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From What Types of Universities do New Scientific and Scholarly Disciplines Emerge?

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Abstract

Advances in science are often associated with pre-eminent research universities. Policy makers and those who collaborate with university researchers may assume that this advantage generalizes to all types of research. This analysis explores whether this generalization applies to research in emerging disciplines. We do so by examining the production of research/scholarship doctorates (primarily PhDs) in new disciplines compared to more traditional disciplines, as determined by inclusion in the US National Center for Education Statistics (ED) Classification of Instructional Programs (CIP) taxonomy and the US-based Carnegie Classifications to distinguish among types of institutions. Results suggest that the more traditional research-intensive institutions dominate production in more traditional disciplines, but other types of institutions play a larger role in producing emerging discipline scholars.

Keywords: research universities; emerging disciplines; classification of instructional programs

1. Introduction

1.1 Problem and Context

Many policymakers, and the public in general, believe that cutting-edge academic and scientific research occurs mostly in the top research universities. Scholars often define those leading universities as the core of the academic research enterprise, for they are responsible for most of the funded research and produce the most research doctorates (Dill & Van Vught, 2010). After World War II, with a massive infusion of federal support, the top research universities of the United States emerged as a distinctive set of institutions that expanded the boundaries of disciplines and technologies, such as nuclear physics, electronics, computing, and medicine (Geiger 2004, 2019).

Because of the prestige and resources associated with being a "world-class research university," several higher education institutions (hereinafter, HEIs) have set as an objective entering the league of such institutions. Outside the United States, governments have developed significant programs to improve university prestige and increase position in global rankings (Russia-Project 5-100; China-Projects 211, 985; and the "Double First-Class University Plan;" Germany-"Excellence Initiative"). The evolution of the US-based Carnegie Classification of Institutions of Higher Education, summarized in Table 1, demonstrates the expansion of the research university categories of the Carnegie Classification, within the context of all US degree-granting HEIs. The 146 institutions classified as "Research 1" (R1) in the 2021 update of the Classification account for less than 4% of institutions, but for over one-quarter of total enrollments, two-thirds of doctorates, and three-quarters of research expenditures as monitored through the National Science Foundation's Higher Education Research and Development (HERD) survey.

US research universities receive substantial federal support for research, with more recent expansion in funding from collaborators and sponsors in the private, non-profit and for-profit sectors. There has been a trend in both federal and foundation funding for sponsors to focus on research that most directly addresses critical economic, health, and applied scientific needs (Boroush & Guci, 2022; Adams 2013). Within a large competitive and market-driven environment like the United States, traditional research universities vie competitively for funding,

as evident in the R1 group accounting for three-quarters of all research & development (R&D) funding at US higher education institutions. This is also evident in differences in distribution of research funding among the R1 and R2 institutions, shown in Figure 1.

Despite the magnitude of differences in these research indicators for the two tiers of US research universities, there have been sufficient resources to enable HEIs outside of the R1 category to find productive niches, especially in applied and emerging areas. The size, diversity, and relatively low state regulation of the US system enables HEIs to pursue areas of specialization especially within areas of innovation and development for which there are interested funders. This enables HEIs to exploit different niches effectively (Datta, Saad and Sarpong, 2019). With escalating expenses associated with both staffing and equipment, and decreasing availability of public funds, universities must be more entrepreneurial to mine existing and find new sources of support for research and scholarship (Sam and Sijde, 2014).

Similarly, in many European countries, Universities of Applied Sciences have productively engaged in research with regional partners and governments, developing in many cases, "third-stream" income from translating applied research into products and services (Gaisch & Nömeyer, 2020).

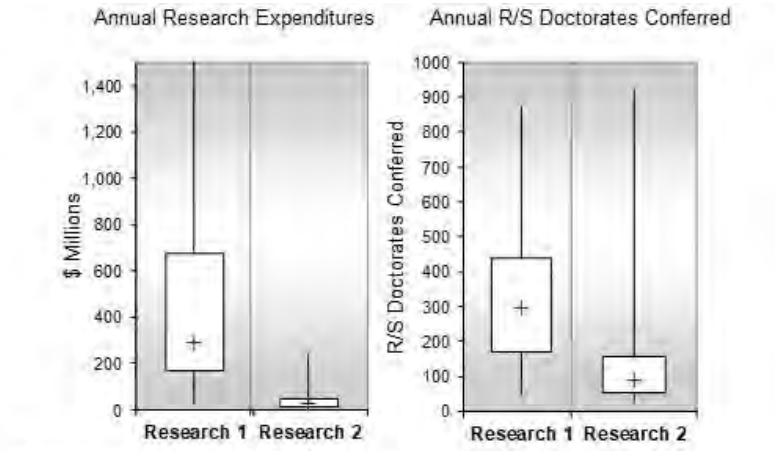
Table 1. US Research Universities as Designated by the Carnegie Classification of Institutions of Higher Education, 1973 through 2021

