

CHAPTER 16

Cities, Research Universities and the Economic Geography of Innovation

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INTRODUCTION

Within the past decade, an increasingly pervasive view argues that “the world is flat”, and that location matters less and less when it comes to economic activity (Friedman, 2005). Information and communication technologies are said to be the key to understanding this trend, since they dramatically reduce the cost and increase the ease with which one moves information between geographically distant sites.

An alternative view proposes a different geography, one in which the distribution of economic activity — and in particular, knowledge-intensive and creative activity — is becoming more geographically concentrated (or “spiky”) over time (Florida, 2005). The forces underlying this dynamic stem from the ability of particular places to foster the generation and circulation of knowledge among economic actors, and to provide a quality of life that is attractive to creative, knowledge-producing workers.

While there is undoubtedly a kernel of truth to each view, a more nuanced understanding of these issues emerges when one examines the key role of research universities, and explores the nature of their relationship to urban regions. Whether one considers research, teaching or “third mission” activities such as innovation and entrepreneurship, the local and global relationships that drive the success of the research university become readily apparent. At the same time, these institutions serve as key economic drivers of their host

urban regions, drawing on their globally networked geographies to fuel this effect.

In this paper, I shall explore this relationship between universities and their host city-regions, arguing that it is fundamentally symbiotic. Moreover, I shall make the case that, contrary to the “world is flat” view, the importance of location has actually increased over time (rather than the opposite), and that this effect is evident with respect to all three elements of universities’ mission: research, education and entrepreneurship. Notwithstanding the growing importance of location, rapidly rising new entrants have shaken up pre-existing geographies of knowledge production, thanks to major investments by the governments of emerging economies to build up research universities on a highly selective and concentrated basis. Such trends add new clusters of knowledge production to global networks, but the production of knowledge remains a fundamentally urban activity.

CITIES — PRIVILEGED SITES FOR INNOVATION

Let me elaborate, beginning with the role of cities in the contemporary global economy.

The international literature on the geography of innovation and prosperity shows that urban regions are privileged sites for innovation, entrepreneurship and the flourishing of ideas and opportunities. (See, for instance, Glaeser *et al.* [1992]; Storper & Venables [2004]; and Gertler [2003].) The forces underlying this connection are many and varied, originating from both the supply-side environment cities offer and the demand they generate.

Cities offer a geographically concentrated, deep pool of inputs that support entrepreneurship and the development of new products — including a wide array of specialized services and, of course, human capital. Indeed, there is growing evidence that the most talented, creative and entrepreneurial members of the labour force prefer to live in urban settings offering a high quality of place: cities that are culturally vibrant, physically appealing, safe, with good schools, and open to newcomers and new ideas.

Urban regions are home to large concentrations of sophisticated and demanding customers and deep, diverse and highly competitive markets that spur innovation. By providing interesting and important problems to solve, cities naturally stimulate new ideas or products to address them. Furthermore, because it is now widely recognized that, in many sectors, innovation is an interactive and iterative process, not a linear one, cities foster innovation particularly well. They bring technology users and producers together in a close, productive dialogue.

Similarly, cities foster the circulation of knowledge among firms — including those in the same or related industries, as well as those in seemingly

unrelated industries. The capacity to facilitate such “knowledge spill-overs” and localized learning provides tremendously fertile conditions for innovation, even in a time when information technologies make it easy for information to be shared instantly over long distances.

These and other features of cities confer significant advantages for innovation, entrepreneurship, economic opportunity and growth, and social well-being.

Accordingly, public policy in many countries has moved increasingly to exploit the intimate connection between cities and a nation’s capacity for innovation, resilience, and long-term prosperity. In the last 10-15 years, we have seen a growing recognition that cities are in fact increasingly critical national resources. They are now appreciated as drivers of innovation, and prosperity — not just locally, but at the national level.

The Right Honourable Greg Clark M.P. (then Minister for Cities and Constitution, HM Government, U.K.) and Greg Clark (Global Fellow, Brookings Institution/JPMorgan Chase Global Cities Initiative), make the point in *Nations and the Wealth of Cities* that “cities now aggregate the productive assets that shape competitiveness...” (Clark & Clark, 2014, p. 20). But at the same time, they continue, “the processes of metropolitan growth have, in many cases, taken place without clear economic understanding or strategic institutional guidance” (Clark & Clark, 2014, p. 20). In response, leaders from Brazil to the United Kingdom to Germany to Hong Kong are moving to provide that missing economic understanding and strategic guidance.

