of cities. Output, GDP per capita, and employment all grew faster in the 2000-2007 period than in the following years. As a result, 12 cities in this group have yet to return to their pre-crisis GDP per capita levels and five cities have yet to regain their pre-crisis employment base. Further, in half of these markets, employment was lower in 2015 than in 2005, reflecting both a demographic transition as well as lower participation in the labor market.

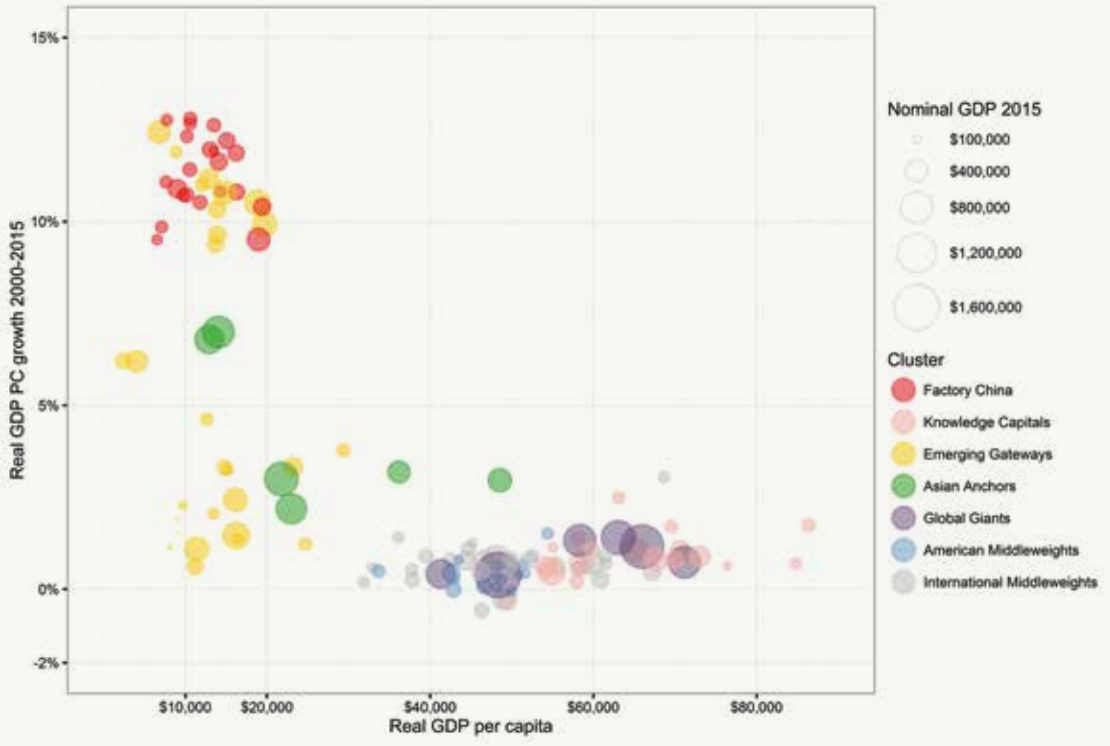
"International Middleweights are the most varied group of metro economies. Cities like Toronto, Sydney, Frankfurt, Madrid, and Copenhagen play a fundamental role in the provision of business and financial services in their national and regional economies."

Examining global city economies through this typology reveals three broad patterns.

First, there is no one way to be a "global city," and every city starts from a different place. But the pervasiveness of globalization has linked metro economies in an international network that is simultaneously collaborative and competitive. How these cities are faring depends largely on their function within that international system of production and exchange. Technological innovation occurs in more cities than ever before, but it is distinctly driven by a set of U.S. and European mid-sized regions that are home to world-leading research universities and patent-generating firms. Two sets of massive global centers—one in established nations and one in rising Asia—form the twin pillars of global finance and investment. They are complemented by a rising set of business, education, and transportation hubs that serve as global gateways to large, middle-income countries. China's unique global rise is reflected in the presence of a group of second and third-tier manufacturing and export-oriented Chinese metro economies. Two additional groups of advanced-economy metros—one concentrated in the United States and the other spread across Europe, Japan, and the U.K. commonwealth countries—are trying to deploy their relatively well-educated populations, industrial specializations in advanced manufacturing and business services, and university and airport anchor assets to maintain relevance globally. In short, our typology reveals multiple models for global engagement.

Second, the different ways cities engage globally are reflected in their economic outcomes. GDP per capita and GDP per worker, as well as growth in each,

Figure 18. Real GDP per capita and real GDP per capita CAGR 2000-2015 for the seven groups



vary significantly across our sample. Unsurprisingly, lower-income metro areas, led by Factory China, have experienced the fastest GDP per capita growth since 2000. The trend toward convergence continues, although the pace is slowing, and developed metro areas still maintain significantly higher incomes than their developing world peers. Within the developed world, Knowledge Capitals and Global Giants not only have higher average incomes but have also experienced faster growth in GDP per capita and productivity, while the American Middleweights and the International Middleweights tend to have not only lower incomes but also lower growth. These varied outcomes reflect how cities fare as global production networks shift.[72] Bringing lagging developed metro areas closer in line with their faster-growing peers will be critical to jumpstarting a slowing global economy.

Third, local and national leaders must approach economic strategies with a clear understanding of their city-regions' global starting points. In an urbanizing, globalizing, and technologically dynamic world, the assets that drive growth and prosperity—tradable clusters, innovation, talent, and infrastructure connectivity—are not evenly distributed across the globe, or even within nations. These groupings reveal cities that share characteristics and, perhaps, solutions. We explore priorities for action within each group below.

GLOBAL GIANTS

These city-regions are the most-connected nodes in the global economy, serving as the main hubs for international business, travel, and decision making in their respective countries. They retain advantages that have been built up over decades, even centuries, and have proved durable over numerous business cycles. These markets house major international airports, globally recognized universities, and large multinational companies that ensure global relevance for the foreseeable future. Yet, what has made them globally fluent metro economies in the first place has also created downsides: an overreliance on finance as an economic driver and high levels of inequality that are creating affordability pressures on low- and middle-income households.

Over the coming decades, these metro areas must both maintain their advantages in catering to large multinational headquarters and financial institutions and also foster environments in which small, entrepreneurial firms can bring new products and technologies to market. The latter involves securing a steady supply of technical talent and helping bridge relationships between universities, research institutions, and companies. New York City is helping finance a new applied science and engineering campus to ensure it has the STEM workers and research capabilities to commercialize new ideas. Similarly, the Île-de-France and French central governments are co-investing in Paris-Saclay, an ambitious effort to consolidate many of France's most potent research institutions under one common brand and co-locate them in one geographic cluster about 45 minutes outside central Paris.[73] London has pursued an international business strategy to boost the global competitiveness of its small and mid-sized businesses.[74] These commitments to technical skills and technological advances help position these metro areas to compete with innovative middleweight metros in the coming decades.