	Research 1					Research 2					All Other				
Year	N.I	%I	%E	%DC	%RD	N.I	%I	%E	%DC	%RD	N.I	%I	%E	%DC	%RD
1973	52	1.8	14.0			40	1.4	7.7			2,733	96.7	78.3		
1976	51	1.7	11.8			47	1.5	8.1			2,973	96.8	80.1		
1987	70	2.1	15.4			34	1.0	6.0			3,283	96.9	78.6		
1994	88	2.4	12.4	65.4		37	1.0	4.1	11.0		3,469	96.5	83.5	23.6	
2000[1]	151	3.8	24.9	79.9		110	2.8	8.2	11.3		3,679	93.4	67.0	9.9	
2005	96	2.2	15.9	60.0	64.3	103	2.4	10.6	18.0	12.0	4,163	95.4	73.5	22.0	23.7
2010	110	2.7	16.8	63.1	68.8	90	2.2	8.4	14.9	9.1	3,949	95.2	74.8	22.0	22.2
2015	115	2.5	19.4	65.2	74.0	107	2.3	9.3	15.0	10.8	4,443	95.2	71.3	19.8	15.2
2018	131	3.0	22.7	66.0	77.7	135	3.1	10.9	14.5	8.1	4,057	93.8	66.4	19.6	14.2
2021	146	3.7	25.9	66.7	79.1	133	3.4	11.4	12.4	6.1	3,660	92.9	62.7	20.9	14.8

*In 2000, doctorate granting institutions were divided into only 2 categories—research extensive and research intensive. Prior to 2000, four total categories were used with the two, non-research categories labeled, Doctoral I and Doctoral II. From 2005 onward, three categories were included, with a third-tier research category from 2005 through 2015, and then a professional/doctoral category introduced in 2018. For further details, consult, https://carnegieclassifications.acenet.edu/

N.I = Number of institutions; %I = Percent of total degree-granting institutions; %E = Percent of total enrollment in degree-granting institutions; %DC = Percent of total research/scholarship doctorates conferred; %RD = Percent of total institutional research and development expenditures

Sources: Carnegie Classification of Institutions of Higher Education; NCES IPEDS Completions; and National Science Foundation (NSF) Higher Education Research and Development (HERD) Survey.



	Research 1 $	Research 2 $	Research 1 R/S	Research 2 R/S
Maximum	$3,110M	$245M	876	555
75 %ile	$678M	$49M	439	95
Median	$293M	$25M	298	54
25 %ile	$166M	$14M	171	33
Minimum	$28M	$4M	50	16

Figure 1. Distribution of annual research expenditures and research/scholarship doctorates conferred among Carnegie Research 1 and Research 2 universities, 2019-20

In addition to strategically developing research niches for institutional development purposes, the transformation of scientific knowledge into useful products and services requires researchers and their institutions to span traditional disciplinary boundaries to solve practical problems (Gibbons et al., 1994). Local community needs can spur institutions, regardless of their general research profile, to create research and development collaborations tailored to local circumstances, more accessible over time, and contributing further to the region's profile (Fitjar & Gjelsvik, 2018). Moreover, public higher education policy often limits the development of traditional research programs to the flagship and other historically active institutions that have well-developed capacities, allowing "second tier" or generally younger aspiring research universities to develop programs in emerging and interdisciplinary areas, to limit duplication of expensive programs and better serve local needs. (Kerekes & Nemeslaki, 2009). But given the very skewed distribution of research funding and research doctorate production displayed in Figure 1, it is not certain that the lower tier HEIs have the infrastructure or depth of experience to compete with the top tier HEIs for research funding.

1.2 Theoretical Considerations

The promulgation of degree programs across higher education institutions can be viewed through the lens of neo-institutional theory. This theory, as originally cast by Meyer and Rowan (1977) and extended by DiMaggio and Powell (1983), describes the sociological forces that influence the growth and development of complex organizations within their local and sectoral environments. Earlier institutional theory, derived from Max Weber's seminal work on bureaucracy and capitalism, described how deterministic environmental forces, such as government regulations, accreditors and consumer markets, work as homogenizing forces, that create pressures toward homogenization of all institutions of a type (for example HEIs). Meyer & Rowan (1977) and DiMaggio and Power (1983) subsequently described how these forces work in varying directions simultaneously and, as a result, HEIs have choices as to how to respond to these pressures.

More specifically, DiMaggio and Power describe three types of isomorphic forces. Coercive isomorphism refers to both cultural expectations and regulatory frameworks that assure that institutions work within bounds that are morally, legally, and ethically appropriate. Normative isomorphism refers to the professional and academic standards that are promulgated through the academy and the myriad communities of scholars and professional groups that set standards relevant to the sector. Finally, mimetic isomorphism refers to competitive pressures related to an institution's standing among its peers. HEIs often look to their peers to determine what they need to do to keep up with, as well as to distinguish themselves from the others.

The combination of these isomorphic pressures provides HEI leaders with leeway regarding their development choices. They may copy a popular new program that their main competitor initiated believing there is a sizeable enough market or that they have competitive advantage. They may opt to develop programs in emerging

disciplines if they believe their competitor has an advantage regarding traditional programs. Moreover, the level of choice that an institution has is posited to be related to its level of influence and power within its environment. However, the level of influence also serves as a barrier to innovation, since the institution that defines a niche is tradition-bound to many of its customs and practices.

Within the context of the current study, we expect that the most influential institutions—those in the R1 category—will have cause to maintain their traditional advantage through the support of traditional academic programs. Because of this influence and their comprehensiveness, we expect them to also engage with new disciplines, but we do not expect large growth relative to other sectors. To the extent that institutions in the R2 sector aspire to be like their R1 counterparts, we may expect to see similar proportions of both traditional and emerging discipline activity. However, to the extent that regulatory or market factors limit their development of traditional programs, we expect to see slightly larger proportions of degrees in new disciplines.

