NOTE RAPIDE
PARIS REGION DEVELOPMENT AND URBAN PLANNING INSTITUTE #5

J. Barande/École polytechnique

RESEARCH AND INNOVATION IN THE PARIS REGION: ACHIEVING GLOBAL EXCELLENCE

THE PARIS REGION IS ONE OF THE WORLD'S LEADING PLAYERS IN R&D. YET, IN SPITE OF ITS INTERNATIONALLY RECOGNISED SCIENTIFIC CREDENTIALS, ITS INFLUENCE VARIES DEPENDING ON THE DISCIPLINE. TODAY, IT MUST MEET THE CHALLENGE OF BETTER COORDINATION BETWEEN NETWORKS AND CENTRES OF INNOVATION IF IT IS TO NURTURE ITS GROWTH, STIMULATE ITS ECONOMIC DEVELOPMENT AND BOOST ITS VISIBILITY.

106,000
RESEARCHERS IN THE PARIS REGION IN 2013

19 billion
SPENDING ON R&D IN THE PARIS REGION IN 2013

Ranked 3rd
GLOBALLY FOR THE VOLUME OF SCIENTIFIC PUBLICATIONS

Large metropolitan areas are investing heavily in research and innovation[1] and are increasingly challenging long-established positions in technological and scientific fields. To secure their development, these areas are all seeking to provide an attractive economic environment, to strengthen their research capabilities and to supply effective innovation ecosystems.
Against this background, the Paris region's research and innovation ecosystem forms a richly endowed and high quality environment that brings together universities, specialised higher educational institutions, research laboratories and centres, business incubators as well as competitiveness clusters and hubs. A genuine hotbed of innovation, the Paris region features a high concentration of management positions, business services, financial institutions and talented people in the fields of science and technology, but also of the arts, culture and entrepreneurship. Given these strengths, where does the Paris region fit into the world? How does it position itself compared to other regions? The analysis of recent data, notably data sourced from the Scopus database made available by Elsevier (see the box on p. 6), provides some answers to these questions.

A STILL FAVOURABLE HUMAN AND FINANCIAL POTENTIAL

At the global level, the Paris region ranks among the leading regions in terms of research and innovation, and in Europe it ranks number one in terms of research and development (R&D) spending, patent registrations and scientific publications. With nearly EUR19 billion invested in 2013, the Paris region accounts for 7% of European spending on R&D, an amount that reflects a capacity for creativity and innovation that is essential to France's international competitiveness.
In France, in 2013, the Paris region accounted for 39% of Gross Domestic Expenditure on R&D (GERD), according to the French Department of Research. It is the only region in France, along with the

