Research Article

Patrick Adler* and Richard Florida

The city as campus: regional organization of research universities

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Abstract: We argue that research universities are best understood as regional systems of learning rather than stand-alone organizations. We introduce the concept of the university complex, a regional agglomeration of multiple universities whose complementarities and competition jointly shape knowledge production, talent attraction, and local spillovers. Using comparable indicators across U.S. Metropolitan Areas and selected global regions, we show that multi-university complexes outperform single-university regions on measures of scientific output and exhibit more diverse specialization profiles. We also show that universities in complexes do not empirically trade-off between economies of scale and economies of scope. These results contribute to the regional innovation systems literature by showing that 'ivory towers' are deeply regionalized.

Keywords: innovation; regional innovation systems; universities; scaling; triple helix; bibliometrics

1 Introduction

How isolated is the university? Metaphors such as "ivory tower," "town and gown," and "academic bubble" convey the impression that they are removed from the rest of society. This view is reinforced by the gated and walled architecture of many campuses as well as academics themselves, who are known to retreat into their networks and offices. Regardless of its origins, the notion that universities are set apart has become increasingly inconvenient in an era where higher education faces mounting political and financial scrutiny (Gertler 2018; Knight et al. 2021) from the outside. At times like this, it is politically expedient for universities to be seen as a crucial part of the local community, rather than some permanent zone of exemption.

In the subfield of regional innovation studies (Pino and Ortega 2018), scholars have already shown that universities are not only connected to society at large but are often the 'straw that stirs the drink' of regional development. Metaphorical frameworks present them as a "triple helix" partner alongside government and industry (Etzkowitz and Leydesdorff 1995), as key nodes within regional innovation systems and learning regions (Asheim 1996; Cooke 1992), as anchors of specialized industrial districts (Markusen 2017), and as keystones of physically distinct but socially integrated innovation districts (Drucker and Kayanan 2024). Across these accounts, the university is depicted more as a power plant for the innovation economy than as some removed monastery.

Within this broader literature, universities are attributed several principal roles. They are sources of commercializable knowledge via patents and spinoffs (Jaffe et al. 1993; Wright et al. 2008); magnets for training and attracting highly skilled workers (Gertler 2010); coordinators facilitating knowledge flows between private sector actors (Bramwell and Wolfe 2008); and relays connecting regional innovation systems to global knowledge networks (Benneworth and Hospers 2007; Huggins et al. 2020).

The view of the university as a regional development engine also has policy precedent. In midcentury West Germany, several new universities were deliberately established in smaller or economically weaker regions as part of a broader strategy to expand access and stimulate local modernization (Krieger and Stratmann 1999; Pinheiro et al. 2015).

The notion that universities shape local outcomes is not always flattering to these organizations. A local campus' presence has been implicated in the generation of regional inequality. Some have identified an "innovation-inequality nexus" in areas where surges in patenting and startup activity coincide with growing income and occupational segregation (Florida and Gaetani 2020). This dynamic reflects broader relationships between innovation and inequality at both regional (Breau et al. 2014) and national

***Corresponding author: Patrick Adler**, The University of Hong Kong, Hong Kong, Hong Kong, E-mail: adler@hku.hk
Richard Florida, Rotman School of Management, The University of Toronto, Toronto, Canada

scales (Acemoglu 2002; Autor 2014) and is often reinforced by localized pressures such as university-driven crowding out of public goods like affordable housing and transportation.

This paper examines how research universities function as regionally connected systems of innovation rather than as isolated units. Specifically, we investigate whether there is a form of connectedness hiding in plain sight that may be a significant but overlooked force in regional development. At this scale, universities do not operate as individual actors; rather, they cooperate, combine, and compete in ways that generate more innovation output per unit of input.

Central to this argument is the concept of the university complex, which we define as the co-location of multiple research universities within a single region. This is a familiar phenomenon but a surprisingly under-theorized one. While past research has regularly noted standout examples – Silicon Valley (anchored by Stanford and Berkeley) versus Boston (Glaeser 2005; Saxenian 1996), North Carolina's Research Triangle (Feldman and Lowe 2011; Link and Scott 2003), or Ontario's Technology Triangle (Bramwell and Wolfe 2008; Vinodrai 2016) – these cases are typically treated as anecdotes rather than as evidence of a more generalizable pattern. The complex itself is rarely treated as a unit of analysis.

In this paper, the region is understood as a meso-scale between the local and national delineated by its density of functional and relational linkages among its constituent actors (Asheim and Gertler 2005; Cooke 1992). Regions provide the principal territorial arena for coordination in innovation and production systems, where firms, universities, governments, and other organizations interact more intensively with one another than with external areas, supported by overlapping institutional systems (Scott 2017; Storper 1997). In economic terms, regions can also be viewed as spatial units within which factor markets – particularly for land, labor, and specialized skills – are interdependent and where prices and wages exhibit a degree of correlation, reflecting shared production and market areas (Fujita et al. 1999; Krugman 1991).[1]

The remainder of the paper proceeds in six parts. Section 2 situates the idea of the university complex within the literature on regional innovation systems and considers how university innovation processes may be organized at a regional scale. Section 3 defines the concept of the university complex and outlines the data sources and typology used to identify regional university configurations, distinguishing between horizontal (multi-university) and vertical (single-dominant-university) systems. Section 4 describes the empirical distribution and structural characteristics of these complexes across U.S. and global regions. Section 5 analyzes the relationship between organizational structure and research performance, assessing whether complexes exhibit efficiency gains or trade-offs between scale and diversity. Section 6 concludes by relating the findings to broader discussions of regional innovation and higher-education policy and by identifying directions for future research.2. The city as campus: why university innovation is regionalized. In order to understand the salience of the university complex, the assumption that university-based innovation can be reduced to what happens at universities themselves requires examination. On paper (for example, in a university annual report), the university appears to be a self-contained unit, typically anchored to a single campus. Modern ranking systems such as QS and Times Higher Education contribute to the notion that organizations are wholly and only responsible for their performance.

In practice, campus innovation is the outcome of processes that extend well beyond campus boundaries. Learning is local but not internal. Labor markets for researchers, staff, and graduates are shaped by regional – not institutional – dynamics. Spinoffs, partnerships, and policy engagement rarely respect the perimeter of a campus gate. While universities matter, they cannot internalize the full set of functions that drive innovation. These processes unfold within a broader regional innovation system (Asheim and Gertler 2005; Cooke 1992; Gertler 2003) that links universities to one another, to firms, to governments, and to the social fabric of the metropolitan areas in which they are embedded.

In the regional innovation systems (RIS) literature, the region is understood as the scale at which regional advantage is forged. This is primarily because it is the scale at which tacit knowledge – a critical input into innovation and technological development – most effectively circulates (Bathelt et al. 2004; Doloreux 2002; Gertler 2003). Unlike codified knowledge, which can be formalized and transmitted globally through language systems, tacit knowledge is experiential, contextual, and deeply embedded in social and cultural practices. It is acquired through close observation, shared norms, and sustained face-to-face interaction (Storper and Venables 2004). As a result, tacit knowledge rarely travels beyond normal activity spaces such as commuting zones or market areas.

1 This definition treats regions broadly enough to include both official administrative units and more fluid metropolitan or cross-border networks, across a range of geographic contexts. This is necessary, given the global scope of our analysis.

Despite its stickiness at the regional scale, tacit knowledge behaves like a local public good within it: it does not depreciate with use, and it is difficult to exclude others once it is shared. As actors move between organizations in their activity space – through employment, collaboration, and social ties – they inevitably transmit tacit knowledge "for free," multiplying its effect (Antonelli 2009; Antonelli and Colombelli 2017). The combination of stickiness and externality helps explain why some regions are persistently more innovative than others.