Industrial diversification must be accompanied by investments in housing to ease affordability pressures. All six Global Giants are among the 15 most expensive cities in the world, according to the *Economist's* cost-of-living survey.[75] Since demand for housing in Global Giants tends to be global while supply is local, there is no easy fix. Deploying a multipronged strategy that eases restrictions on housing supply, incentivizes affordable housing production, and coordinates housing, transportation, and land use planning can help ensure that households lower on the income ladder can continue to afford to live and work in these cities and contribute their needed complementary skillsets to the labor market. Osaka and Tokyo tend to be more affordable than their Western counterparts due to liberal zoning policies, which allow for uniquely active housing construction markets.[76]

ASIAN ANCHORS

Asian Anchors are widely considered to be some of the world's most impressive examples of urban economic growth. As the global investment community's entry points into Asia, they have thrived by providing relatively sound fiscal and investment environments, good aviation and digital infrastructure connectivity, and a relatively skilled workforce. Recent GDP per capita growth in these markets has been robust as a result. However, the model that brought Asian Anchors to this point will not be enough alone to drive continuous income growth in the coming decades. For that, these metro areas must focus on boosting productivity, embracing entrepreneurship, investing in education and skills, and addressing affordability and infrastructure concerns.

The six metro areas in this group share many priorities with Global Giants but also the pressures on affordability. According to the *Economist Intelligence Unit's* survey, Singapore has the world's highest cost of living, Hong Kong the third highest, and Seoul the eighth highest.[77] Their rapid expansion demands greater housing supply and continued transportation investments. In Beijing, for instance, planners are trying to coordinate subway and high-speed rail investments, high-density housing construction, and large-scale commercial developments as growth spills over into neighboring Tianjin and Hebei provinces. Plans to integrate the 82,000-square-mile Jing-Jin-Ji megalopolis, home to 130 million people, are some of the most ambitious in the world.[78]

Notwithstanding this priority, the greatest imperative for these cities may be making the necessary investments in competitiveness to lift their populations into upper-income status. These metro economies are no longer the "low-cost" option for firms and industries, and so they must compete with developed metro areas based on the quality of their products and services. Yet, output per worker remains about one-third that of their Global Giant counterparts. Understanding this imperative, these cities are focused intently on upgrading the education and skills of their citizens. About 36 percent of residents in these markets have attained tertiary education, and expanding access to university and vocational education remains urgent.[79]

Encouraging new, nimble firm entrants, which help introduce new technologies and products to the marketplace, is one way to infuse new dynamism across both manufacturing and services industries. Through significant government support, Asian Anchors have developed world-leading corporations (e.g., Beijing-based Lenovo or Seoul-based Samsung). Singapore and Hong Kong are two of the leading destinations for large foreign subsidiaries. But can these regions organically generate new rounds of successful, home-grown companies that can compete in global markets? National governments are investing significantly in research and development in these markets to gain footholds in emerging technologies. Singapore is pursuing an active industrial cluster policy to cement advantages in water technology, applied health sciences, and aerospace.[80] South Korea is trying to help Seoul firms move beyond their legacy as "fast followers" by providing top-down investments of up to 1 billion KRW (approximately $900,000) to support startups with research and development, capital raises, and global expansion.[81]

EMERGING GATEWAYS

The metropolitan areas in this group serve as the entry point to emerging markets of secondary and tertiary cities that are expected to generate significant economic growth in the coming decades. This position allows Emerging Gateways to serve as hubs for advanced financial and business services and transportation. The function is similar to that of Asian Anchors, but the Emerging Gateways have yet to achieve as prominent a role, partly due to the fact that their markets are not yet the size of East Asia but also because the competitiveness factors required to generate new products and services are not as developed in these markets as in the Asian Anchors.

Many of the Emerging Gateways embraced globalization early on, consolidating their positions as beachheads for capital, ideas, technology, and people. This role allowed them to concentrate important

competitive assets and become the knowledge and innovation centers of their respective countries. However, many of these cities, particularly those outside of Asia, have tended to underinvest in durable growth drivers like research and development and infrastructure connectivity.

The rapid economic growth and the concentration of competitive assets that allowed these cities to connect to the global economy have also produced high levels of inequality. Cities like Rio de Janeiro, Johannesburg, Mexico City, and Santiago have registered some of the highest levels of inequality in the world.[82] Emerging Gateway cities need to address these challenges if they wish to continue their growth trajectory.

Attention to productivity is also urgent. Emerging Gateways as a group trail peers in terms of output per worker and output per worker in the business, financial, and professional services sector, a key industry for these cities. Tackling this challenge will require additional investments in education, not only to increase the share of the working-age population with tertiary education but to also to improve the quality of the skills provided. Brazil, Chile, Mexico, and Turkey all rank at the bottom of the OECD quality-of-education rankings.[83]

In terms of innovation, these metro areas need to take advantage of their privileged position as magnets of knowledge and talent, at least within their respective nations and regions, to facilitate a transition toward higher value-added sectors. A closer collaboration between the private sector and universities should be among the top priorities for policymakers in this cluster. The steps that cities like Santiago are taking to bring together firms, entrepreneurs, universities, and the public sector will be paramount to unveiling new avenues for economic growth.[84]

These metros serve as the transportation hubs for countries that connect nearly half the world's population. Despite this status, however, Emerging Gateway metros rank fourth in air passenger traffic, and investing in global connectivity should be a priority for many of these cities. Mexico City, betting on transportation to power its economic growth, is investing in a new airport that will be able to serve up to 50 million passengers per year, a vast improvement from the current capacity of 16 million. Similarly, Santiago, Rio de Janeiro, and Warsaw are investing to expand the current capabilities of their airports to allow for more seamless travel between their national markets and the rest of the world.[85]

FACTORY CHINA

Factory China metros exemplify their country's assertion in global markets. Between 2000 and 2015, as these regions industrialized and drew on robust global demand for locally manufactured products, GDP per capita grew by 400 percent. In these regions millions of Chinese residents moved into the global middle class.