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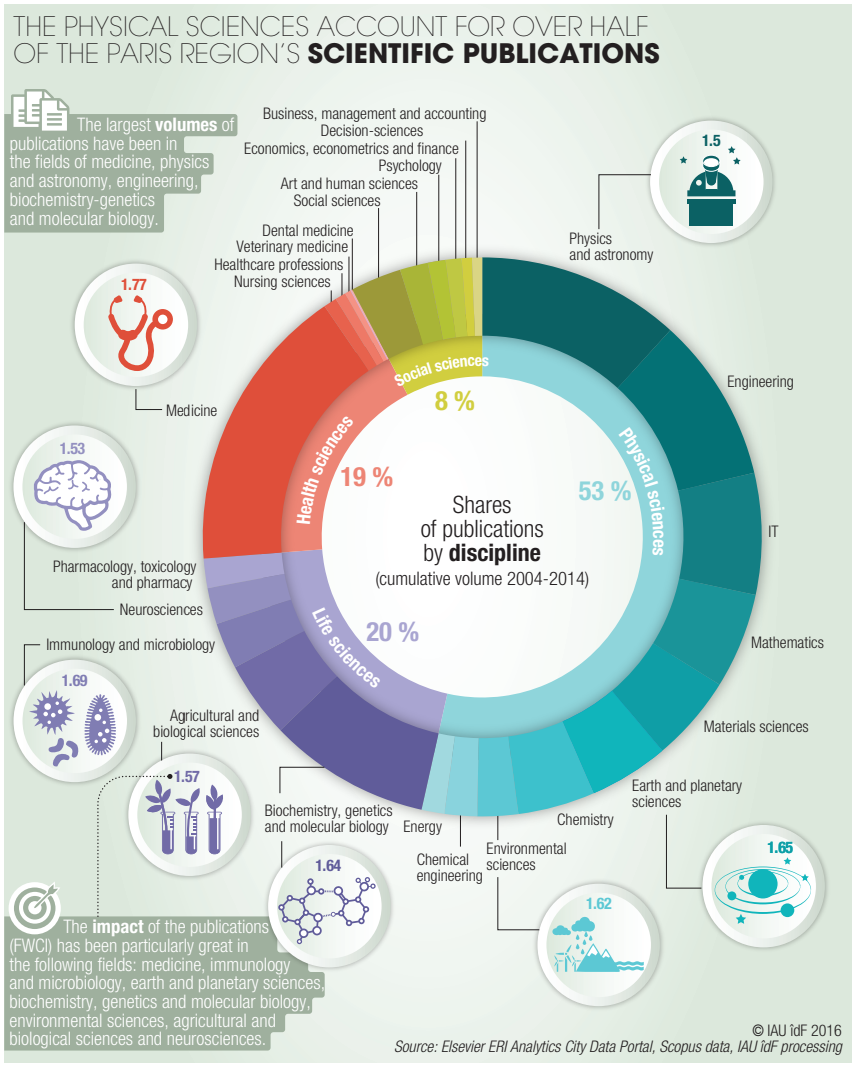
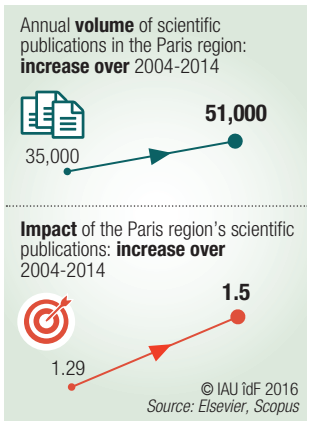




Midi-Pyrénées region (4.8%), to devote over 3% of its GDP to spending on research (the objective set by the Europe 2020 strategy). Private research activities represent two thirds of regional expenditure and are mainly conducted by large and medium-sized businesses, which account for 90% of the Paris region's research effort, compared with 10% by SMEs and very small businesses. Two thirds of private R&D expenditure are concentrated in high-tech and medium-tech activities, while over a quarter of such expenditure is generated in the service sectors. Like the Rhône-Alpes region, the Paris region is relatively more diversified than the others. Less than 40% of private R&D expenditure is concentrated in the Paris region's top three sectors for research spending, i.e. the automotive, pharmaceutical and computer/IT services sectors.

In 2013, 155,000 people were employed in public and private research (37% of the national workforce). Two thirds of them were researchers or R&D engineers, who accounted for 40% of French researchers. The Paris region is highly specialised: 27 out of 1,000 salaried employees in R&D, compared with an average of 17 out of 1,000 salaried employees in France. PhD students, the pool of current and future research workers, are also more numerous in the Paris region: four doctoral students out of 10 study in the Paris region, whereas only a quarter of the total student population of France does so. Over a third of the national total of personnel involved in public research work is located in the Paris region, working mainly in large public agencies such as the CNRS[2], Inserm[3] or the CEA[4]. In addition, 40% of personnel involved in private research are employed in the Paris region.

TERRITORIAL CONCENTRATION OF R&D FACILITIES

Public research facilities are highly concentrated in Paris, the inner suburbs (Condorcet, Nanterre, Villejuif, Créteil, etc.) and in centres of excellence such as Paris-Saclay, Evry, Cergy-Pontoise or Marne-la-Vallée. By contrast, private R&D facilities are highly concentrated in the two counties of Hauts-de-Seine and Yvelines, which are home to major research and innovation centres (Renault Technocentre, PSA, Dassault Systèmes, etc.).

A STABLE SCIENTIFIC RANKING

R&D results can be assessed by using two indicators, which, although imperfect, allow historical and geographical comparisons to be made: first, scientific publications as an indicator of scientific excellence; and second, patent registrations as an indicator of technological performance.

