

# GLOBAL PARIS

PROFILING THE REGION'S INTERNATIONAL  
COMPETITIVENESS AND CONNECTIONS





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## EXECUTIVE SUMMARY

In imagination and in fact, Paris is a quintessential global city. It has been one of the world's most visited places for centuries, and its economy prospers today thanks to a well-educated workforce, modern infrastructure, and global niches in creative industries, business services, and tourism. Yet, facing new pressures related to globalization, technological disruption, and demographic change, the region's growth has lagged relative to global peer regions that share its economic size, wealth, and industrial structure. To deliver economic opportunities for its residents, Paris must boost growth.

This report, developed as part of the Global Cities Initiative, a joint project of Brookings and JPMorgan Chase, provides a framework for leaders in the Paris region to sustain the region's prosperity and to better understand its competitive position in the global economy. The report offers information and insights on Paris's global economic position by benchmarking the region against eight global peer regions based on economic size, wealth, productivity, industrial structure, and competitiveness. Its key findings are:

**Paris is a wealthy city-region, but its economy is growing slowly relative to other major global cities.**

The Paris regional economy, defined as a metropolitan labor market slightly larger than the Île-de-France region, housed 12.5 million people in 2015 (19 percent of France's population) and generated \$818 billion in output (31 percent of national gross domestic product, or GDP). Paris is the fourth-largest metro economy in the world and boasts the fifth-highest average wealth (GDP per capita) among the world's 120 largest global city-regions. Paris is prosperous, but stalled growth is limiting increases in that prosperity. Jobs and GDP have increased at a slower rate than in global peer city-regions. Average GDP per capita is growing at such a pace that it will take nearly a century for living standards in Paris to double. Income gains from that growth have been more broadly shared than in major U.S. cities or in London, but those gains have been so minimal that the average household's disposable income has actually slightly declined over the last

15 years. In a composite economic performance index, Paris ranks fifth in comparison with its eight global peers.

**The Paris region can take advantage of changing market, technology, and demographic trends, but it must focus on the core drivers and enablers of competitiveness.** A competitive region is one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households. Globally competitive traded sectors, functioning innovation ecosystems, and skilled labor are the key drivers of overall productivity, employment creation, and income growth. Two enablers support these three drivers: well-connected, spatially efficient infrastructure and a reliable governance structure and business environment.





The Paris region contains notable strengths and significant opportunities to better deploy these five factors—trade, innovation, talent, infrastructure, and governance—to increase its global competitiveness:



**TRADE: Paris specializes in a diverse set of tradable industries—from financial and business services to advanced manufacturing to creative industries—but is limited by low participation of small and medium-sized enterprises (SMEs) in trade.**

Unlike some of its peers, Paris has a diversified global presence in financial services, multinational firm headquarters, advanced manufacturing, and international tourism, culture, fashion, and media. These industries tend to drive growth in jobs and value-added, exports, and foreign direct investment. However, most firms are not globally engaged; French SMEs account for 44 percent of value-added but only 16 percent of exports. In a composite trade index, Paris places fourth among peers.



**INNOVATION: Paris accounts for significant shares of national research and development (R&D), patents, and venture capital, but it is not yet on par with other leading innovation hubs.**

Paris is the center for innovation in France. It houses world-class research universities, agglomerations of high-tech employment, patent-intensive multinational companies, and high levels of R&D spending. Yet, as compared to its global peers—some of the most innovative places in the world—Paris lags on metrics such as patenting intensity, industry collaboration on scientific research, and venture capital attraction. In a composite innovation index, Paris ranks second to last among peers. Nonetheless, significant recent growth in the patenting output of local firms and research institutions bodes well for the Paris region's innovation potential.



**TALENT: Paris is one of the most educated regions in the world, but it has higher unemployment than peer regions.**

The Paris region's high levels of human capital remain a critical asset. Sectors of the economy that employed high levels of professionals and university graduates accounted for most of the job growth in the region over the past decade. In fact, despite accounting for only 24 percent of the

workforce, professional occupations accounted for nearly all net job growth during that time. As they demand more skilled labor, local firms are placing new demands on existing education and training systems. Continuing to produce more high-skill workers and attract talent from both domestic and international sources will prove necessary in order to jumpstart growth and counter high unemployment, particularly among youth. In a composite talent index, Paris places sixth among global peer regions.



**INFRASTRUCTURE: Paris's transportation and digital connectivity are strong, but it must continually invest to address bottlenecks.**

The region is a major aviation hub, but growing strain from passenger flows at Charles de Gaulle International Airport warrants further investments. The region's digital connections are fast and wide-reaching, supporting efficient communication between Paris and other economic hubs. However, physical infrastructure bottlenecks remain, especially in public transit in outlying areas, logistics, and housing supply. While Paris's core is better connected by public transit than any peer metro area, its transit system is much less comprehensive in suburban communities. It is relatively more expensive to ship goods out of Paris than other markets. Housing remains expensive, even as compared to other global cities, although the region has been able to increase the supply of new housing over the past year. In a composite infrastructure index, Paris ranks third among peers.



**GOVERNANCE: Satisfaction with government services is in line with peer countries, but the region's business and regulatory environment is more restrictive than in city competitors.**

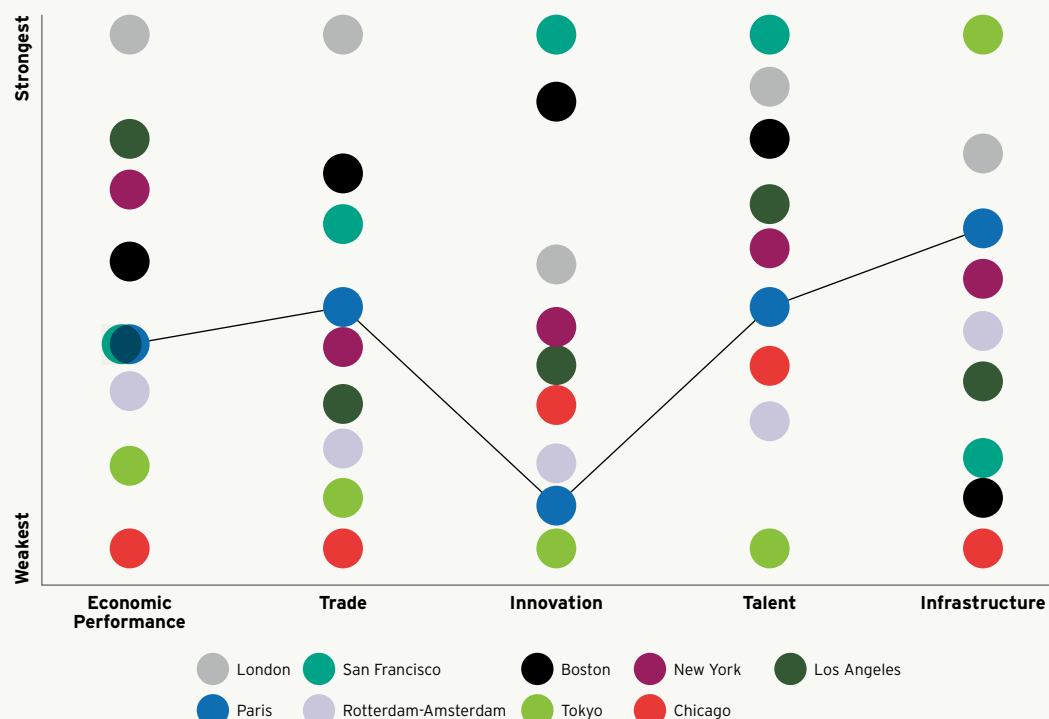
The Paris region operates within a more centralized government structure than its peer cities in the United States, which means it will naturally have less fiscal and spending authority. The Île-de-France region has made admirable attempts to consolidate its highly fragmented municipal structure, but public goods and services are still delivered in a relatively fragmented setting, and this mode of governance likely limits efficiency and lowers overall local productivity. Government services are

high quality, but they could likely be delivered in a more coordinated and efficient fashion. The region can make improvements around the business and regulatory environment. The World Bank's Doing Business project, which assembles its analysis from the perspective of a firm located in the largest city in the country, suggests that Paris's business environment lags those in places like Amsterdam, London, Los Angeles, New York, and Tokyo.

This profile benchmarking Paris against its international peers coincides with the Île-de-France Regional Council's efforts to create a new economic strategy to help solidify the Paris region's core economic strengths and address outstanding challenges. The Paris region is well-positioned to act on these

findings, and we recommend the region pursue its strategy using the international lens deployed in this report. Such a strategy would acknowledge that the Paris region's tradable industries, which are engaged in the global marketplace for trade and talent, are the ultimate drivers of Paris's growth. And with its comparative advantage residing in technology-intensive portions of the economy, Paris must focus particularly on supporting its regional innovation system and preparing workers to participate in these expanding sectors. Investments and reforms to the region's infrastructure and governance, respectively, also could help enable the region's competitiveness. By taking purposeful action now, the Paris region's public, private, and civic institutions can build a globally competitive economy that works for all.

#### Summary of Paris's performance and competitiveness factors



Metro areas are ranked according to a composite index of several variables within each category. For a full list of these variables used in these indices, see methodological appendix.

## I. INTRODUCTION

Cities around the world are having to adapt to a set of global forces that are redefining what it takes to excel in today's global economy.

First, globalization is intensifying. Revolutions in information technology and transportation, the rapid rise of emerging markets, the globalization of finance, and the advent of global value chains have intensified international exchange. Global flows of goods, services, and capital have expanded fivefold over the last two decades, from \$5 trillion in 1990 to \$26 trillion in 2012.<sup>1</sup>

Second, technology is altering how we communicate, how firms create products and services and deliver them across the globe, and the very nature of work itself.<sup>2</sup> The McKinsey Global Institute predicts that 12 emerging technologies will generate an annual economic impact of \$33 trillion by 2025.<sup>3</sup> Risks accompany these breakthroughs; for instance, already-demonstrated technologies have the potential to automate 45 percent of work activities in the United States.<sup>4</sup>

Third, urbanization is changing the geography of growth and economic activity in emerging markets, especially in Asia and Africa. The share of global population in metropolitan areas grew from 29 percent in 1950 to 50 percent in 2009, and it is predicted to reach 60 percent by 2030.<sup>5</sup>

Cities are on the frontlines of these shifts, and their position creates both challenges and opportunities. As more emerging markets come online—connected by technology and trade—the possibilities for where firms and workers can locate their activities have expanded, generating new pressures on individual cities to attract mobile talent and firms. This basic premise is not necessarily new; for centuries firms have sought out supportive environments that provide them the inputs required to sell their products and services. Cities have always utilized this external demand as a critical route to expanded local wealth and prosperity.<sup>6</sup> However, the competition for firms and workers has heightened considerably today, due to the sheer

number and size of cities actively engaged in global flows of trade, talent, and capital. Of course, these same dynamics have created abundant market opportunities for cities as well. For those places that allow firms and people to successfully plug into the global economy, the returns are high.<sup>7</sup>

**“Competitive regions are, by this definition, supportive environments for both people and companies.”**

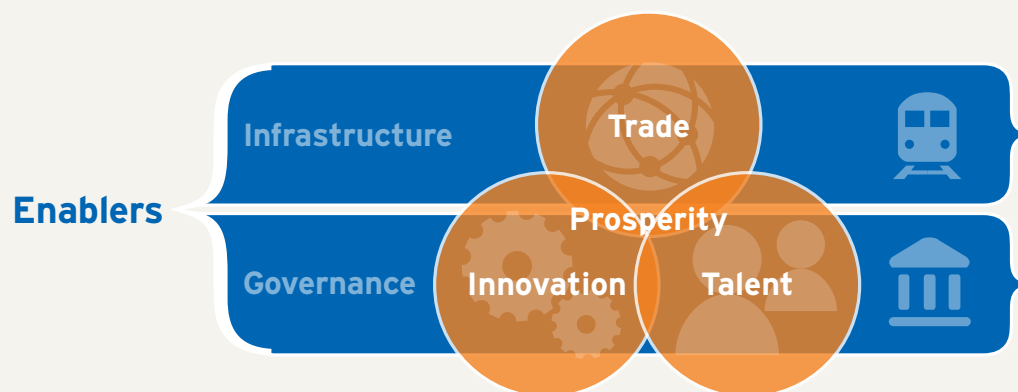
Political, business, and civic leaders across the world have thus become increasingly focused on understanding and enhancing their city-regions' economic competitiveness and connections. To help inform their efforts, the Global Cities Initiative—a joint project of Brookings and JPMorgan Chase—is exploring the competitiveness of global city-regions through a two-year series of *Global City Profiles*, which include Paris. This research draws on Harvard Business School research to define a competitive region as one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households.<sup>8</sup> It acknowledges that firms ultimately compete in the global marketplace, but that the public sector can support a healthy and vibrant private sector through investments in skills, innovation, and infrastructure. It also acknowledges that corporate success alone is unsustainable if it is not accompanied by flourishing workers and families, and that connecting residents to education, training, basic infrastructure, finance, and human services is also critical.<sup>9</sup> Competitive regions are, by this definition, supportive environments for both companies and people.

This profile draws upon a unique dataset of globally comparable performance indicators to offer new insights about the economic competitiveness of the Paris region (see the accompanying boxes on benchmarking and on defining the Paris region). It uses international benchmarking to explore the overall

economic performance of the region and assess its comparative strengths and weaknesses on five key competitiveness factors, and it concludes with implications for the city-region's network of government, business, civic, and community leaders to consider as they position the Paris region on the global stage.

### Defining and measuring competitiveness through international benchmarking

Competitiveness is defined in many ways. This research draws 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.<sup>10</sup> Competitive regions are, by this definition, supportive environments for both companies and people. Building on an extensive literature review on regional economic development by researchers at George Washington University, this research analyzes competitiveness through a five-factor framework—trade, innovation, talent, infrastructure, and governance.<sup>11</sup> The first three factors—globally competitive traded sectors, innovation ecosystems, and skilled labor—are the key drivers of overall productivity, employment creation, and income growth. The other two factors—well-connected, spatially efficient infrastructure, and reliable governance, public services, and business environment—enable these drivers.<sup>12</sup> 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 like one-time tax breaks or depressed wages.



This report utilizes a group of carefully selected metropolitan peers to understand competitiveness beyond a national context. We selected the Paris region's peer cities through a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering using 22 variables that measure economic size, wealth, productivity, industrial structure, and competitiveness.<sup>13</sup> This analysis revealed eight metropolitan economies that most closely resemble the economic profile of the Paris region. Table 1 compares the city-region to its peer metro areas on five of these variables. Similar to Paris, these metro areas are large in terms of output and population, are quite wealthy, and tend to be important hubs of business and exchange in their respective countries and regions. Whenever possible, the analysis employs comparable metrics of economic performance and the five competitiveness factors to unveil areas of comparative strength and weakness.<sup>14</sup>



**Table 1. Key indicators for Paris and global peer metro areas**

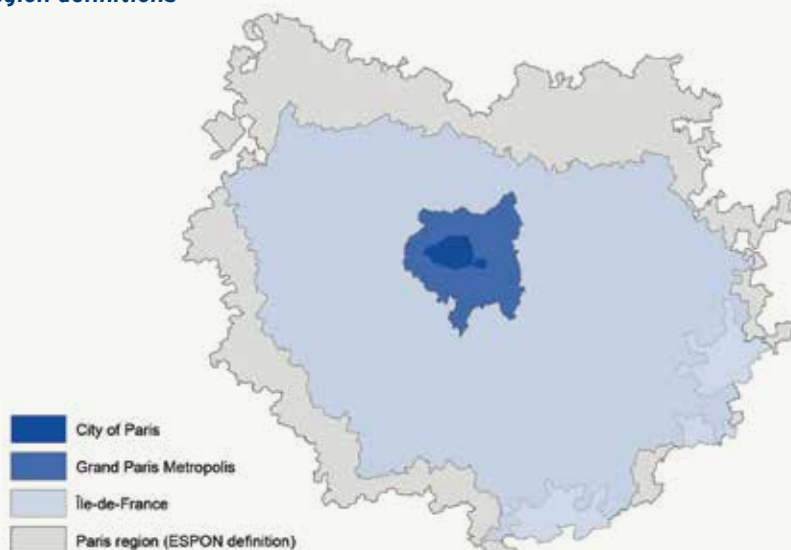
Rank	Population	Nominal GDP	Employment	GDP per capita	GDP per worker
1	Tokyo	Tokyo	Tokyo	San Francisco	San Francisco
2	New York	New York	New York	<b>Paris</b>	Los Angeles
3	London	Los Angeles	London	Boston	New York
4	Los Angeles	London	<b>Paris</b>	New York	<b>Paris</b>
<b>5</b>	<b>Paris</b>	<b>Paris</b>	Los Angeles	Los Angeles	Boston
6	Chicago	Chicago	Chicago	Rotterdam-Amsterdam	Chicago
7	Rotterdam-Amsterdam	Rotterdam-Amsterdam	Rotterdam-Amsterdam	London	Rotterdam-Amsterdam
8	Boston	San Francisco	Boston	Chicago	London
9	San Francisco	Boston	San Francisco	Tokyo	Tokyo

Source: Brookings analysis of Oxford Economics data.