Universities exemplify this regional stickiness. Their training role connects directly to workforce development for the wider labor force and is tied to regional planning in formal and informal ways. Unlike private organizations, universities cultivate forward linkages to other organizations. In the U.S. context, for example, survey evidence indicates that 61 percent of university students plan to remain where they attended college (Tallo 2022). Universities are also major regional employers. They compete with other universities, firms, government agencies, and households for labor, and regional market forces largely determine wage levels. Dual-career households reinforce these regional dynamics: about 36 percent of full-time faculty have partners who are also academics (Costa and Kahn 2000; Schiebinger et al. 2024). Such couples may prefer co-employment at one organization, but they ultimately depend on the regional labor market to solve their dual-career problem.

As research hubs, universities seek to disseminate discoveries widely, yet uptake of tacit components is greatest locally. In the U.S., technology-transfer infrastructures are often organized at regional or state scales, and roughly three-quarters of university spinoffs remain in the home state (AUTM 2020; Ranga and Etzkowitz 2015). Within academic fields, there is typically more research available than scholars can read; local seminars and informal exchanges thus act as filters – "curation" – mechanisms that promote local research to wider networks (Adler 2021).

At the same time, universities are heterogeneous and not internally coherent. organizations vary in how they organize space, structure academic labor, and train students. Specialist schools achieve economies of scale in narrow domains; generalists seek economies of scope by training across fields. Even within universities, departments differ in how they allocate labor or share expertise. These micro-heterogeneities ultimately work themselves out at the regional level, where labor supply and demand must balance across traded and local sectors.

When taken together, these observations suggest that the regional scale is the natural unit of analysis for university-related innovation and labor-market coordination (Duranton and Puga 2004). Analytically, this implies that indicators often reported at the organizational level – such as patents, publications, or spinoffs – may be more meaningfully interpreted when aggregated to the regional scale, where inter-university linkages and labor markets actually operate.

Building on this regional framing, we define the university complex as a configuration of multiple research universities whose proximity and differentiation generate collective capacities that no single unit could achieve alone. The complex is characterized by spatial co-location, educational variety, and functional interdependence among universities engaged in research, teaching, and public service. Together, these relationships create a system of horizontal and vertical connections that shape how knowledge circulates, how talent is trained and retained, and how innovation integrates with regional economies. Through a competition of active cooperation, passive cooperation, and direct competition, regional complexes generate favorable regional outcomes for their communities.

Analytically, the university complex represents a genotype – a general organizational form that manifests in diverse ways across higher-education systems. Its phenotypes vary with context, depending on industrial structure, national and local policy, market access to students, and other factors. In this paper, our focus is on theorizing and analyzing the common, underlying organizational form of the university complex, which might also be understood as a local 'cluster' of universities.

2 The regional organization of research universities

Having established that key university innovation processes are fundamentally regional in nature, we now turn to the concept of the university complex as a way of understanding how research activity is organized at the regional scale. We begin by outlining ideal distributional types for university resources at a regional scale and next present evidence that the complex is a prominent pattern.

2.1 Vertical and horizontal types

Within universities, resources can be distributed across faculties, departments, and research teams in different ways, and the same is true at the regional level. There are two ideal types for how this distribution might occur. A fully vertical regional university system would centralize all activities

within a single research unit, while a horizontal one would evenly split activities among several schools.

In practice, university systems are rarely designed from scratch. They evolve over time to serve diverse missions on behalf of a range of stakeholders, often without deliberate coordination at the regional level. Nevertheless, a region's university system can be understood as continually fluctuating between the two types. For example, whenever a research grant is awarded to the dominant university in a region, the system tilts toward a more vertical structure. Conversely, when resources are distributed proportionally across multiple universitiess, the system shifts toward a more horizontal configuration.

University funders will occasionally intervene to reshape the regional university system entirely. In 2013, Russia launched the so-called "5–100" program, directing substantial investment to 21 select universities with the aim of promoting at least five of them into the global top 100 rankings by 2020 (Kotchegura et al. 2022). Although the program fell short of that benchmark, it effectively redistributed resources toward a subset of already prominent campuses, creating a more vertical system within the average region and the country as a whole.

By contrast, the estimated 333 international campuses established by universities over the past several decades (Cross-Border Education Research Team 2025) have pushed receiving regions toward more horizontal configurations. A new campus within a region will inevitably attract resources – human capital, funding, and policy attention – that might otherwise have gone to existing players. The campus may also weaken the university's ties to its home region (Gertler 2018), thereby affecting multiple university systems at once.

2.2 How common are university complexes?

To assess the degree to which research university activity is horizontally organized at the regional level, we analyze two university populations. The first is a U.S.-only sample comprising 466 universities classified as "Research Colleges and Universities," including R1 and R2 units – those with very high and high research activity, respectively, under the Carnegie Classification system (American Council on Education 2025), with data drawn from the 2025 Integrated Postsecondary Education Data System (IPEDS; U.S. Department of Education 2025). The second is a global sample consisting of all universities ranked in the QS World University Rankings 2024 (Quacquarelli Symonds 2024), using data sourced directly from QS. While these datasets do not capture all research activity within a region, they represent universities that have met either a nationally defined threshold for research intensity (in the U.S. case) or a globally recognized benchmark of research university quality. Thus, a substantial share of regional research output is effectively represented in these data.

While the QS dataset provides a globally comparable inventory of research-intensive universities, it is not without limitations. Like other global rankings, QS reflects both methodological choices and systemic biases – most notably, a strong weighting toward English-language publications, reputational surveys, and citation databases that underrepresent non-Anglophone or regionally oriented research (Hazelkorn 2018; Shin and Toutkoushian 2011). Alternative rankings such as the Academic Ranking of World Universities (ARWU) or Times Higher Education (THE) often produce different hierarchies, underscoring the absence of a single objective standard of "quality." In this study, QS data are therefore not used in a normative way to confirm excellence but as a consistent, cross-national proxy for identifying globally visible research universities. With this caveat in mind, we now turn to what these imperfect data can nevertheless reveal about regional university organization.

A simple analysis shows that some degree of horizontal organization is present in most regions – that is, most regions have multi-university complexes of some sort. Table 1 shows the top U.S. regions Core-Based Statistical Areas with research universities, ranking them by total enrollment and shading them by the number of research universities in the region. Sixty-five out of the 92 regions are complexes, and 27 are fully vertical "superuniversities."

It should be expected that regions with more universities have higher enrollment, all else equal, but Orlando, Champaign, State College, and Gainesville concentrate more university students in their single-university regions than large cities like Nashville, Detroit, and Denver do in their complexes. And not all vertically organized regions are "university towns" – Orlando, Lansing, Madison, and Tucson are all top-50 metropolitan regions in terms of size, with complex economies and only one research university. Insert Table 1 About Here.

Among university research complexes, there is wide variation in primacy, that is, the extent to which the leading university dominates regional research capacity. To measure this, Table 2 ranks the most centralized university complexes based on academic staff employment. It reports Hirschman-Herfindahl Index (HHI) scores, where 1 indicates total concentration and 0 indicates perfect equality, alongside the percentage of university staff employed at the top university in each region. Columbus, Ohio – dominated by The Ohio State University – emerges as the most vertically structured complex, with 95.3 % of staff employed

Table 1: Concentration of regional university enrollment across major U.S. regions (2025).