Accelerated growth has not come without costs, however. Life expectancy in cities like Changchun, Dalian, Haerbin, Qingdao, Shenyang, Shijiazhuang, Tangshan, Yantai, and Zibo are on average five years lower than in the rest of the country due to air pollution.[86] Population growth, climate change, and industrial demand are creating water shortages in Shijiazhuang, Tangshan, Changchun, Dalian, Shenyang, Qingdao, and Zibo.[87] Pricing these negative externalities must be a critical goal of energy, environmental, and industrial policy going forward. High levels of debt pose another challenge that Factory China cities must address to transition to a more sustainable growth model. Recent estimates show that China's debt-to-GDP ratio has soared from 150 to nearly 260 percent over the past decade.[88]

Manufacturing will continue to be the growth engine in Factory China for the foreseeable future, but it may never provide the mass employment of the 2000s again. Accelerating automation and the shift in global supply chains to new, lower-cost markets may limit the benefits of industrialization in many of these metros. New evidence already suggests that manufacturing is experiencing diminishing returns in raising the living standards in developing nations.[89]

Factory China metros must spur an industrial transition through productivity-enhancing investments. Supporting education and workforce training is paramount for higher value-added industries to thrive. Just as the United States did with major university investments in the 19th century, China can position these second and third-tier cities for the 21st century by improving the scientific impact of their universities.

In the past, industrial powerhouses that underinvested in their prime competitive assets have struggled to successfully compete in an ever-changing and demanding global economy.[90] For Factory China metros, a long-term strategy that addresses both environmental issues alongside investing in the fundamentals of competitiveness are necessary if they wish to sustain robust growth.

KNOWLEDGE CAPITALS

These American and European metros have achieved high-wealth status due to their significant stocks of human capital, innovative firms and universities, and sound infrastructure connectivity. Unlike the Global Giants, they are not the primary city-regions in their national or supranational systems and are not necessarily global centers of finance. Rather, they often operate at a smaller scale as regional hubs of business and professional services in their respective countries (e.g., Atlanta in the American South, Minneapolis in the American North, Denver in the American Mountain West, and Stockholm in Scandinavia) and as key transportation nodes (e.g., major international airports in metros like Atlanta, Chicago, and Dallas).

Where Knowledge Capitals maintain truly global relevance is in knowledge creation and commercialization. These are the world-leading centers for new ideas and technologically advanced products. Silicon Valley—anchored by San Francisco and San Jose—is arguably the world's leading innovation ecosystem, best known for its breakthroughs in biotechnology, information technology, and digital services. But this grouping of metros also includes other global nodes of information technology (San Diego, Seattle, and Stockholm), life sciences (Boston and Philadelphia), medical technology (Minneapolis), and semiconductor manufacturing (Austin and Portland). If, as Richard Freeman argues, "knowledge creation (is) the fundamental global driver of economic outcomes in today's information economy," the world is disproportionately reliant on these metros to fuel the innovation engine.

Maintaining and expanding their technological advantages are these metro areas' top priorities. Most prominently, that will demand strategies that ensure the competitiveness of key advanced industries: building the pipeline of STEM talent from middle-skill professionals to Ph.D. scientists, and better coordinating the education and training system with employer needs; engaging universities and research institutions in technology commercialization, especially in small and mid-sized firms; and aligning state and federal resources and institutions, including federal labs, with local industries.[91]

Beyond investing in the assets that drive industrial competitiveness, Knowledge Capitals must aggressively assert their industries in the global marketplace. For all their advantages, Knowledge Capitals lag other groups in volume of inward foreign direct investment. Setting aside larger Knowledge Capitals like Chicago, Boston, or Silicon Valley, the small scale of these metros limits their name recognition in other parts of the world, necessitating more intentional and aggressive global engagement. Along these lines, Knowledge Capitals like Atlanta, Chicago, Minneapolis, Portland, San Diego, Seattle, Stockholm, and Washington are either planning or executing public-private strategies aimed at boosting exports or attracting more foreign direct investment in key industries.[92]

Some Knowledge Capitals face ongoing affordability challenges as a result of their success. Many of the industries in which Knowledge Capitals compete are experiencing winner-take-all dynamics, especially in the tech sector. Firms are experiencing record profits, the benefits of which are concentrating among a relatively small set of investors, executives, and highly skilled workers. Rising incomes have bid up housing prices, squeezing lower- and middle-income

households in particularly hot markets. Improperly functioning housing markets can hinder regional economies when they limit labor mobility: the overall potential of the economy diminishes if people are locked in their housing and cannot move to other parts of the region to take a new job in which they would be more productive. Within a U.S. context, Jason Furman has argued that low housing supply can limit workers' ability to relocate to highly productive cities, and this limitation lowers long-run growth and productivity at the national level.[93] And in Stockholm, for instance, the founders of the online streaming application Spotify have cited that region's insufficient housing supply as a major hindrance to being able to lure foreign talent for the firm.[94] Knowledge Capitals retain significant advantages in the knowledge economy, but rising competition from both developed and emerging metro economies brings new urgency to acknowledging and addressing these affordability concerns.

AMERICAN MIDDLEWEIGHTS

American Middleweights are striving to find their global niche. This group generates particularly high concentrations of local output in non-tradable sectors. Since these industries tend to be less productive, this large concentration has contributed to below-average growth in output, employment, and GDP per capita. This dynamic plays out differently across American Middleweights. For many metros in the American South and West (Orlando, Phoenix, Sacramento, Tampa), the financial crisis upended a housing-driven growth model. Similarly, for many of the manufacturing-intensive metro economies like Cleveland, Detroit, and Indianapolis, the recession accelerated what has been a secular decline in manufacturing employment.

While these metros still maintain relevance globally through their specializations, retooling those key tradable industries for the 21st century is the urgent challenge for American Middleweights. For many of these metro areas, manufacturing has historically been their traded-sector backbone, but it has been challenged by competition from overseas and by automation.

But after taking their toll, these global forces may now offer opportunities for new avenues of growth. The increasing reliance on software and the industrial internet demands the creation of protocols, software, and platforms to connect and automate production. Manufacturing in the 21st century will require software to fully exploit the benefits of automation, and cities with the right combination of a manufacturing legacy and research universities have a good opportunity to insert themselves in this nascent value chain.[95] For instance, General Electric has chosen Detroit as its base of operations to create software that will connect the machines of the future.[96]

The infusion of software will also touch non-tradable sectors like health care and education, which represent growth opportunities for the metros that have specialized in "eds and meds." Entrepreneurs in many of these metros are eliminating inefficiencies and developing new platforms and business models. For instance, the University of Pittsburgh, Carnegie Mellon University, and the University of Pittsburgh Medical Campus, the largest network of hospitals in western Pennsylvania, epitomize this bet to disrupt local services. Together they are digitizing the medical history of patients to apply advanced analytics to reduce health care costs, improve diagnostics, and fundamentally change the provision of health care.[97] By leveraging their unique combination of strengths, these three local actors are trying to create a new industry that could transform Pittsburgh into a global digital health care powerhouse that spawns novel technologies and services for deployment well beyond Pittsburgh.