## Defining the Paris region

There are several geographic definitions of the Paris region, but two of the principal ones are the European Spatial Planning Observation Network (ESPON) designation, which this report uses, and the Île-de-France designation (see map). The Île-de-France region contains 1,279 independent communes and 21 administrative units in the City of Paris, and has a population of 12 million. The ESPON definition, which assigns a population of 12.5 million, considers commuting patterns between municipalities, so its area extends slightly beyond the Île-de-France region to reflect workers moving in and out of the region. We find this to be the best approximation of the regional economy as compared to municipal or regional administrative definitions. Where data are not available for the ESPON area, we use data for Île-de-France and, in a few cases, for the City of Paris. The Grand Paris metropole geography has been introduced recently, but we do not use it in our analyses.

### Paris region definitions



## II. THE STATE OF THE PARIS REGION'S ECONOMY

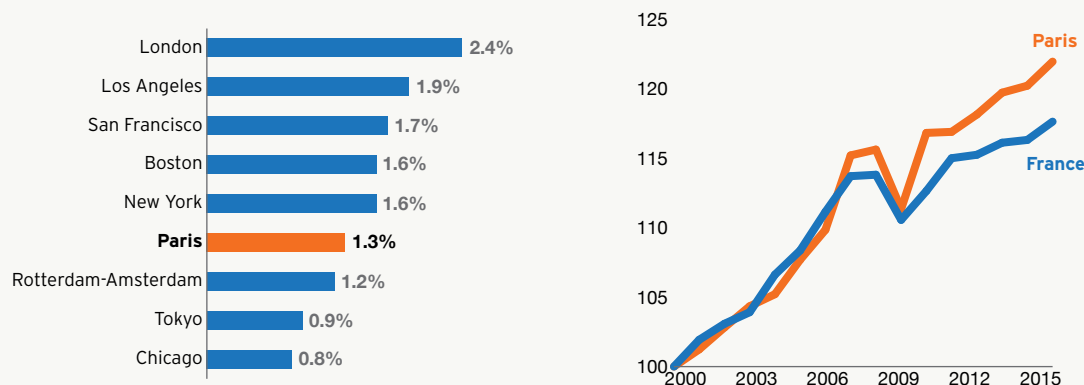
The Paris region, the economic engine of France, is a preeminent global city. Defined here as a metropolitan labor market slightly larger than the Île-de-France region, the Paris regional economy housed 12.5 million people and generated \$818 billion in economic output in 2015, accounting for 19 percent of France's population and 31 percent of national gross domestic product (GDP). Paris is the fourth-largest metro economy in the world and boasts the fifth-highest average wealth (GDP per capita) among the world's 120 largest global city-regions.<sup>15</sup>

In this section we profile the state of the Paris regional economy by examining three elements of its economic performance: growth, prosperity, and inclusion.

**Employment and output growth in Paris have been below average compared to global peers, and employment growth has lagged the national economy.** The rate of change in the size of the regional economy indicates its progress toward expanding economic opportunity. Real GDP growth averaged

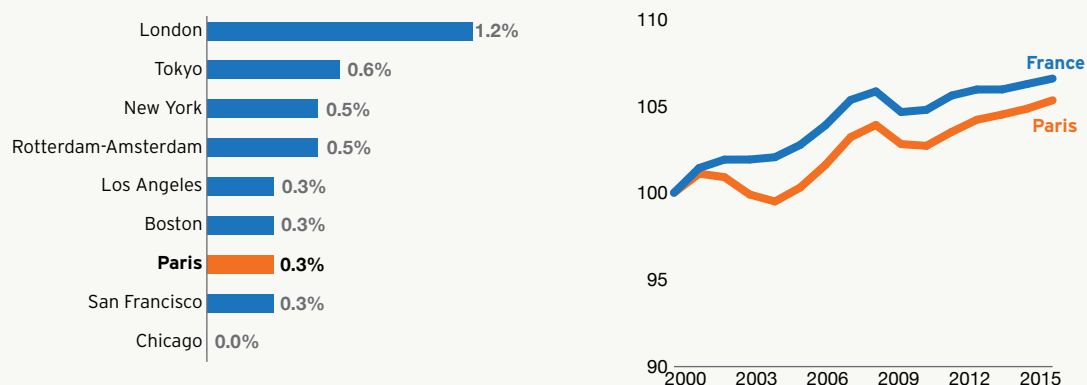
1.3 percent between 2000 and 2015, sixth among nine metro areas in this analysis but faster than France's 1.1 percent annual growth during the period (Figures 1A and 1B). Employment growth has been more modest, averaging 0.3 percent per year since 2000, placing Paris in the bottom third of its metro peers and behind France's 0.4 percent annual rate (Figures 2A and 2B). Both employment and output experienced severe contractions in 2009, but in the post-crisis years they have returned to pre-recession growth trajectories.

Figures 1a and 1b. Real output growth, CAGR and index, 2000-2015



Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

**Figures 2a and 2b. Employment growth, CAGR and index, 2000-2015**

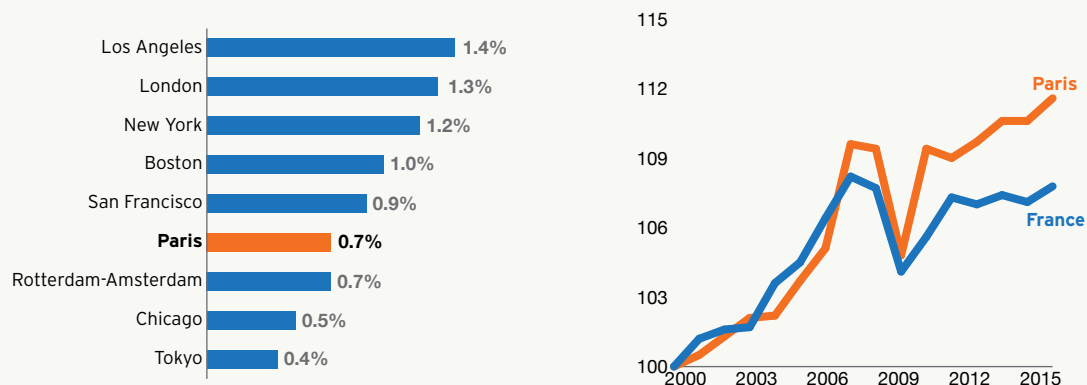


Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

**GDP per capita and productivity in the Paris region are growing faster than in France as a whole, but still remain sluggish compared to global peers.** To create lasting prosperity, economic growth must keep pace with population and labor force growth so that individuals can continue to see their standards of living rise. Annual GDP per capita growth, a common metric of standard of living, has averaged 0.7 percent in Paris since 2000, higher than national trends but sixth among its peer group (Figures 3A and 3B).<sup>16</sup> GDP per capita growth is in turn related to productivity, or the ability of firms and workers to transform the

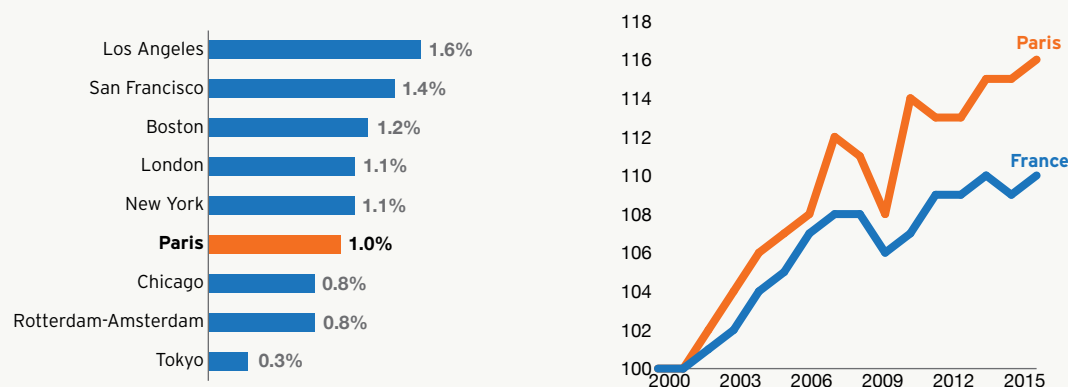
factors of production into more valuable products and services. Productivity, measured as GDP per worker, grew by a 1.0 percent average annual rate from 2000 to 2015 (Figures 4A and 4B). Over the past 15 years, both output per worker and GDP per capita grew faster in the Paris region than in France as a whole, but at the current rate of sluggish GDP per capita growth it would take nearly 100 years for average living standards to double. Indeed, when adjusted for inflation, the average household's gross disposable income actually declined by 92 euros between 2003 and 2013 (Figure 5).

**Figures 3a and 3b. Real GDP per capita growth, CAGR and index, 2000-2015**



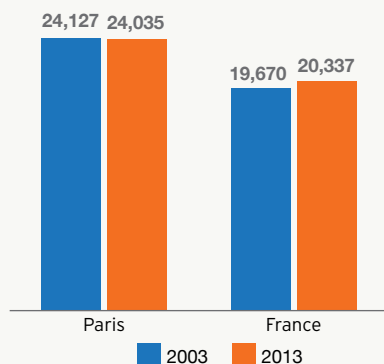
Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

**Figure 4a and 4b. Growth of output per worker, CAGR and index, 2000-2015**



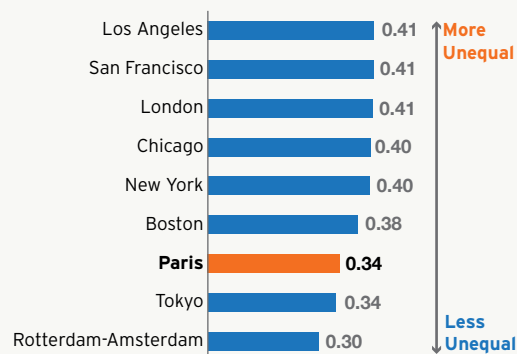
Source: Brookings analysis of Oxford Economics data. CAGR = compound annual growth rate.

**Figure 5. Gross disposable income per household (inflation-adjusted), EUR**



Source: Brookings analysis of INSEE, Division Statistiques Régionales and IMF CPI

**Figure 6. Gini income inequality index, latest available year**

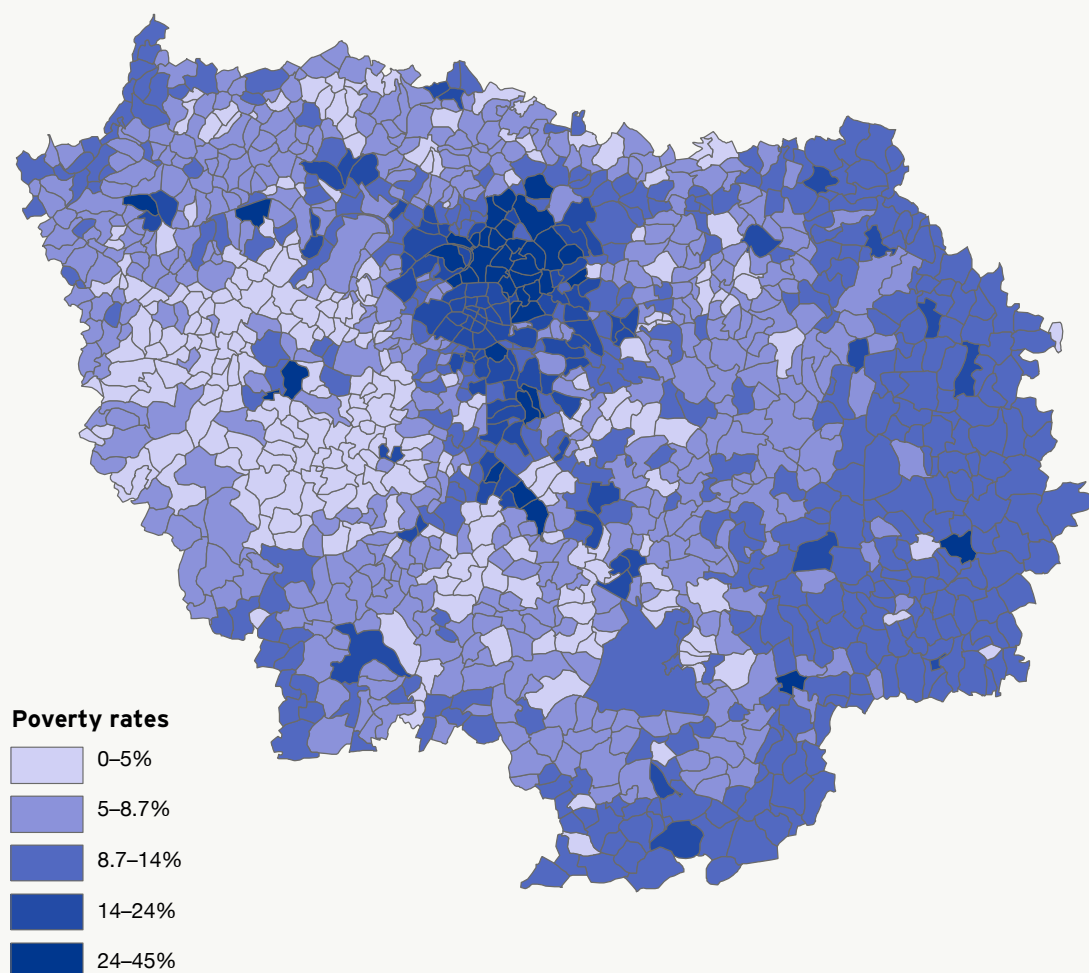


Source: Brookings analysis of OECD data and national statistical offices

Growth is more broadly shared than in peer city-regions, but the benefits have not extended to all parts of the Paris region. High inequality can reduce the durability of economic growth if it undermines access to health care and education, limits productivity-enhancing investments, and diminishes social cohesion.<sup>17</sup> While many of the global economic trends that contribute to income inequality are beyond the control of any individual city, understanding how income gains are distributed within a regional economy can reveal who among the population is benefitting from local growth. One common way to measure income inequality is the Gini coefficient,

which defines inequality on a scale from zero (perfect equality) to one (perfect inequality). The Paris region registered a Gini ratio (after taxes and transfers) of 0.34 in 2010 (Figure 6).<sup>18</sup> Income inequality in Paris is much lower than in the U.S. states in which Paris's peer cities are located, i.e., California, Illinois, New York, and Massachusetts. Paris's income distribution is also more equitable than London's. Still, Paris exhibits significant spatial inequality. Poverty rates in the northern and eastern parts of the region remain much higher than those in the south and east (Figure 7).

**Figure 7. Percentage of population living in poverty, Île-de-France municipalities, 2012**



Source: INSEE, Recensements de la population.

► **BOTTOM LINE:** Paris is an extremely wealthy region, boasting the second highest GDP per capita among its peer regions, behind only San Francisco. Yet economic growth has been slight over the past 15 years. Despite Paris's relative affluence, jobs and GDP have increased at a slower rate than in global peer city-regions. Average GDP per capita is growing at such a pace that it will take nearly a century for living standards in Paris to double. Income gains from that growth have been more broadly shared than in major U.S. cities or in London, but those gains have been so minimal that the average household's disposable income has actually slightly declined. Sluggish productivity growth of only 1.0 percent per year is contributing to this lackluster performance. Paris, and France more broadly, need to jumpstart growth.



### III. COMPETITIVENESS DRIVERS AND ENABLERS

#### A. TRADE



**WHY IT MATTERS:** Trade is a critical driver of prosperity and competitiveness. 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.<sup>19</sup> Participating in global trade also makes metro areas more competitive and productive. Firms that generate revenue from outside their home markets must provide goods and services faster, better, and more cheaply than global competitors. Local companies that embed themselves in global value chains gain access to high-quality inputs, lower their overall costs, and as a result become more globally competitive. This process tends to boost productivity and wages.<sup>20</sup> A 1 percent increase in international trade leads to a 0.5-2 percent gain in income per capita.<sup>21</sup> Therefore, the traded economy, as measured by trade in goods and services and by foreign direct investment, is both an important signpost and a critical driver of competitiveness.