	Metro. Area	Enrollment.	Univ. #	6+	3–5	2	Super
1	New York	455,877	33	✓			
2	Boston	206,761	16	✓			
3	Los Angeles	206,089	14	✓			
4	Chicago	173,616	13	✓			
5	Philadelphia	158,403	10	✓			
6	Dallas	145,300	7	✓			
7	Atlanta	137,861	6	✓			
8	San Diego	119,787	6	✓			
9	Washington	105,808	7	✓			
10	Houston	96,703	6	✓			
11	Austin	85,593	2			✓	
12	San Francisco	83,157	4		✓		
13	Miami	82,591	6	✓			
14	Cincinnati	70,648	4		✓		
15	Columbus	66,449	2			✓	
16	St. Louis	66,408	7	✓			
17	Sacramento	65,602	2			✓	
18	Provo	62,631	2			✓	
19	Pittsburgh	62,171	5		✓		
20	Baltimore	60,890	4		✓		
21	Ann Arbor	60,186	2			✓	
22	Seattle	59,481	3		✓		
23	Tampa	59,304	3		✓		
24	Minneapolis	57,715	3		✓		
25	San Jose	56,247	3		✓		
26	Orlando	55,513	1				✓
27	Birmingham	54,862	2			✓	
28	Durham	54,355	3		✓		
29	Riverside	52,382	3		✓		
30	Champaign	50,580	1				✓
31	State college	49,378	1				✓
32	Gainesville	48,292	1				✓
33	Lansing	47,994	1				✓
34	Lafayette	47,618	1				✓
35	Tallahassee	46,943	2			✓	
36	Madison	46,725	1				✓
37	Tucson	45,997	1				✓
38	Nashville	45,561	4		✓		
39	Bloomington	44,454	1				✓
40	Baton Rouge	41,686	2			✓	
41	Knoxville	41,008	2			✓	
42	San Antonio	40,956	3		✓		
43	Denver	40,023	4		✓		
44	Detroit	39,794	3		✓		
45	Athens	38,963	1				✓
46	Hartford	38,521	3		✓		

Table shows all metropolitan regions (CBSAs) in the United States with at least 38,000 enrolled students, and the corresponding number of universities that account for this number. 'Superuniversities' are high-enrolling regions with only one university. Data from IPEDS.

there. At the other end of the spectrum, New York is the least centralized; New York University accounts for just 20.8 % of the region's university staff. Boston's almost paradigmatic complex is similarly balanced, ranking second-lowest in concentration. Philadelphia, Los Angeles, Chicago, and Washington, are all noteworthy for their multiple quality universities, and with low HHI scores. At the same time, most regions, however, are not nearly as balanced as these regions. In the median cases of Rochester and Denver, the lead university employs roughly 70 % of the total academic staff – a normal city therefore has multiple universities organized around a single primate.

The global distribution of QS Top 500 universities shows a somewhat more vertically concentrated pattern (Table 3), as might be expected given the rankings' emphasis on quality at the world scale. In total, 216 regions are represented among QS-ranked schools, but 171 of these host only a single university.

Still, notable outliers exist. Melbourne, Paris, and Hong Kong each contain six or more QS-ranked universities; London, Seoul, and Boston host five; New York, Sydney, Los Angeles, and Tokyo have four; while Shanghai, Beijing, Raleigh, Berlin, Washington, Stockholm, and Brisbane each include three. Approximately 41 % of students enrolled in QS Top 500 institutions are located in regions with more than one ranked university. Because the regional geography of QS-ranked universities reflects not only the number of organizations but also their perceived quality, it is less straightforward to interpret than the U.S. data. Still, we can be confident that extensive complexes of world-leading universities would not be expected by chance.

Some national-level patterns are apparent in the QS data. Major metropolitan regions in the Global South – such as Mexico City, Buenos Aires, São Paulo, and Jakarta – typically appear with only a single QS-ranked university, if at all. By contrast, regions with large university complexes tend to be concentrated in the G10 and Greater China. Notably, Toronto – despite being a G10 metropolitan area with a population exceeding 7 million – is represented by only one QS-ranked university.

Unfortunately, due to limited data on academic staff at the global level, we use student enrollment as a proxy for total university activity. Based on this measure, the most unequal QS complex is Vienna, where the University of Vienna accounts for 68 % of total enrollment. At the other end of the spectrum, Seoul is the most balanced, with

Table 2: The degree of centralization among US university complexes 2025.

Rank | metro | HHI | top %	Rank | metro | HHI | top %	Rank | metro | HHI | top %	Rank | metro | HHI | top %
1. Columbus (0.92 | 95.9 %)	20. Hartford (0.69 | 82.0 %)	39. Columbia (0.52 | 59.4 %)	58. San Juan (0.39 | 43.3 %)
2. Ann Arbor (0.89 | 94.0 %)	21. Buffalo (0.69 | 81.1 %)	40. San Francisco (0.51 | 68.9 %)	59. Huntsville (0.38 | 49.9 %)
3. Seattle (0.84 | 91.3 %)	22. Oklahoma City (0.67 | 79.2 %)	41. Milwaukee (0.51 | 56.2 %)	60. Nashville (0.37 | 54.5 %)
4. Birmingham (0.83 | 90.3 %)	23. San Jose (0.66 | 80.0 %)	42. Little Rock (0.51 | 57.6 %)	61. Omaha (0.37 | 45.5 %)
5. Minneapolis (0.82 | 90.0 %)	24. Richmond (0.66 | 78.2 %)	43. Colorado Springs (0.51 | 55.3 %)	62. Portland (0.35 | 49.9 %)
6. Indianapolis (0.79 | 88.4 %)	25. Savannah (0.65 | 77.2 %)	44. Charleston (0.51 | 58.6 %)	63. Houston (0.27 | 40.7 %)
7. Knoxville (0.78 | 87.2 %)	26. Athens (0.63 | 75.9 %)	45. Greensboro (0.51 | 58.6 %)	64. Albany (0.27 | 39.9 %)
8. Blacksburg (0.77 | 86.9 %)	27. Deltona (0.61 | 73.5 %)	46. Greenville (0.50 | 51.8 %)	65. Atlanta (0.26 | 38.1 %)
9. Fayetteville (0.77 | 86.7 %)	28. Bloomington (0.61 | 73.3 %)	47. Bridgeport (0.50 | 54.6 %)	66. Virginia Beach (0.25 | 33.0 %)
10. Baton Rouge (0.76 | 86.2 %)	29. Cleveland (0.60 | 72.6 %)	48. Spokane (0.50 | 53.5 %)	67. Miami (0.23 | 35.5 %)
11. Trenton (0.75 | 85.5 %)	30. Burlington (0.59 | 71.0 %)	49. St. Louis (0.49 | 68.5 %)	68. Philadelphia (0.20 | 38.9 %)
12. Lafayette (0.74 | 84.5 %)	31. Macon (0.58 | 69.4 %)	50. Detroit (0.49 | 64.5 %)	69. Los Angeles (0.20 | 36.3 %)
13. New Orleans (0.74 | 84.7 %)	32. Toledo (0.58 | 69.4 %)	51. San Antonio (0.48 | 63.8 %)	70. Washington (0.19 | 29.7 %)
14. Sacramento (0.73 | 84.0 %)	33. Dayton (0.57 | 68.1 %)	52. Durham (0.47 | 53.9 %)	71. Chicago (0.18 | 25.4 %)
15. Syracuse (0.72 | 82.9 %)	34. Baltimore (0.57 | 74.3 %)	53. Riverside (0.44 | 60.0 %)	72. Dallas (0.16 | 20.6 %)
16. Tampa (0.71 | 83.6 %)	35. Akron (0.54 | 64.2 %)	54. San Diego (0.44 | 63.7 %)	73. Boston (0.14 | 25.9 %)
17. New Haven (0.70 | 83.1 %)	36. Provo (0.53 | 62.0 %)	55. Providence (0.43 | 56.9 %)	74. New York (0.11 | 20.8 %)
18. Tallahassee (0.70 | 81.6 %)	37. Rochester (0.53 | 67.5 %)	56. Pittsburgh (0.42 | 59.0 %)	
19. Austin (0.69 | 80.7 %)	38. Denver (0.53 | 70.4 %)	57. Cincinnati (0.41 | 58.6 %)	

The Hirschman–Herfindahl Index (HHI) measures the concentration of university staff within each metropolitan area, calculated as the sum of squared staff shares across universities. Values range from 0 (equal distribution) to 1 (complete concentration). "Top %" shows the share of total academic staff in the largest university. A region with only one university represents maximum concentration (HHI = 1.00; 100 %). Source: authors' calculations based on IPEDS 2025 data.