We posit that the diverse doctorate-granting institutions in the R3 and Special Focus domains are less bound to emulate the R1 and R2 institutions and more likely to seek distinction and avoid competition by focusing on programs in new disciplinary domains. In addition to strategic reasons described by neo-institutional theory, the interdisciplinary and applied focus of many new disciplinary areas are suitable for these institutions that often seek to connect their work to issues most pertinent to their region. We also expect differences by control, with public institutions more subject to governmental regulations and private institutions, especially those outside of the R1 sector, having to focus more on competitive market forces

2. Data and Methods

2.1 Sample and Data Source

The sample for our analysis consists of US-based research/doctorate programs that awarded at least one research/scholarship doctorate during academic years 2013-14 (AY14) through 2019-20 (AY20). We use research/scholarship (herein, RS) doctorates as a generalized measure of research activity. Across US research universities, the number of RS doctorates was correlated +0.80 with total research expenditures for institutions in the 2021 Update of the Carnegie Classifications.

All degree-granting accredited colleges and universities in the United States report their degree conferrals to the US Department of Education's National Center for Education Statistics (NCES). Institutions use a federally maintained taxonomy, known as the Classification of Instructional Programs (CIP), to report degrees into a common set of categories. For example, the broad category of Psychology (42.xxxx), identified by the first two digits, is divided into four subcategories (General; Research and Experimental; Clinical Counseling, and Applied; and Other), identified by the second two digits. A third level of disaggregation (final two digits) provides the finest level of detail in this taxonomy with, for example, the Research and Experimental area of Psychology is subdivided into 11 disciplines, including Cognitive Psychology and Psycholinguistics; Comparative Psychology; Developmental and Child Psychology; Experimental Psychology; Personality Psychology, Social Psychology; and five other such specific program areas. We count as a "program" the categories at the most detailed, 6-digit level.

Every 10 years, the CIP taxonomy is revised to accommodate changes in disciplinary and program structure among reporting institutions. To determine these changes, NCES staff use four sources of information (NCES, 2020). First, they scan institutional web sites to collect information of actual program names. Second, they look at the specific names provided in their surveys for programs that fall into "Other" categories within general disciplinary areas. Third, they survey institutional contacts who provide responses to the surveys for their institutions, typically staff in the student records or institutional research offices. The final two steps of their decennial review process include review by national panels of experts, called "Technical Review Panels," and posting in the Federal Register for review of their proposed changes. For the purposes of this analysis, we consider the new degree areas added to the 2010 revision to be the "emerging" areas of research and scholarship.

In addition to indicating the degree field using the CIP taxonomy, institutions also categorize their degrees by level. The first three levels, associates (2-year), baccalaureate and masters, are single categories, regardless of differences within level, for example, between a Master of Arts, Master of Science, or Master of Business Administration degree. However, for doctorates, institutions report degrees into one of three categories as determined by the institutions. These categories of doctorates, and the total number awarded in those categories over the four-year time span of this study are shown in Table 2. This analysis focuses on the degrees reported as "research/scholarship" doctorates, which includes all PhD degrees plus other doctorates that similarly require a capstone dissertation (for example, many, but not all EdD degrees are reported in the research/scholarship category).

The Carnegie Classification of Institutions of Higher Education has been a popular typology for characterizing the diverse landscape of postsecondary institutions in the United States. Since its original publication in 1973, the classification has been revised nine times to accommodate changes in the landscape. Although several additional classification systems were added to the Carnegie set in 2005, most people are familiar with the "basic" classification that distinguishes first between comprehensive institutions and special focus institutions that offer programs in one or a very limited set of areas (e.g., a free-standing School of Law or Health Center). The comprehensive institutions are then divided by highest degree level (associates, baccalaureate, masters, doctorate), with thresholds for entering a higher degree level category (e.g., 50 master's degrees conferred in the target year to enter the master's categories, and 20 research/scholarship doctorates conferred to be considered a "research" university). The degree level categories are further subdivided by differing characteristics: the associates category is further distinguished by the program focus (transfer v. career/technical) and student profile (traditional/nontraditional). Baccalaureate institutions are subdivided by program focus (arts & sciences, diverse fields) and master's institutions by size. Most pertinent to this analysis, doctoral universities are divided by their level of research activity.

Through the remainder of this analysis, we use a slight expansion of the categories used in Table 1, pulling out from the 'other than R1 and R2' institutions, other institutions with doctoral-level education as part of their mission. This includes the third research level category that had been in place for the 2005 through 2021 updates (referred to here as "R3"), as well as special focus (SF) institutions. R3 institutions include many with relatively low profiles of both research expenditures and doctorates conferred, as well as a few very large, for-profit universities that confer large numbers of doctorates but do not support funded research activity. SF institutions include several research-intensive medical schools and health centers. The other large group among special focus institutions are the "faith-related" institutions, including, theological seminaries, bible colleges, and others that primarily confer degrees in theology and religious studies.

Financial control—public; private-non-profit (non-profit), and private-for-profit (for-profit)—is another important distinction among US HEIs. Figure 1 shows the distribution of doctorate granting institutions (all types of doctorates) by Carnegie type and control distinctions. Notably, the R1 and R2 categories are similarly distributed between public (about 70%) and non-profit (about 30%) control. However, the more numerous, but generally smaller in size institutions in the R3/SF and other (masters and bachelors) categories, most of which confer small numbers of doctorates, are majority non-profit (about two-thirds). Additionally, for-profit institutions that conferred doctorates in the timeframe are primarily in the latter two categories (R3/SF and Others).

