



CREATIVE ENERGY

Percentage growth in scientific production in each metropolitan region (1996 - 2013)

The DNA of innovation in metropolises

Researcher shows how big universities influence the economy and environment of the urban regions where they are located

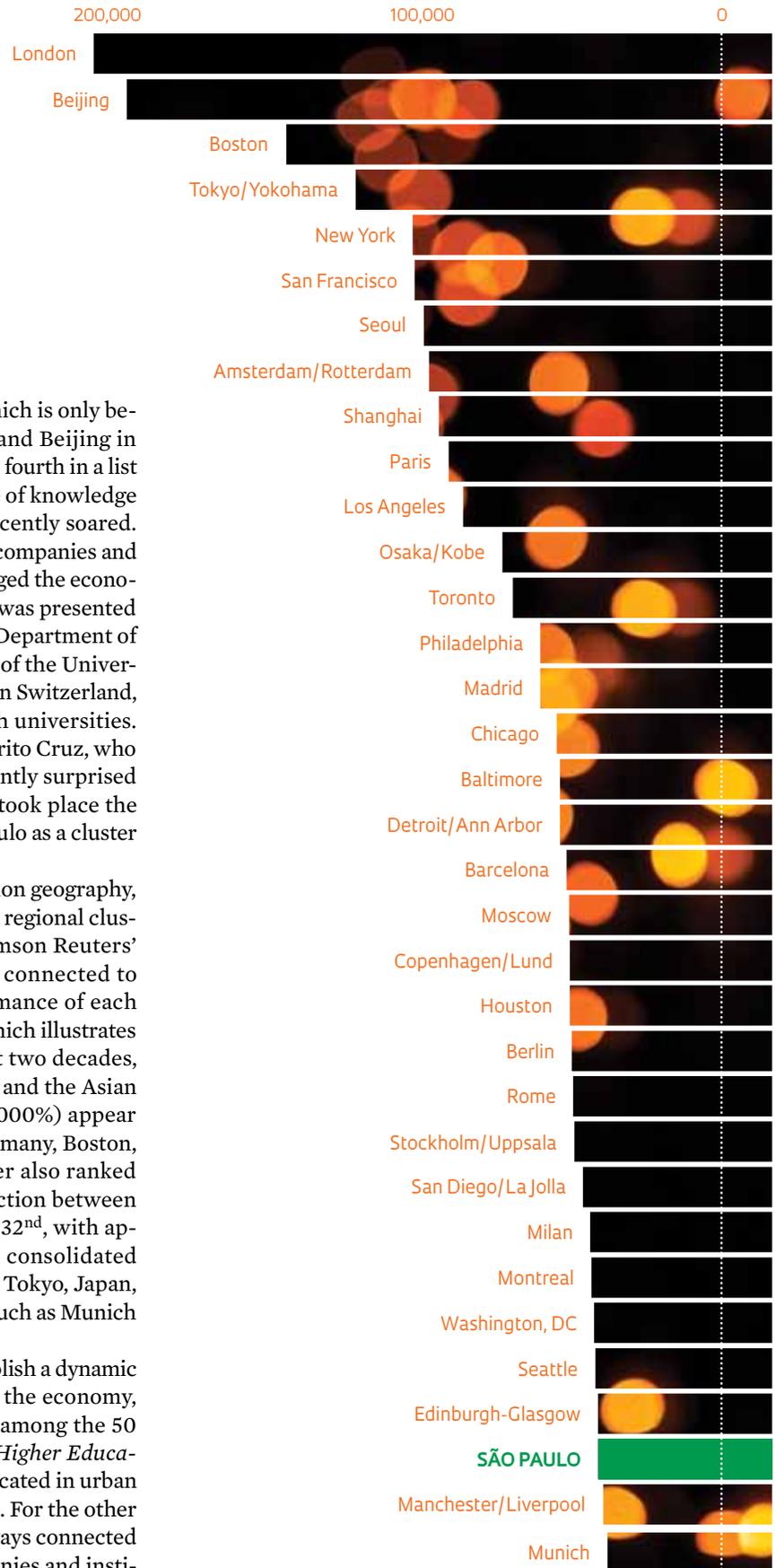
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SOURCE: WEB OF SCIENCE/THOMSON REUTERS AND UNIVERSITY OF TORONTO (2014)

LEADERS IN KNOWLEDGE

Scientific publications by institutions in each metropolitan region (2011 -2013)



The São Paulo Metropolitan Region, which is only behind the megalopolises of Shanghai and Beijing in China, and Seoul in South Korea, ranks fourth in a list of urban clusters in which the volume of knowledge generated by their universities has recently soared.