Sungkyunkwan University enrolling just 21 % of the city's QS student population.

Overall, QS complexes exhibit greater organizational balance than their U.S. counterparts. As shown in Table 4, the median global complex concentrates only 52 % of enrollment in its largest university – substantially lower than the median concentration observed in U.S. research complexes. Intriguingly, complexes are less common in the QS 500, but when they exist, they are more balanced.

These patterns suggest that university complexes are common – representing the dominant formation in U.S. regions and a prominent feature of the global sample. Most complexes are not evenly structured; in many cases, a single university commands a disproportionate share of staff or enrollment. However, a notable subset of regions – such as Boston, London, and Seoul – exhibit more balanced distributions. These same regions are also strongly associated with broader innovation dynamics, including high levels of technology formation, venture capital investment, and patenting activity (Florida and King, 2018).

3 The efficiency of university complexes

We now address the relationship between organizational type and efficiency. We start with a theoretical review which outlines the presumed advantages of each ideal type and continues by presenting preliminary evidence that university complexes tend to be more productive than vertically concentrated systems.

3.1 Economies of scale versus competition

In considering which structure is theoretically most efficient, it is helpful to focus strictly on the essential and inarguable advantages of each type. For a given quantity or quality of resources, what are the factors that would uncontroversially favor investing them in a single university versus spreading them proportionally across several? In its simplest form, a theory of regional university efficiency would posit two countervailing forces: the centralizing force of scale economies and the countervailing force of competition.

University scale economies refer to the numerous advantages, on a per-resource-unit basis, that can be realized by increasing a university's scale of operation. Scale-economy justifications for larger universities closely resemble those for larger cities within city systems (Helpman 1995; Henderson 2005; Krugman 1991). Like cities, universities are specialized agglomerations of people around shared infrastructures. As with cities, greater scale can lead to the amortization of infrastructure costs across more users, the overcoming of fixed cost thresholds, deeper divisions of

Table 3: Concentration of QS-500 university enrollment across major global regions (2025).

	Metro. Area	Enrollment	Complex size	6+	3–5	2	Super.
1	Melbourne, Australia	281,194	6	✓			
2	Paris, France	162,017	6	✓			
3	Hong Kong, China	113,812	6	✓			
4	London, United Kingdom	133,377	5		✓		
5	Seoul, South Korea	117,976	5		✓		
6	Boston, USA	111,168	5		✓		
7	New York, USA	139,142	4		✓		
8	Sydney, Australia	132,286	4		✓		
9	Los Angeles, USA	127,600	4		✓		
10	Tokyo, Japan	114,406	4		✓		
11	Shanghai, China	104,243	3		✓		
12	Beijing, China	103,433	3		✓		
13	Raleigh, USA	81,326	3		✓		
14	Berlin, Germany	78,027	3		✓		
15	Washington, USA	77,413	3		✓		
16	Stockholm, Sweden	67,149	3		✓		
17	Wuhan, China	111,842	2			✓	
18	Milan, Italy	83,205	2			✓	
19	Madrid, Spain	80,175	2			✓	
20	Barcelona, Spain	78,223	2			✓	
21	Montreal, Canada	77,342	2			✓	
22	Munich, Germany	69,995	2			✓	
23	Amsterdam, Netherlands	69,951	2			✓	
24	Santiago, Chile	66,871	2			✓	
25	San Francisco, USA	60,815	2			✓	
26	Singapore, Singapore	59,749	2			✓	
27	Birmingham, United Kingdom	58,011	2			✓	
28	Glasgow, United Kingdom	56,811	2			✓	
29	Vienna, Austria	55,730	2			✓	
30	Mexico City, Mexico	161,134	1				✓
31	Buenos Aires, Argentina	115,993	1				✓
32	Bologna, Italy	90,291	1				✓
33	Toronto, Canada	81,904	1				✓
34	São Paulo, Brazil	65,722	1				✓
35	College Station, USA	64,752	1				✓
36	Rome, Italy	63,585	1				✓
37	Vancouver, Canada	58,684	1				✓
38	Jeddah, Saudi Arabia	56,557	1				✓
39	Xi'an, China	55,975	1				✓
40	Columbus, USA	55,031	1				✓
41	Hangzhou, China	54,378	1				✓
42	Phoenix, USA	54,289	1				✓
43	Prague, Czech Republic	51,727	1				✓
44	Austin, USA	51,158	1				✓
45	Champaign-Urbana, USA	50,580	1				✓
46	Leuven, Belgium	50,457	1				✓
47	Lisbon, Portugal	50,344	1				✓

labor (Duranton and Puga 2004), and user network effects (Katz and Shapiro 1985).

In the regional university context, cost savings from shared support staff and facilities are easy to imagine. A single registrar's office, a centralized teaching hospital, or one large football stadium could reduce duplication and economize on infrastructure and staffing compared to maintaining separate versions across six different universities. Network effects are also likely important. The so-called "sheepskin" value of a university degree among employers

Table 4: The degree of centralization among QS 500 university complexes (2025).

Rank | metro | HHI | top %	Rank | metro | HHI | top %	Rank | metro | HHI | top %	Rank | metro | HHI | top %
1. Vienna (0.68 | 80.1 %)	13. Helsinki (0.53 | 61.3 %)	25. Perth (0.50 | 52.9 %)	37. Shanghai (0.34 | 37.6 %)
2. Bogotá (0.66 | 78.0 %)	14. Madrid (0.53 | 61.6 %)	26. Wuhan (0.50 | 52.1 %)	38. Los Angeles (0.32 | 35.6 %)
3. Edinburgh (0.66 | 78.4 %)	15. Santiago (0.52 | 59.8 %)	27. Munich (0.51 | 50.6 %)	39. Paris (0.32 | 42.6 %)
4. Copenhagen (0.65 | 77.1 %)	16. Hsinchu (0.51 | 57.8 %)	28. Zurich (0.50 | 50.0 %)	40. Tokyo (0.29 | 37.5 %)
5. Kuala Lumpur (0.65 | 77.1 %)	17. Lausanne (0.51 | 55.9 %)	29. Chicago (0.50 | 54.8 %)	41. Sydney (0.27 | 35.8 %)
6. San Francisco Bay area (0.59 | 70.9 %)	18. Amsterdam (0.51 | 55.3 %)	30. Brisbane (0.48 | 63.5 %)	42. London (0.24 | 32.9 %)
7. Atlanta (0.58 | 70.3 %)	19. Dublin (0.51 | 56.7 %)	31. New York (0.43 | 48.9 %)	43. Boston (0.23 | 28.8 %)
8. Gothenburg (0.56 | 67.0 %)	20. Singapore (0.51 | 56.7 %)	32. Washington (0.37 | 49.2 %)	44. Hong Kong (0.23 | 34.4 %)
9. Pittsburgh (0.56 | 67.6 %)	21. Birmingham (0.51 | 55.2 %)	33. Raleigh (0.36 | 41.7 %)	45. Melbourne (0.21 | 30.6 %)
10. Brussels (0.56 | 67.3 %)	22. Barcelona (0.51 | 58.2 %)	34. Stockholm (0.36 | 43.8 %)	46. Seoul (0.20 | 21.4 %)
11. Bristol (0.55 | 66.2 %)	23. Milan (0.51 | 56.3 %)		
12. Glasgow (0.54 | 63.5 %)	24. Montreal (0.50 | 50.5 %)		

The Hirschman–Herfindahl Index (HHI) measures the concentration of university staff within each metropolitan area, calculated as the sum of squared staff shares across universities. Values range from 0 (equal distribution) to 1 (complete concentration in one university). "Top %" shows the share of total academic staff in the largest university. A region with only one university represents maximum concentration (HHI = 1.00; 100 %). Source: authors' calculations based on QS 2024 data, published in 2025.