According to the Scopus database (see the box on p. 6), between 2004 and 2014 the Paris region registered nearly 500,000 scientific publications, mainly in the fields of medical research, physics and astronomy, engineering sciences, biochemistry, genetics, and molecular biology. The main contributors were the CNRS, the universities of Paris-VI and Paris-Sud and the Inserm Institute.

Internationally, Paris is ranked third worldwide in terms of the volume of scientific publications, behind Beijing and Tokyo, but ahead of New York, Washington, London and Boston. Over the period in question, the volume of scientific publications increased in the 66 global cities whose R&D results were analysed, while the ranking of Paris has remained stable since 2004.

London, Rome, Boston and New York: preferred partners

The Paris region is open to the world and engaged in numerous collaborative activities. Paris is at the forefront (in volume terms) of international co-publications (co-publications involving at least one foreign author), ahead of London, Beijing and Boston. Its main partners are the regions of London, Rome, Boston and New York. In the area of partnerships between public research and the business world, the Paris region is also a global giant. It is ranked fifth in terms of the volume of co-publications with the private sector (public/private co-authorship), behind Beijing, San Francisco, Tokyo and New York. Such academic excellence is a factor in anchoring and attracting large global companies, which locate their innovation centres in regions whose research and innovation ecosystems are the best-performing. Although lagging far behind the Silicon Valley, which,

according to Compass, is home to over 50 global innovation centres, Paris (nine centres) and London (10 centres) are destinations of choice in Europe.

Top publications but varying scientific impact

Paris has a high scientific profile: the region is ranked seventh worldwide for its star publications, i.e. those ranked among the 5% of most-cited publications where the top positions are occupied by English-speaking regions, except for Beijing, which publishes enormously. These very high profile publications account for 8% of the total number of papers published by the Paris region, compared with 12% by Boston and San Francisco, 10% by London, 6% by Tokyo and 4% by Beijing.

The impact and quality of the publications can be assessed on the basis of the adjusted number of citations per discipline. In this case, Elsevier's Field-Weighted Citation Impact (FWCI) index has been used as an indicator. With an FWCI index of 1.5 for all disciplines taken together, the impact of the Paris region's publications is greater than the global average (equal to 1). The region's outstanding fields are medical research, immunology and microbiology, earth and planetary sciences, biochemistry, genetics and molecular biology, environmental sciences, agricultural/biological sciences and neurosciences. As in all global cities (except for Istanbul), the impact of the Paris region's publications improved over the period under consideration, with its index rising from 1.29 in 2004 to 1.5 in 2014.

However, this overall finding masks more contrasting results in terms of the visibility and recognition of the Paris region's scientific work. In spite of the increase in the impact of its publications in absolute terms, the region's global ranking has remained stable for 10 years in 47th position, well below its weight in volume terms. The regions of Seattle, Oxford, Cambridge, Boston, San Francisco and San Diego have had the greatest impacts, with indices higher than 2. Copenhagen (1.96), Geneva (1.96) and Amsterdam (1.95), are the top metropolises in Europe, with Singapore (1.79) and Hong Kong (1.64) in Asia. London has an index of 1.83. On average, the global cities studied have an FWCI index of 1.59. This shows that the Paris region benefits from collaborative activity, as the impact of its co-publications is much greater than that of papers by a single author, whether the co-publications involve public institutions located abroad (FWCI index=1.95) or the private sector (FWCI index=6.59!).

TECHNOLOGICAL PERFORMANCE: A DECLINING POSITION…

Patent registrations are an indicator of technological performance. The Paris region is still in the lead in Europe, ahead of Munich and Stuttgart, but its relative share has been steadily eroding: in 2002 it accounted for 6.1% of patent applications in the EU28 compared with 5.1% in 2012, according to the Science and Technology Observatory (OST). However, the Paris region's main competitors, notably in Germany, have experienced the same erosion, indicating the growing power of new emerging regional hubs, albeit smaller in size. For example, in France, the relative shares of the Rhône-Alpes-Auvergne and Languedoc-Midi-Pyrénées regions have increased.