This knowledge has multiplied interactions with companies and organizations within their communities and changed the economy and environment of their cities. This ranking was presented in June 2015 by Méric Gertler, a professor at the Department of Geography and Planning and current chancellor of the University of Toronto, Canada, at the Glion Colloquium, in Switzerland, a biennial forum attended by leaders of research universities. FAPESP Scientific Director Carlos Henrique de Brito Cruz, who took part in the event, commented: “I was pleasantly surprised when I attended Méric Gertler’s lecture, which took place the day after my own, and heard him highlight São Paulo as a cluster of scientific production.”

An international leader in the study of innovation geography, Gertler compiled data on scientific production in regional clusters, extracted from the Web of Science, a Thomson Reuters’ website, and analyzed collaboration networks connected to that production. He then compared the performance of each region between 1996 and 2013. In that ranking, which illustrates the evolution of scientific output during the last two decades, São Paulo (with an increase of more than 400%) and the Asian metropolises (with an increase in Shanghai of 1000%) appear at the top, ahead of regions such as Munich, Germany, Boston, the United States, and London, England. Gertler also ranked regions based on the volume of scientific production between 2011 and 2013. On that list, São Paulo appears in 32nd, with approximately 40,000 publications, behind more consolidated regions such as San Francisco, the United States, Tokyo, Japan, and Berlin, Germany, but ahead of major regions such as Munich and Manchester-Liverpool, England.

The data suggest that research universities establish a dynamic spirit within their home regions, jump-starting the economy, innovation, and creativity. Gertler showed that among the 50 most highly regarded universities in the *Times Higher Education* World University Rankings, only seven are located in urban centers with a population of less than one million. For the other 43, the presence of a world-class university is always connected to some major metropolitan region where companies and insti-



The manager of a venture capital fund went straight to the point when he said: money flows to where ideas are flowing, says Gertler

tutions benefit from the knowledge and human resources generated by academia, while at the same time making demands that challenge the academic community. The São Paulo urban cluster is defined, in Gertler's analysis, as a megalopolis of more than 30 million residents formed by the state capital and the cities of Campinas and São José dos Campos, with institutions such as the University of São Paulo (USP) and the University of Campinas (Unicamp), the federal universities of the ABC region (UFABC) and of São Paulo (Unifesp), and the Technological Institute of Aeronautics (ITA), as well as three institutions that are part of São Paulo State University (Unesp). USP, whose main campus is in the state capital city, is itself responsible for 22% of Brazilian scientific output, according to figures from the Web of Science. "This Brazilian hub is part of a remarkable story. As recently as 25 years ago, it was little known and highly specialized. Now it is a global force," Méric Gertler told *Pesquisa FAPESP*. "According to bibliometric data from Thomson Reuters, in 1990 USP was collaborating with 350 institutions in 28 countries. By 2014, it was working with more than 6,500 institutions in 145 countries. That is simply extraordinary."

According to Gertler, partnerships with universities play a crucial role in the economic reinvention of cities. He cites as an example the U.S. city of Pittsburgh, Pennsylvania, which managed to make the transition from a leading U.S. steelmaking hub into a prosperous and diversified region, a model in education, technology, health care and financial services. "Pittsburgh has benefitted tremendously from the impact of Carnegie Mellon University, the University of Pittsburgh, and 35 other universities and colleges. Similarly, metropolitan areas like Boston, San Francisco, Raleigh (North Carolina), and Austin (Texas) have benefitted from the influence of MIT, Harvard University, Stanford, the University of California San Francisco, the University of North Carolina at Chapel Hill, Duke University, the University of Texas, and dozens of smaller, less famous schools," Gertler observes. "This is equally true across Canada, in places like Toronto and Vancouver, and the same

is true around the world. Think of Singapore or the São Paulo region, including São José dos Campos and Campinas, for example."