#### TRADED SECTOR STRUCTURE AND GROWTH

**Paris's traded sectors are responsible for 43 percent of value-added and 35 percent of employment.**

Services, which account for 93 percent of total economic value-added in the region, dominate the Paris economy. The Paris region has the fourth-largest service economy in the world. Professional, scientific, and technical services (13 percent of value-added and 12 percent of jobs) and information and communication services (11 percent of value-added and 7 percent of jobs) are the region's largest tradable services (Table 2). Non-tradable services like wholesale and retail trade absorb significant shares of employment (13 percent) and output (11 percent). Higher labor productivity in professional, scientific, and technical services explains why a smaller number of workers generate a larger share of output in the region.<sup>22</sup> Manufacturing accounts for 6.9 percent of output and 5.6 percent of jobs.

**Table 2. Paris Region's Industrial Structure, 2015**

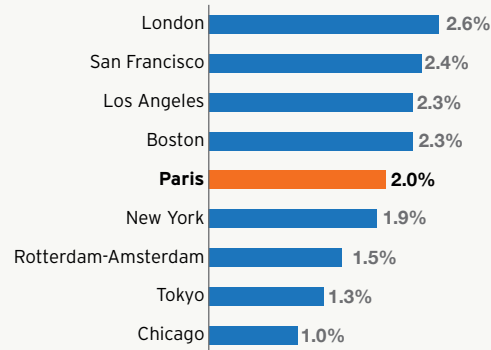
Sector	Share of jobs	Share of value added
<b>Tradable</b>	<b>34.7%</b>	<b>43.4%</b>
Professional, scientific & technical activities	11.8%	13.0%
Information & communication	6.8%	11.4%
Manufacturing	5.6%	6.9%
Transportation & storage	5.6%	5.2%
Financial & insurance activities	4.7%	6.7%
Agriculture, forestry & fishing	0.3%	0.1%
Mining & quarrying	0.0%	0.0%
<b>Non-Tradable</b>	<b>65.3%</b>	<b>56.6%</b>
Wholesale & retail trade	12.8%	10.8%
Human health & social work	9.2%	5.9%
Administrative & support activities	8.7%	5.9%
Public administration & defense	8.0%	6.4%
Education	6.2%	3.7%
Accommodation & food services	5.3%	2.6%
Construction	5.2%	3.5%
Other services	3.7%	1.4%
Arts, entertainment & recreation	3.2%	1.7%
Real estate activities	1.8%	12.9%
Electricity, gas & water supply	1.0%	1.9%

*Source: Brookings analysis of Oxford Economics data.*

Advanced services have driven Paris's traded sector growth since 2000. Overall, economic output in the tradable portion of Paris's economy has grown at 2 percent per year since 2000, fifth among peer regions (Figure 8). One simple way to gauge the health of traded sectors is to examine the change in jobs and economic value-added within each of them. Three sectors—professional, scientific, and technical services; information and communications services; and finance and insurance—generated 53 percent of net employment growth in Paris (equivalent to 175,000 positions) between 2000 and 2015 (Figure 9B). This contrasts starkly with the significant employment declines in manufacturing (161,000 fewer jobs than in 2000), which occurred more precipitously than in the nation as a whole. Manufacturing output slightly increased during this same period, reflecting the fact that technological advancements have made the sector more productive. Output growth was fastest in information and communication (3.8 percent annually), finance and insurance (2.5 percent), and

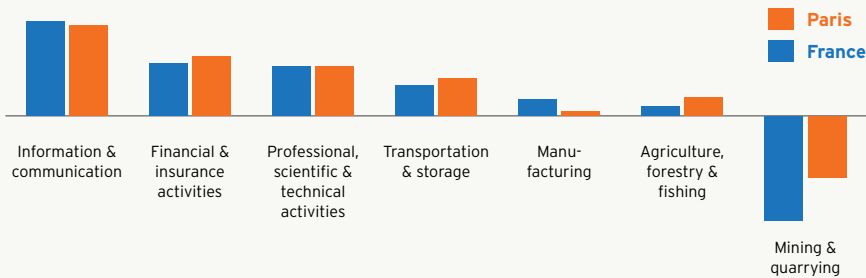
professional, scientific, and technical services (2.1 percent) during these years (Figure 9A). Traded output in advanced services has increased at a faster pace than employment, indicating productivity gains in these sectors over the past 15 years.

**Figure 8. Output growth in traded sectors, CAGR, 2000-2015**



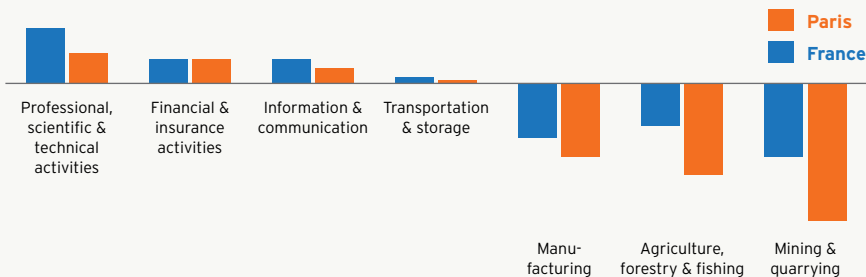
Source: Brookings analysis of Oxford Economics data.

**Figure 9a. Output growth in key traded sectors, CAGR, 2000-2015**



Source: Brookings analysis of Oxford Economics data.

**Figure 9b. Employment growth in key traded sectors, CAGR, 2000-2015**



Source: Brookings analysis of Oxford Economics data.

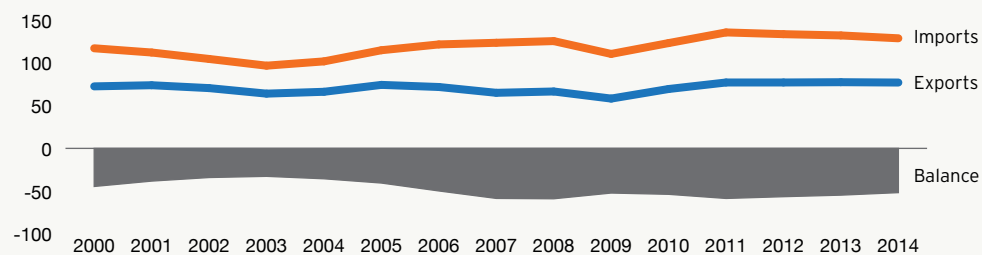
## GOODS AND SERVICES TRADE

**The Paris region registered €77 billion and €129 billion in goods exports and imports, respectively, accruing a trade deficit of €52 billion in 2014.**

Goods trade deficits are common among large service economies, which tend to import most of their primary goods and raw materials to meet basic retail, energy, and business needs.<sup>23</sup> Paris's goods trade deficit was higher in 2015 than in 2000 (when it was €45 billion), but it has declined from a peak of €59 billion in 2008 (Figure 10). Post-recession recoveries in transportation equipment and mechanical, electronic, and computer equipment exports have helped close the gap. These two industries alone, powered by major multinational companies like PSA Group (automotive) and Dassault Aviation (air, space,

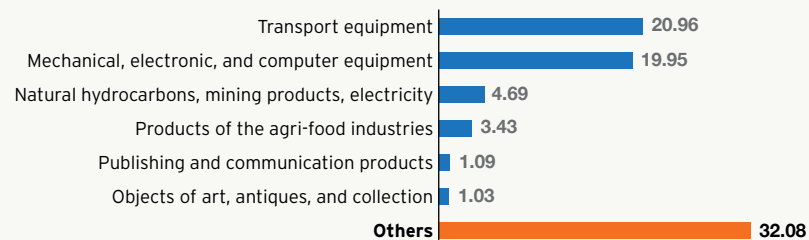
and defense) account for nearly half of the region's overall goods exports (Figure 11). Between 2014 and 2015, the automotive and aerospace industries contributed nearly two-thirds of the region's goods export growth. While advanced manufacturing may no longer be a widespread source of employment, it remains a critical export industry. Large firms tend to dominate exports. Nationwide, small and medium-sized enterprises (SMEs) account for 50 percent of private-sector employment, 44 percent of total value-added, and 32 percent of business investment, but only 16 percent of export revenues.<sup>24</sup> Undoubtedly, some SMEs are involved as suppliers to larger exporting companies and are therefore not reflected in the official statistics. However, it is still notable that only 5 percent of SMEs export, half the share as in Germany.<sup>25</sup>

**Figure 10. Global goods trade, Île-de-France, 2012, billions EUR**



Source: Direction interrégionale des douanes and World Bank-OECD national accounts deflator.

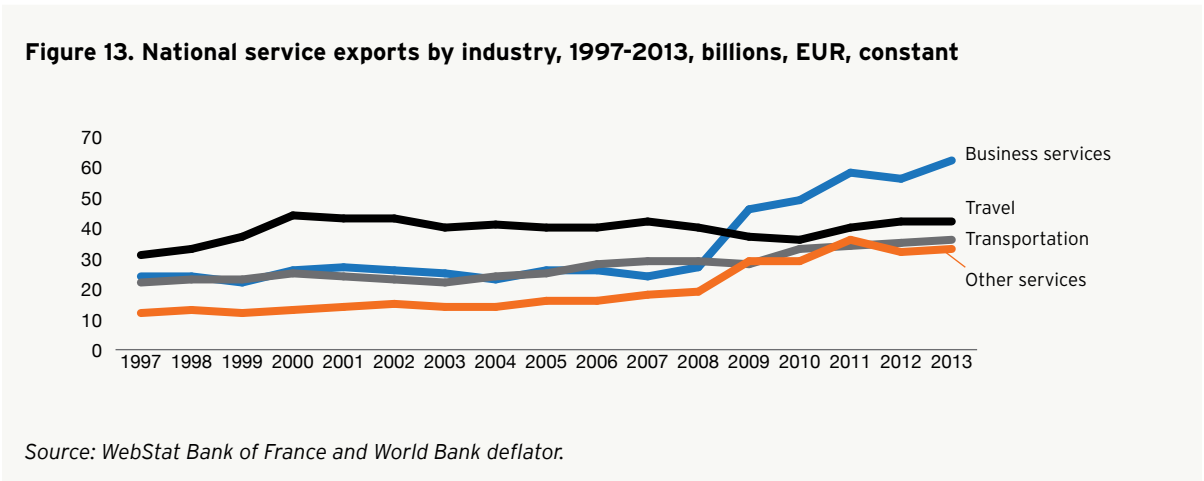
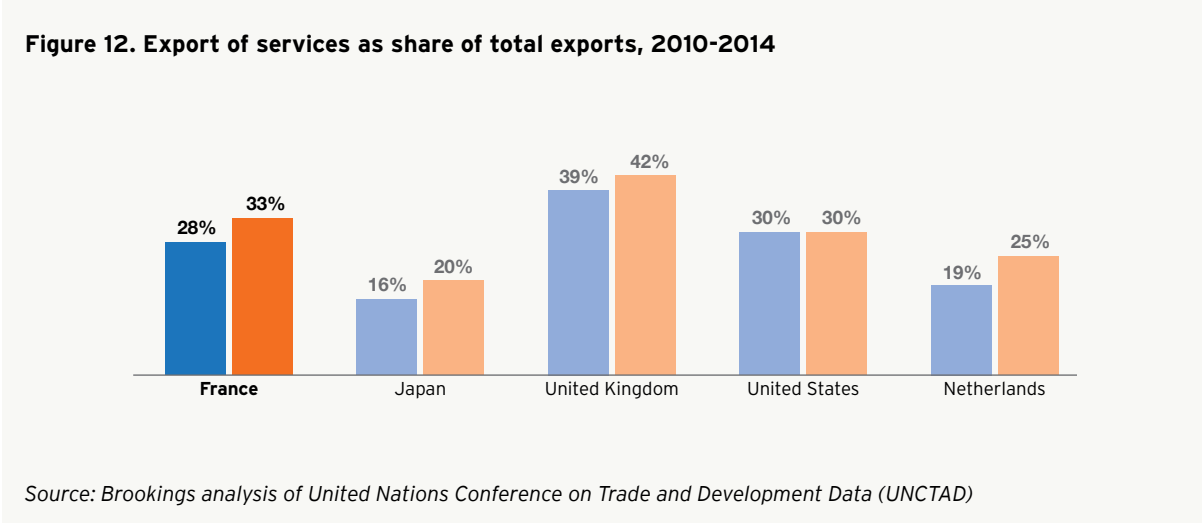
**Figure 11. Goods exports, Île-de-France, 2015, billions EUR**



Source: Brookings analysis of fDi Intelligence data.

**Paris is the epicenter of a growing national services trade.** In the absence of region-level data, national trade statistics are the closest proxy available to determine Paris's role in services trade. Nationally, services are an increasingly important component of France's export basket. In 2014, services were 33 percent of all exports, up from 28 percent in 2010 (Figure 12), and were a greater share than in Japan, the Netherlands, and the United States but

lower than in the United Kingdom. Since 1997, business services, travel, and transportation (due to the large inflow of international travelers to the country) have generated, on average, 82 percent of France's services exports (Figure 13). Given that Paris hosts more than 60 corporate headquarters and attracts 16 million visitors per year, it is likely that a significant share of these revenues concentrate in the region (see the box on France's service exports).<sup>26</sup>



## How Paris leads France's service exports

France is a growing services exporter. Even through the recession, national services exports maintained a €35 billion surplus by 2013. Many of these industries cluster and concentrate in the Paris region, which accounts for 43 percent of France's tradable services value-added. Data measuring the networks of multinational services firms confirm these findings. According to the Globalization and World Cities (GaWC) Research Network (Table 3), Paris is the fourth most connected region in the world for advanced services, a rank that stems from its high concentration of corporate headquarters and the supportive management consulting, accounting, financial, legal, and marketing services those businesses require. Indeed, firms with their corporate headquarters in Paris have larger balance sheets and generate higher revenues than those in London or New York.

**Table 3. Global 2000\* corporate headquarters and connectivity measures, 2012 or most recent data available**

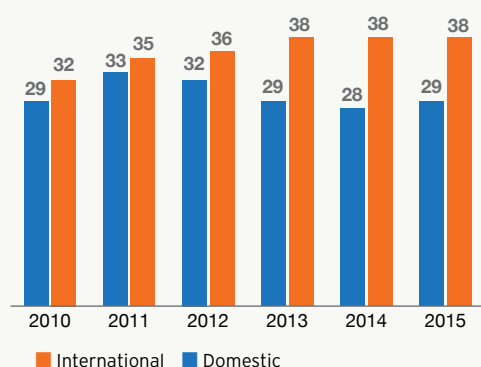
City	Country	Number of head-quarters	Revenue (USD billion)	Profits (USD billion)	Assets (USD billion)	Global network connectivity rank	Degree of network connectivity (% connected)
Tokyo	Japan	154	3,444	125	13,088	6	65
New York	U.S.	82	1,682	191	10,875	2	94
London	U.K.	68	1,681	156	10,694	1	100
<b>Paris</b>	<b>France</b>	<b>60</b>	<b>2,011</b>	<b>103</b>	<b>11,137</b>	<b>4</b>	<b>72</b>
Chicago	U.S.	31	548	43	974	11	60
San Francisco	U.S.	17	605	67	1,947	31	49
Los Angeles	U.S.	16	211	20	313	18	56
Boston	U.S.	12	135	14	389	38	45
Amsterdam	Netherlands	9	305	12	1,845	23	53

Source: Brookings analysis of GaWC data. \*The Global 2000 is a list of the 2000 largest publicly-traded companies in the world.

Paris is also a hub for creative industries (e.g., fashion, media, culture, etc.). It enjoys a near monopoly in the couture market, which translates into exports not only of luxury goods but also of fashion design and brand management services. Consistently ranking among the world's most visited cities—receiving close to 16 million people per year—Paris is also directly responsible for a large piece of France's €10 billion tourism revenues. International visitors have accounted for most tourism growth in the past five years. Total nights spent in Paris hotels by domestic visitors has been flat since 2010, while those spent by international travelers has increased by 19 percent. Increasingly, these visitors are coming for leisure, not business: the share of nights spent in hotels by business travelers has declined from 50 percent in 2010 to 33 percent in 2015 (Figures 14A and 14B).