(De Schepper et al. 2023) grows as recognition of the university itself grows – and recognition generally increases with scale. Harvard may be better regarded than University of Central Florida, but through size effects alone, the latter is much more likely to be recognized than a smaller school and would therefore be more valuable on the job market.

Set against the centripetal force of scale economies is centrifugal competition, which may take at least three forms: product differentiation, price competition, and innovation. In each case, the presence of multiple universities within a regional complex can enhance overall productivity by expanding the set of choices available to regional stakeholders – whether students, funders, or employers. These expanded choices may generate consumer surplus, lower prices, or stimulate novel offerings.

The first advantage of complexes lies in stakeholder choice. Like any large organization, a research university must make decisions that affect a wide array of stakeholders with diverse and often conflicting preferences. It may strive to balance these interests, but no single university can satisfy all constituencies at once. A regional system with multiple universities allows them to position themselves strategically in "feature space" (Hotelling 1939; Lancaster 1990), offering distinct value propositions that raise aggregate welfare. Consider the ongoing debate around institutional political expression on campuses (Patel 2025): while some stakeholders expect their universities to adopt explicit positions, others advocate strict neutrality. A multi-university system increases the likelihood that each constituency can find a home that aligns with its expectations – something a single dominant university is unlikely to achieve as effectively.

Second, price competition tends to improve terms of trade for stakeholders. Even when differentiated in mission or identity, universities within a region still compete for students, staff, and funding. This competition can lead to more favorable tuition rates, better compensation, or improved services. Horizontal arrangements thus tend to benefit stakeholders outside the university, while vertical integration strengthens the market power of a dominant university – often to its own financial advantage. The fully vertical regional university enjoys monopsony power in many more areas than the member of a networked complex.

Finally, there is the imperative to innovate. A university, by virtue of its research mission, must continually operate near the frontier of knowledge production or risk declining influence over time. The same imperative applies to its workforce-development function for changing labor markets. As universities adapt in these ways, they can be understood as upgrading their dynamic capabilities – the organizational capacity to integrate, build, and reconfigure internal competencies in response to a changing environment (Barreto 2010; Teece et al. 1997). There has long been debate about how market structure affects innovation, with Schumpeter (1976) emphasizing the innovative potential of monopoly rents and scale economies, while others – such as Porter (2000) – highlight the creative pressure exerted by competitive environments. The weight of empirical literature tends to support the latter view: that competition motivates innovation, particularly when rival organizations are on relatively equal footing (Acemoglu and Linn 2004; Aghion et al. 2005; Vives 2008). Whether a "war chest" of resources aids innovation once the decision to act has been

made is an important question – but a distinct one from whether competition stimulates that decision in the first place. Universities should be expected to care more about innovation under conditions of local competition.

How do the opposing forces of competition and scale economies resolve themselves to arrive at an equilibrium number of universities in a region? The foundational monopolistic-competition model (Dixit and Stiglitz 1977) analyzes this question directly and provides the foundation for an urban literature that, as is the case with economies of scale, is highly relevant to university systems (Fujita et al. 1999; Krugman 1991). Models from the New Economic Geography explore the conditions under which centralizing forces (such as scale economies and market access) dominate dispersion forces (like congestion or transport costs) in city systems – with product variety emerging not from rivalry per se, but from the feasibility of sustaining differentiated offerings under increasing returns.

One of the most important implications of these models is that as effective market size increases – whether through lower transport costs or population growth – a greater number of varieties can be supported. Applied to the university complex, this suggests that larger or more integrated regions are better able to sustain a diverse and specialized set of universities – not because competition demands it, but because bigger markets can absorb more similarly sized universities.

3.2 The efficiency of university complexes

Having now considered the theoretical advantages of super-universities and complexes, we can turn to the empirical question of which are most efficient. Our initial indications are that regions organized as complexes tend to receive more research outputs per key unit of input, and that they do not necessarily trade scale for variety. For this analysis, we use bibliometric data from Scival (Elsevier 2024) for the years 2020–2024.

Research universities take on a diverse mix of missions – what Talcott Parsons (Parsons and Platt 1973) called "bundles" of functions, faculties, disciplines, and values. What ties research universities together, in particular, is their reliance on generating new knowledge as a central part of their mission. Although research defines the modern university's mission, it rarely pays for itself. Teaching income typically subsidizes research activity, making teaching the financial engine and research the expenditure it sustains. Teaching can therefore be seen as a cost and research output as a kind of revenue, with the relationship between the two offering a rough proxy for organizational efficiency.

Table 5 reports OLS estimates of the relationship between regional university structure and regional research outcomes. All models include controls for metropolitan population and per-capita income (taken from U.S. Census Bureau data 2022).

Table 5: Horizontal organization and regional research performance (2025).

	Schol. Output	Citations	Citing articles.	Media (print)	Patents
Panel A: 3+ Complex membership					
Complex (3+)	20,954.30*** (7,751)	516,688.01*** (188,482)	1,335.53*** (434)	11,567.02** (4,573)	608.23** (248)
Metro. Pop	0.01*** (0.00)	0.12*** (0.03)	0.00*** (0.00)	0.00*** (0.00)	0.00** (0.00)
Per capita income	0.67*** (0.18)	18.49*** (4.32)	0.04*** (0.01)	0.47*** (0.10)	0.00 (0.01)
R-squared	0.49	0.44	0.44	0.48	0.20
N	181	181	181	181	181
Panel B: Graduate enrollment inequality index					
HHI (Grad)	−33,566.51*** (11,684)	−809,012.54*** (284,390)	−1,918.85*** (658)	−19,337.57*** (6,882)	−1,105.53*** (372)
Metro. Pop	0.01*** (0.00)	0.11*** (0.03)	0.00*** (0.00)	0.00*** (0.00)	0.00* (0.00)
Per capita income	0.68*** (0.17)	19.00*** (4.24)	0.04*** (0.01)	0.48*** (0.10)	0.00 (0.01)
R-squared	0.49	0.44	0.43	0.48	0.21
N	181	181	181	181	181

Ordinary least squares (OLS) estimates. Dependent variables are regional totals for five indicators of research performance in 2025: scholarly publications, citations, citing articles, print-media mentions, and patents. Panel A uses a binary variable identifying metros with three or more research universities located within 5 km (complex membership). Panel B replaces this with the Herfindahl–Hirschman Index (HHI) of graduate enrollment, capturing concentration versus dispersion of research capacity. All models include controls for metropolitan population and per-capita income. Robust standard errors are shown in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{**}p < 0.01$. Source: Authors' calculations based on Elsevier (Scopus) and U.S. Census Bureau data.

Results in Panel A show that regions containing three or more universities in a complex tend to exhibit higher levels of scholarly output, citations, media visibility, and patents. These associations remain positive and statistically significant after accounting for population size and prosperity, suggesting that the presence of multiple research universities contributes independently to regional research performance.