The same international literature to which I referred earlier makes equally clear that the goal of urban economic development strategy should be to enhance and support those local firms and sectors that demonstrate unique capabilities and competencies, based on their innovative activities. In a world of highly globalized production systems and supply chains, the only reliable source of sustained prosperity is to focus on those activities whose competitive advantage is difficult to replicate by other firms or in other regions.

The starting point in the endeavour is to acknowledge that those activities with the greatest innovative capacity are not evenly spread across the national landscape, but are instead highly concentrated in a relatively small number of city-regions. Public sector investments designed to stimulate innovation ought to be similarly concentrated, rather than allocated in a diffuse and overly dispersed way. And, as I shall argue below, such investments should target both physical and knowledge infrastructure — that is, research universities.

CITIES — PRIVILEGED SITES FOR RESEARCH UNIVERSITIES

This brings me to the second element in the interrelationship highlighted in the title: research universities.

One way governments have helped develop a region's competitive advantage is by investing in institutions of higher education and advanced research. In this connection, it is worth highlighting that the same features that make cities privileged sites for innovation, entrepreneurship and the flourishing of ideas and opportunities also make cities ideal sites for the flourishing of universities and other research institutions.

For example, universities thrive in part by solving problems brought to them by demanding local customers — who become partners in an interactive innovation process. The creativity and ingenuity of their faculty and students are enhanced by their exposure to interactive learning opportunities and rampant knowledge spill-overs locally.

The ability of universities to attract their most important inputs — faculty and students — depends directly on the quality of life in the city around them. Those same creative, energetic and entrepreneurial people, who can choose where they want to live, often decide to live where there are good schools and hospitals, vibrant neighbourhoods, stable property values and so on. So quality of place becomes a crucially important determinant of the long-term success of research universities.

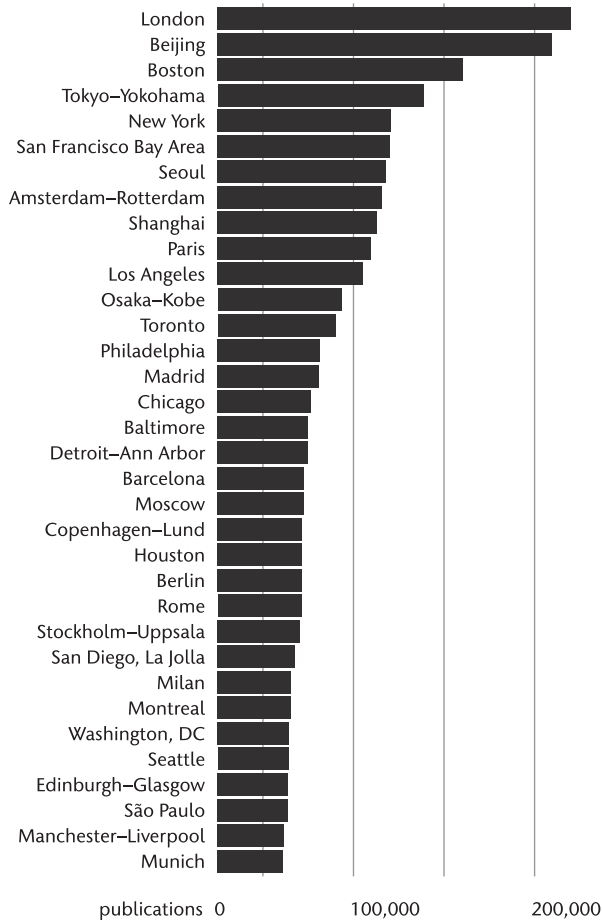
In fact, it is evident that cities and universities thrive in the same environments and fuel the same outcomes. Indeed, the partnership between cities and universities has a *propulsive effect* — whereby each enhances the strengths of the other. This means that if cities are going to achieve their full potential, they will need to leverage the advantages of nearby universities or research institutions, and *vice versa*.

This relationship is *symbiotic*. A strong university helps build a strong city, and a strong city helps build a strong university. Leveraging this relationship creates mutual advantage, leading to prosperity for both the university and the city-region that hosts it. To put it even more directly: cities foster the development of world-class research institutions and universities, while at the same time universities and research institutions foster world-class cities.