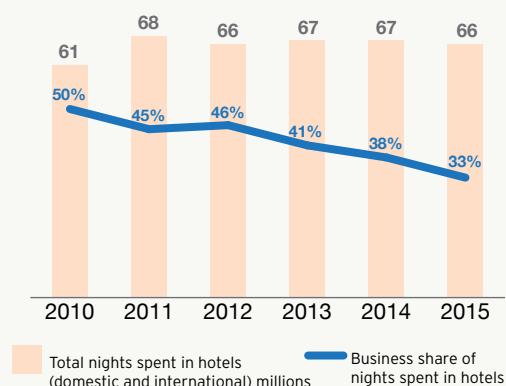


**Figure 14a. Nights spent in hotels by international and domestic visitors, 2010-2015, millions**



Source: Bilan d'activité CRT 2010 à 2015

**Figure 14b. Total nights spent in hotels, 2010-2015, millions, and share of business visitors**

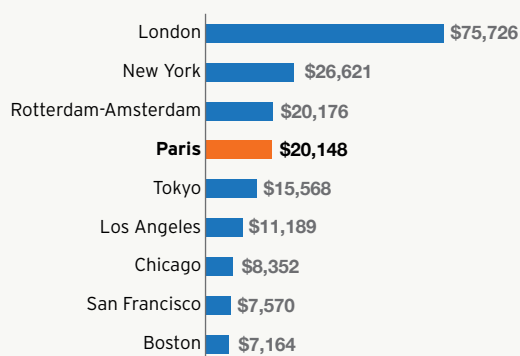


## Foreign direct investment

**Paris attracted \$20 billion in new foreign direct investment (FDI) since 2009, the fourth most among global peers.** Greenfield investments—new establishments in foreign markets—help reveal the extent to which multinational firms find the Paris region an attractive operational environment vis-à-vis

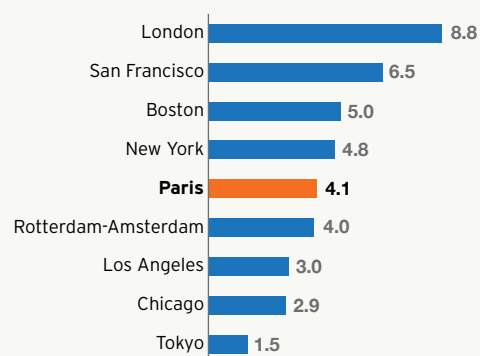
other global regions. Paris ranked fourth among global peers in terms of total FDI inflows between 2009 and 2015 (Figure 15). These investments created approximately 51,000 jobs, also fourth among peers. On a per capita basis, Paris's FDI inflows rank fifth (Figure 16). No metro area in this analysis comes close to London (\$76 billion), which receives more FDI than New York, Rotterdam-Amsterdam, and Paris combined.

**Figure 15. Total greenfield FDI, 2009-2015, millions, USD**



Source: Brookings analysis of fDi Intelligence data.

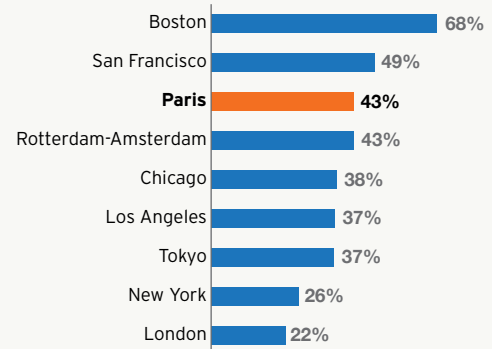
**Figure 16. Total greenfield FDI per capita, 2009-2015, thousands, USD**



Source: Brookings analysis of fDi Intelligence data.

**Technology-intensive sectors have accounted for 43 percent of total FDI since 2009.** Between 2009 and 2015, four of every 10 dollars invested by firms in the Paris region were spent in science- and technology-intensive advanced industries, led by communications and software/ information technology services. Paris's share of FDI in advanced industries trails only Boston and San Francisco (Figure 17), arguably the United States' two leading innovation hubs. Other major industries included business services (\$3.3 billion), consumer products (\$3.2 billion), and textiles (\$3.0 billion), reflecting Paris's world-leading specializations in business and fashion (Table 4).

**Figure 17. Share of total FDI in tech-intensive sectors, 2009-2015**



Source: Brookings analysis of fDi Intelligence data.

**Table 4. Greenfield foreign direct investment by industry, 2009-2015**

Industry	Total FDI (USD million)	Cumulative share of total FDI
Business services	3,323	16%
Consumer products	3,244	33%
Textiles	3,011	48%
Communications	2,294	59%
Software & IT services	1,913	68%
Financial services	1,535	76%
Real estate	1,077	81%
Hotels & tourism	595	84%
Leisure & entertainment	408	86%
Beverages	405	88%
Others	2,343	100%

Source: Brookings analysis of fDi Intelligence data.

➤ **BOTTOM LINE:** Unlike some of its peers, Paris has a diversified global presence in financial services, multinational firm headquarters, advanced manufacturing, and international tourism, culture, fashion, and media. High value-added, technology-intensive sectors are the region's comparative advantage and growth engine. Growth in jobs and value-added, exports, and foreign direct investment point to a common set of industries in advanced manufacturing and professional and technical services. However, most firms are not globally engaged. Paris can fully live up to its export potential by helping more firms connect to international trading opportunities, supporting key tradable industry clusters, and branding the region aggressively as the premier business and technology hub in Europe.

# B. INNOVATION

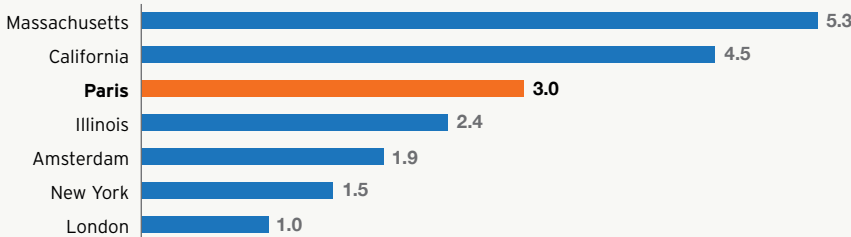


**WHY IT MATTERS:** A region's innovative capacity and levels of entrepreneurship both have implications for its ability to develop and deploy commercial applications, start new businesses, and maintain industrial competitiveness in the face of disruptive technological change. Innovation takes many forms and can be hard to measure, especially innovation that improves processes or management techniques or that occurs in the informal economy. Yet the most productive and technologically advanced metropolitan economies in the world tend to combine a common set of institutions and assets into a rich, collaborative innovation ecosystem that can commercialize research and development into new products and services. Further, for developed nations the creation of new technologies, products, and services constitutes the only way forward to achieve economic growth.

## The Paris region accounts for 39 percent of France's research and development (R&D)

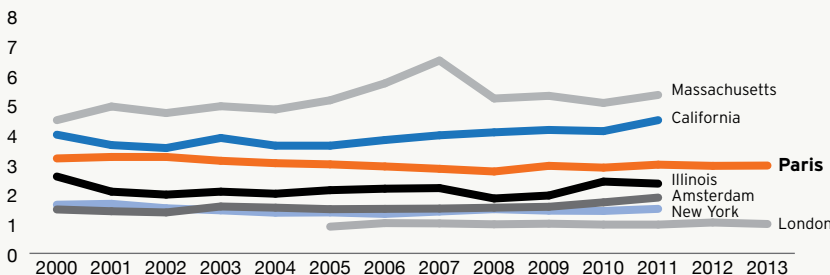
**expenditures, but R&D investment as a share of GDP has declined slightly over time.** R&D is an important measure of the resources invested in the discovery and commercialization of new products, processes, and technologies,<sup>32</sup> and Paris is an R&D-intensive region. It allocates 3 percent of total GDP to R&D activities, higher than the national rate of 2.3 percent and almost twice as much as the average metro in Organisation for Economic Co-operation and Development (OECD) countries (1.6 percent of total GDP). However, R&D investments have slightly declined from a high of 3.3 percent in 2003. As of the latest year for which we have data, R&D investment in Paris as a percentage of its regional economy is lower than in Massachusetts (largely dominated by Boston) and California (which includes Los Angeles and San Francisco) (Figures 18A and 18B). Corporates are the largest source of R&D in the region, accounting for 68 percent, followed by higher education institutions (17 percent) and the government (13 percent). Government R&D investment has declined overall since 2000 while higher education's share has grown (Figure 19).

Figure 18a. R&D investment as a percentage of GDP, 2013 or latest year available



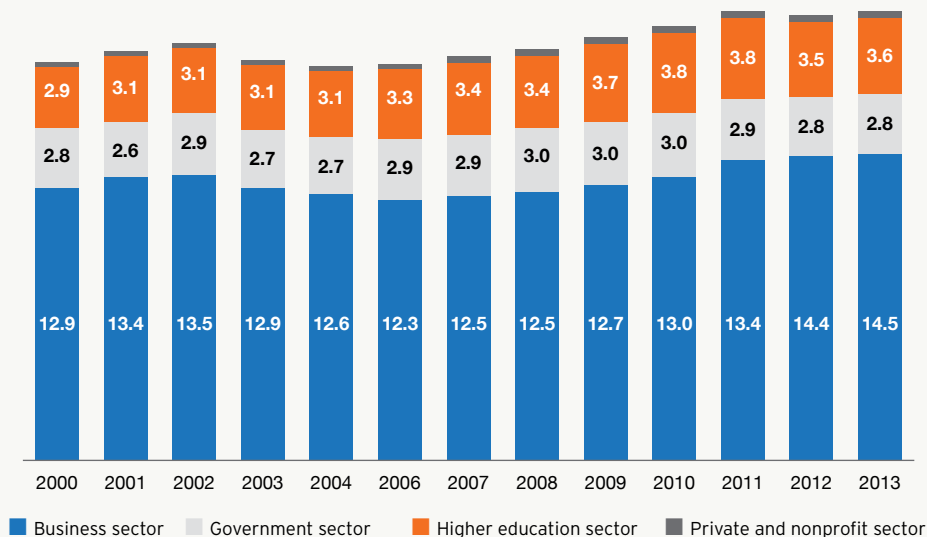
Source: Brookings analysis of OECD Regional Innovation Indicators

Figure 18b. R&D investment as a percentage of GDP, 2000-2013 or latest year available



Source: Brookings analysis of OECD Regional Innovation Indicators

**Figure 19. R&D expenditures by sector, 2000-2013, billions (U.S. dollars), constant PPP**



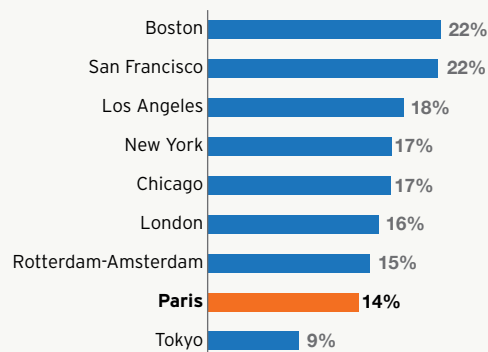
Source: Brookings analysis of OECD Regional Innovation Indicators

**A strong network of research universities supports R&D and innovation in the Paris region, but collaboration with the private sector could be improved.**

Research universities play a major role in driving innovation by providing basic research that underlies scientific discovery and understanding, facilitating the translation of research results into consumable goods and services, and attracting and supporting the growth of other research-intensive industries.<sup>33</sup> To measure the scientific impact of universities, the Centre for Science and Technology Studies (CWTS) and Leiden University have compiled metrics for 750 major universities worldwide. Six universities in the Paris region (École Polytechnique, Paris Descartes University, Université Paris Diderot, Université Paris-Est Créteil Val de Marne, Pierre and Marie Curie University - UPMC, and Paris-Sud University) are ranked within the top 750 research universities, and the region trails only Tokyo and London on concentration of world-class research universities.<sup>34</sup> As compared to global peers, however, the research in

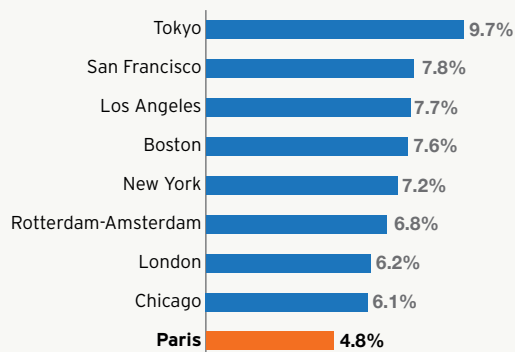
these universities is less likely to appear in high-impact scientific journals. Fourteen percent of all publications rank in the top 10 percent of most cited academic papers, a common metric to gauge quality of research (Figure 20), more than the world average of 11 percent but less than all global peers except Tokyo. Since English-language journals tend to be the most widely read in the scientific community, and since much of the scientific research in Paris is likely done in French, it is not surprising that Paris ranks relatively low on this metric. Current efforts by the French government are consolidating leading universities into a single consortium to better utilize resources and produce higher-quality research. These efforts also aim to spur research collaborations with industry partners, a key element for the successful translation of knowledge into new ventures. Currently, Paris ranks at the bottom in terms of the share of total scientific publications done with industry (Figure 21).

**Figure 20. Share of total publications in top 10 percent most cited papers in all fields, 2010-2013**



Source: Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

**Figure 21. Share of total publications done with industry, 2010-2013**

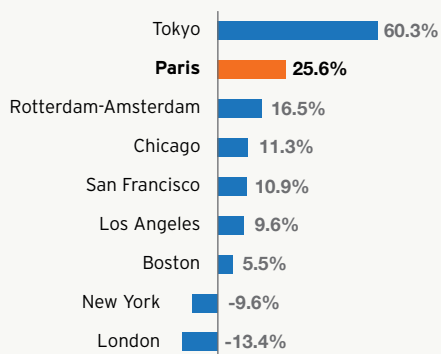


Source: Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

**The Paris region registered a 26 percent increase in the number of patents per capita in the last 10 years** (Figure 22). Patents provide a reliable and comparable, if imperfect, measure of new inventions that spur economic development.<sup>39</sup> Paris concentrates 37 percent of France's total patents, and the region is increasing its patenting intensity. Between 2008

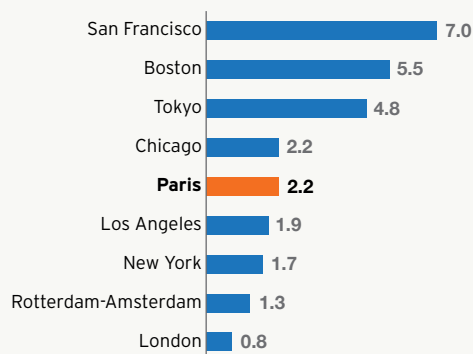
and 2012 the region produced 2.2 patents per 10,000 workers (Figure 23), a 26 percent increase from the 2003 to 2007 output. This represented the second-fastest growth rate in patent output among its metro peers, behind only Tokyo. Even with these gains, however, Paris trails its most patent-intensive peers.

**Figure 22. Change in patent per capita output, 2003-2007 to 2008-2012**



Source: Brookings analysis of OECD REGPAT data.

**Figure 23. Patents per 10,000 workers, 2008-2012**



Source: Brookings analysis of OECD REGPAT data.



**The private sector accounts for more than a third of all patents invented in the region.** Four industries account for nearly three-quarters of total patents: life sciences (21 percent), advanced manufacturing and information technology (20 percent each), and energy and infrastructure (13 percent). Large multinational companies in industries with vertically integrated value chains help to spur innovation in the region by investing in different parts of the supply chain that complement their products and services. For example,

L'Oreal, a firm that specializes in cosmetics and other consumer goods, has patents in organic fine chemistry, advanced manufacturing, macromolecular chemistry, polymers, textiles, paper, and other consumer goods. The same pattern can be observed in other firms in the automotive sector, energy, and machinery manufacturing. Table 5 highlights the technologies in which the Paris region generates the most patents, highlighting those in which it has a unique specialization.