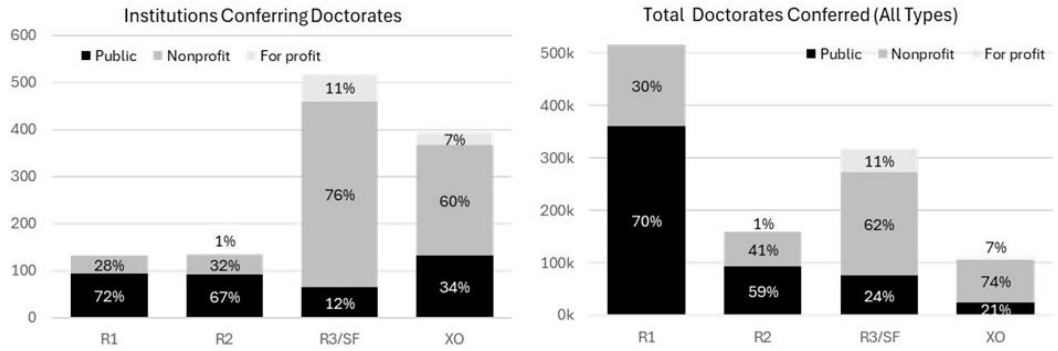


Figure 2. Institutions that conferred doctorates and number conferred, academic years 2013-14 through 2019-20, by Carnegie Classification type and control

R1 institutions represent just over 10% of the total of institutions that confer at least one doctorate (of any type) but, as shown in Table 2, account for nearly two-thirds (63.8%) of research/scholarship doctorates conferred across the seven years, with the relatively large and heterogenous R3/SF (40.7% of the institutions) accounting for just over one in six (17.6%) of the research/scholarship doctorates. The smaller R2 group (about 10% of institutions), accounts for just over 15% of research/scholarship doctorates. The R1 and R2 institutions combined account for nearly 80% of the research/scholarship doctorates conferred over these four years. In contrast, they account for one-half (53.8%) of professional practice doctorates. These degrees are concentrated in medicine and health fields (e.g., MD, DDS, OD, DVM, DPT, OTD, etc.), but also include doctorates in Law (JD), and divinity (DDiv). Finally, "Other" doctorates account for just 1.1 percent of all doctorates conferred during this time.

"Other" doctorates includes an inconsistent mixture of such degrees as doctorates in Education (EdD), Business (DBA), Public Administration (DPA), Music (DM), and other such professional area doctorates.

For the remainder of this analysis, we focus on a slightly smaller population of institutions. Whereas Table 2 includes the 1,205 institutions that conferred any type of doctorate across the eight-year timeframe, the analysis from this point onward focuses on 762 of these institutions that conferred at least one research/scholarship doctorate during the time frame. This includes the same 115 (15.1%) R1 and 107 (14.0%) R2 institutions shown in Table 2 but reduces the two other group sizes to 275 (36.1%) R3/SF, and 265 (34.8%) other institutions.

Table 2. Doctorates conferred by US Institutions of Higher Education by Carnegie Classification Type, Academic Years 2013-14 through 2019-2020

Type	Definition	Total	R1	R2	R3/SF	Other
		1,176 (100%)	131 (11.1%)	135 (11.5%)	517 (44.0%)	393 (33.4%)
Research/ Scholarship	A Ph.D. or other doctor's degree that requires advanced work beyond the master's level, including the preparation and defense of a dissertation based on original research, or the planning and execution of an original project demonstrating substantial artistic or scholarly achievement. Some examples of this type of degree may include Ed.D., D.M.A., D.B.A., D.Sc., D.A., or D.M, and others, as designated by the awarding institution.	426,909 100%	272,477 63.8%	64,341 15.1%	74,396 17.4%	15,695 3.7%
Professional Practice	A doctor's degree that is conferred upon completion of a program providing the knowledge and skills for the recognition, credential, or license required for professional practice. The degree is awarded after a period of study such that the total time to the degree, including both pre-professional and professional preparation, equals at least six full-time equivalent academic years. Some of these degrees were formerly classified as first professional and may include [list of formerly designated programs], and others, as designated by the awarding institution.	660,590 100%	241,676 36.6%	93,732 14.2%	234,805 35.5%	90,377 13.7%
Other	A doctor's degree that does not meet the definition of a doctor's degree - research/scholarship or a doctor's degree - professional practice.	12,949	1,401	352	7,563	3,633

2.2 Limitations

There are several measurement limitations to this study. First, using research/scholarship (RS) doctorates as a proxy for research production has its limitations. Although, as previously noted, there is a strong correlation between RS doctorates and research expenditures (+0.82), the relationship may not be consistent across Carnegie type of institution. Specifically, that correlation is based only on the R1 and R2 categories of institutions, and the other types of institutions that contribute just over 20% of RS doctorates may not exhibit that same pattern. Another limitation is related to how different institutions categorize their doctorates by type (research/scholarship, professional practice, and other). Again, R1 and R2 universities are less likely to use the "other" category and more likely to lean toward research/ scholarship over professional for such degrees as the EdD, DBA, and DMUS, for example.