American Middleweights have a base of educated workers, research universities and hospitals, and tradable clusters. Aligning these assets to improve export competitiveness through coordinated economic strategies will be critical if these metros are to compete in global markets. The urgency to engage globally has resulted in action; many metro areas in this group are aligning their local economic assets to promote exports in sectors where they enjoy a competitive advantage. In an effort to better position themselves in the global economy, half of all the metropolitan areas in this group have developed global trade and investment plans.[98]

INTERNATIONAL MIDDLEWEIGHTS

This diverse cluster contains metro economies that have experienced middling growth but remain relatively globally connected on people and investment flows. The economic crisis of 2008-2009 heavily impacted many of the cities in this group, particularly in Europe and Japan, and growth rates have not returned to pre-crisis levels. Some metro areas in this group have yet to regain the employment levels that held before the crisis.

For International Middleweights, the challenge is no longer to find economies of scale or to optimize existing products and services, but rather to create new business models, products, and ideas. Although this cluster houses some notable entrepreneurship hubs, these metro areas as a whole have not been able to draw on high-growth entrepreneurs to the same extent as the Knowledge Capitals. Insufficient levels of capital to fund the expansion of new firms are partly to blame in Canada.[99] Many Australian companies face the same challenge, resulting in the prime minister's initiative to increase late funding for startups and provide tax breaks for venture capitalists investing in tech companies.[100] Regulatory hurdles are also preventing the adoption and growth of new business models. The constant legal battles that have engulfed tech companies like Amazon, Uber, and Google in the European Union make it harder for startups to bet on the European market for testing their products and services. Drawing on the research and ideas produced in their notable concentration of leading universities will be a critical pillar of boosting local innovation.[101]

Dwindling population growth is another trend that should worry government and business leaders in International Middleweights. An aging workforce will add additional pressure to an already faltering economy by increasing the cost of hiring new workers and by effectively bringing overall labor costs up. Germany, where the workforce is poised to shrink 16 percent by 2030, is facing a shortage of more than 100,000 skilled workers in STEM fields.[102] For Japanese metro areas this challenge is starker given declining population and fertility rates and extremely low levels of international migration, which combined have greatly reduced potential economic growth.[103] For European and Australian metropolitan areas in this group, the influx of refugees from the Middle East represents an opportunity to replenish a shrinking workforce, but only if these cities and countries put in place the right policies to create a pipeline to fill job openings. The apprenticeship models prevalent in many European nations could be tailored to provide the new influx of migrants with the necessary skills. Economic integration of in-migrants will be critical to maintaining stability.

GOVERNING FOR GROWTH IN GLOBAL CITIES

The economic primacy of major cities is rarely matched by their formal governing powers. Governance matters for competitiveness because proactive government, public, and civic groups can marshal investment from a wide variety of domestic and international sources to enable new growth strategies. Central, provincial, and municipal governments also have unique and complementary roles to play in supporting metropolitan competitiveness.[104] National governments—through policies governing tax, trade, and immigration as well as platform investments in R&D and infrastructure—are critical investors in their urban hubs. National governments also bear some responsibility for supporting cities that have experienced industrial decline as a result of global competition. Indeed, as residents in some cities benefit greatly from their economic position, national governments—through tax and transfer policy—can help compensate those that may be left behind by global currents. Notwithstanding the distinct starting points of global cities, cross-cutting priorities should frame a governing approach to growth.

First, local leaders should map their economic starting point. What industries drive the tradable economy? How are local skills, innovation, and infrastructure assets performing relative to peers? Globalization and technological change are demanding a new vigilance in cities about these challenging aspects of the local policy agenda. Decision makers who take the time to

dive into the data, talk with local firms, and engage with multiple stakeholders will be better positioned to get what our colleague Amy Liu calls "the markets right.[105]

Second, with an appreciation of the starting point, all levels of government must align policies and investments behind the assets—innovation, talent, and infrastructure connectivity—that undergird the competitiveness of critical industries. Workforce development should align with growing sectors of comparative advantage. Universities can link their research agendas to the regional economies in which they locate. Investments in digital and physical connectivity must be maintained. Too often, however, the systems responsible for the skills, R&D, and infrastructure agendas are too siloed to coordinate properly at the regional scale, limiting the impact of implementation. And despite the critical role of cities, most national economic plans rarely take into account sub-national variation when deploying platform investments and transfers.

Finally, government, business, and civic coalitions—what the World Bank calls "growth coalitions"—can help lend more coherence, resources, and political will for economic development priorities. In metropolitan areas across the world, regional competitiveness is becoming an increasingly shared agenda. Formal and informal networks of public, private, and civic leaders are coming together to design and implement economic strategies. These networked approaches, while certainly more complex, incorporate the market expertise, financial resources, and political will of a wider range of stakeholders and thus make economic strategies more market-oriented, community-driven, and sustainable beyond political cycles.[106] Similarly, these networks can help advocate for more coordinated region-wide governments and overcome productivity-limiting fragmentation between jurisdictions.[107]

Local and national leaders must govern in ways that deliver growth that is sustainable and inclusive, and standardized metropolitan data can help inform those strategies. For decision makers in global cities, this report, and its accompanying online interactive, can help to strengthen governance in a few key respects. First, as cities benchmark their comparative strengths and weaknesses, this report provides a framework for identifying the most relevant peer city comparisons. Second, peer identification can help reveal more relevant global innovations to local challenges. Policy innovations that thrived in one city may not always transition seamlessly to another, but those applications will be more likely to find relevance in markets that share similar economic challenges. Like what C40 Cities has accomplished for climate and environmental policy, groups of cities that share similar economic priorities can exert influence with national and international bodies that help shape tax, trade, and immigration policy. Third, we hope that this report can help reinforce a city-region's relative role and performance to inform economic strategies that ensure ongoing and broad prosperity.

VI. CONCLUSION

Urbanization has placed cities at the vanguard of global economic growth. And while the urbanized world extends far beyond the metro areas covered in this analysis, these large global cities exemplify the unique spatial concentration of the drivers of modern economic growth: trade, innovation, talent, and infrastructure connectivity. Mapping these factors at the metropolitan scale reveals a highly differentiated landscape, offering new evidence that cities plug into the global economy based on their particular competitive assets. Indeed, there is no one way to be a global city.

Economic stagnation has heightened concerns about where the next round of global growth will emerge. Global governmental, corporate, and civic leaders must understand and adapt to powerful currents—from technological advancement to global integration—that are roiling industries, labor markets, and even the social fabric. Decision makers must understand these trends and how they influence the distinct competitive position of their regions, and then respond accordingly through data-driven economic strategies. Sustained global prosperity depends on effective stewardship of major urban areas. We hope that this report proves a useful platform from which to build that understanding.