**Table 5. Top technologies by number of patents, Paris, 2008-2012**

Rank within Paris	Rank among peers (X/9)	Technology family	Technology	Number of patents registered, 2008-2012	Share of total patents, 2008-2012	Technology specialization (LQ), 2008-2012
<b>1</b>	<b>4</b>	<b>Life sciences</b>	<b>Organic fine chemistry</b>	<b>1593.2</b>	<b>11.3%</b>	<b>1.70</b>
<b>2</b>	<b>2</b>	<b>Transport</b>	<b>Motor vehicles</b>	<b>1190.6</b>	<b>8.5%</b>	<b>2.93</b>
3	3	Precision systems	Measurement	1011.6	7.2%	1.37
4	2	Information technology	Digital communication	878.2	6.2%	0.88
5	6	Information technology	Computer technology	866.7	6.2%	0.87
<b>6</b>	<b>2</b>	<b>Advanced manufacturing</b>	<b>Engines, pumps, turbines</b>	<b>838.5</b>	<b>6.0%</b>	<b>2.05</b>
7	2	Energy and infrastructure	Electrical machinery, energy	554.7	3.9%	0.75
8	5	Life sciences	Biotechnology	492.1	3.5%	1.09
9	7	Life sciences	Medical technology	476.0	3.4%	0.49
10	2	Advanced manufacturing	Mechanical elements	393.0	2.8%	1.06
11	2	Advanced manufacturing	Materials, metallurgy	345.2	2.5%	1.26
12	3	Energy and infrastructure	Oil and Gas	340.4	2.4%	1.38
13	5	Life sciences	Pharmaceuticals	253.8	1.8%	1.34
<b>14</b>	<b>2</b>	<b>Energy and infrastructure</b>	<b>Environmental technology</b>	<b>233.6</b>	<b>1.7%</b>	<b>1.51</b>
15	2	Precision systems	Control	230.9	1.6%	1.21
<b>16</b>	<b>1</b>	<b>Transport</b>	<b>Aerospace</b>	<b>166.7</b>	<b>1.2%</b>	<b>3.58</b>
<b>17</b>	<b>2</b>	<b>Energy and infrastructure</b>	<b>Combustion and Steam</b>	<b>64.3</b>	<b>0.5%</b>	<b>2.57</b>
18	3	Transport	Ships and watercraft	57.9	0.4%	1.33
<b>19</b>	<b>2</b>	<b>Energy and infrastructure</b>	<b>Nuclear engineering</b>	<b>49.2</b>	<b>0.3%</b>	<b>1.98</b>
20	2	Transport	Other vehicles	37.0	0.3%	1.05

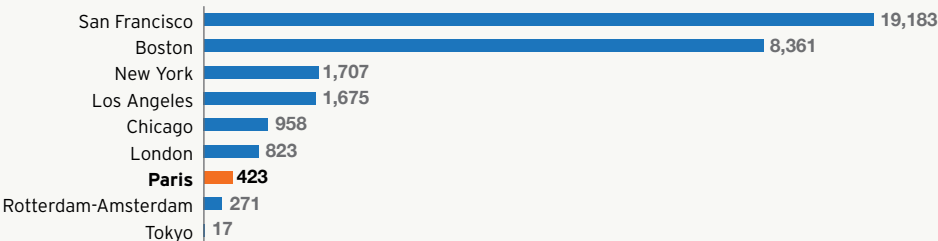
Source: Brookings analysis of OECD REGPAT data. Items in red indicate technologies in which Paris has a unique specialization.

**Paris concentrates 63 percent of all venture capital invested in France, but investment flows lag most of its European and North American peers.**

Venture capital (VC) provides funds for innovative enterprises positioned for high growth and the potential to create and capture entire new markets.<sup>40</sup> Firms that receive venture capital can be particularly important stimulants to regional economies: VC recipients are three to four times more patent-intensive than other firms and are much more likely to translate their R&D activities into high-growth

ventures.<sup>41</sup> Compared to other metro peers, Paris ranks near the bottom in terms of venture capital flows, ahead of only Tokyo and Rotterdam-Amsterdam (Figure 24). About 62 percent of all VC investments in Paris come from domestic sources, in part bolstered by government efforts to spur innovation.<sup>42</sup> Five industries concentrate 60 percent of all VC investments into Paris: software (24 percent), media (11 percent), pharmaceuticals and biotechnology (10 percent), commercial services (10 percent), and medical devices (9 percent).

**Figure 24. Total venture capital investments per capita, 2005-2015, USD**



Source: Brookings analysis of Pitchbook data.

**“Five industries concentrate 60 percent of Paris’s venture capital investment: software, media, pharmaceuticals and biotechnology, commercial services, and medical devices.”**

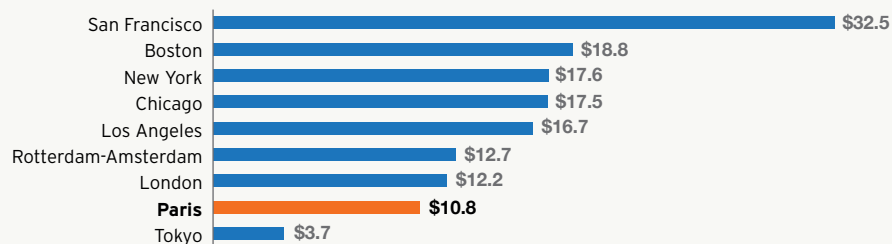
## Financing the startup ecosystem in Paris

Startups are important players in regional economies because they help translate R&D into economic activities that have the capability of creating entirely new industries.<sup>43</sup> More broadly, their often innovation-intensive business models represent one of the most important avenues for economic growth in advanced economies.

The Paris region concentrates the necessary elements required for a thriving startup scene. It agglomerates France's most important innovation inputs: 27 percent of the nation's world-class research universities, 37 percent of patents, 30 percent of high-tech employment, and 63 percent of all venture capital investments. Yet, given all these assets, startups frequently struggle to achieve the scale and relevance of their American and European counterparts. Out of 191 startups with valuations higher than \$1 billion, 21 are located in Europe but only one, Blabla Car, is headquartered in Paris.<sup>44</sup>

Financing is one of the main challenges affecting the performance of Parisian startups. Seed capital, a segment of the investment cycle typically provided for activities like market research and prototyping, has room to improve in France. A recent OECD study found that this type of investment tends to be smaller in France than in other European countries (particularly Germany) and highly concentrated among certain firms and sectors.<sup>45</sup> These trends are also apparent for Paris and its regional peers: Paris ranks near the bottom, above only Tokyo and Rotterdam-Amsterdam, in number of seed capital deals (Figure 25). Venture capital is not the only way to measure financing for small firms, but it illustrates the technology-intensive portions of the economy in which Paris seeks to specialize.

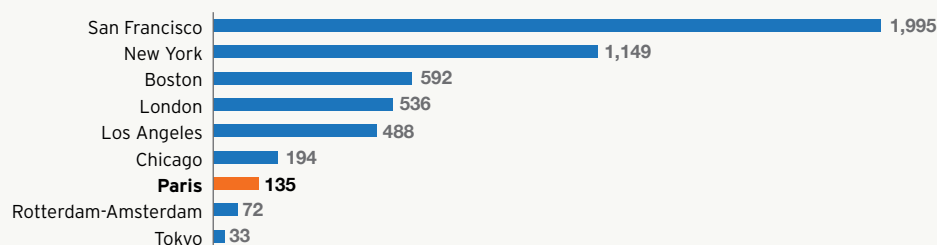
**Figure 25. Seed capital deals, 2006-2015**



Source: Brookings analysis of Pitchbook data.

Startups in Paris also face funding constraints once they have developed a business model, are receiving steady revenue, and are ready for expansion. Compared to global peers, Paris ranks second to last on the average “late stage” venture capital investment (Figure 26). This lower access heavily impacts the capabilities of Parisian firms to tap into new markets and consolidate their business models internationally.

**Figure 26. Average later stage investment deal, 2006-2015, millions USD**



Source: Brookings analysis of Pitchbook data.

► **BOTTOM LINE:** As the center for innovation in France, Paris houses world-class research universities, clusters of high-tech employment, patent-intensive multinational companies, and high levels of R&D spending. The rate at which new inventions, as measured by patents, are being created is on the rise. Yet the region still lags behind some of its most innovative peers on several indicators. In high-growth entrepreneurship, as measured by venture capital funding, Paris trails all of its American peer regions and London. Paris has the necessary elements to compete with some of the most innovative places on earth, but more coordinated efforts to better utilize its assets are required. Fostering a closer alignment of the private sector and research universities, as well as promoting a business environment conducive to innovation, will be critical in the region's efforts to solidify itself as Europe's leading global knowledge center.

**“Paris has the necessary elements to compete with some of the most innovative places on earth and solidify itself as Europe's leading knowledge center.”**

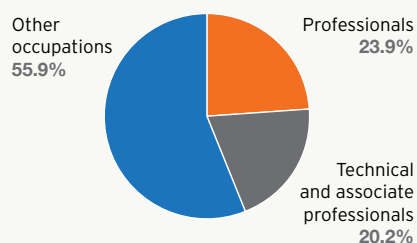
## C. TALENT



**WHY IT MATTERS:** 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.<sup>46</sup> Producing, attracting, and retaining educated workers; creating jobs for those workers; and connecting those workers to employment through efficient labor markets all matter for regional competitiveness and ensuring broad-based economic opportunity for a metropolitan area's population.<sup>47</sup>

**The Paris labor market can be broken down into three categories of occupations** (Figure 27A). The first is professional occupations, workers who create new knowledge and apply advanced scientific or artistic concepts to their work. Common examples include physicists, engineers, university professors, economists, lawyers, and medical practitioners.<sup>48</sup> These occupations account for about one-fourth of jobs in the Paris region. The second category can be classified as technical and associate professional occupations, which involve tasks related to the application, rather than creation, of knowledge. These workers include technicians in science, engineering, or medicine as well as teachers and social workers. These occupations account for about 20 percent of the regional labor market. The third category—other occupations—includes clerical support, service and sales, agriculture, craft and related trades, plant machine operators, and elementary occupations. This category accounts for 55 percent of total jobs.

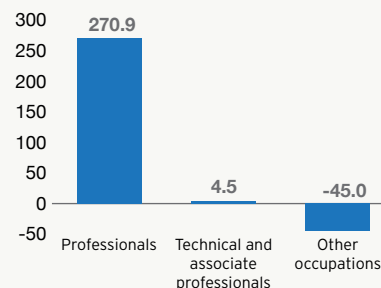
**Figure 27a. Share of overall employment by broad occupations, 2015**



Source: Brookings analysis of Oxford Economics and EuroStat data.

Professional occupations accounted for nearly all net job growth over the past decade, revealing the upskilling of the Paris labor market. The previous section argued that Paris sits at the center of the knowledge economy, and one of the hallmarks of the knowledge economy is an elevated demand for professional workers. Between 2006 and 2015, the Paris region experienced a net gain of 271,000 jobs in professional occupations, accounting for nearly all net new job growth and revealing the broad professionalization of the Paris labor market (Figure 27B). Technical and associate professional occupations experienced a net gain of 4,500 jobs in this same period, while other occupations actually lost 45,000 jobs.

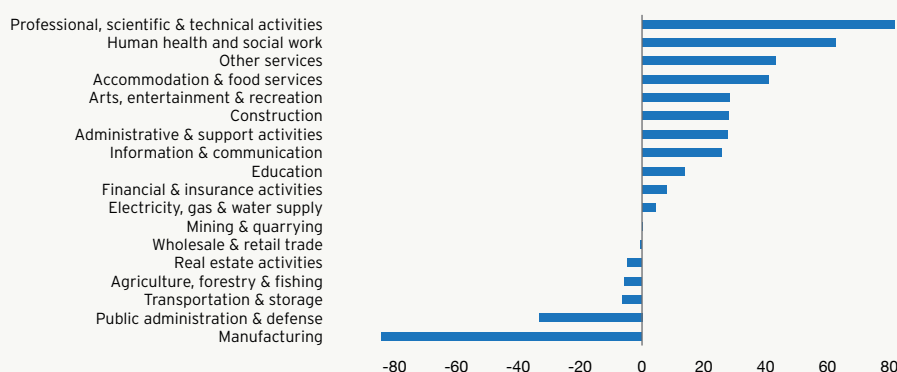
**Figure 27b. Job change by broad occupation, 2006-2015, thousands**



Source: Brookings analysis of Oxford Economics and EuroStat data.

**Over the past decade job growth in the Paris region has concentrated in industries that demand highly skilled workers.** Paris's employment gains have been largest in service sectors, led by education, information and communication, professional and scientific activities, and health and social work. Together, these sectors created 184,000 jobs between 2006 and 2015, accounting for 80 percent of the region's job growth during that period (Figure 28) and employing 63 percent of professional workers. These highly professionalized sectors also play an important role with respect to innovation. They employ 52 percent of workers with tertiary education and account for 55 percent of Paris's jobs in science and technology, occupations that pay a 42 percent wage premium

**Figure 28. Change in jobs by industry, 2006-2015, thousands**

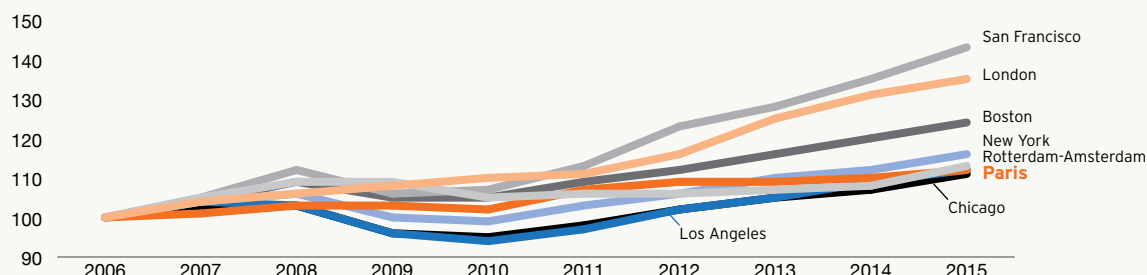


Source: Brookings analysis of Oxford Economics data.

in France and are therefore a critical route to lifting incomes.<sup>49</sup> Technical and associate jobs, which tend to demand more skills than other occupations but fewer than professional occupations, offer one pathway for middle-skill workers. It is therefore notable that, despite the net growth in associate-level occupations, there was considerable volatility across industries. For instance, construction added 46,000 new technical and associate-level jobs, public administration added 20,100 jobs, and finance and real estate added 20,100, while professional and scientific lost 42,200 associate-level jobs, information and communication lost 26,000, and manufacturing lost 25,200. As the economic environment becomes more disruptive, it will be critical for Paris to adapt its workforce to the evolving needs of the knowledge economy in order to remain globally competitive and bolster broad-based growth at all skill levels.

**One key advanced sector—professional, scientific, and technical activities—has been a particularly critical driver of labor market demand, yet that sector is growing slower locally than in many of Paris’s peer regions.** Among the sectors driving the expansion of professional occupations, professional and scientific activities accounted for 42 percent of the 271,000 net jobs created, followed by finance and real estate at 16 percent and health services at 10 percent. Professional and scientific activities encompass a range of advanced services including legal, accounting, engineering, design, software, consulting, R&D, and public relations. Examples of firms in the Paris region belonging to this sector include Centre National de la Recherche Scientifique (CNRS), a publically supported scientific research center; Assystem, a top nuclear engineering company; IT-CE, a financial technology consulting firm; and Consort NT, a digital technology services provider. Despite the outsized role of professional and scientific activities in the Paris economy, this sector is growing at a much slower pace compared to peers such as New York, Boston, London, and San Francisco (Figure 29). Paris may not be able to re-create the success of these leading global tech hubs, but it can better capitalize on the forces driving growth in these industries.

**Figure 29. Percent change in jobs for professional, scientific & technical activities, 2006-2015, 2006 = 100**



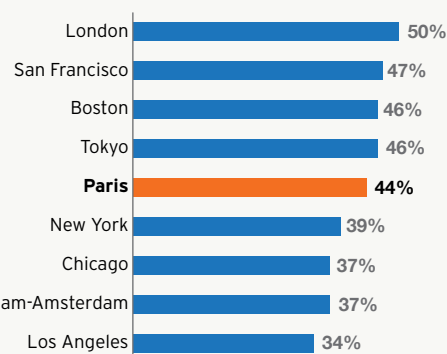
Source: Brookings analysis of Oxford Economics and Moody's Analytics data.

**The Parisian workforce is among the largest and most highly educated in the world.** In 2013, 44 percent of Paris's population above 15 years old has attained tertiary education. Among its peer group, Paris ranks fifth in terms of educational attainment, a few percentage points behind London, San Francisco, Boston, and Tokyo (Figure 30). All of these metro economies are among the most well-educated in the world, so Paris still maintains educational advantages over most global metro areas. One prominent feature of France's overall population is the higher rates of tertiary education among young people. The growing share of young highly educated workers suggests that Paris may be on track to catch up to its peers in terms of tertiary education attainment, helping it adjust to the increasing demand for professionals brought upon by the changing structure of the global economy.

**Despite the influx of young highly educated workers, the Parisian economy faces potential labor shortages as more workers reach retirement age.**

As populations across Europe, Japan, and the United States become older, businesses must fill the positions held by retiring workers who often take with them substantial experience, skills, and knowledge built over long careers. Based on the demographic structure of Paris, 44 percent of the current working-age population will reach retirement age by 2034. Moreover, compared to 2000 Paris today has a smaller population age 25-39 and a substantially

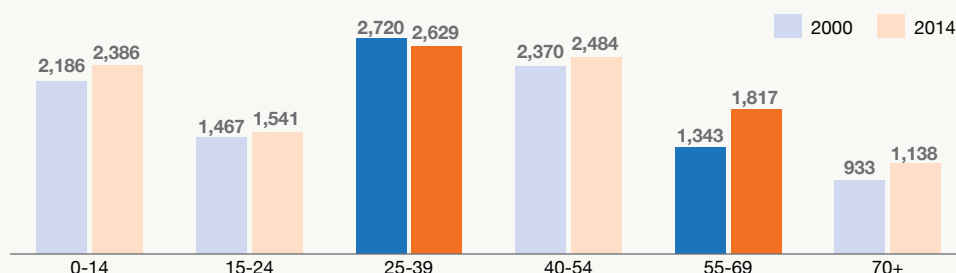
**Figure 30. Share of population above 15 years old with tertiary education, 2013 or most recent data available**



Source: Brookings analysis of data from Oxford Economics. Data measure the population aged above 15 years old and are from 2014.

larger retirement-age population age 55-69 (Figure 31). These changes to workforce composition present both opportunities and challenges. On the upside, businesses will have a once-in-a-generation opportunity to replenish vacancies with workers who are better able to exploit new technologies and implement innovative production processes and organizational models. On the other hand, Paris will need to ensure that its current workforce keeps pace with shifting job requirements in order to meet the demand.