Panel B replaces the complex indicator with a measure of graduate-enrollment concentration (the HHI). Here, the coefficients are uniformly negative and significant, implying that regions where graduate students are concentrated in fewer units (i.e., where there is more inequality among graduate programs) tend to generate fewer research outputs, fewer citations, and less media coverage. Together, the two panels indicate that more horizontally organized university systems are associated with stronger regional research performance, while concentration of resources in a small number of organizations is associated with weaker outcomes.

The reason that complexes overperform on patents may be because, contrary to theory, there is not a significant empirical trade-off between scale and selection across regions (see Table 6). In the U.S., schools in complexes actually have larger total enrollments, graduate enrollments, and staff employment than those without neighbors. Complexes with more than two schools have marginally more employment than those with only two, but the differences in graduate enrollment and staff size are not substantial. The global population does show more of a trade-off, but schools outside of complexes have only roughly 1 percent larger enrollments than those with four or more neighbors.

Therefore, it appears that complexes tend to offer more university choice at similar scales because they are found in larger regions. On average, regions with university complexes are significantly more populous than those with a single research university and can therefore afford to endow more universities at similar scales to those available in single-university regions. This pattern echoes models from New Economic Geography, where larger markets support greater product diversity without proportionately higher costs. Access, however, is a different matter: the concentration of research-university capacity relative to the local population is substantially higher in single-university regions.

The finding that average university size is not necessarily higher in vertical systems leads us to consider the issue of university size and economies of scale more explicitly. Even if super-universities are similar in size to those in complexes, do they gain more from being large? To explore this topic, we follow the natural size–output literature

Table 6: Average university size by region type.

	US research Universities				
Number of universities in metro. Area	**Average enrollment**	**Average graduate enrollment**	**Average total FTE staff**	**Average CBSA population**	**Universities per million**
1 University	14,390	3,433	3,156	347,586	2.88
2+ Universities	16,000	5,093	4,188	5,511,411	0.18
3+ Universities	15,354	5,352	4,213	7,102,992	0.14
4+ Universities	15,342	5,564	4,045	8,313,227	0.12
	Global QS 500 universities				
Number of universities in metro.	**Average enrollment**			**Average metro population**	**Universities per million**
1 University	28,326			3,778,102	0.26
2+ Universities	27,448			7,686,416	0.13
3+ Universities	27,838			11,057,249	0.09
4+ Universities	27,949			10,961,740	0.09

U.S. data include all institutions classified as “Research Universities” (R1 and R2) in the 2025 Integrated Postsecondary Education Data System (IPEDS). Global data include all universities ranked in the *QS World University Rankings 2024*. Enrollment and staff values are institutional averages aggregated by metropolitan area (Core-Based Statistical Area for the U.S.; analogous metro scale for global regions).
Source: Authors’ calculations based on (U.S. data): U.S. Department of Education *(IPEDS)* 2025; (Global data): QS 2024.

(Bettencourt et al. 2007; Broekel et al. 2023; Lobo et al. 2013) and calculate log-log relationships between university size and outcomes based on two measures – undergraduate enrollment and graduate enrollment – at U.S. universities. A size exponent of 1 indicates a linear or proportional relationship, while one above 1 indicates increasing efficiencies with size. Global data are excluded because graduate-enrollment data are not available for all schools.

In line with the sub-literature on university size effects, we find that outputs (revenues, patents, articles, citations, and mentions) increase more than proportionally with university size – that is, larger universities gain more output from scale (see Figure 1). Interestingly, the relationship

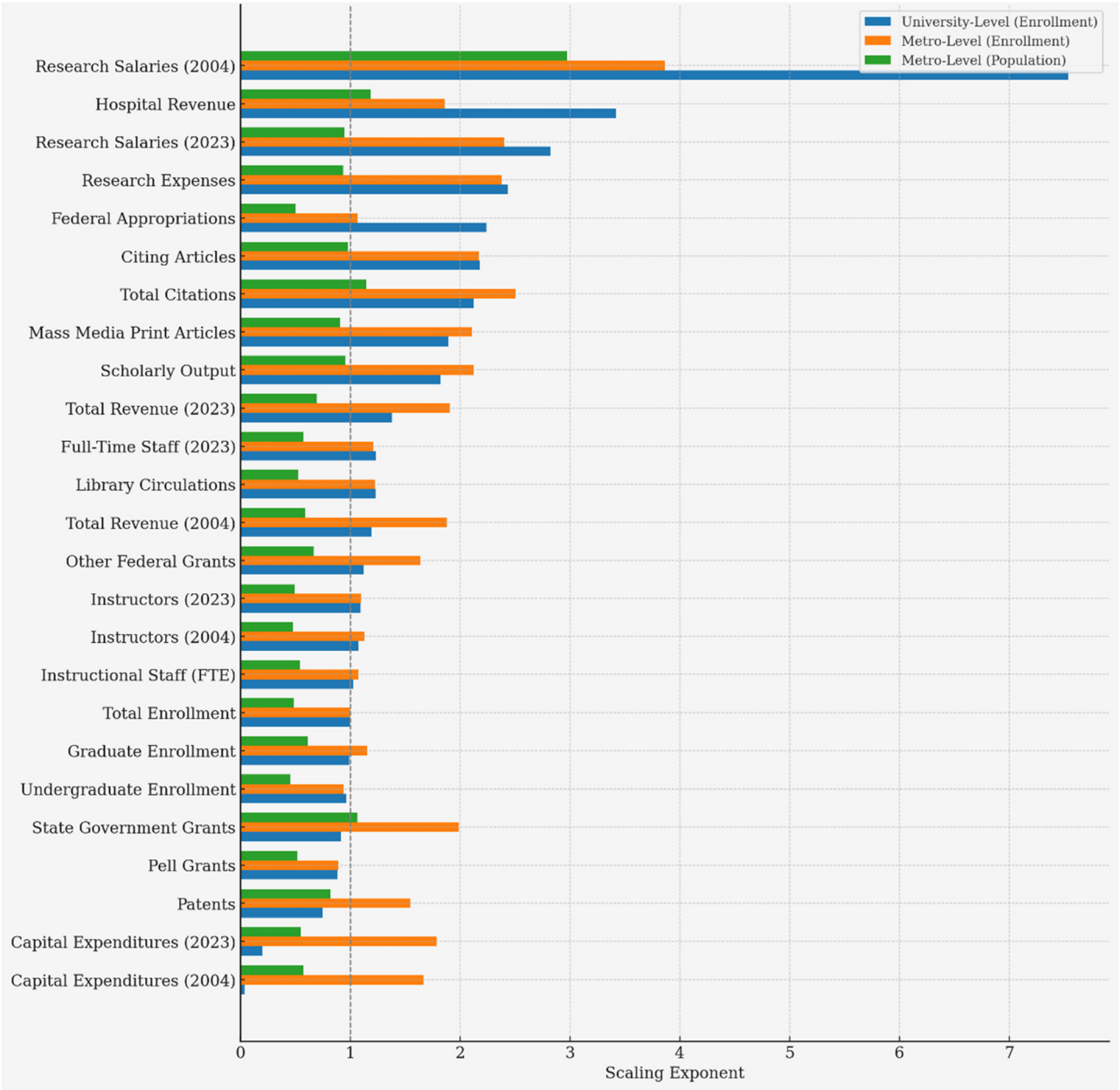

Figure 1: The relationship between university size and research and financial outputs across scale. Notes: each bar represents the scaling exponent – the slope of the relationship between a measure of university or metropolitan size and a corresponding research or financial outcome. Values above 1 indicate that the outcome increases more than proportionally with size (superlinear scaling), while values below 1 indicate less-than-proportional increases (sublinear scaling). Source: Authors' calculations based on U.S. Department of Education *(IPEDS)* 2025; and Elsevier (2024).

between size and outcomes for citations, mentions, patents, and total revenues is stronger when regional enrollment is used than when campus enrollment is used. We take this as additional evidence, consistent with the prior section, that the regional scale is an important organizing level for university activity.