Many countries, recognizing the value of participating in global networks of knowledge, have selected some of their leading research universities as targets for concentrating investments. This investment helps attract and retain talented students and researchers. "This is resulting in huge increases in publications, citations, and collaborations—it is good news for all," says Gertler.

The survey adopted a methodology used by other research groups, according to which bibliometric indicators also serve to show, albeit indirectly, the vigor of the economic activities and elements of civil society that are naturally connected with universities. "Scientific research is, by definition, a creative and innovative activity—and is itself an engine of urban development," writes Christian Wichmann Matthiessen, a researcher from the University of Copenhagen, with Annette Winkel Schwarz and Soren Find from the Technical University of Denmark. Matthiessen, Schwarz and Find made this statement in a 2009 article about world cities that used the same methodology as Gertler. "The manager of a venture capital fund made the point explicitly when he said: 'ultimately, money flows where ideas flow,'" Gertler observes. He warns, however, of the acknowledged limitations in the use of bibliometric indicators, which usually say a lot about quantity but not necessarily much about quality.

Gertler has dedicated much of his academic career to the study of the economies of urban regions and the role that large institutions such as universities play in their development. He says there are several ways in which universities that are intensively engaged in research spur regional innovation, prosperity and reinvention of the economy. First, he says, universities provide sources of energy and resilience for the economies of urban regions. They generate huge budgets and partner with industries, institutions, and non-profit organizations. "Research based on partnerships often leads to new findings in basic and applied science. When local partners work with a university, faculty and students both try out new ideas and benefit from them. Furthermore, much of the research

University of
Toronto Chancellor
Méric Gertler:
international
leader in studies of
the geography of
innovation



conducted within our institutions ultimately finds its way into the marketplace through a variety of channels as measured by technology licensing agreements, patents, and startups.”

Gertler observes that universities contribute to their regions and countries mainly by forming human capital. “Educating students is by far the main form of technology transfer on the part of universities. University graduates provide a powerful injection of creativity, engagement, and energy into a community,” the chancellor says, and this is true for all fields of knowledge. “We often hear that our nations need more graduates in science, technology, engineering and mathematics. Of course, those fields are crucial. Nevertheless, it must be said that graduates in humanities and the social sciences engender dynamism and resilience as much as STEM grads do. The humanities and social sciences enable us to think broadly and deeply about our problems and the values that guide us in forging solutions.” In the digital era, he argues, it is vital to be able to analyze information critically and creatively, to arrange the key points to build persuasive arguments and to listen and learn from other perspectives.

Research universities also function as gateways that connect their regions to the world, and vice versa. “Collaboration among researchers and publications in co-authorship are becoming more and more important, and increasingly international. Moreover, these international partnerships are not randomly distributed around the globe but are most frequently found among elite institutions located in other major urban regions. To quote a recent editorial in the journal *Nature*, ‘excellence seeks excellence, so elite national universities are also leading international collaborators,’” Gertler says. This is important because the present and future prosperity of our universities depends on

their ability to access and use not only locally produced knowledge but also the knowledge developed in other leading centers of research and innovation around the world.

Finally, universities exercise a stabilizing influence on their neighborhoods. “To borrow a term from retailing, our institutions are the ‘anchor stores’ of their communities. The size of our institutions has a substantial economic impact throughout the region—creating jobs, boosting tax revenue, and fostering the entrepreneurial spirit,” says Gertler, who also points to the positive local impact the extension activities offered by his teaching staff, employees, and students are having on neighboring communities and districts. For example, dental students from the University of Toronto treated 78,000 patients in 2014 as part of their extension work.

Universities also help rebuild the physical infrastructure of their cities and frequently play a leading role in regenerating the urban fabric. “That’s one reason why so many municipalities around the world have pursued post-secondary institutions as sources of new vitality for aging urban centers.”