**Figure 31. Population by age cohort, 2000 and 2014, thousands**



Source: Brookings analysis of OECD Regional Demographic Indicators.

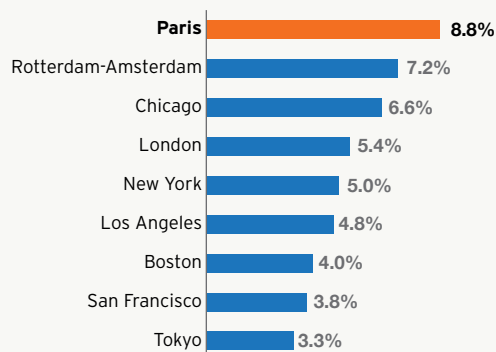
**“Paris benefits from a highly educated youth population, but a large section of youth are struggling to participate in labor markets and take full advantage of the region’s educational resources.”**

**While not at crisis levels, Paris suffers from relatively high unemployment, particularly among youth and workers lacking tertiary education.** Paris led all of its peers in 2015 in terms of unemployment, with a rate (8.8 percent) more than 1.6 times the peer average of 5.4 percent (Figure 32A). As is the case in many other countries, unemployment in France has a strong relationship with educational attainment (Figure 32B). According to OECD country-level data, workers with less than tertiary education experience double-digit unemployment rates. Among the unemployed, young workers who dropped out of education or training before successfully completing their programs are oftentimes the most at risk of becoming inactive. A common measure of youth labor market disconnection is the proportion of young people age 18-24 neither in employment nor in education or training (NEET), a ratio that remains in double digits in the

Paris region (Figure 33). However, one encouraging sign is that the percent of early leavers from education or training has decreased recently, from a high of 12.5 percent in 2008 to 8.1 percent today. As demonstrated in previous sections, Paris benefits from a highly educated youth population, but a large section of youth are struggling to participate in labor markets and take full advantage of the region’s educational resources. In order to curb rising unemployment and meet the anticipated demand for replacement workers, Paris needs to improve education outcomes among youth and direct investment into workforce training programs that better equip the unemployed with the skills necessary to find jobs.

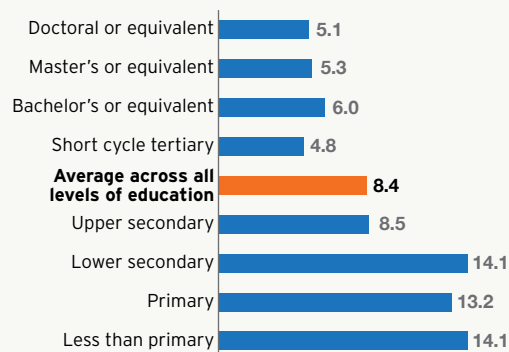


**Figure 32a. Unemployment rate, 2015 or most recent data available**



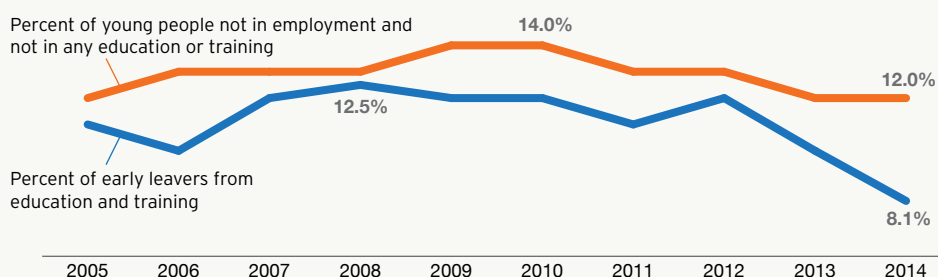
Source: Brookings analysis of Oxford Economics data and INSEE.

**Figure 32b. Unemployment rate in France by education attainment level, 2014 (percentage of unemployed 25-64 year olds among those participating in labor force).**



Source: Brookings analysis of OECD data Table A5.2a Page 108 of Education at a Glance Interim Report: Update of Employment and Educational Attainment Indicators.

**Figure 33. Share of youth disconnected, Île-de-France, 2005-2014**



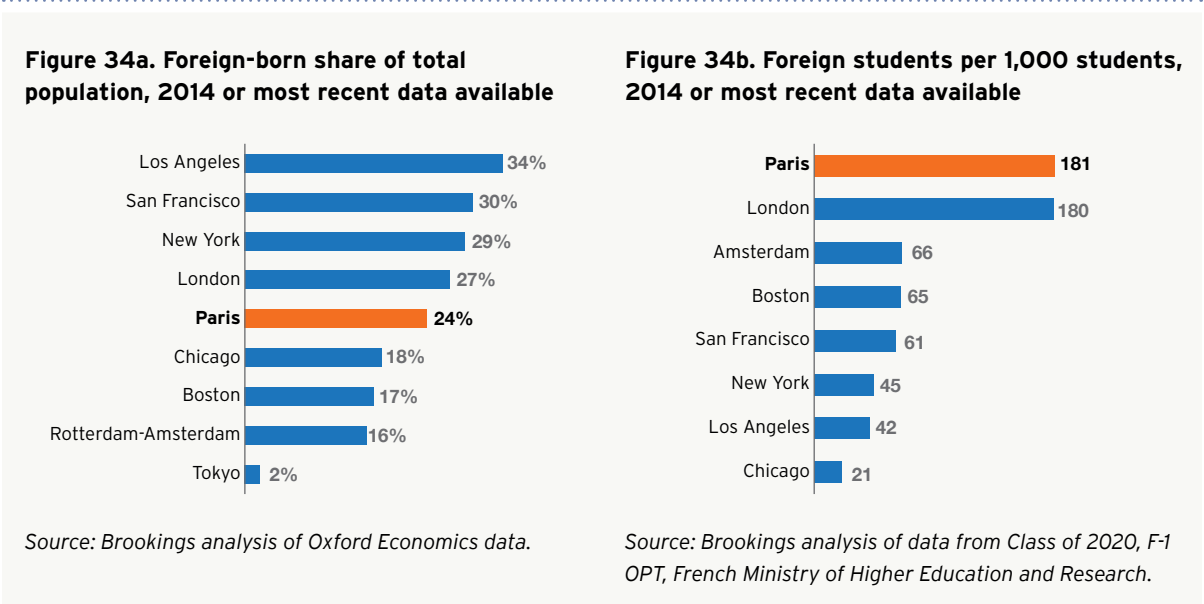
Source: Brookings analysis of OECD Regional Social Indicators

**The large and growing foreign-born population may be a source of labor supply across various skill levels.** In order to stay competitive in the face of an aging workforce and evolving skill requirements, civic and industry leaders must explore both domestic and international sources of labor. Approximately 24 percent of Paris's population is foreign born (Figure 34A), and foreign-born workers are both more likely to be overqualified based on the average education requirements of their particular job and more likely to start their own businesses.<sup>50</sup> In France as of 2013, 27

percent of highly educated foreign-born individuals (who are not presently enrolled in school) compared to 19.4 percent for the native-born population are considered overqualified for their jobs.<sup>51</sup> In terms of entrepreneurship, 11 percent of foreign-born individuals in France are self-employed, compared to just 9 percent of the native-born population. One group of immigrants that is especially well-equipped to support the Parisian economy is foreign students, who are more likely to pursue degrees in science and engineering, possess valuable language skills, and bring knowledge

of foreign markets. Foreign students also support the local economy through tuition and living expenditures. Paris leads all of its peers in terms of the number of foreign students as a proportion of all students in higher education, at more than 180 per 1,000 (Figure

34B). Continuing to increase the number of foreign students and attracting high-skill immigrants will play a critical role in strengthening Paris's workforce and adapting it to the global economy.



► **BOTTOM LINE:** The Paris region's high levels of human capital remain a critical asset and driver of job creation. Sectors of the economy that employed more professionals and university graduates accounted for most of the job growth in the region over the past decade. In fact, professional occupations accounted for nearly all net job growth despite their small share of total employment. By upskilling, the Paris labor market is placing new demands on existing education and training systems. Continuing to produce more high-skill workers and attracting talent from both domestic and international sources will prove necessary in order to jumpstart growth and counter rising unemployment, particularly among the young. These human capital needs will only become more apparent as Paris's workforce continues to age.

## D. INFRASTRUCTURE



**WHY IT MATTERS:** Infrastructure and the spatial layout of a metropolitan area matter

for competitiveness in two ways. First, firms rely upon global access, both physically, through seaports, airports, and logistics systems, and digitally, through the internet, to bring their products and services to outside markets in the most cost-effective manner.<sup>53</sup> Second, the competitiveness of a regional economy also hinges on its ability to productively connect its people and physical assets to their best use within the region through a spatially efficient alignment of local land use, transportation, and housing policies.<sup>54</sup>

**Paris sits at the center of a dense logistics network, but that system's performance trails that of peer countries.** Freight transportation networks allow firms to send their products abroad and receive critical inputs via global supply chains.<sup>55</sup> No comparable city-level data exist to compare freight infrastructure, but national assessments provide insights into the broader transportation systems in which cities operate. The World Bank's Logistics Performance Index ranks France 16th in the world, well above most countries, but trailing the Netherlands, the United Kingdom, the United States, and Japan (Table 6).<sup>56</sup> The index, which surveys logistics professionals and business executives, rates France higher on the timeliness of the overall system and lower on the ease in which firms can arrange international shipments. For example, the World Bank Doing Business survey finds that it costs more to export a container from Paris than from any peer city in this analysis.<sup>57</sup>

**Table 6. Logistics performance index rank, 2016**

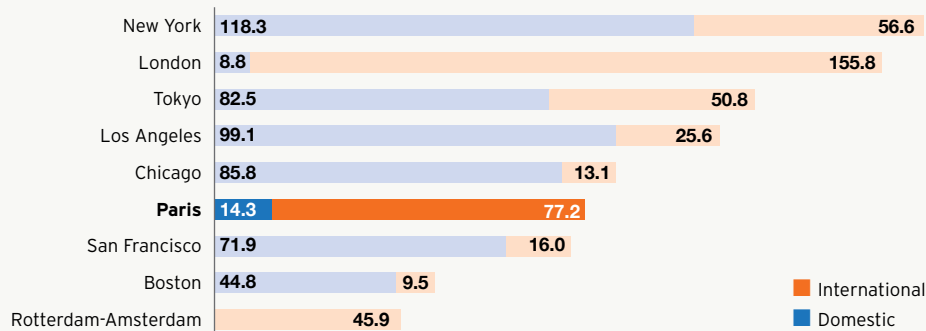
Rank	Country (City)
4	Netherlands (Rotterdam-Amsterdam)
8	United Kingdom (London)
10	United States (multiple cities)
12	Japan (Tokyo)
16	France (Paris)

Source: World Bank Logistics Performance Index.

**"Among peer cities, Paris has experienced the third-fastest aviation passenger growth since 2004, straining the capacity at Charles de Gaulle International Airport."**

**Paris's airports are critical connectors to the rest of the world, moving 90 million passengers in 2014 alone.** Airports serve as key exchange points in the domestic and international flow of people and ideas, and in doing so help stimulate regional employment and GDP growth.<sup>58</sup> In 2014, a little more than 90 million people used Paris's airports—Charles de Gaulle (CDG) and Orly—to access the region for business and leisure travel. Approximately 85 percent of these "origin-destination" passengers—those who were not simply passing through Paris's airports to connect to their final destination—came from other countries. As compared to its peer cities, Paris does not yet rival the aviation passenger volumes of New York, London, and Tokyo, or even Los Angeles or Chicago (Figure 35). U.S. metro economies in this analysis move higher numbers of aviation passengers because that is the primary mode of travel across the vast American territory. After London, Paris is the second most important aviation center in Europe, but it is also important to note that Paris moves many passengers via rail, a much more prominent travel mode than in the United States. High-speed rail is integral to transport in France, which has an extensive network connecting to the Benelux countries, Italy, Germany, Spain, Switzerland and the United Kingdom. While we do not have benchmarked data to compare, it is clear that high-speed rail is a critical aspect of Paris's international mobility offering.

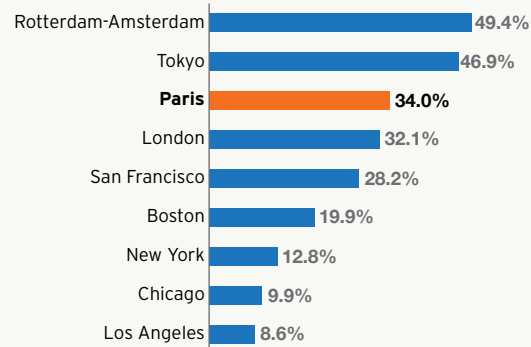
**Figure 35. Total aviation passengers, 2014, millions**



Source: Brookings analysis of Sabre data.

**Paris has exhibited the third-fastest aviation passenger growth since 2004, straining the capacity at Charles de Gaulle International Airport.** Between 2004 and 2014, Paris boosted its origin-destination aviation traffic by 34 percent, more than in all but two of its metro peers (Figure 36). If Paris traffic keeps growing at the same rate for the next 10 years, the region will overtake Chicago as the fifth-largest global passenger hub in this analysis. This growth is being powered by greater flows to countries in Asia and the Middle East, including South Korea, the United Arab Emirates, Turkey, and Israel. Growth is a good problem to have—it reveals global demand for access to Paris—but it also demands new investments. Current traffic projections reveal that by 2024 CDG may not be able to accommodate traffic flows based on its existing footprint.<sup>59</sup>

**Figure 36. Total aviation passenger growth, 2004-2014**

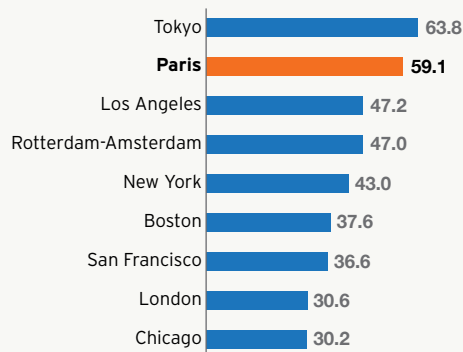


Source: Brookings analysis of Sabre data.

**Paris boasts world-leading digital infrastructure and provides relatively widespread household access to broadband.**

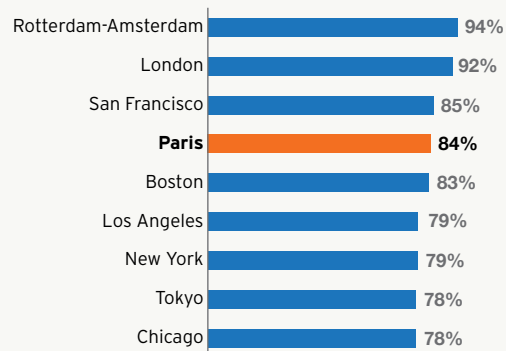
Consistent and quality broadband access is increasingly a prerequisite for students, workers, and firms to utilize the knowledge available online in ways that spur regional economic development.<sup>60</sup> Faster broadband speeds have implications for productivity in their ability to ease communication, process large amounts of information, and empower learning among all members of society. One common way to measure broadband quality is the speed at which data are transferred through the network. By this metric, the average download speeds reported by internet users in the Paris region were the second fastest (59 mbps) after Tokyo, and well ahead of tech centers like Boston and San Francisco (Figure 37). Equally important, broadband speeds have increased significantly since 2012, allowing Paris to surpass Rotterdam-Amsterdam and New York. And broadband access is relatively widespread; 84 percent of the region's households have access to broadband in their homes, the fourth-highest share among peers (Figure 38).

**Figure 37. Internet download speed, 2015, mbps**



Source: Brookings analysis of Ookla data.

**Figure 38. Share of households with broadband access, 2014 or most recent year available**

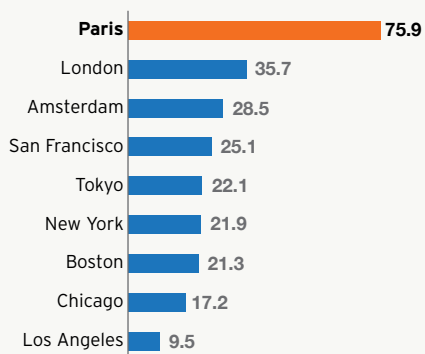


Source: Brookings analysis of data from U.S. Census, Eurostat, and Federal Communications Commission.