Another similar limitation may be the most important for this study. Using degrees reported under CIP Codes added in 2010 as proxy for "emerging disciplines" is likely a very conservative indicator. Institutions vary in their diligence in how they report programs using CIP Codes, with many opting to use more general categories than highly specific ones. Differences in naming conventions may lead institutions to use more general or miscellaneous categories (e.g., xx.xx99), if the label of the specific discipline does not match their program name precisely. For example, an institution that offers a PhD in Intercultural Studies may continue to report that degree in the category, 30.2301 Intercultural/Multicultural and Diversity Studies, rather than using the new CIP category, 09.0907 International and Intercultural Communication. Some institutions may be more likely to review and update their reporting when the codes change, especially those in the public sector, the majority of which are more strictly regulated by their state agencies with regard to assigning and reviewing CIP Codes, since most states use the CIP code taxonomy within their own higher education data systems.

3. Results

Tables 3 through 6 and Figures 3 and 4 summarize the results of this analysis. Across the 2014 to 2020 academic years, US higher education institutions conferred just under 510,000 research/scholarship doctorates. Fewer than 5% of these doctorates (4.2% precisely) were conferred within disciplines that were added to the CIP taxonomy

in the 2010 update. Table 3 compares the distribution of research/scholarship doctorates in "new" vs. "traditional" (existing prior to 2010) disciplinary areas, across the different types of institutions that have conferred at least one RS doctorate.

Table 3 and Figure 3 depict the number and proportional share of RS doctorates conferred in new and traditional disciplines by Carnegie type of institution. Overall, R1 universities account for nearly two-thirds (65.7%) of all RS doctorates, but just over two-fifths (42.8%) of the RS doctorates conferred in new disciplines. It is interesting to note that the R2 institutions also conferred proportionately fewer RS doctorates in new fields, although they have a slightly higher proportion of their total RS doctorates conferred in new disciplines (4.3%) compared to R1 institutions (2.7%). The larger (in terms of number of institutions) R3/SF group accounts for a slightly larger proportion of total RS doctorates (17.7%) than the R2 group (13.8%). Most notably the R3/SF group accounts for nearly twice the proportion of degrees in the 2010 added disciplinary areas (38.5%) than in disciplinary areas existing before 2010 (16.8%).

Figure 3. RS doctorates conferred in new and traditional disciplines by Carnegie type

Table 3. Research/Scholarship Doctorates Conferred in New vs. Traditional Disciplines by Carnegie Type, 2013-14 through 2019-20 combined - All Institutions

	Institutions		Number of R/S Doctorates			Row Percentages		Column Percentages		
Type of Inst.	N	%	New	Trad.	Total	New	Trad.	New	Trad.	Total
R1	119	15.0%	7,063	265,414	272,477	2.6%	97.4%	41.4%	64.8%	63.8%
R2	108	13.6%	2,187	62,154	64,341	3.4%	96.6%	12.8%	15.2%	15.1%
R3/SF	284	35.9%	6,827	67,569	74,396	9.2%	90.8%	40.0%	16.5%	17.4%
Others	281	35.5%	1,004	14,691	15,695	6.4%	93.6%	5.9%	3.6%	3.7%
Grand Total	792	100.0%	17,081	409,828	426,909	4.0%	96.0%	100.0%	100.0%	100.0%

Tables 4 through 6 provide the same information as Table 3 for the subgroups of public, non-profit, and for-profit institutions. Figure 4 illustrates the pattern of results, showing that R1 Universities confer the largest numbers of RS doctorates, in both traditional and new disciplines followed by the heterogeneous R3/SF institutions. The role of "other than R1" universities is much more notable among the RS doctorates conferred in new compared to traditional universities. Moreover, whereas the R1 and R2 institutions are predominantly public institutions (162 of 227 or 71%), non-profit and for-profit institutions account for an even larger proportion (126 of 170 or 74%) of the R3/SF institutions conferring RS doctorates in new disciplinary areas.

Table 4. Research/Scholarship Doctorates Conferred in New vs. Traditional Disciplines by Carnegie Type, 2013-14 through 2019-20 combined - Public Institutions

Carnegie Type	Institutions		Number of R/S Doctorates			Row Percentages		Column Percentages		
	N	%	New	Trad.	Total	New	Trad.	New	Trad.	Total
R1	81	26.0%	5,007	193,519	198,526	2.5%	97.5%	63.1%	76.0%	75.6%
R2	81	26.0%	1,413	41,273	42,686	3.3%	96.7%	17.8%	16.2%	16.3%
R3/SF	58	18.6%	1,315	15,275	16,590	7.9%	92.1%	16.6%	6.0%	6.3%
XO	91	29.3%	204	4,606	4,810	4.2%	95.8%	2.6%	1.8%	1.8%
Grand Total	311	100.0%	7,939	254,673	262,612	3.0%	97.0%	100.0%	100.0%	100.0%

Table 5. Research/Scholarship Doctorates Conferred in New vs. Traditional Disciplines by Carnegie Type, 2013-14 through 2019-20 combined - Private, Nonprofit Institutions

Carnegie Type	Institutions		Number of R/S Doctorates			Row Percentages		Column Percentages		
	N	%	New	Trad.	Total	New	Trad.	New	Trad.	Total
R1	38	8.8%	2,056	71,895	73,951	2.8%	97.2%	34.9%	55.5%	54.6%
R2	27	6.3%	774	20,841	21,615	3.6%	96.4%	13.2%	16.1%	15.9%
R3/SF	192	44.4%	2,314	28,063	30,377	7.6%	92.4%	39.3%	21.6%	22.4%
XO	175	40.5%	740	8,849	9,589	7.7%	92.3%	12.6%	6.8%	7.1%
Grand Total	432	100.0%	5,884	129,648	135,532	4.3%	95.7%	100.0%	100.0%	100.0%