Figure 2 decomposes the size–output effect among complexes and super-university regions. It shows that the degree to which economies of scale are higher in complexes depends on how size is operationalized. Using the more coarse but widely available total-enrollment variable, super-universities see greater economies of scale than complexes; but when graduate size is used, it is complexes that gain more from being larger. We prefer the latter measure because higher graduate enrollment indicates a higher relative focus on research activities.

On the cost side, the picture is more mixed. Research expenses increase more strongly than any output when total enrollment is used, suggesting diseconomies of size, especially outside of complexes. Capital expenditures also increase more than proportionally, though not as steeply as outputs. Instructional staff increase less than proportionally, indicating modest labor efficiencies. However, when measured against graduate enrollment, research expenses appear to grow even more steeply in complexes, exceeding the increase in any measured output. One possible explanation is that research-intensive metros compete for scarce and high-cost resources – such as superstar faculty, real estate, or advanced research infrastructure – which drive up costs disproportionately. That said, higher cost growth should not be interpreted on its own as inefficiency: outputs may more than justify their additional expense.

In sum, university complexes combine greater organizational diversity with comparable l scale, and they appear to realize stronger returns to size. Overall, the evidence suggests that multi-university complexes outperform so-called "super-universities," at least at the global level analyzed here.

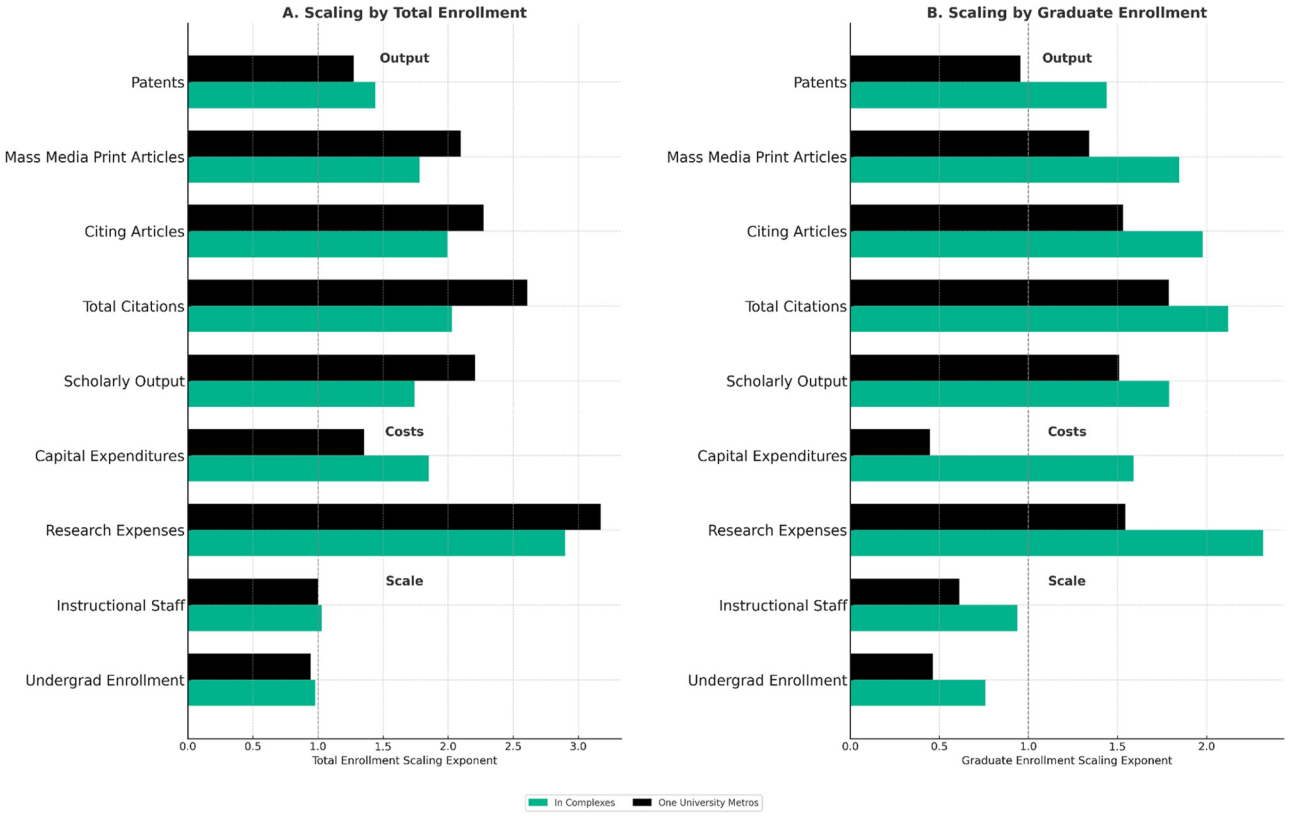

Figure 2: Returns to university size by regional university structure and enrollment measure. Notes: each bar shows the estimated size elasticity (slope) from regressions linking university outputs and inputs to institutional size. Panel A uses total enrollment as the measure of size; Panel B uses graduate enrollment. Values above 1 indicate that the outcome increases more than proportionally with size (increasing returns to scale), while values below 1 indicate less-than-proportional growth (diminishing returns to scale). Comparisons are made between metros with a single research university and metros containing multi-university complexes. Source: Authors' calculations based on U.S. Department of Education *(IPEDS)* 2025; and Elsevier (2024).

4 Complexes have distinctive spatial structures

The efficiency of university complexes, or lack thereof, reflects more than just the dynamics within or between universities themselves – it also relates to broader characteristics of the regions in which they are embedded. We close with a discussion of these contextual factors.

Figure 3 plots regional average statistics from the American Community Survey, Occupational Employment Statistics, (Adler and Florida 2025), and Barrero et al. (2023) for different categories of U.S. regions that have at least one research university, expressed relative to regions with only one. Values are also colored by the magnitude of each difference. The final two columns refer to U.S. regions included in the QS Top 500.

In addition to being larger, university complexes are typically situated in regions that are not only wealthier – a relationship established earlier in the analysis – but also more socioeconomically dynamic. Metropolitan areas with multi-university complexes, particularly those hosting three or more universities, exhibit clearly higher rates of population growth, income per capita, and employment in finance and professional services. They also display elevated levels of remote work and educational attainment, including a higher concentration of creative-class occupations.