APPENDIX A

SELECTION AND DEFINITION OF METROPOLITAN AREAS

The sample of metropolitan areas is based upon a list of international metros provided by Oxford Economics, as well as a list of the largest metropolitan economies in the United States built with data provided by Moody's Analytics.

This study uses the general definition of a metropolitan area as an economic region comprising one or more cities and their surrounding areas, all linked by economic and commuting ties. In the United States, metro areas are defined by the U.S. Office of Management and Budget (OMB) to include one or more urbanized areas of at least 50,000 inhabitants, plus outlying areas connected by commuting flows.[108] For the European Union countries, Switzerland, and Norway, the European Observation Network for Territorial Development and Cohesion (ESPON) defines metro areas as having one or more functional urban areas of more than 500,000 inhabitants.[109] This study uses the most accurate metropolitan area compositions of European metro areas because the current ESPON 2013 database employs commuting data at the municipal level to define functional urban areas, the building blocks of metropolitan areas.[110] This identification method is most consistent with the U.S. definition of metro areas based on commuting links, with the possibility of a metro area crossing jurisdictional borders and having multiple cities included.

For metropolitan areas outside of the United States and Europe, this study uses the official metropolitan area definition from national statistics. Not all countries, especially developing ones, have created statistical equivalents of a metropolitan area. Due to data limitations, some metropolitan areas in this report do not properly reflect regional economies, but rather the federal city (Moscow), or provincial-level and prefecture-level cities, as in China. Additionally data at the city level for Singapore and Hong Kong correspond to national statistics, given their status as city-states.

TYPOLOGY DEVELOPMENT

The typology was developed based on economic characteristics and competitiveness factors. Classifying and identifying peers allows policymakers and stakeholders to better understand the position of their economies in a globalized context as well as to conduct constructive benchmarking.

To select peers we utilized a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering.[111] These commonly used data science techniques allowed us to group metro areas with their closest peers given a set of economic and competitiveness indicators. For this report we selected 22 economic variables: population, nominal GDP, real GDP, real GDP per capita, productivity (defined as output per worker), share of the population in the labor force, industry share of total GDP (eight sectors), and productivity by sector (eight industries).[112]

We included 13 additional variables that measure one of the four quantitative dimensions of the competitiveness analysis framework used in this report. The four quantitative dimensions and variables included are (1) stock of greenfield foreign direct investment between 2009 and 2015 (traded clusters), stock of greenfield FDI per capita between 2009 and 2015 (traded clusters), and total stock of jobs created by FDI between 2009 and 2015 (traded clusters); (2) number of highly cited papers between 2010 and 2013 (innovation), mean citation score between 2010 and 2013 (innovation), total patents between 2008 and 2012 (innovation), and total patents per capita between 2008 and 2012 (innovation), Stock of venture per capita 2006–2015 (innovation) and stock per capita of venture capital 2006 to 2015 (innovation); (3) share of the population with tertiary education (talent); and (4) number of aviation passengers in 2014 (infrastructure), number of aviation passengers per capita in 2014 (infrastructure), and average internet download speed in 2014 (infrastructure).

Table A-1. Indicators used in the clustering algorithm

Dimension	Indicator	Source
Economic Performance	Gross domestic product	Oxford Economics, Moody's Analytics
	Employment	Oxford Economics, Moody's Analytics
	Gross domestic product per capita	Oxford Economics, Moody's Analytics, U.S. Census Bureau
	Output per worker	Oxford Economics, Moody's Analytics
	GINI coefficient	OECD
Trade	Traded sector output	Oxford Economics, Moody's Analytics
	Traded sector employment	Oxford Economics, Moody's Analytics
	Exports and imports	Statistics Sweden data
	Greenfield foreign direct investment	fDi Intelligence data
Innovation	Share of total publications in top 10 percent cited papers	Centre for Science and Technology Studies (CWTS) and Leiden University data
	Mean citation score 2010–2013	
	Share of total publications done with industry	
	Patent output per 1,000 inhabitants	REGPAT
	Venture capital investments, millions of dollars per 1,000 inhabitants	Pitchbook
	Venture Capital Stock by Industry	
Talent	Share of population 15+ with tertiary education	Oxford Economics, U.S. Census Bureau
Infrastructure	Total aviation passengers	SABRE
	Average download speed	Net Index
	Population density	Oxford Economics

Our analysis proceeded in three steps. First, we applied PCA to reduce the number of dimensions of our data by filtering variables that are highly interrelated while retaining as much variance as possible. PCA generates "components" by applying a linear transformation to all the variables.[113] To successfully perform our clustering algorithm we selected the number of components that explain 80 to 90 percent of the variance of a dataset. For this report we selected the nine principal components, which accounted for 86 percent of the total variation of the data.

The second stage applied a k-means algorithm to the nine components, a process which calculates the distance of every observation in our dataset to each other, then generates a cluster centroid and assigns each data point to the closest cluster.[114] K-means repeats this procedure until a local solution is found. This algorithm provides a good segmentation of our data and under most circumstances it is a sufficient method for partitioning data.[115] However k-means sometimes generates clusters with multiple observations, thus obscuring some of the closest economic relationships between metro areas. To improve the results of k-means we implemented a third step, hierarchical clustering, which follows a similar approach to k-means. Hierarchical clustering calculates Euclidean distances to all other observations, but generates a more granular clustering that permits clearer peer-to-peer comparison.

DATA SOURCES

Oxford Economics:
Economic indicators as well as selected indicators corresponding to talent for non-U.S. metropolitan areas were provided by Oxford Economics (OE). Economic variables such as GDP, gross value added, employment, unemployment rates, educational attainment, and industry-level employment and output were collected by OE from national statistics bureaus in each country or from providers such as Haver, ISI Emerging Markets, and Eurostat. Population estimates and the share of the foreign-born population were based on official population projections produced by national statistical agencies and/or organizations such as Eurostat, adjusting migration assumptions on a case-by case basis. The study uses GVA and GDP in nominal terms at purchasing power parity rates and in real terms at 2009 prices and expressed in U.S. dollars. All the indicators were provided at the metropolitan level.

Moody's Analytics:
Economic indicators for U.S. metro areas were provided by Moody's Analytics. Moody's uses data published by the Bureau of Labor Statistics and by the Bureau of Economic Analysis to generate its estimates of employment and GDP at the county level. We aggregated those estimates to metropolitan areas using the current Census Bureau definition. For real GDP, both total and at the industry level, Moody's provides 2009 chained dollars. For nominal analysis it reports its estimates in current dollars.