The city of São Paulo was formed by the convergence of favorable economic movements such as coffee-growing and industrialization, cultural diversity promoted by migratory movements, and scientific development fostered by major universities, observes Leandro Medrano, a professor at the USP School of Architecture and Urban Studies. “Its regional leadership is tied to that unique situation that transformed a town into Latin America’s biggest megacity within less than a century. Such diversity and economic clout have driven continual cycles of innovation in various areas, such as science, culture, and the arts,” he says.





In Medrano's opinion, the greatest threat to this structure is urban violence and the desire of part of society to close itself off from the community. "The proliferation of gated communities and commercial centers could split the city into walled-off microsystems. In addition, that would impair the region's potential as a center of innovation. Fortunately, the trend we observed in the 1980s and 1990s seems to have run its course. São Paulo may be embarking on a new cycle of progress with regard to its urban potentials," he says.

Renato de Castro Garcia, a professor at the Institute of Economics at Unicamp, recalls that there was a time when the São Paulo region experienced a flight of industries to regions where costs were lower and logistical facilities were better. "But the technological solutions employed by the companies are harder to decentralize because those businesses attach a lot of importance to remaining physically and geographically close to the places where knowledge is generated," he says. Garcia was the advisor on a master's thesis defended at USP by economist Ariana Ribeiro Costa, who analyzed the dynamics of information technology companies in the São Paulo Metropolitan Region. "The companies that are concentrated in the city and nearby regions are knowledge-intensive," she says. She concluded that those companies continue to settle in the vicinity of the state capital because, despite the costs, they identify links that help them become stronger and offer opportunities for the exchange of knowledge. "Face to face contact and diversification of production play a vital role in that concentration and the exchanges of knowledge that occur in those environments," says Costa, who uses the concept of tacit knowledge that was extensively explored by Méric Gertler in his studies of economic clusters. Tacit knowledge, as opposed to the codified knowledge found in books, is the kind of knowledge that is not easily transferable and depends on personal contact, regular interaction, and trust to be passed on.

Costa's thesis helps explain why the São Paulo capital city was the only metropolis in Latin America listed in the latest edition of *Global Startup Ecosystem Ranking 2015*, which assesses the environment for development of the infant technology companies known as startups. São

Paulo ranks 12th, behind such locations as Silicon Valley (California), New York, Los Angeles, and Boston, all in the United States. With regard to São Paulo, the study cites as strengths the fact that it is the economic capital of Latin America, and that there is financing availability for technology startups already in business, whose numbers are estimated at 2,700. Investments by venture capital funds in São Paulo technological startups in 2014 exceeded those made in companies in Seattle, in the United States. "São Paulo has more talent than any other startup ecosystem in South America," the authors of the study emphasize.

The clout wielded by innovation clusters challenges the idea that because of globalization, the world has become flat, as argued by U.S. journalist Thomas Friedman in his book *The World is Flat: A Brief History of the Twenty-first Century*. Veneziano de Castro Araújo, a professor of economics at Unifesp, argues that "While it is true that global-

ization has led to a convergence that enabled countries like India and China to join the global supply chain of goods and services, there still exist points inside those countries where competence will cluster." In 2013, Araújo, also advised by Renato Garcia, defended a doctoral dissertation at USP in which he addressed the effects of proximity on the local dimensions of innovation in Brazil.

Araújo cites the establishment of Unicamp as an example. "The university began graduating well-qualified engineers and adapting its surroundings to attract companies, which expanded demand for those professionals. The needs expressed by companies also required engineers to study technologies that were not available and promoted collaborations with the university. Furthermore, other

companies that wanted to come to Brazil, interested in the excellent interaction between the university and industry, chose Campinas as their home," he explains. "Embraer, a Brazilian aircraft manufacturer, is another example; it originally relied on engineers trained by ITA, but now absorbs graduates of USP and Unicamp. Proximity to the technological expertise and knowledge of the region makes this possible," he says. According to Araújo, this does not prevent interactions from intensifying between researchers and companies in distant regions, but such interactions do not flow as swiftly as the collaborations within the clusters. ■

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