These metropolitan areas are not just economically distinct – they are also more culturally and demographically diverse, with higher amenity scores and lower proportions of white residents, particularly in globally recognized QS-ranked complexes. At the same time, complex regions tend to have weaker ties to traditional industrial employment and lower homeownership rates, indicating a more mobile,

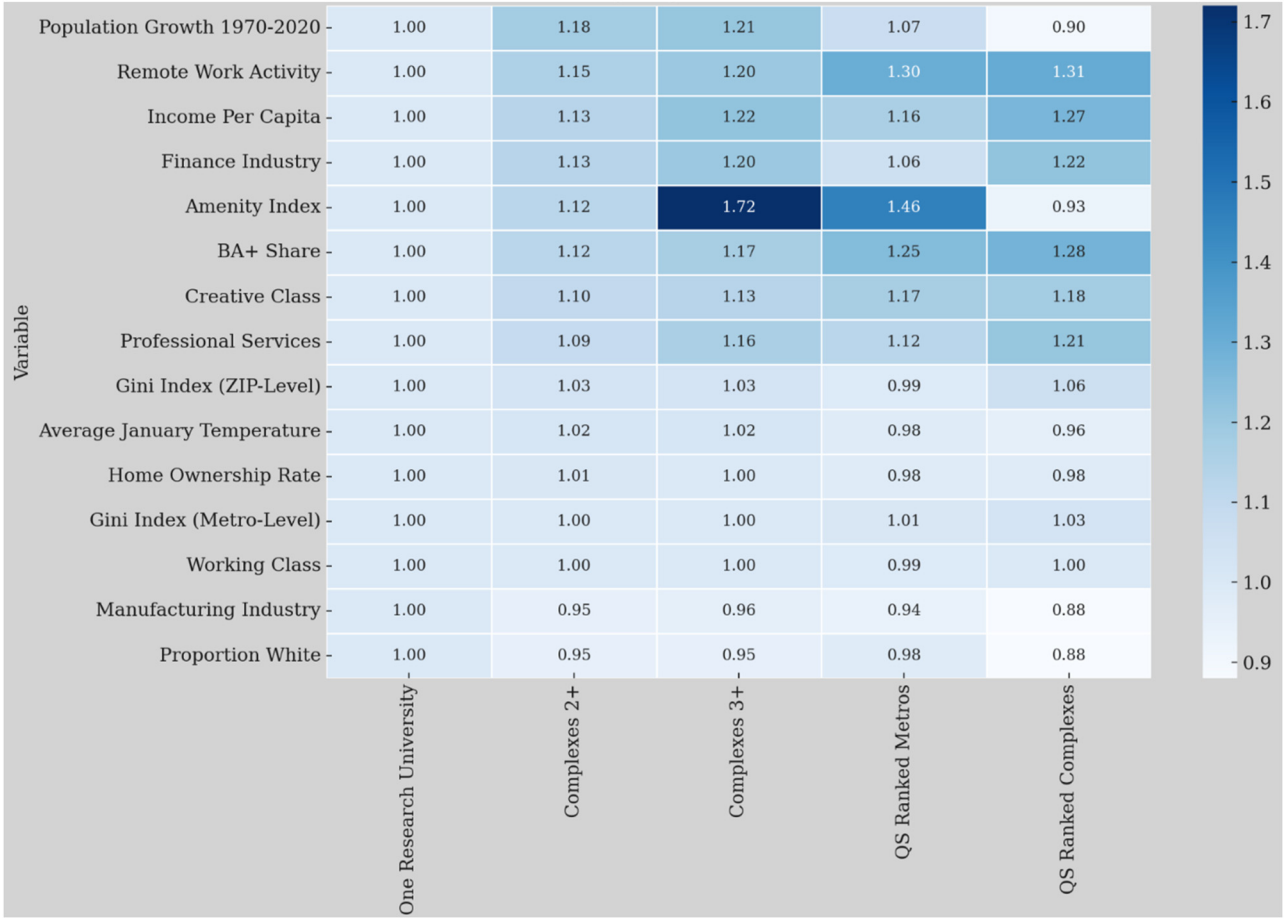

Figure 3: Regional socioeconomic indicators, expressed relative to single-university regions (2024). Notes: each cell shows the mean value of the indicated regional characteristic, normalized to the average for metros with one research university (set to 1.00). Values above 1.00 indicate that the characteristic is higher in that type of university system, while values below 1.00 indicate lower levels. The figure compares demographic, economic, and occupational attributes across metropolitan areas with different configurations of research universities, including single-university regions, multi-university complexes, and those with globally ranked institutions. Source: Authors' calculations based on US Census Bureau (2022).

post-industrial urban character. While our focus here is on the importance of complexes, we do not suggest that complexes are themselves responsible for these favorable regional conditions. Still, given the results of the previous section, it is conceivable that more dynamic, innovative regions are buoyed by their more horizontal regional university structures. Interestingly, measures of inequality – such as regional and neighborhood-level Gini coefficients – do not meaningfully distinguish complex from non-complex regions, even though research universities themselves are associated with greater income and occupational inequality (Florida and Gaetani 2020).

Altogether, these patterns suggest that the presence of a university complex is part of a broader metropolitan profile – one marked by scale, specialization, and openness – that may both support and be reinforced by a dense academic presence.

5 Conclusions

This analysis shows that the university complex is a recurring and significant feature of regional innovation systems rather than an exception to them. Understanding university complexes requires recognizing the region as a fundamental platform for organizing academic and research activity. Processes of localized learning, knowledge diffusion, and workforce development are inherently regional in nature. It is therefore misleading to assume that university activities stop at the campus gates, just as it would be to assume that patenting activity occurs solely within the firm.

Once university activities are viewed at the regional level, their organizational configuration emerges as a key variable. We identified two ideal types of regional university systems: a vertical system, dominated by a single super-university, and a horizontal system, where several institutions of comparable scale share activities. Across both U.S. and global contexts, multi-university complexes appear as the prevailing pattern, even though internal hierarchies persist. Several leading innovation regions – such as Boston, London, and Seoul – illustrate more balanced, horizontally organized systems.

Regression analyses indicate that more horizontally organized regional university systems are consistently associated with stronger research performance. After accounting for differences in population size and per-capita income, regions with three or more research universities tend to produce higher levels of scholarly output, citations, patents, and media visibility than those dominated by a single university. Conversely, regions where graduate students are concentrated in fewer universities – indicating a more unequal or vertical structure – show significantly weaker outcomes. These results suggest a robust statistical relationship between organizational diversity and regional research performance, though they stop short of establishing causality.

University complexes are typically situated in regions that are not only wealthier but also more socioeconomically dynamic. Metropolitan areas with multi-university complexes, particularly those hosting three or more universities, exhibit higher rates of population growth, income per capita, and employment in finance and professional services. They also display elevated levels of remote work and educational attainment, including a higher concentration of creative-class occupations. Such patterns imply that university complexes co-evolve with broader metropolitan processes of scale, specialization, and openness, rather than driving them outright.

Our concept of the university complex resonates with Meric Gertler's long-standing view of the city-region as a living knowledge ecosystem – an interdependent network in which universities serve as anchors for innovation and development. Like Gertler's work, it highlights how universities translate local learning into influence on regional and global development (Bramwell and Wolfe 2008; Gertler and Wolfe 2004; Gertler 2010). In this way, our argument continues his project of making visible the often-hidden social structures that sustain regional prosperity. This perspective also parallels Gertler's leadership as President of the University of Toronto, where he advocated inter-university collaboration across the city's universities for the purposes of regional development.

Future research could examine regional university systems in greater depth, moving beyond the correlational patterns identified here. Promising directions include tracing the movements of individuals between regions to assess how complexes shape local learning and labor-market outcomes, and investigating historically the conditions under which different organizational forms of higher education emerge. Such work would help clarify whether and how regional or national policies influence the vertical or horizontal organization of higher-education systems. The geography of existing complexes suggests that such configurations primarily develop in large metropolitan contexts (Florida et al. 2017).

These findings also resonate with ongoing policy initiatives aimed at strengthening inter-university coordination. In the United Kingdom, efforts such as the White Rose Consortium, GW4 Alliance, and Midlands Innovation link geographically proximate universities through formal collaboration frameworks. The Paris-Saclay Innovation

Cluster integrates universities, research agencies, and private laboratories within a contiguous research district (Cenik and Miteva 2022). In China, the "University Town" developments – large-scale districts consolidating multiple universities on metropolitan fringes – represent another form of regional integration (Li et al. 2014; Ruoppila and Zhao 2017). Understanding how such institutional geographies evolve provides a foundation for assessing the effectiveness and equity of regional higher-educations.

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