**Paris's core areas boast one of the best public transit networks in the world, but outlying parts of the region are less well connected.**

Mobility is a key issue in today's urban policy agenda, and many inhabitants of large cities place commuting times as a top policy priority. High traffic levels are, in some ways, an indicator of prosperity because they reflect the success of the economy as more people move through the region traveling to work, school, and social encounters.<sup>61</sup> However, there are clear economic and environmental costs of congestion as well, and moving residents through the region via public transit remains a clear focus of Paris's policymakers.<sup>62</sup> In 2014, the ratio of rapid transit coverage to residents ranked first among peer metro areas, double that of London (Figure 39), meaning that people, goods, and service providers have more options of rapid transportation in the French capital than in its competitors. However, these networks are disproportionately concentrated in the central part of the Île-de-France region. Outlying areas are much less connected via public transit, a deficiency the Grand Paris Express project is seeking to address through €27 billion in new investments to build 72 stations and 200 kilometers of rail lines by 2030.

**Figure 39. Rapid transit to resident ratio, 2014, km transit/million residents**



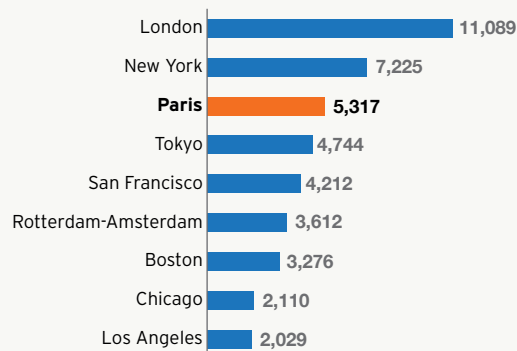
Source: ITDP Rapid Transit Database

**Paris remains one of the most expensive housing markets in the world.**

It is no secret that Paris is an expensive city, a trait it shares with many leading global cities. Only London and New York are more expensive than Paris in a ranking comparing properties with similar sizes (around 120 square meters), characteristics (corporate amenities), and location (central neighborhoods) (Figure 40). The same is true for rentals, where lessors have to pay on average \$5,317 per month. However, one niche of the housing market—investors and wealthy families looking to invest in second homes—has seen a price

fall of 8.3 percent in the past five years under concerns that higher taxes for the wealthy might eventually be implemented.<sup>64</sup> The departure of these second-home owners for London and other European metros could indicate a more affordable Paris in coming years. Affordability can be bolstered by greater housing supply, and the latest statistics are hopeful in this regard. Housing starts in the Île-de-France region over the past 12 months are up 26 percent, to 67,700 units, nearly on par with the region's goal of 70,000 housing starts.<sup>65</sup>

**Figure 40. Rent per month in city center, most recent year available, USD, current**



Source: Brookings analysis of Global Property Index and Zillow data.

► **BOTTOM LINE:** Paris's transportation network and digital connectivity exceed global peers in quality and quantity. The region is a major aviation hub and has many ground transport networks to move people, goods, and services. Its digital connections are fast and wide-reaching, supporting efficient communication between Paris and other economic hubs. However, physical infrastructure bottlenecks remain, especially in logistics and housing supply. It is relatively more expensive to ship goods out of Paris than other markets. Housing remains expensive, even compared to other global cities. Addressing these infrastructure deficiencies with new investments and policies can ensure that Paris has the transportation networks and connectivity to maintain its status as an integrated global center.

## E. GOVERNANCE

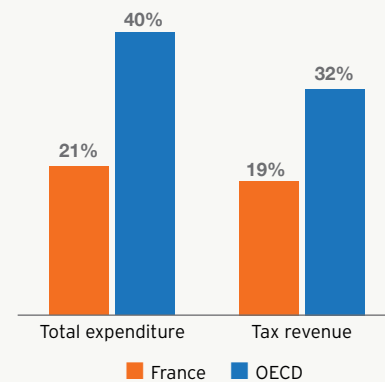


### WHY IT MATTERS: Broadway and Shah

define governance as “the formulation and execution of collective action at the local level.”<sup>66</sup> Therefore, we consider governance to include formal government structure as well as the quality and capacity of public, private, and civic institutions to positively influence competitiveness.<sup>67</sup> Governance matters for competitiveness because a proactive government along with the private sector and civic groups can marshal investment from a wide variety of domestic and international sources to enable new growth strategies. Central, regional, and municipal governments also have unique and complementary roles to play in enabling firms and their wider regions to succeed in global markets.<sup>68</sup>

**French sub-national governments, including Paris, have less fiscal and spending authority than their peers in the OECD.** The OECD provides several useful metrics of sub-national fiscal power, including the share of sub-national government expenditures and the share of sub-national tax revenues. In 2014, 21 percent of total French government spending (including central government transfers and subsidies) was undertaken by sub-national governments, much lower than the 40 percent average across OECD countries (Figure 41). Fiscal autonomy is also quite low. Sub-national governments in OECD countries account for approximately 32 percent of public tax revenues; in France that figure is 19 percent. French sub-national governments have much more fiscal autonomy than their peers in the United Kingdom (5.9 percent) but less than in the United States (45 percent). France has been pursuing decentralization over the past several decades. The Île-de-France region controls many aspects of economic strategy—including workforce training, economic development, and some aspects of transportation, technological development, and education—but its powers to raise revenues for those functions and to share in the revenue uplift from local growth are more limited than they are for many of its global peer cities.

**Figure 41. Sub-national share of total government expenditures and revenues, 2014**

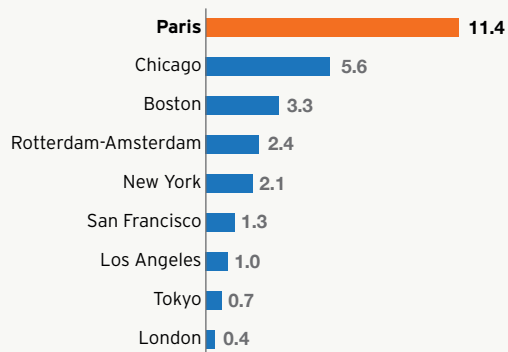


Source: Brookings analysis of OECD data.

**Paris contends with high levels of local government fragmentation.** Horizontal fragmentation refers to multiple governments within one broader regional economy.<sup>69</sup> The OECD uses territorial fragmentation—the number of local governments in comparison to the total population of the metropolitan area—as a proxy for horizontal fragmentation. By this metric, the Île-de-France region exhibits very high levels of fragmentation. The region has about 11 local governments per 100,000 inhabitants, double that of its next most fragmented peer, Chicago (Figure 42). This government structure and coordination matter for competitiveness: the OECD finds that, all else equal, more fragmented metropolitan economies are less productive.<sup>70</sup> Within the region, coordination must occur across seven departments, 1,300 municipalities, numerous special agencies for public services (e.g., electricity, wastewater, sewage, drinking water), and now the Paris Metropolis (Grand Paris). The creation of the Paris Metropolis was meant to better coordinate decision making among municipalities in the most urbanized portion of the Île-de-France region, including the City of Paris. Yet Paris Metropolis does not contain significant regional economic assets like the Charles de Gaulle Airport or the Paris-Saclay innovation cluster, making it difficult for it to conduct comprehensive economic planning.



**Figure 42. Number of local governments per 100,000 inhabitants, 2014**



Source: Brookings analysis of OECD data.

#### The Paris business environment lags global peers.

Firms often cite the business environment as a determining factor in where they locate operations.<sup>71</sup> This environment is based partly on factors (e.g., property

rights, national taxes, quality of financial markets, distance to export markets) outside the remit of local or regional officials as well as those squarely within their control (e.g., local tax rates, permitting processes, other regulatory structures, corruption). The World Bank's Doing Business project, which collects measures of the business environment, assembles its analysis from the perspective of a firm located in the largest city in the country. In this way, it provides a window into the business environment of Paris itself as well as several other global peer cities. France performs well (31 out of 189 countries) in terms of the overall ease of doing business (Figure 43). Yet, when comparing it to business environments in peer cities in Japan (Tokyo), the Netherlands (Amsterdam), the United Kingdom (London), and the United States (Los Angeles and New York), Paris ranks last. Firms in Paris find it relatively easy to start a business, protect minority investors, trade across borders, and enforce contracts, but the rankings reveal barriers to registering property or obtaining construction permits, red tape that can hinder new development.<sup>72</sup>





**Figure 43. Rank in World Bank Doing Business 2015 Report (out of 189 countries)**



► **BOTTOM LINE:** The Paris region operates in a more centralized government structure than its peer cities in the United States, which means it will naturally have less fiscal and spending authority. Public goods and services are delivered in the region via highly fragmented local governments, a means of provision that likely limits the efficiency of these goods and services and lowers overall local productivity. Government services are high quality, but they could likely be delivered in a more coordinated and efficient fashion. Where the region can make improvements is around the business and regulatory environment. Compared to its peers, it takes much longer to register property or obtain construction permits. Easing basic barriers firms face in engaging with government can accelerate the growth of these businesses and enhance dynamism in the regional economy.



#### IV. IMPLICATIONS AND OPPORTUNITIES

**T**he Paris region's tradable industries, which are engaged in the global marketplace for trade and talent, are the ultimate drivers of Paris's growth. Thus, this assessment argues that the economic planning process for the Île-de-France region must incorporate an international competitiveness lens. Looking at economic planning from a global perspective reveals that Paris's advantages tend to reside in industries that are high value-added, technology intensive, and demand scientific knowledge and workers who can deploy that knowledge.

How, then, can the Île-de-France Regional Council use this economic strategy to best support its industries of comparative advantage, position workers to benefit from industrial expansion, and create a compelling global identity that markets those advantages to the world? To help answer this question, this section highlights implications and opportunities arising from our benchmarking exercise that align with the five drivers and enablers of regional prosperity explored in the report.

**A. Help position local firms for success in international markets:** ensure Paris's status as an international business and travel hub by aligning ongoing export support, foreign direct investment attraction, and global brand promotion into a coherent, region-led international business strategy that supports Paris's key traded sectors.

This analysis affirms that Paris is a leading hub of international business, slightly below the level of London, New York, and Tokyo but well above its other European and American peer city-regions. Paris plugs into the global network of cities in several ways. It is a major financial center. It houses a significant concentration of large multinational firm headquarters and the suite of law, accounting, media, and consulting firms that support them. It has a viable advanced industries base—from automotive and aerospace to digital technologies to life sciences. And it is a magnet for international tourists. These traded sectors are the region's growth engines.

A comprehensive set of strategies can sustain and enhance this position by boosting trade and investment and solidifying Paris's global visibility:

➤ **Streamline export support services and foreign direct investment promotion through a comprehensive international business strategy.** Currently there are a range of economic promotion organizations, chambers, and local, regional, and central government bodies conducting FDI attraction and offering export support to firms in the Paris region. A coordinated regional strategy can help align and streamline services and focus them upon sectors of

comparative advantage and, in the case of exports, ready-to-export mid-sized companies. For example, the London Export Programme links companies to mentoring services provided by entrepreneurs and business leaders, expert advice and workshops, targeted trade missions, and access to live leads and opportunities in the three broad sectors of technology, life sciences, and urban infrastructure development. In Toronto, the Toronto Region Board of Trade has launched TAP GTA, a trade accelerator program to serve as a one-stop shop for a local company's export needs. The accelerator directs firms to supportive services from provincial and national government and from a private-sector coalition of financial institutions, supply-chain providers, and transportation companies.

➤ **Target the supply chain.** The Paris region houses major global manufacturers that rely upon local clusters of suppliers. Upgrading the productivity and innovative capacity of small and mid-size suppliers can strengthen the "stickiness" of these clusters. Innovative work is being undertaken by Astech to help aerospace suppliers integrate into the supply chains of large firms like Airbus and Safran by diffusing new technologies and management best practices into their operations. Regional leaders across government, chambers, and economic development groups should engage other large firms in sectors like automotive to see if similar programs can be adopted.

➤ **Assist entrepreneurs seeking to be "born global."** The Paris region has an incredible density of accelerators, incubators, and other institutions and programs that are supporting entrepreneurship. These organizations have a unique opportunity to help new companies find global investors and export opportunities by networking with their counterparts in other global regions. One example is Chicago's 1871, an entrepreneurial hub that has established agreements with counterparts in London, Mexico City, and Tel Aviv. These agreements afford access to startups seeking expansions in Latin America, Europe, or the Middle East.

► **Update the region's global identity.** Paris is many things to many audiences and does not lack international recognition. Our conversations with local business and government leaders suggest that, unlike London or New York, Paris's culture and history have uniquely defined its global brand. To be sure, this noteworthiness has been a tremendous asset in sustaining Paris's visitor economy. However, Paris's historic assets may crowd out the opportunity to position the region as a global hub of business, ideas, and technological innovation. This analysis finds that these assets are indeed present, but perhaps under-advertised within the global business community. For instance, there is no reason that Paris should not try to position itself as the science and technology capital of Europe. Regional leaders have an opportunity to update this brand through a combination of international marketing efforts, targeted trade missions, the hosting of international delegations and conferences, and the establishment of partnerships with other global regions in key economic sectors. Bringing together major efforts like the expanding Paris-Saclay cluster, the formation of the Arc de l'innovation, and the development of dozens of startups, incubators, and other organizations committed to technological innovation under one collective international promotion effort could increase the impact of each.

**B. Infuse innovation across the regional economy:** respond to disruptive technological changes by acknowledging science and technology as the region's long-term global comparative advantage.

To raise living standards, Paris must compete and thrive in the knowledge economy. The scale and pace of technological change appear to be accelerating, but the future impact of these changes on industries and workers is far from certain. Innovation takes many forms, and includes improvements in products, services, processes, and management techniques. It can be hard to measure and even harder to predict. But research suggests that a few things influence the quality of innovation ecosystems: R&D, commercialization of that R&D into new products and services (e.g.,

patents), and the presence of entrepreneurial activities that are linked to technology development and advanced industrial production.

The region's innovation strategy should, therefore, take into account these aspects of the innovation chain. Interventions will occur across varying sectors and levels of government, but working collectively across stakeholder groups the region needs to:

- **Enhance its research and development base.** France has long placed a priority on investing in R&D, and the Paris region has been the top destination for national R&D. But R&D spending as a share of the economy has been flat, while metros in California and Massachusetts have raced ahead. Corporate R&D has been growing slightly while government and university R&D has been flat. Central government basic research funding and corporate R&D are critical drivers; both should be expanded from 3 percent of GDP to 4 percent.
- **Support big technological bets.** The Paris region's competitiveness clusters are supported by cluster-specific intermediaries that help firms, educational institutions, and research laboratories co-develop the next round of new technologies in key industries. In doing so, these cluster organizations serve as important actors in the entrepreneurial ecosystem by linking large firms with their small and medium-sized counterparts, and they can provide a critical link to global markets by establishing international partnerships with other universities, research labs, and economic development groups. Funding for these competitiveness clusters should be continued at the regional and central government levels to help spur the next round of new inventions.
- **Seize the venture capital opportunity.** This analysis reveals that the Paris region receives much less venture capital on a per capita basis than do its global peers. Expanding access to venture capital and other investments can help entrepreneurs bring innovative products and services to market at scale. As part of ecosystem development, public,





private, and civic organizations can jointly position the Paris region as a more attractive investment location for investors seeking high-growth returns. This effort could involve the formation of locally based, corporate-led funds such as Intel Capital. It could also involve an explicit focus to raise the profile of the Paris startup community in particular markets, such as the United States, by hosting large-scale investment conferences in Paris or taking entrepreneurs on missions to major investment hubs like New York and Silicon Valley. For example, acknowledging that venture capital investment tends to be more limited in the American Southeast, in 2006 that region began hosting Venture Atlanta to help connect Georgia entrepreneurs with venture capitalists and other financial investors from across the world.<sup>76</sup> Connections could be built through hosting catalytic events, sponsoring meet-up groups, and connecting startups with large corporate interests. This function can also bridge Paris's ecosystem to international entrepreneur networks like the Global Entrepreneurship Network or the Global Accelerator Network. Government can also be a source of information by cataloguing the organizations and resources avail-

able to entrepreneurs. For instance, Paris Region Enterprises has smartly created a platform that catalogues the thousands of organizations that contribute to the entrepreneurship ecosystem.

**C. Endow more Parisians with the requisite technical skills:** leadership in an advanced economy demands a workforce at all skill levels that can complement the new technologies that increasingly define Paris's leading industries.