THE PARIS REGION'S UNTYPICAL POSITIONING IN RELATION TO GLOBAL CITIES

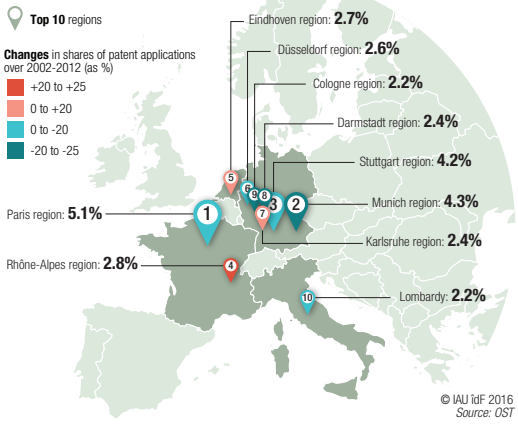
The Paris region benefits from strong international positions in both the scientific and technological fields, unlike the major German regions, which are more focused on technology, and unlike certain English regions such as London, Cambridge and Oxford, which are more focused on science.

However, although in terms of the volume of scientific publications Paris is unquestionably ranked as a global giant, in 2014 the impact of its publications was weaker, i.e. close to the impact of smaller metropolitan areas such as Tel-Aviv, Madrid, Berlin or Vienna. During the 2004-2014 period, its position remained stable: Paris enhanced its impact more than Boston, San Francisco and Tokyo, but less than London and numerous other European hubs (see the chart on p. 5).

Overall, beyond the weight of each region in absolute terms, national and even continental scientific impact strategies are taking shape that differentiate North American cities that remain leaders but with almost zero growth in impact from Japanese and Korean cities whose impact is diminishing and from Chinese and European cities whose impact is increasing. The impacts of the scientific publications in Asian cities are relatively weak (partly due to the language barrier), despite Beijing and Shanghai have significantly increased their publications in volume terms between 2004 and 2014. That said, the impact of Shanghai's publications has increased considerably, as has that of Singapore's publications. The impact of the Japanese cities of Tokyo, Osaka, Kobe and Kyoto is declining.

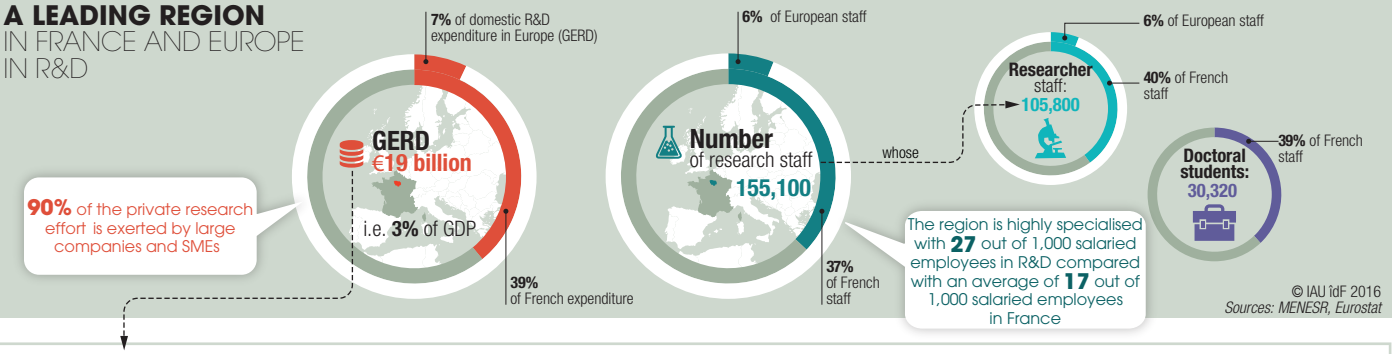
In Europe, the secondary hubs have been the most dynamic and have achieved the most remarkable trends in terms of impact. The two largest European hubs, London and Paris, have recorded increases in impact rates close to the average for global cities, but the positioning of the English capital remains more favourable than that of its French counterpart, which is lagging behind.