Table 6. Research/Scholarship Doctorates Conferred in New vs. Traditional Disciplines by Carnegie Type, 2013-14 through 2019-20 combined - Private, For-Profit Institutions

Carnegie Type	Institutions		Number of R/S Doctorates			Row Percentages		Column Percentages		
	N	%	New	Trad.	Total	New	Trad.	New	Trad.	Total
R1										
R2				40	40	0.0%	100.0%		0.2%	0.1%
R3/SF	34	69.4%	3,198	24,231	27,429	11.7%	88.3%	98.2%	95.0%	95.4%
Others	15	30.6%	60	1,236	1,296	4.6%	95.4%	1.8%	4.8%	4.5%
Grand Total	49	100.0%	3,258	25,507	28,765	11.3%	88.7%	100.0%	100.0%	100.0%

Tables 7 and 8 list the institutions that conferred the largest total numbers (Table 7) and largest percentages (Table 8) of RS doctorates in new disciplines. Table 7 is led by five for-profit R3/SF institutions and only two traditional R1 institutions make the list, despite their size. In contrast, Table 8, which includes those with the highest percentage of RS doctorates in new disciplines, has a mix of institutions by control (8 non-profit, 4 for-profit, 5 public), but is dominated by 11 R3/SF institutions with just 6 R2 institutions and not a single R1 institution of any control.

Table 7. Institutions Conferring at least 300 RS doctorates in New Disciplinary areas, Academic Years 2013-14 through 2019-20

		Carnegie Class.	Total RS Doctorates	RS Docs in New Disciplines	
Institution	Control			N	%
Walden University	For profit	R3	7,719	795	10%
University of Phoenix-Arizona	For profit	R3	2,184	652	30%
Capella University	For profit	R3	6,654	529	8%
American Sentinel University	For profit	SF:Med	463	463	100%
Grand Canyon University	For profit	R3	1,315	437	33%
Duke University	Non-profit	R1	3,484	381	11%
Arizona State University-Downtown	Public	R2	588	344	59%
The University of Texas at Austin	Public	R1	5,242	343	7%

Table 8. Institutions Conferring the largest proportions of RS doctorates in New Disciplinary areas, Academic Years 2013-14 through 2019-20

		Carnegie Classification	Total RS Doctorates	New Disciplines	
Institution	Control			N	Pct.
Antioch University-Leadership and Change	Non-profit	SF:Other	101	101	100%
Our Lady of the Lake University	Non-profit	R2	156	156	100%
Saint John Fisher College	Non-profit	R2	272	272	100%
American Sentinel University	For profit	SF:Health	463	463	100%
Arizona State University-Skysong	Public	R2	310	279	90%
Bakke Graduate University	Non-profit	SF:Faith	120	105	88%
Texas Tech University Health Sciences Center	Public	SF:Health	312	204	65%
William Carey University	Non-profit	R3	218	128	59%
Arizona State University-Downtown Phoenix	Public	R2	588	344	59%
University of Massachusetts-Dartmouth	Non-profit	R2	169	95	56%
Rocky Mountain University of Health Professions	For profit	SF:Health	164	85	52%
Villanova University	Non-profit	R2	140	56	40%
The Univ of Texas Health Sci Ctr San Antonio	Public	SF:Health	312	104	33%
Grand Canyon University	For profit	R3	1,315	437	33%
University of the Cumberlands	Non-profit	R3	482	148	31%
University of Phoenix-Arizona	For profit	R3	2,184	652	30%
University of Maryland, Baltimore	Public	SF:Health	460	122	27%

*Includes institutions that conferred at least 100 total RS doctorates over the seven-year time frame

4. Discussion

4.1 Findings

The cumulative advantages enjoyed by top-tier higher education institutions (HEIs) often prompt other doctoral universities to seek growth opportunities in emerging disciplinary fields. This analysis highlights that the large, traditional research universities in the United States—those classified as R1 under the Carnegie Classification system, representing just 10% of institutions—account for a significant majority (66%) of research/scholarship (RS) doctorates conferred between 2013-14 and 2019-20. However, other institution types, particularly the heterogeneous R3 and Special Focus (SF) institutions, play a pivotal role in awarding RS doctorates in newly established disciplines—those introduced through the 2010 Classification of Instructional Programs (CIP) taxonomy.

The findings reinforce the dominance of R1 institutions in traditional RS doctorate production while illustrating the crucial contributions of R3 and SF institutions to the development of emerging fields. Neo-institutional theory supports these observations: R1 institutions confer the highest proportion of RS doctorates in traditional disciplines compared to other groups but award the lowest proportion in new disciplines. Nevertheless, due to their vast research output, R1 institutions still account for 40% of the doctorates in emerging disciplines conferred between AY14 and AY20. R2 institutions exhibit a similar profile to R1 institutions, though with a slightly higher share of degrees awarded in emerging disciplines. In contrast, R3 and SF institutions demonstrate the largest proportional focus on new disciplines, with 16.5% of their doctoral degrees in these areas, though this remains a minority.

Private, for-profit institutions are particularly inclined to capitalize on opportunities in emerging disciplines. However, our findings indicate little difference between public and non-profit institutions across the R1, R2, and R3/SF categories. While for-profit institutions represent a small proportion of all institutions, they show the most significant engagement with emerging fields, as evidenced by comparisons across Tables 4, 5, and 6 and the details in Tables 7 and 8.