U.S. Census Bureau:
The indicators for talent for U.S. metro areas come from a variety of surveys published by the U.S. Census Bureau. The population estimates were created using intercensal population estimates at the county level and then aggregating those estimates to the metro level using the current definitions of metropolitan areas. For the foreign-born share of the population and unemployment rates, we utilized American Community Surveys at the county levels and aggregated them at the metropolitan level. The educational attainment variables were obtained through the Integrated Public Use Microdata Series platform (IPUMS) from the Minnesota Population Center. Data were built up from microdata on the educational attainment and age of residents for Public Use Microdata Areas (PUMAs). These age intervals were utilized to comport with the international education attainment levels. For more information, see Steven Ruggles, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek, *Integrated Public Use Microdata Series: Version 6.0* [machine-readable database], Minneapolis: University of Minnesota, 2015.

REGPAT:
The source of the patents data is the OECD's REGPAT database. The OECD manages this database as part of the Patent Cooperation Treaty, which offers patent protection to organizations and individuals planning to do business in multiple countries. A number of research decisions went into the construction of the patent estimates. Patent locations correspond to the inventor's place of residence or workplace. In cases when there are multiple inventors, the patent was fractionally counted and apportioned in equal shares to each co-inventor. Patents that fall under multiple international patent classification (IPC) technology codes were also apportioned in equal shares to each technology class in order to account for the cross-cutting nature of technological development. To mitigate year-to-year fluctuations in invention activity, patents were summed in five-year intervals. The time dimensions represent the "priority year" when the patent was first filed. This year is closest to the actual date of invention and is the most relevant reference date when assessing an area's technological activity at a specific point in time. Since patent filing is a costly and administratively burdensome process, the analysis excludes patents submitted in 2013 and 2014, since patents filed in these years only account for a portion of products or processes actually invented and may bias places and organizations with better systems for shortening lag time between the date of invention and the application year. For more information see Stephane Maraut, Helene Dernis, Colin Webb, Vincenzo Spiezia, and Dominique Guellec, "The OECD REGPAT Database: A Presentation," June 3, 2008,

http://www.oecd.org/sti/inno/40794372.pdf.

Leiden:

The source of the university scientific impact data is the Centre for Science and Technology Studies (CWTS) at Leiden University. This publically available database tracks bibliometric performance data for 750 universities with the largest publication output in internationally recognized journals. The database relies on the Thomson Reuters Web of Science citations indices, which researchers cleansed, geocoded, and classified into fields of study. CWTS reports publications based on full-counting methods, which give equal weight to all publications from a university, and fractional counting methods, which apportion shares to each collaborator. Brookings' analysts focused on fully counted publications and aggregated the raw university-level citations data into metro-level estimates (see geocoding section below). Mean citation scores were aggregated based on the metro average weighted according to university-level publication count. Brookings analysis primarily focused on two measures. First, the mean normalized citation score is the average number of citations of the publications of a university, normalized for field differences and publication year. A value of two for instance means that the publications of a university have been cited twice above world average. Second, the percent of publication in the top 10 percent most cited is the proportion of the publications of a university that, compared with other publications in the same field and in the same year, belong to the top 10 percent most frequently cited. For more information see L. Waltman, C. Calero-Medina, J. Kosten, E.C.M Noyons, R.J.W Tijssen, N.J. Van Eck, T.N. Van Leeuwen, A.F.J. Van Raan, M.S. Visser, and P. Wouters, "The Leiden Ranking 2011/2012: Data Collection, Indicators, and Interpretation, *Journal of the American Society for Information Science and Technology* 63, no. 12 (2012): 2419–32, **http://www.leidenranking.com/methodology**.

PitchBook:

The source of the venture capital data is PitchBook, a private financial research firm that collects and tracks global private equity activity. Pitchbook analysts deploy web crawlers to perform a daily systematic scan of media reports and public filing information on deals that they then record and validate through a manual review process. In assembling its database it includes address-level data for both investors and recipient companies, industry details, investor details, and the deal value. Brookings' analysts took the data and then assigned the investors and recipients to metropolitan geographies (see geocoding section below). The primary statistic in the analysis is the cumulative stock of venture capital, which is the sum total of year-to-year investment flows. Secondary statistics examine the number of investors and companies along with data between different geographies, deal categories, and industries. The advanced industries classification is an approximate grouping based on detailed industry categories matched to Brookings' NAICS-based definition. All value measures were inflation-adjusted to 2014 dollars. For more information see **http://blog.pitchbook.com/wp-content/uploads/2014/06/3Q-2014-PE-Breakdown-Methodology.pdf.**

Net Index:

The source of the internet download speed data is Ookla's "Net Index" (now rebranded as "Speedtest Intelligence"). Ookla is a web service that offers free internet speed tests to users as part of an internet intelligence business. The coverage is global in scope because the service relies upon user-submitted tests logged through the speedtest.net website that gauges internet speeds. Ookla reports the raw data at the city level at the daily frequency that Brookings' aggregated into annual metro-level averages weighted according to the number of tests in each city-day record (see geocoding section below). Since the data are crowd-sourced from users, they may be susceptible to bias if users disproportionately share characteristics that diverge from the average internet user in their metro area. One reason to trust the data is that it is unlikely that this bias would systematically vary between metro areas; if there is a "slow" or "fast" bias it would likely affect all places equally. In addition, the vast majority of metros display normal distributions and the sample size is quite large, with the largest 100 metro areas by population recording an average of over 30 million tests in 2014. For more information see **https://www.ookla.com/speedtest-intelligence**.

Sabre:

The source of the aviation data is Sabre Aviation Solutions' global demand dataset (GDD). The dataset includes a record for every international itinerary entering and leaving the United States or any large global metro area with economies larger than $100 billion in 2014. Each record includes the origin and destination airports plus up to three connecting airports, with the number of passengers and total revenue generated from that specific itinerary for that year. The GDD is based on a variety of sources including information developed from direct business relations between Sabre and over 400 global airlines. For international itineraries not reflected in its database, Sabre imputes missing flights and passenger levels based on additional market data. The result is a complete dataset of travel into and out of major global aviation centers. Brookings' performs a number of additional value-adds. These include assigning all airports to global metropolitan areas (see geocoding section below), obtaining latitude and longitude coordinates to derive distance measures, cleansing anomalous records, and aggregating the passenger and revenue flows to better facilitate regional analysis. All value measures were inflation-adjusted to 2014 dollars. For more information see Adie Tomer, Robert Puentes, and Zachary Neal, "Global Gateways: International Aviation in Metropolitan America" (Washington: Brookings Institution, 2012),

http://www.brookings.edu/~/media/research/files/reports/2012/10/25-global-aviation/25-global-aviation.pdf.