THE PARIS REGION ACCOUNTS FOR 5.1% OF ALL **EUROPEAN PATENT APPLICATIONS** IN EU-28



KEY DATA ON R&D IN THE PARIS REGION

A LEADING REGION IN FRANCE AND EUROPE IN R&D



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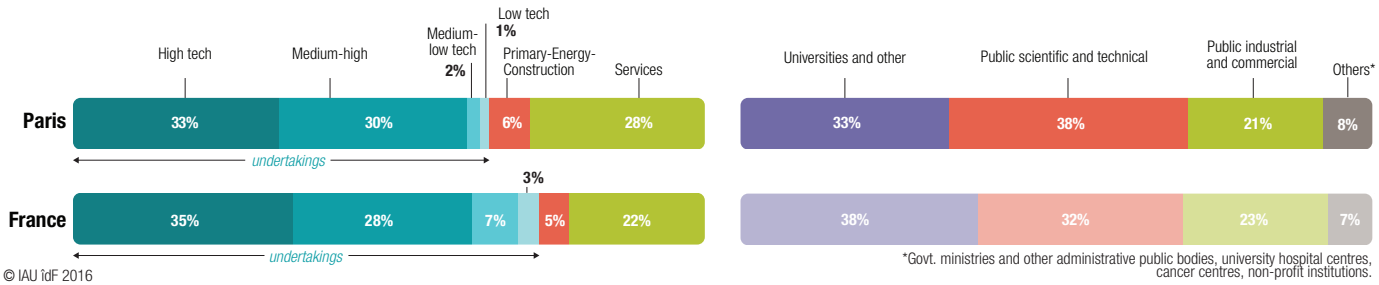
Sources: MENESR, Eurostat

THE PARIS REGION'S **DOMESTIC EXPENDITURE ON R&D** IS SPLIT INTO 2/3 **BUSINESS ENTERPRISE** EXPENDITURE (BERD)… AND 1/3 **GOVERNMENT** EXPENDITURE (GVERD)



*Govt. ministries and other administrative public bodies, university hospital centres, cancer centres, non-profit institutions.

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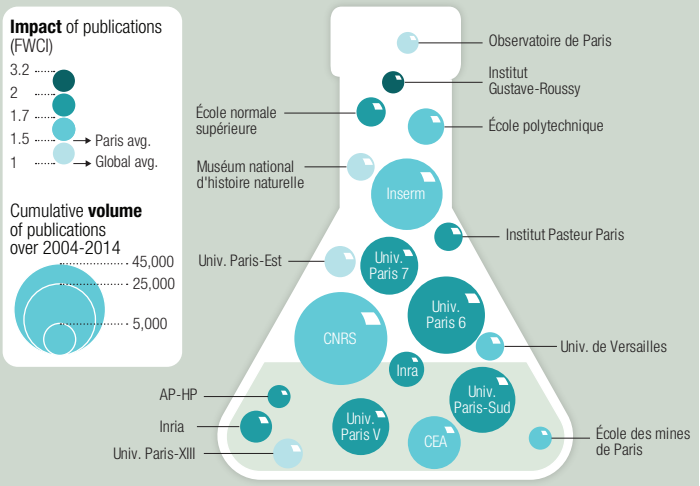
Source: MENESR DGESIP-DGRI SIES, 2013 data

THE MAIN **INSTITUTIONAL CONTRIBUTORS** TO THE PARIS REGION'S SCIENTIFIC PUBLICATIONS



AP-HP: Assistance publique-Hôpitaux de Paris; CEA: Commissariat à l'énergie atomique; CNRS: Centre national de la recherche scientifique; Inria: Institut national de recherche en informatique et en automatique; Inra: Institut national de la recherche agronomique; Inserm: Institut national de la santé et de la recherche médicale.

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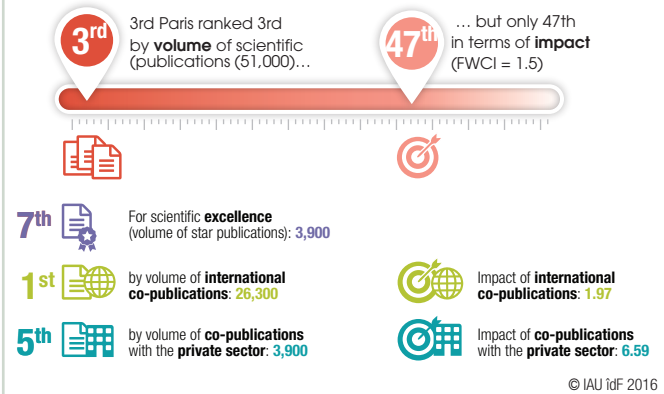
Source: Elsevier ERI Analytics City Data Portal, Scopus data, IAU îdF processing. (Partial result: the full identification of the authorities in charge of French laboratories has not been completed yet).