Doctoral education, frontier research, and the cultivation of scholars in new disciplines remain concentrated within research universities, particularly the most research-intensive R1 institutions. However, other types of institutions contribute more substantially than commonly assumed to disciplinary innovation and the generation of new knowledge. As research funding increasingly prioritizes solutions to complex social, economic, and environmental challenges, the gap between traditional research-intensive universities and more entrepreneurial institutions may narrow. Additionally, strategic partnerships and collaborations are likely to grow in importance. Smaller, more agile institutions can complement the strengths of mature research universities, bridging scientific innovation with local communities to address pressing public health, environmental, and business needs.

4.2 Theoretical Contributions

The findings of this study validate and expand upon neo-institutional theory. Neo-institutionalism posits that organizations tend to converge due to legitimacy mechanisms (DiMaggio & Powell, 1983). This study reveals that top-tier HEIs dominate doctoral degree production in traditional disciplines, suggesting that other HEIs, particularly those in the “second tier” R2 Carnegie Classification, imitate top-tier universities to align with legitimacy expectations. However, in emerging disciplinary fields, other HEIs deviate from this pattern, indicating that isomorphism may not exert as strong an influence as neo-institutional theory suggests within the diverse U.S. higher education landscape.

From the perspective of organizational ecology, disciplinary professional organizations operate within an environment shaped by alternating "legitimacy mechanisms" and "competition mechanisms," depending on the density of such organizations (Hannan & Freeman, 1977). In the early stages of disciplinary formation, legitimacy mechanisms dominate as organizations strive to build credibility and capacity. As disciplines mature and the density of similar organizations increases, resource competition intensifies due to overlapping ecological niches and limited carrying capacity. This transition shifts the dynamic from collective legitimacy-seeking to internal competition, with organizations vying for distinct positions. Consequently, some HEIs carve out unique paths by establishing distinctive disciplines to differentiate themselves within the academic landscape.

This study also illustrates the applicability of Resource Dependence Theory. Private HEIs, particularly in the for-profit sector, have demonstrated a propensity to develop doctoral programs in emerging disciplines. Resource Dependence Theory asserts that an organization’s behavior and decision-making are shaped by its dependency on environmental resources (Pfeffer & Salancik, 2006). Compared to public institutions, private HEIs benefit from greater flexibility in resource allocation, enabling them to establish new disciplines more readily. This

aligns with Ross (1976), who observed that universities with abundant resources and minimal economic pressures are more likely to develop traditional mainstream majors—such as biophysics, linguistics, statistics, computer science, and environmental studies—while institutions with greater reliance on tuition and a higher proportion of non-white populations often establish innovative disciplines like urban and ethnic studies. These programs help differentiate institutions, attract student and community support, and secure additional resources for development.

Clark (1996) referred to the creation and growth of new disciplines as "substantive growth," distinct from "reactive growth." Substantive growth, driven by academic research, typically originates from top-tier research universities. Clark expressed concern that such growth might widen the knowledge gap between elite and other institutions. In The Higher Education System (Clark, 1983), he argued that new disciplines often spill over from dynamic centers to peripheral institutions. This study corroborates and extends Clark's assertions, highlighting that top-tier universities not only catalyze the expansion of emerging disciplines but also influence their proliferation across the higher education system. Doctoral graduates from these elite institutions often populate programs at a wide range of HEIs, thereby stimulating innovation and knowledge dissemination.

4.3 Practical Implications

It is essential to challenge stereotypical perceptions of universities and advocate for a more nuanced, horizontal framework for classifying higher education institutions (HEIs). Historically, biases have driven the use of singular, vertical criteria to stratify HEIs, often overlooking the diverse and vital contributions of other types of institutions to academic research. This study underscores the significant role that non-elite institutions play in advancing academic frontiers, supporting the case for horizontal diversification (Borden, 2018).

Rather than aspiring to emulate top-tier institutions, universities should adopt distinctive strategies tailored to their unique strengths. Riesman (1956) observed that lower-status institutions in the U.S. often mimic prestigious research universities to elevate their status, fostering a monolithic development model in higher education. However, our findings suggest that under specific environmental conditions, other universities can harness their unique characteristics to pioneer new research areas. Encouraging collaboration between enterprises and universities can lead to the establishment of distinctive disciplines that address societal needs. Ensuring sufficient institutional autonomy is critical for enabling HEIs to carve out specialized niches and pursue differentiated development paths.

Institutions seeking to define their developmental niche should proactively explore and capitalize on opportunities in emerging disciplines, especially those that align with the economic, social, and scientific needs of their local communities. One particularly transformative area is artificial intelligence (AI), which is driving a paradigm shift in scientific research. The research paradigm has evolved through various stages—from empirical and theoretical paradigms to computational and data-driven paradigms (Hey, Tansley, & Tolle, 2009). Today, AI for Science is emerging as a new paradigm poised to revolutionize research practices, accelerate innovation, and enable breakthroughs across numerous disciplines (van Dis et al., 2023).

This AI-driven paradigm shift may help mitigate the cumulative advantages of top-tier HEIs by creating new opportunities for other HEIs and research organizations to compete for scientific development funding and recognition. As AI reshapes the research landscape, it provides a unique chance for diverse institutions to engage more equitably in driving scientific progress and addressing societal challenges.