FDI Intelligence:

The source of the greenfield FDI data is the *Financial Time*'s fDi Markets database. This database tracks all cross-border investment into new physical projects or expansions of an existing investment, otherwise known as "greenfield" investment. Company announcements form the basis for the database, and each submission is manually verified before being published. In cases when the capital investment and job counts are not publicly released, analysts impute the value invested and jobs created using an econometric model. The primary sources of the data are newswires, internal sources, top business journals, industry organizations, investment agencies, and data purchased from private vendors. Brookings' analysts assigned metro areas to the city-level information available in the database and processed the flows between different investor and recipient geographies and industry levels. The preferred metric is the cumulative stock of FDI invested and jobs created over the reference period from 2009 to 2015. All value measures were inflation-adjusted to 2014 dollars. For more information see **http://www.fdimarkets.com/faqs/**.

Geocoding process

An addition layer of data assignment was required for data that were not available at the metropolitan scale. Geographic identifiers were used to process individual data points through the Google Maps Geocoding API to obtain latitude, longitude, and other geographic information.[116] Using the latitude and longitude information, we assigned an observation to a metropolitan area using defined geographic boundaries through a geo-intersection.[117] Finally we aggregated observations and created a metropolitan-level indicator. We iterated this process several times to ensure data consistency and the adequate allocation of observations to its corresponding geographic boundaries.

ENDNOTES

1. International Monetary Fund, "IMF Survey: Global Economy Faltering From Too Slow Growth for Too Long," (Washington: IMF, 2016).

2. For a detailed review of global cities indices, see Greg Clark, *A Short History of Global Cities* (Washington: Brookings Institution Press, 2016), and Scott Leff and Brittany Petersen, "Beyond the Scorecard: Understanding Global City Rankings" (Chicago: Chicago Council on Global Affairs, 2015).

3. These are not the only major shifts to which cities must respond. Geopolitical insecurity, the inexorable impact of climate change, and rising mass migration are all presenting new challenges for urban areas.

4. UN Habitat, "Urbanization and Development: Emerging Futures. World Cities Report 2016" (2016).

5. Dani Rodrik, "Premature Deindustrialization," Working Paper 107 (Princeton, N.J.: Institute for Advanced Study, School of Social Science, 2015).

6. UN Habitat, "Urbanization and Development: Emerging Futures. World Cities Report 2016" (2016).

7. Economist Alfred Marshall developed the idea in the late 1800s to describe geographically clustered economic activity. Marshall—and later economists Kenneth Arrow and Paul Romer—described the benefits that accrue to firms, workers, and local economies from clustering by way of three categories of "externalities"—input externalities, labor market externalities, and knowledge externalities. A geographic concentration of producers in a given industry provides incentives for input suppliers to locate nearby. As a consequence, producers can share specialized services, share public goods like infrastructure, save on transportation costs, or purchase inputs more efficiently. Input externalities thus help improve the local availability of inputs for growth. These labor market externalities also lead more workers with a particular specialization to locate in the region, creating "thick" labor markets and increasing the availability of labor and the likelihood of a satisfactory match between firms and workers. In addition, these pools of specialized workers interact in ways that improve their own skills, enhancing regional productivity. Finally, the geographic concentration of related economic activity leads to local exchange of information and knowledge, or "spillovers." As Marshall put it, "The mysteries of the trade become no mystery, but are, as it were, in the air." These knowledge externalities promote growth by enhancing worker productivity and the diffusion of technology. Alfred Marshall, *Principles of Economics* (London: Macmillan, 1890). Kenneth J. Arrow, "The Economic Implications of Learning by Doing," Review of Economic Studies 29: 155-173. Paul M. Romer, "Increasing Returns and Long Run Growth," *Journal of Political Economy* 94: 1002-1037.

8. Richard Dobbs et al., "Urban World: Mapping the Economic Power of Cities" (San Francisco: McKinsey Global Institute, 2011).

9. Patricia Clarke Annez and Robert M. Buckley, "Urbanization and Growth: Setting the Context," in Michael Spence, Patricia Clarke Annez, and Robert M. Buckley, eds., *Urbanization and Growth* (Washington: World Bank, 2009).

10. Richard Dobbs et al., "Infrastructure Productivity: How to Save $1 Trillion a Year" (San Francisco: McKinsey Global Institute, 2013).

11. Ibid.

12. Homi Kharas and Geoffrey Gertz, "The New Global Middle Class: A Crossover From West to East" (Washington: Brookings Institution, 2011).

13. Recent data showing the slowdown, or perhaps even stalling, in global goods trade have raised new questions about whether the world will continue its long march toward integration. Simon Evenett and Johannes Fritz, "Global Trade Plateaus," 2016, www.voxeu.org/article/global-trade-plateaus.

14. James Manyika et al., "Digital Globalization: The New Era of Global Flows" (San Francisco: McKinsey Global Institute, 2016).

15. Ibid.; Cristina Constantinescu, Aaditya Mattoo, and Michele Ruta, "The Global Trade Slowdown: Cyclical or Structural?" (Washington: International Monetary Fund, 2015). Simon J. Evenett and Johannes Fritz, "Global Trade Plateaus: The 19th Global Trade Alert Report" (London: Centre for Economic Policy Research, 2016).

16. James Manyika et al., "Digital Globalization: The New Era of Global Flows" (San Francisco: McKinsey Global Institute, 2016).

17. Marc J. Melitz and Daniel Trefler, "Gains From Trade When Firms Matter," *Journal of Economic Perspectives* 26, no. 2 (2012): 91–118; OECD, "Interconnected Economies: Benefiting From Global Value Chains" (2013); World Trade Organization, "World Trade Report 2013." Workers at multinational firms earn hourly wages 26 percent higher than in the same occupations in establishments that only operate domestically; Elizabeth Weber-Handwerker, Mina Kim, and Lowell Mason, "Domestic Employment in U.S.-Based Multinational Companies," *Monthly Labor Review* (October 2011), www.bls.gov/opub/mlr/2011/10/art1full.pdf. Further, exposure to global markets can also help insulate firms from local economic shocks; exporters are 10 percent more likely to survive downturns; Andrew Bernard and J. Bradford Jensen, "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics* 47 (1999): 1-25.

18. In 2014, for example, U.S. exporters supported 6.2 jobs for every $1 million in export revenue. Brookings analysis of data from Census, BEA, Moody's analytics, BLS, NAFSA, IRS, EIA, and Sabre. Masahisa Fujita, Paul R. Krugman, and Anthony Venables, *The Spatial Economy* (Cambridge, Mass.: MIT Press, 1999). The simple model of base-multiplier analysis has not been immune from criticism—most importantly, that by focusing only on the demand side of the regional growth equation, it overlooks important supply-side factors like capital and labor flows, including the self-reinforcing process of agglomeration. See, e.g., Andrew Krikelas, "Review of Economic Base Literature," *Economic Review* (Federal Reserve Bank of Atlanta, 1992).