Our analysis reveals that the Paris region's labor market is generating mainly high-skill jobs in advanced services, and all industries are "professionalizing," meaning that their occupational structure is becoming more skilled. This long-term labor market transition will likely only accelerate, and therefore it is imperative to prepare Parisians from all skill levels and all backgrounds to gain a foothold in the advanced economy. Yet it is not clear whether the region's education and training system has fully adapted to this new reality. On the one hand, Paris boasts an incredible stock of university-educated workers, even compared to the most-educated metro areas in the world. Foreign-born workers and students add to this stock every

year. Yet unemployment remains higher in the Paris region than in its peer cities. About 12 percent of the region's youth are neither employed nor in an education or training system. And subpar educational and employment outcomes tend to cluster in particular neighborhoods. These challenges are not unknown, nor are they necessarily unique to Paris. But preparing all residents for labor market success is not only a moral and social imperative, it is a requirement for the region's sustained industrial competitiveness. Once again, skills development is not the mandate of only the regional government; it will require support from central and local government actors, civil society, and the private sector. Together, this cross-section of leaders could undertake several priorities to build the pipeline of technical talent:

► **Map pathways to good-paying jobs and establish sectoral coalitions to train workers for those jobs.** Job seekers often have few insights about what education and training pathways will yield good labor market outcomes. This type of detailed occupational analysis is beyond the scope of this report, but it would serve as an important first step for local students, educators, trainers, employers, and policymakers to assemble a baseline understanding of what industries are growing and declining, which occupations those industries tend to rely upon, and what skills those occupations demand. Sectoral coalitions of employers, vocational schools and universities, and government leaders can then adapt training and job placement services to meet industry's needs. CFA-AFMAé, a partnership between the aerospace industry and local training providers, provides one example of such a coalition.<sup>77</sup> Extending these efforts to core service sectors is a key next step. In Atlanta, for instance, the Atlanta Regional Commission and the Metro Atlanta Chamber of Commerce have mapped high-growth industries and in-demand occupations using real-time labor market data, with a core focus on information technology. After reviewing that data with local firms and vetting the findings with the experiences of employers, the initiative will use the data to inform degree and credential programs across all levels of the education system.<sup>78</sup>

► **Embed digital skills in primary and secondary education.** The prominence of technology-intensive industries in the Paris region calls for a particular focus on science, technology, engineering, and math (STEM) skills. And as technology pervades the entire economy, digital skills will likely become attractive to employers across all industries. As a longer-term strategy, the primary and secondary school systems could make computer science a core requirement of the curriculum. In 2014, the French education minister Benoît Hamon announced that computer programming would be offered as an elective in primary schools, yet many of Paris's peers are moving to make such courses a requirement. In 2016 the City of Chicago announced that computer science would become a graduation requirement for all high school students, and it is working with Code.org to develop and implement a computer science curriculum.<sup>79</sup> In fall 2016 New York City's public schools planned to unveil a new slate of computer science programs targeted at elementary, middle, and high school students. The initiative is part of Mayor Bill De Blasio's longer-term program to make computer sciences a requirement within a decade.<sup>80</sup> Any effort would need to be matched with new investments to ensure that trainers and teachers were adequately prepared to teach these technical skills.

► **Establish and scale science- and technology-focused training institutions that help bridge the transition from school to work.** Non-traditional educational institutions that provide STEM training can supplement the public education system. A coding school in Paris, 42, is the best known example of this type of organization. In the P-TECH 9-14 model in the United States, school districts, colleges and universities, and employers work collaboratively to develop engineering and computer science degree programs. IBM founded the first P-TECH schools in New York City, but they have since expanded to several additional U.S. cities.<sup>81</sup>

► **Engage foreign students.** Along with London, Paris has a globally distinct concentration of students from abroad. Conversations with local stakeholders revealed that the presence of these

students was a known but underutilized talent advantage. Foreign students not only contribute to a region's competitiveness through their human capital, but they can foster economic connections to their home markets. The conversations we had with stakeholders suggest that Paris is not retaining enough of these foreign students. A first step is to better understand the problem. One model for achieving this is Barcelona's International Professional Talent Monitor, which surveys expatriates living in Barcelona to uncover the region's strengths and weaknesses in attracting and retaining professional talent.<sup>82</sup> A similar survey could yield insights about Paris's foreign student base and inform further action. Beyond better understanding the problem, universities—long known for their role as local economic catalysts—are experimenting with new ways to leverage the networks, knowledge, and language skills of foreign students to connect local firms with global markets. In the Los Angeles region, under the aegis of the Los Angeles Regional Export Council (LARExC), the University of Southern California (USC) Marshall School of Business and the Anderson School of Management at the University of California, Los Angeles (UCLA) have created the Export Champions program, in which teams of business students work on an international business consulting project to help Los Angeles-based companies export to global markets. Firms pay fees that cover the student teams' costs, which include multi-week international trips to interview potential customers and suppliers and to gather information on competitors. The social networks, cultural familiarity, and language prowess developed by students who have lived and traveled abroad are brought to bear in making these connections. The final outputs of the program are proprietary market reports that guide firm decision making.<sup>83</sup>

**D. Invest in enabling infrastructure:** leveraging key global access points (e.g., airports and seaports) for economic development, ensuring digital infrastructure is available to all residents, and sustaining investments in transportation, housing, and place-making can all improve competitiveness and access to opportunity.

Paris's transportation networks help it sustain its position as a global economic hub by linking firms to the global marketplace. For those who do not physically travel, the region's digital infrastructure connects students and workers to the knowledge and networks they need to thrive. Both elements are critical. Paris's competitiveness will also depend on its ability to connect its people and physical assets to their best use within the region, a goal that implicates transit, housing development, and placemaking. An incredible set of investments—led by the \$40 billion investment in the Grand Paris Express—that will reshape Paris's built environment for the next century should be designed with the region's economic competitiveness in mind:

- **Maintain Paris's world-leading aviation connectivity.** Paris's airports are an important economic asset, but current traffic projections reveal that by 2024 Charles de Gaulle airport may not be able to accommodate traffic flows within its existing footprint. Securing the development of Terminal 4 at CDG will accommodate an additional 30-40 million passengers per year.<sup>84</sup> Furthermore, the Roissy area surrounding CDG remains a major site for activities, such as freight and logistics, conference hosting, and hospitality, that demand close proximity to the airport. The region should continue to build around the airport through initiatives like HubStart and seek to connect the surrounding communities to the economic activities that have been generated.
- **Expand access to broadband.** Average internet download speeds across the region are among the highest in Paris's peer group. Around 84 percent of Île-de-France households subscribe to broadband internet, which is about average among peers. But as the regional economy becomes more digitally dependent, broadband internet is joining electricity as a fundamental input to economic competitiveness. Understanding why households are not adopting broadband and whether they are geographically clustered is a critical first step to developing a strategy. Following that assessment, regional and department leaders can determine what tactics are most appropriate. In the United States, several approaches to closing the digital

divide are being pursued, from income supports at the federal level to local and state efforts like launching digital literacy campaigns or brokering public-private partnerships with internet providers to expand coverage and/or improve affordability.

► **Maximize accessibility through aligned housing and transportation investments.** Insufficient housing supply and rising demand to live in Paris have resulted in the region being one of the most unaffordable in the world. At the same time, transit coverage, while robust in the region's dense core, has failed to connect many of the region's outlying communities. Through its master plan, the Île-de-France government, in tandem with other levels of government, has implemented an intentional effort to coordinate housing development projects with major transportation investments, including the \$40 billion Grand Paris Express expansion. Prioritizing access to key destinations and job centers should remain the focus of this plan. The Grand Paris Express investments will improve connectivity along many corridors, but gaps will likely remain throughout the region. Non-rail alternatives such as bus rapid transit and shared mobility strategies (e.g., car-share fleets, ride-on-demand services, etc.) could help supplement major investments in fixed rail and avoid a "cars versus transit" mentality. At the same time, over the past couple of years housing construction has failed to reach the master plan's target of 70,000 new units per year, although recent housing data suggest that supply is growing.<sup>87</sup> Allowing for high-density housing development near transit and employment centers, as has been pursued through the Territorial Development Contracts, can improve access to jobs and improve spatial efficiency. And as new development projects come online, special attention should be given to the mix of market-rate and social housing to ensure that lower-income residents have opportunities to benefit from new economic activity. New York Mayor de Blasio has pursued a comprehensive plan to build or preserve 200,000 units of affordable housing in 10 years.<sup>88</sup> The ultimate goal of housing and transportation policy should be access to economic opportunities, not simply mobility, and for this reason regions like

New York have adopted new measures of employment access to track performance of their transportation system.<sup>89</sup>

**E. Simplify and streamline governance:** efforts to reduce government fragmentation, streamline regulations and permitting processes, and encourage public-private-civic collaboration can all strengthen governance in ways that improve the competitiveness of the Paris region.

Recent work by the OECD finds that, all else equal, more government fragmentation hinders productivity, and this analysis affirms the well-documented extent of government fragmentation in the Paris region. Between municipalities, departments, the Paris Metropolis, the Île-de-France regional government, and the central government, governing is a complex task. The Île-de-France has the highest number of local governments per 100,000 inhabitants among all peer cities. At the same time, cross-country measures reveal that the Paris region is lagging competitor city-regions in terms of the business and regulatory environment. How can government deliver policies and services more effectively, and what is the role of non-government actors in shaping regional governance? We highlight three priority actions here:

► **Continue to incentivize municipal consolidation and empower the regional function.** Municipal fragmentation continues to be an issue that the Regional Council can address by providing fiscal incentives to municipalities to merge. U.S. states—from New York to Illinois to Massachusetts—have launched similar government efficiency grant programs to encourage municipal actors to streamline their services and, at times, consolidate into larger jurisdictions. These efforts can allow for the more efficient provision of government services, freeing up public resources for additional investments. Similar reforms have consolidated the number of French regions from 22 to 13, and, of the thousands of municipalities countrywide, incentives have consolidated 772 municipalities into 230 "merged municipalities."<sup>90</sup> Those efforts should be continued. In addition to municipal consolidation, the creation of the Paris Metropolis has raised questions



about the full function of the Île-de-France region. Given that the key economic assets (e.g., CDG airport, the Paris-Saclay innovation cluster) reside outside the Paris Metropolis boundaries, economic development should remain primarily the function of the Île-de-France region.

- **Announce a region-wide challenge to streamline regulations.** Standardized data collected as part of the World Bank's Doing Business report suggest that the business and regulatory environment in Paris hinders investment. In response, the Regional Council could launch an effort to streamline regulations and provide a more simplified engagement between government and business owners. Ontario, the province in which Toronto sits, has launched a "Red Tape Challenge," an online consultation tool designed to "identify and eliminate duplication, lessen compliance burdens, shorten response times and make it easier for businesses to interact with the government." The province will begin with six sectors, starting with auto parts manufacturing and food processing, to identify issues.<sup>91</sup>
- **Engage private and civic actors in economic development.** Through a competitiveness advisory council and ongoing engagement with non-government stakeholders, the Île-de-France

region's leadership has made outreach to private and civic leaders a priority, as have the City of Paris and other municipalities. These efforts are in line with a global trend: regional competitiveness is becoming an increasingly shared agenda. 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. 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. Similarly, these networks can help advocate for more coordinated region-wide governments and overcome productivity-limiting fragmentation between jurisdictions. The region's competitiveness advisory group is a good forum for exchange on key issues of regional competitiveness, and it could be expanded to engage private and civic leaders as advocates for critical regional priorities. For example, World Business Chicago, the economic development arm of the City of Chicago, tasked corporate champions to address key regional priorities like workforce development, innovation, advanced manufacturing, and freight and logistics.<sup>92</sup>

**"The region's competitiveness advisory group is a good forum for exchange on key issues of regional competitiveness, and it could be expanded to engage private and civic leaders as advocates for critical regional priorities."**



## V. CONCLUSION

**T**his report analyzes the Paris region's economy from a global standpoint by comparing it to many of the largest metropolitan economies in the world. Analyzing the region through an international lens reveals that regional leaders can strengthen global engagement by building on Paris's key assets: global niches in creative industries and business services; a well-educated workforce that draws in international talent; and high levels of air and digital connectivity. But we have also flagged areas of weakness: limited productivity growth; little global engagement among small and mid-sized firms; and an innovation system that is not as capable as that of its global peers. These insights and a full discussion of their implications can hopefully lead to discrete topics and initiatives that will enable the Paris region to jumpstart its economy and deliver prosperity to all its residents.

## VI. METHODOLOGICAL APPENDIX

### SELECTION OF PEERS

Global peer cities were selected 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.<sup>93</sup> 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 14 economic variables: population, nominal GDP, real GDP per capita, productivity (defined as output per worker), total employment, share of the population in the labor force, and industry share of total GDP (eight sectors).<sup>94</sup> We included six additional variables that measure one of the four quantitative dimensions of the competitiveness analysis framework used in this report. The variables included are: share of the population with tertiary education (talent), stock of Greenfield foreign direct investment (FDI) (trade), number of international passengers in 2014 (infrastructure), number of highly cited papers between 2010 and 2013 (innovation), mean citation score between 2010 and 2013 (innovation), and average internet download speed in 2014 (infrastructure).

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 inter-related while retaining as much variance as possible. PCA generates “components” by applying a linear transformation to all the variables.<sup>95</sup> 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 first seven components, which accounted for 84 percent of the total variation of the data.

The second stage applied a k-means algorithm to the seven components, a process that 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.<sup>96</sup> 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.<sup>97</sup> 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.

We ranked Paris and its peers along the five quantitative dimensions that this report examines. The categories and indicators we used to create indexed scores are as follows: economic performance (indicators: 2000-2015 annual growth in output, employment, productivity, and GDP per capita; Gini coefficient, 2010 or most recent year available); trade (2000-2015 traded sector output growth; total greenfield FDI investment per 1000 workers, 2009-2014; share of greenfield FDI in tech-intensive industries, 2009-2014; and advanced services connectivity as defined by GaWC, 2012); innovation (local universities share of total publications in the top 10 percent of cited papers, 2010-2013; local universities mean citation score, 2010-2013; number of local universities ranked in the 750 most impactful research universities, 2010-2013; patents per 1,000 inhabitants, 2008-2012; venture capital investment per 1,000 inhabitants); talent (unemployment rate (2014 or latest year available); share of population above 15 with tertiary education, 2013; share of foreign-born population 2014; share of population in working age, 2014); infrastructure (total aviation passengers, 2014; total aviation passengers growth, 2004-2014; broadband download speed, 2014; and population density, 2014). For every indicator in a

given dimension we take the value of every observation minus the median value of that variable, and then we divide that difference by the distance between the values of that variable at the 90th percentile of the distribution minus the value at 10th percentile. We repeat the process for all the indicators in a dimension and then sum the results to obtain a global score. We rank the metropolitan areas based on these scores

for all the dimensions. For the graph that we present we scaled the highest value to 100 and adjusted the remaining scores proportionally. For more information on the variables used see the methodological appendix. For information on the methodology see: Joseph Parilla and others, “Global Metro Monitor 2014: An uncertain recovery” (Washington: Brookings Institution, 2015).

# Key variables

Table 1. Main indicators used in the report		
Dimension	Indicator	Source
<i>Economic Performance</i>	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
<i>Trade</i>	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
<i>Innovation</i>	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	REGPAT
	Patent output per 1,000 inhabitants	
	Venture capital investments, millions of dollars per 1,000 inhabitants	Pitchbook
<i>Talent</i>	Venture Capital Stock by Industry	
	Share of population 15+ with tertiary education	Oxford Economics, U.S. Census Bureau
<i>Infrastructure</i>	Foreign-born share of total population	Unemployment rate
	Total aviation passengers	SABRE
	Average download speed	Net Index
	Population density	Oxford Economics

# 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 (GVA), 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.

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#### **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 (BLS) and by the Bureau of Economic Analysis (BEA) 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.

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#### **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 level 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 PUMA level microdata on the educational attainment and age of residents. 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.

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#### **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 patents 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>.

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#### **Leiden:**

The source of the university scientific impact data is the Centre for Science and Technology Studies (CWTS) at Leiden University. This publicly 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 fractionally 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>.

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#### **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, which they then record and validate through a manual review process. In assembling its database, Pitchbook includes address-level data for both investors and recipient companies, industry, and investor details along with 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 of detailed industry categories matched to Brookings' NAICS-based definition. All value measures were inflation-adjusted to 2014 dollars.

For more information see PitchBook.com, <http://blog.pitchbook.com/wp-content/uploads/2014/06/3Q-2014-PE-Breakdown-Methodology.pdf>.

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#### **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, which 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, so 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 average largest 100 metro areas by population recording over 30 million tests in 2014.

For more information see Ookla.com, <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 an economy 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 fDi Markets.com, <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. Using the latitude and longitude information, we assigned an observation to a metropolitan area using defined geographic boundaries through a geo-intersection.<sup>98</sup> 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 their corresponding geographic boundaries.

For more information on the Google Maps Geocoding API see <https://developers.google.com/maps/documentation/geocoding/intro>.

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