4.4 Limitations

Noting again the measurement limitations of this study, the present analysis raises questions warranting further research in several directions. Although we believe that conferral of research/scholarship doctorates is a reasonable proxy for institution research productivity, bibliometric measures can and should be similarly applied. Additionally, the US higher education landscape is likely more diverse regarding institutional types and especially sources of funding, compared to the higher education systems of most other countries. Whether these findings can be generalized to other countries is one potential next direction for this research. This study also looks across the full range of disciplines. Further exploration into disciplinary areas is warranted. For example, the Carnegie Classification clusters doctorates into four general disciplinary areas: Humanities & Fine Arts; Social Sciences; Science, Technology, Engineering and Mathematics (STEM), and all other fields (dominated by Health and other professional areas, such as business and education). Research is warranted to determine whether the general patterns of this study are consistent across disciplinary areas.

Authors contributions

Prof. Victor M. H. Borden was responsible for overall study design, data collection and writing parts of the

manuscript and revising. Dr. Guiping Tian analyzed the data, wrote parts of the paper, and contributed substantially to revisions. Both authors agree with viewpoints expressed in the paper and approve the final manuscript.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Not relevant - only publicly available data used in the analysis.

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The data that support the findings of this study are available on request from the corresponding author. The data are publicly available.

Data sharing statement

Data were all extracted from publicly available sources and so are freely available to all.

References

Adams, J. (2013). Collaborations: The fourth age of research. *Nature, 497*, 557-560. https://doi.org/10.1038/497557a

Borden. V. M. H. (2018). Classifying institutions to guide mission-relevant performance assessment. *International Journal of Chinese Education, 7*, 246-261. https://doi.org/10.1163/22125868-12340100

Boroush, M., & Guci, L. (2022). *Research and development: US trends and international comparisons.* National Science Foundation and National Science Board NSB2022-5. Science and Engineering Indicators. National Center for Science and Engineering Statistics. Retrieved from https://ncses.nsf.gov/pubs/nsb20225/

Clark, B. R. (1983). *The higher education system: academic organization in cross-national perspective*. Berkeley, Los Angeles, London: University of California Press. https://doi.org/10.2307/jj.2711690

Clark, B. R. (1996). Substantive growth and innovative organization: New categories for higher education research. *Higher education, 32*(4), 417-430. https://doi.org/10.1007/BF00133256

Dattaa, S., Saad, M., & Sarpong, D. (2019). National systems of innovation, innovation niches, and diversity in university systems. *Technological Forecasting & Social Change, 143*, 27-36. https://doi.org/10.1016/j.techfore.2019.02.005

Dill, D. D., & Van Vught, F. A. (2010). *National innovation and the academic research enterprise: public policy in global perspective*. Baltimore: The John Hopkins University Press. https://doi.org/10.56021/9780801893742

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(2), 147-160. https://doi.org/10.2307/2095101

Fitjar, R. D. & Gjelsvik M. (2018). Why do firms collaborate with local universities? *Regional Studies, 52*(11), 1525-1536. https://doi.org/10.1080/00343404.2017.1413237

Gaisch, M., & Nömeyer, D. (2020). Third mission at Austrian Universities of Applied Sciences and the translational role of hybrid middle managers. In B. Broucker, V. M. H. Borden, T. Kallenberg, & C. Milsom (Eds.), *Responsibility of higher education systems* (pp. 250-269). Brill Sense. https://doi.org/10.1163/9789004436558_014

Geiger, L. R. (2004). *Research and relevant knowledge: American research universities since World War Ⅱ*. Routledge. https://doi.org/10.4324/9781315128481

Geiger, L. R. (2019). *American higher education since World War II: A history.* Princeton University Press. https://doi.org/10.1515/9780691190648

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge the dynamics of science and research in contemporary societies*. SAGE Publication Ltd. http://digital.casalini.it/9781446265871

Hannan, M. T., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology, 82*(5), 929-964. https://doi.org/10.1086/226424

Hey, T., Tansley, S., & Tolle, K. (2009). *The fourth Paradigm: Data-intensive scientific discovery*. Retrieved from https://www.microsoft.com/en-us/research/wp-content/uploads/2009/10/Fourth_Paradigm.pdf

Kerekes, S. & Nemeslaki, A. (2009). Education 2.0: Exploring the challenges of Corvinus University in the long tail economy of global higher education. *Society and Economy, 31*(1), 125-146. https://doi.org/10.1556/socec.31.2009.1.8

Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology, 83*(2), 340-363. https://doi.org/10.1086/226550

Pfeffer J. & Salancik G. R. (2006). The external control of organizations：A resource dependence perspective. In J. B. Miner (Ed.), *Organizational Behavior 2: Essential Theories of Process and Structure* (pp. 16). California: Stanford University Press. https://doi.org/10.4324/9781315702001

Riesman D. (1956). *The academic procession: constraint and variety in American higher education.* London: University of Nebraska Press.

Ross R. D. (1976). The Institutionalization of Academic Innovations: Two Models. *Sociology of Education, 49*(2), 146-155. https://doi.org/10.2307/2112519

Sam, C. & Sijde, P. van der. (2014). Understanding the concept of the entrepreneurial university from the perspective of higher education models. *Higher Education, 68*(6), 891-908. https://doi.org/10.1007/s10734-014-9750-0

Van Dis, E. A., Bollen, J., Zuidema, W., Van Rooij, R., & Bockting, C. L. (2023). ChatGPT: five priorities for research. *Nature, 614*(7947), 224-226. https://doi.org/10.1038/d41586-023-00288-7