THE **PARIS REGION'S GLOBAL RANKING** IN 2014



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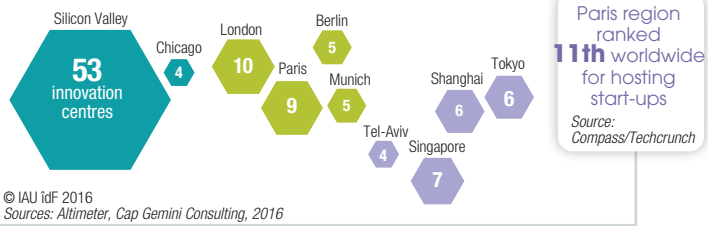
Source: Elsevier ERI Analytics City Data Portal (66 global cities), Scopus data, IAU îdF processing

HOSTING OF INNOVATION CENTRES THE PARIS REGION RANKED FAR BEHIND SILICON VALLEY



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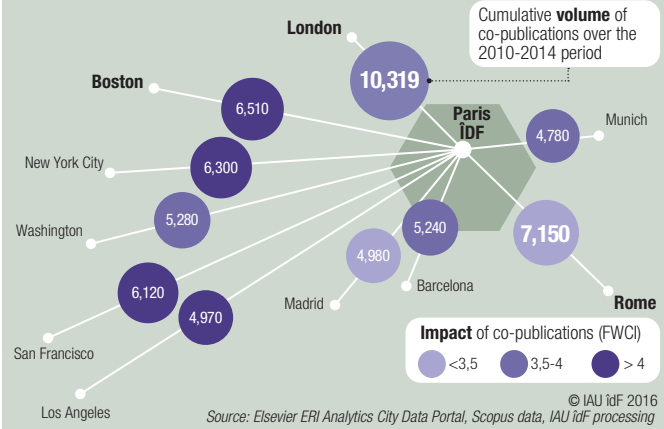
Sources: Altimeter, Cap Gemini Consulting, 2016