The following observation supports this hypothesis. Of the top 100 universities ranked by *Times Higher Education* in 2014, 89 are situated in the environs of an urban region with a population greater than a million people — and all but one of the top 30 (*Times Higher Education* 2014).

The correlation is equally pronounced when you consider *Times Higher Education's* ranking of the world's top young universities, the “Top 100 Under 50”. Of the top 100 universities under 50 years old, 83 are situated in the environs of an urban region with a population of a million or more — and every one of the top 50.

While the mutually beneficial connection between research universities and their host city-region is strongly evident, this intensely local relationship is complemented by critically important global connections. Leading

Figure 1: Leading Urban Regions by research publication productivity 2011-2013.

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urban regions with leading institutions of education and research are interconnected.

Figure 1 shows the world's leading centres of research productivity based on the number of publications produced between 2011 and 2013. Clearly, the world's leading research-producing regions are also the world's most dynamic metropolitan economies, demonstrating the extent to which research enterprise depends on the qualities of the urban regions in which they are situated — and vice versa.

However, it is important to note that these regions do not thrive in isolation. Collaboration (and co-publication) between scholars in different

locations is becoming more pronounced over time, and increasingly this collaboration is *international*. So this phenomenon is also global in nature. Moreover these international partners are *not* randomly distributed around the globe, but are most frequently found at other elite institutions, located in other major urban regions around the world. In the words of a recent editorial in *Nature*, “Excellence seeks excellence, so elite national universities are also leading international collaborators” (Adams, 2013, p. 558).

Consider that the London urban region produced more than 195,000 research publications between 2011 and 2013, the largest number of any urban region in the world. Other urban regions among the world’s top 15 research producing centres include Boston (135,000+ publications), Tokyo (113,000+ publications) and Toronto (65,000+ publications). These publications were produced in collaboration with tens of thousands of institutions in thousands of metropolitan regions. Remarkably, just these four regions — London, Boston, Tokyo, and Toronto — collaborated variously on more than 15,000 publications in that same three-year period. The institutions of education and research in these regions are the all-important gateways connecting their host city-regions to global knowledge networks.

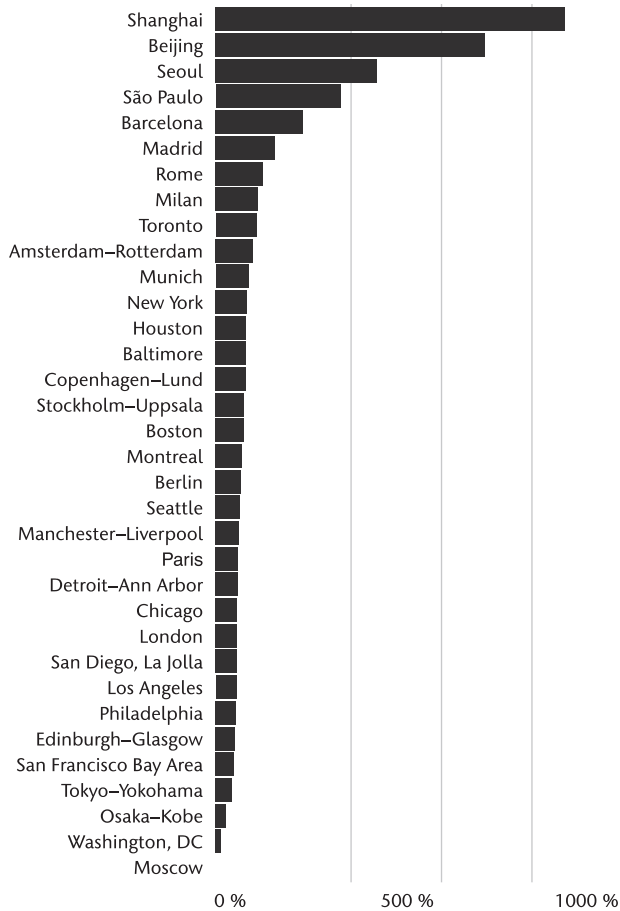
Forward-looking governments around the world are increasingly recognizing the value of participation in these global knowledge networks. Consequently, as noted above, many national and sub-national governments have clustered their investments, building upon the strength of select regions’ universities (and the regions themselves). Notably, they are concentrating capital funding for infrastructure, differentially investing in fundamental research at leading institutions, and attracting and retaining talented students and faculty, not just locally but internationally (see, for instance, Yang & Welch, 2012).