19. Adie Tomer, Joseph Kane, and Robert Puentes, "Metro Freight: The Global Goods Trade That Moves Metro Economies" (Washington: Brookings Institution, 2013).

20. One study estimated that 20 percent of net new employment in developing economies over the past decade was associated with rising exports. Harvard economist Richard Freeman argues that it is the spread of knowledge and capabilities that has improved living standards in a wide swath of lower-income countries. And Ricardo Hausmann's "economic complexity" theory contends that economic development derives from the spread and deployment of tacit knowledge, knowledge that cannot be codified easily and is best shared face-to-face. Oftentimes tacit knowledge must be imported from outside the country through foreign direct investment or migration, key components of global exchange. A recent OECD study found that having a high share of a region's economy in the traded sector was one significant factor associated with above-average productivity growth. In other words, trade allows for convergence across regions with differing productivity levels. See Richard Dobbs et al., "The World at Work: Jobs, Pay, and Skills for 3.5 Billion People" (San Francisco: McKinsey Global Institute, 2012); Richard B. Freeman, "One Ring to Rule Them All? Globalization of Knowledge and Knowledge Creation," Working Paper 19301 (Cambridge, Mass.: National Bureau of Economic Research, 2013); Ricardo Hausmann, "Tacit Knowledge Economy," Project Syndicate, October 30, 2013; OECD, "Regional Outlook 2016" (forthcoming).

21. Their notable finding was not that manufacturing jobs disappeared, but the expected movement of dislocated workers into new industries never materialized. What economists call the "adjustment costs" of trade may be much greater and longer lasting than previously theorized. See David H. Autor, David Dorn, and Gordon H. Hanson, "The China Shock: Learning From Labor Market Adjustment to Large Changes in Trade," Working Paper No. 21906 (Cambridge, Mass.: National Bureau of Economic Research, 2016).

22. Jonathan D. Ostry, Prakash Loungani, and Davide Furceri, "Neoliberalism: Oversold?" *Finance and Development* 53, no. 2 (2016): 38-41.

23. Saskia Sassen, *Cities in a World Economy* (Thousand Oaks, Calif.: Pine Forge Press, 2012).

24. OECD, "Inclusive Growth in Cities Campaign," www.oecd.org/inclusive-growth/Inclusive%20Growth%20in%20Cities_Flyer_ENG.pdf.

25. Federico Cingano, "Trends in Income Inequality and Its Impact on Economic Growth" (Paris: OECD, 2014).

26. James Manyika et al., "Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy" (San Francisco: McKinsey Global Institute, 2013); Michael Chui, James Manyika, and Mehdi Miremadi, "Four Fundamentals of Workplace Automation," *McKinsey Quarterly*, November 2015.

27. Ibid.

28. Mark Muro et al., "America's Advanced Industries" (Washington: Brookings Institution, 2015).

29. Yet even with these major technological changes, productivity growth has been stagnant, a paradox that has created an intense debate among economists. Scholars like Northwestern's Robert Gordon argue that the United States is experiencing a "regression to the mean" to its low historical norm of technology-induced productivity growth. Other research shows that, while the pace of recent digital innovation has been relentless, it has been unevenly distributed across industries, labor markets, and communities. At the industry level, information and communication technology, media, professional services, and finance are highly digitized whereas agriculture, construction, hospitality, health care, and government are less so. These dynamics are also playing out at the firm level. The OECD finds that the differential in productivity growth has been increasing between the most innovative firms and their less-innovative counterparts. Essentially, some firms are pulling ahead in the race to create innovative products and services, and those innovations are not trickling through to other firms. In other words, there has been a breakdown in the diffusion of new innovations between the most innovative "frontier" firms and their "non-frontier" counterparts. Several explanations, none definitive, have been put forth: it may be that frontier firms uniquely use technologies that non-frontier firms do not have the capabilities to leverage; it may be that the rising importance of tacit knowledge in the information economy means that practices are not easily translated between firms; and/or it may that new, winner-take-all dynamics are prevalent in certain industries. Future research is required to definitively answer these questions. Whatever their cause, these trends matter for regional economies because they are where the dichotomy between frontier and non-frontier comes to ground. Because frontier firms demand high levels of technology, relatively scarce technically skilled workers, and access to ecosystems of complementary firms, universities, and research laboratories, they tend to cluster in certain city-regions. For instance, San Jose, the home of Silicon Valley, boasts six times the share of employment in advanced industries (30 percent) as Miami (5 percent). This dynamic has given rise to "frontier regions" and "non-frontier regions." The OECD has documented that frontier regions are pulling away from non-frontier regions in terms of productivity growth. See Mark Muro, "Look to Advanced Industries to Help Drive Productivity Gains," The Avenue, July 21, 2016; OECD, "The Productivity-Inclusiveness Nexus" (2016); OECD, "Regional Outlook 2016."

30. Muro et al., "America's Advanced Industries."

31. Melanie Arntz, Terry Gregory, and Ulrich Zierahn, "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis" (Paris: OECD, 2016).

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The Global Cities Initiative equips city and metropolitan area leaders with the practical knowledge, policy ideas, and connections they need to become more globally connected and competitive.

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ACKNOWLEDGMENTS

For his research assistance and help with graphics, we would like to thank Andre Assumpcao. We are grateful to our colleagues Alan Berube and Nick Marchio, who were critical partners of ours in this research and provided consistently helpful feedback and new ideas. For their comments or advice on drafts of this paper, the authors thank the following individuals: Alan Berube, Andrew Boraine, Greg Clark, Brad Cunningham, Amy Liu, Tim Moonen, Mark Muro, Jaana Remes, and Adie Tomer. For advice on the competitiveness framework, the authors would like to thank Scott Andes, Lewis Dijkstra, Kenan Fikri, Mikael Larsson, Amy Liu, Mark Muro, Zachary Neal, John Ng, Jaana Remes, Jonathan Rothwell, Neil Ruiz, Chad Shearer, William Tompson, Jill Wilson, and Tiffany Wong. We thank Pat Watson for editing, Maria Sese Paul for layout and design, Stephen Russ for web layout, and Alec Friedhoff for his development of the supporting data interactive.

This report is made possible by the Global Cities Initiative: A Joint Project of Brookings and JPMorgan Chase. The program would also like to thank the Metropolitan Leadership Council, a network of individual, corporate, and philanthropic investors who provide us financial support and, more importantly, are true intellectual and strategic partners.

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