LONDON, ROME AND BOSTON ARE THE PARIS REGION'S MAIN **SCIENTIFIC PARTNERS**



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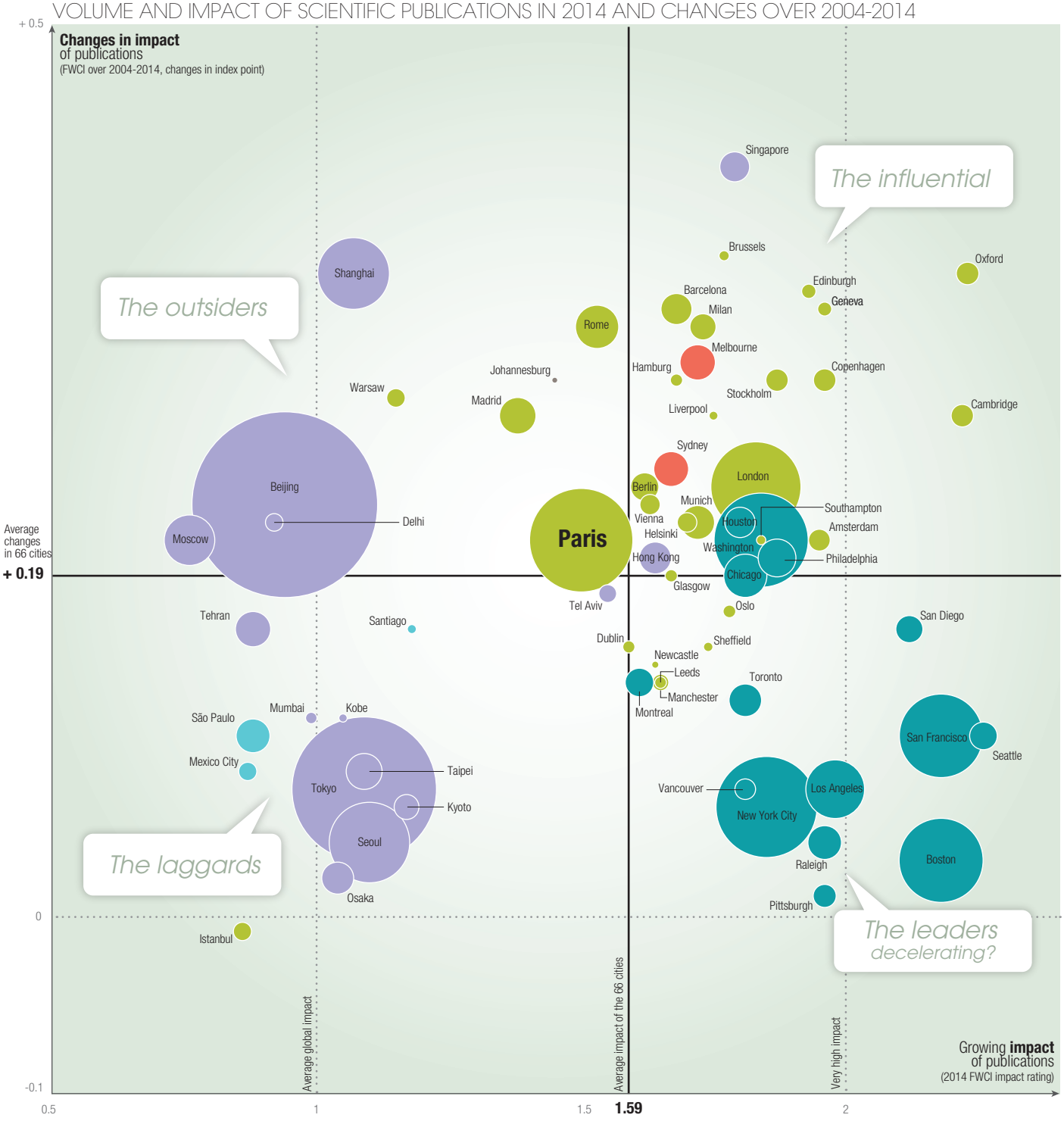
Source: Elsevier ERI Analytics City Data Portal, Scopus data, IAU îdF processing

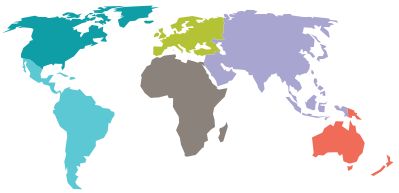
THE SCIENTIFIC INFLUENCE OF GLOBAL CITIES

VOLUME AND IMPACT OF SCIENTIFIC PUBLICATIONS IN 2014 AND CHANGES OVER 2004-2014

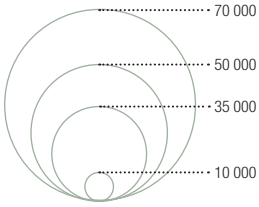


Over the 2004-2014 period, all global cities recorded a growth in the number of scientific publications and an increase in their impact (except for Istanbul). However, their growth trajectories varied according to their **continents** of location, their **weights** in absolute terms (volume of publications over 2004-2014) and the growth rates of the **impact** of the publications.

Location of global cities



Cumulative **volume of publications** over 2004-2014



The impact of the scientific publications of global cities is measured by the Field-Weighted Citation Impact ratio (FWCI). If the FWCI is >1, the city is specialised. The average impact ratio of the 66 global cities stands at 1.59.

The changes in the impact of the scientific publications by global cities was calculated over the 2004-2014 period. The average impact growth rate of the 66 cities was +0.19 point.