Moreover, the investments are clearly working (see Figure 2). Between 1996 and 2013, while the research output of the London region grew by 60%, the rate of growth from emerging research powerhouses was simply astonishing. Research output in Shanghai grew by 970%, in Seoul by 450%, in São Paulo and Singapore by 340%, and in Hong Kong and Mumbai by 200%. Collaborations among these urban regions and other knowledge-producing hubs around the world have also been skyrocketing, to the advantage of all cities that take part in this activity.

Why does this matter? Quite obviously, in London, Boston, Tokyo, and Toronto — *as in every other region* — our present and future prosperity depends on our ability to access and use knowledge; not just knowledge produced locally, but also knowledge produced in other leading centres of research and innovation around the world.

Hence, leading metropolitan regions are vital knowledge hubs. They are gateways, exchanging and developing innovations and ideas with partners around the world and, in the process, advancing our collective prosperity. A

Figure 2: Leading Urban Regions by research publication productivity % change, 1996 to 2013.



Source: Web of Science * This data is reproduced under a license from Thomson Reuters (2014); and the University of Toronto, Office of the President.

paper in the *Handbook of Creative Cities* captured this idea succinctly: “[W]ell connected research cities are likely to be important cities in the global economy; nodality in research often corresponds to nodality in other parts of the local economy” (Matthiessen, Schwarz & Find, 2011, p. 227).

In other words, well-connected, globally networked centres of knowledge production are increasingly coming to the fore as the world’s leading economic centres. Venture capital and other forms of mobile investment now seek out these special places and the opportunities that are signalled by their world-leading research, talent and partnerships.

EDUCATION

Do the same analysis and conclusions derived from universities' research mission also apply to their education mission? Many would argue that the importance of location has declined over time when it comes to the teaching mission of our institutions. After all, information technology provides virtually instant communication, allowing seamless remote collaboration, and education offers a striking example. Enrolment in Massive Open Online Courses (MOOCs) has exploded. *Coursera* counts over 12 million users; *edX* over 3 million users; and over 4 million students are enrolled at Indira Gandhi National Open University in India. The numbers are continuing to grow.

In this regard, there has been considerable discussion of a revolution in post-secondary education driven by advances in digital technology. The focus of much of the discussion, particularly in the media, has been that innovation in digital pedagogy is liberating universities and students from the expensive constraints of real estate. This will drive participation and improve access — and certainly the numbers quoted above would seem to support this thesis.

It should be acknowledged that the possibilities afforded by advances in communications technology are momentous. Increasing access to education, the most powerful and progressive force in human history, is a wonderful development. Moreover, it is clear that we have only begun to appreciate the scope and scale of the possibilities that digital technology will enable.

In a 2013 survey of MOOC faculty from the *Chronicle of Higher Education*, there was overwhelming support (86%+) for the idea that MOOCs would eventually reduce the cost of education — and nearly three quarters of those surveyed reported that one of their primary motivations in signing up to teach a MOOC was to increase access to higher education (Kolowich, 2013).

Hence, these observations about the digital disruption in post-secondary education would appear to challenge the future of the symbiotic relationship between universities and cities. With access to education increasingly available online, the co-location of top universities and major urban regions revealed in the global rankings would seem to be endangered and likely to weaken over time.

In fact, I think that *just the opposite* will happen.

There is no question that post-secondary education is being disrupted. But not necessarily in the way that the media have articulated and popular imagination might believe. In this connection, it is interesting to note a tension in the modern post-secondary landscape. The rise of online learning is having a surprising effect: it is compelling us to ensure that the value of “being there” in person, in the classroom, in the library, in the lab, or on the playing field, is sufficiently great to compete successfully against purely digital modes of teaching.

Indeed, we are already seeing that new tools and technologies are helping us rethink the way we teach in the classroom. Paradoxically, digital challenges

to traditional education are helping us reimagine traditional, campus-based education. This was apparent to those most closely involved right from the beginning. According to that same 2013 *Chronicle* survey, about three quarters of surveyed instructors who have taught online courses report that they have been inspired through this experience to change the way they teach in the traditional classroom.