To help you read the chart

Source: Elsevier ERI Analytics City Data Portal, Scopus data, IAU îdF processing

THE PARIS REGION'S INNOVATION SYSTEM HAS NOT ACHIEVED ITS FULL POTENTIAL YET

In spite of its strengths and the progress made these last few years, international comparisons show that the Paris region has some persistent weaknesses that hamper its economic development driven by research and innovation. Cooperation between research and industry, large corporations and SMEs and between the technology supply chains and the applications sector remains weak. Efforts and resources allocated to technology enhancement and transfer are scattered and there is little use of venture capital: the amounts raised are lower than those raised in global regions. SMEs and start-ups invest very little in R&D. All too often, obstacles to innovation and risk aversion prevent ideas from being rapidly turned into marketed products and services. They hinder the scaling up of SMEs and slow the dissemination of innovations likely to respond to major territorial challenges. Moreover, the physical concentration of technological discovery research, on the one hand, and the more diffuse nature of the other forms of social, organisational and practical innovation, have had divisive consequences for mindsets and initiatives.

Ensuring consistency between networks

Major challenges facing the Paris region include enhancing the skills base and improving coordinated networking on the part of stakeholders. Networks are lacking in coordination and visibility. True, the emergence of *pôles de compétitivité* (competitiveness hubs) has improved the situation by helping to meet the challenges facing academic research in the region by focusing more on applied research and by generating more synergies between economic players. However, these hubs are still very recent and lack a high profile internationally compared with other world-famous foreign clusters. And the overall support system remains unclear, notably for SMEs.

The need to strengthen the focal points of innovation

The Paris region features a dense and diversified regional innovation ecosystem, but it is geographically dispersed. Although some centres of innovation have gained strength, they have found it difficult to make their presence felt across the region and internationally. Locations that foster geographical proximity to corporate research and knowledge while at the same time easing the outward mobility required by creativity benefit from a comparative advantage and enhance competitiveness. Projects undertaken to develop campuses and clusters meet the imperative of economic development. They also provide opportunities to plan for high quality urban areas and to enhance the urbanity of locations that are often deprived of good urban design. Today, in the Paris region, several major sites in tune with current trends in innovation ecosystems are driven by this dynamic momentum, namely: Paris-Saclay university, the Cancer Campus in Villejuif, the Condorcet Paris-Aubervilliers campus and Paris Sciences et Lettres (PSL) research university. Strengthening these locations is a key issue for the Paris region's economic development.

A role as an innovation focal point that needs to be boosted

The strength of the Paris region lies in its positioning as a multidisciplinary territory. Although this positioning is good for its territorial resilience, the result is that it sometimes also appears as largely generalist and, in the eyes of stakeholders, as featureless and with a low profile. This limits the Paris region's ability to present a narrative that highlights its distinct global competitive advantages. Thus, the region would gain from becoming a focal point for experimentation at a time when businesses, notably in sectors undergoing deep digital and environmental transformations, are seeking promising sites in terms of innovation, skills, infrastructures and financing. Among the 40 "unicorns" (innovative companies valued at USD1 billion or more) operating in Europe, only three - Criteo, BlaBlaCar and Vente-privee.com – have located their headquarters in the Paris region.

In an open and competitive international environment, in order to remain at the top of the value chain, it is of crucial importance to use research and innovation as driving-forces of economic development and employment by fostering cooperative ventures, strong growth in high value-added research-related sectors and by targeting the courses of action required to achieve all this. ■

Odile Soulard, economist
under the responsibility of Vincent Gollain, director of the economics department

1. In the appendix to this Note Rapide, on our website, you will find precise definitions, characteristic features, descriptions of activities and of the range of applications of research and development and innovation.
2. National Centre for Scientific Research.
3. National Institute of Health and Medical Research.
4. Atomic Energy Commission.

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ELSEVIER'S SCOPUS DATABASE

Scopus is a database of scientific publications produced by Elsevier and operated regarding the Paris region in partnership with the IAU îdF. It reveals in detail the Paris region's strengths in the field of science compared with the rest of the world's major regions. The Elsevier ERI Analytics City Data Portal compares data from 66 international metropolises (metropolitan areas or functional urban areas) in terms of indicators based on scientific publications and their impact, by discipline, over the 2004-2014 period. The impact and quality of scientific publications are measured on the basis of the number of citations thanks to the Field-Weighted Citation Impact (FWCI) index, which provides a standardised index of impact covering a range of research fields in which the number of publications and citations varies a great deal. Where the FWCI >1 (1 = the global average), the global city concerned is a specialised city.

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