More recently, efforts to study the pedagogical impact of technology-enhanced learning have produced some intriguing results suggesting how in-person forms of teaching and learning may be transformed and strengthened in the process. For example, researchers in the Department of Computer Science at the University of Toronto have observed important differences in learning methods and outcomes between students taking a traditional introductory computer science course and students taking an inverted introductory computer science course covering exactly the same material. In an inverted (or “flipped”) classroom, students are first introduced to new material online through video clips or screencasts. Students then achieve a deeper understanding of the material through in-class problem solving, discussions and active learning, often in pairs or small groups and with the face-to-face help of professors and teaching assistants. Homework consolidates what a student has learned and helps prepare for subsequent classes and in-class or online quizzes and examinations (adapted from Bruff, 2012, and Horton *et al.*, 2015).

According to the Toronto research, overall rates at which students in traditional and inverted classes drop, fail or pass their respective courses do not differ significantly. However, students who failed the midterm and continued in the course did *substantially* better in the inverted class than those in a similar position in the traditional class. And similarly, students in the inverted class did significantly better on the final exam than their counterparts in the traditional class (see Campbell *et al.*, 2014; Horton *et al.*, 2014; and Horton & Craig, 2015).

This is a new field of pedagogical research and more study needs to be done. Nevertheless, early results such as those from the University of Toronto cautiously suggest that students in inverted classrooms benefit from the active-learning environment and face-to-face interaction with peers and instructors in the time traditionally reserved for lectures. In particular, it appears that students in the inverted classrooms are making better decisions regarding course persistence, getting individually tailored extra help, and addressing student-specific challenges. One plausible inference is that these benefits stem from increased opportunity for instructor-student and peer-to-peer face-to-face interaction.

Going beyond the confines of the classroom or the lab, universities can help foster the development of our students by harnessing the opportunities of the urban regions in which they are situated.

Experience-based learning and service learning, for example, are critical elements of post-secondary education that are inextricably linked to location. Co-op programs, internships, inter-institution collaboration, industry partnerships and urban research are activities that are fundamentally dependent on location. Universities situated in major urban regions are able to take advantage of such opportunities more readily because they are literally on their doorstep. Thus, urban regions themselves become important elements in post-secondary education.

In these ways, the value of *being there* is heightened, the educational experiences and outcomes for our students are improved, and the prospects for innovative solutions to global challenges are increased. A research-intensive university's setting is not electronically replicable.

SOCIAL IMPACT AND ENTREPRENEURSHIP

Increasing attention has been paid in recent years to universities' so-called "third mission": fostering broader social and economic impact by cultivating knowledge mobilization, innovation and entrepreneurship. Here too, I would argue, research universities situated in major urban regions have an important competitive advantage.

Let me offer the following example. According to the 1911 Census of Canada, 35% of Toronto's workforce (in a sign of the times, aged 10 years and older) was employed in the manufacturing sector, and the clothing and textile industries constituted the majority of the sector. Indeed, according to the Census, clothing and textile workers outnumbered bankers 50 to 1 and for every accountant in Toronto in 1911, there were five musical instrument makers (*Fifth Census of Canada, 1911, 1915*).

Today, the Toronto Census Metropolitan Area is the third largest technology hub in North America, comprising some 43% of Canada's technology sector by investment (City of Toronto, 2015). The region is the third largest financial services centre in North America (City of Toronto, 2015), and one of the top three largest life sciences clusters on the continent (Canadian Trade Commissioner Service, 2014).

Like Boston, New York, London, Hong Kong and dozens of other metropolitan regions, the Toronto region has reinvented itself continually over the course of its history. Where does such resilience come from? There are many forces at work, of course. However, among the most important is the partnership between the region and its institutions of higher education.

To be sure, the primary form of knowledge mobilization or technology transfer from universities to their host urban regions occurs through the production and graduation of well-educated human capital. This has been very much the model in Toronto. The graduates of its universities have been the backbone

of an educated, diversified and highly creative workforce for years. It is this mutually enriching partnership, more than anything else, that has sustained Toronto's enduring prosperity, as it has in Boston, New York, London, Hong Kong and other major urban regions.

But this is only part of the story. Leading metropolitan regions are increasingly powering a surge in entrepreneurship, the very essence of urban resilience and reinvention. Between 2007 and 2013, the Association of University Technology Managers (AUTM) has reported an increase of nearly 50% in the number of start-ups reported to them (Association of University Technology Managers, 2015). University faculty and students play a vital role in innovation and entrepreneurial clusters, actively creating companies, jobs and entirely new industries.

Moreover, as Figure 3 demonstrates, these clusters thrive in urban regions. Conspicuously, 82% of the start-ups reported to AUTM during this same time period were spun out of universities within the environs of urban regions with populations greater than half a million people. This is no accident, of course. Start-ups depend for their success upon the multi-sectoral, convergent strengths found only in urban regions. New ventures of all sorts require access to capital, marketing, design, advertising, IT services, product development and testing, IP lawyers, management, packaging, logistics and highly qualified personnel. These elements provide an essential catalyst for entrepreneurship and a powerful spark for innovation.

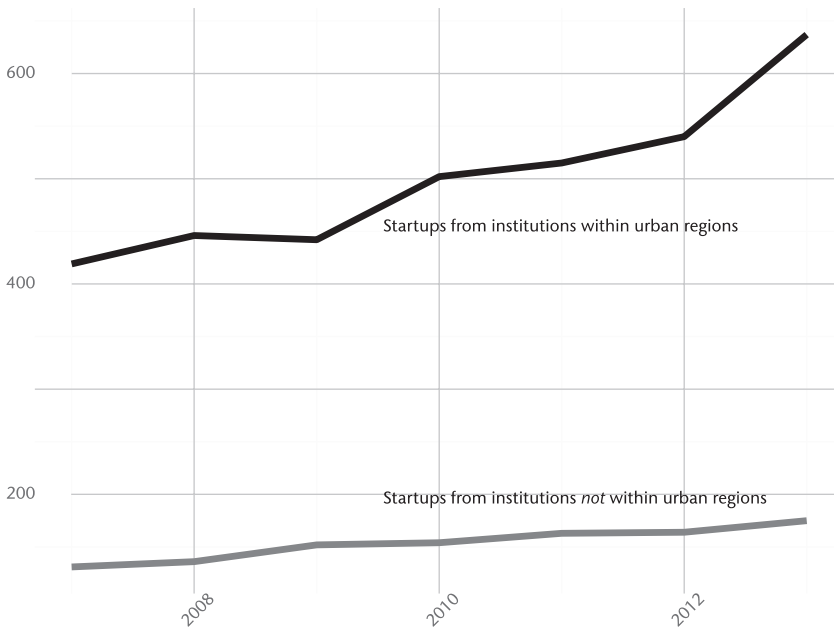
In a virtuous circle, new businesses in turn spawn investment, employment, and partnership opportunities, along with local spill-over and knock-on effects. They open research and educational opportunities and build a region's capacity to absorb and harness the knowledge, discoveries and — most importantly — highly qualified personnel being generated by the higher education and advanced research sectors. And they create international affiliations with institutions in other jurisdictions, leveraging global knowledge networks for local advantage. These complex interrelationships form the engine of the world's most innovative regions, ecosystems where scholars, scientists, students, entrepreneurs, venture capitalists and industry leaders translate knowledge into prosperity.

CONCLUSION

To recapitulate, the relationship between universities and their host city-regions is fundamentally symbiotic and confirms the importance of location for research, education, innovation and entrepreneurship. This observation has important ramifications for public policy.

Success in a knowledge-based economy requires thoughtful, strategic support for a nation's urban regions *and* for its leading institutions of advanced

Figure 3: The Geography of Entrepreneurship (Startups reported to AUTUM, 2007 to 2013 by proximity to urban regions).



research and education. Moreover, these leading institutions are most likely to be located in such urban regions. Public policy aimed at enhancing local and national prosperity, as well as higher education policy aimed at enhancing the global standing of a nation's universities, should acknowledge and leverage the relationship between these critical national assets. This idea stands in stark contrast to the status quo in many national and sub-national jurisdictions, where the political logic of distributing investments geographically and treating all universities as equal often exerts a powerful force over economic development and higher education policy.

This analysis also holds important implications for university leaders, at a time when the financial sustainability and reputation of many institutions are at risk (Baldwin, 2013). It is becoming clear that, for research universities in major urban regions, the ability to leverage the benefits of their favourable location — to advance their research, teaching, entrepreneurship and outreach missions — constitutes an increasingly important source of competitive advantage. Moreover, as they do so, these institutions also enable their host city-regions to address their biggest social, economic and environmental challenges, and achieve their full potential. As this mutually beneficial dynamic takes hold, the urban foundations of research universities' success become ever more strongly accentuated.

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