The Top American Research Universities

2018 Annual Report

The Center for Measuring University Performance

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ISBN 978-0-9856170-8-0

This publication made possible through the support of the University Libraries,
University of Massachusetts Amherst.

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INTRODUCTION

This 19th edition of *The Top American Research Universities* reflects a consistent and continuing view of the remarkable commitment of American universities to an academic research mission. Over the years, within the constantly changing circumstances for American higher education, the research mission of these institutions has remained a key element in defining the competitive context within which American universities operate. This competition is reflected in many ways, especially in the recruitment, retention, and graduation of students and the acquisition of high quality faculty and staff. Our work has focused on the elements that define the top research universities within this competitive context, relying on data that is public and reasonably verifiable.

The consistency of our approach to measuring research university performance since 2000 has allowed us to observe the impact of the changing economic circumstances surrounding American higher education on the research mission of these institutions. As is our tradition, each year we offer an introductory essay that focuses on some aspect of the context of American research university competition. Among the many elements that define this competition, nothing is more important than money. Although the rhetoric of our profession speaks of resources, the critical dimensions of research university success depend on the financial resources available to each institution that can be invested in the acquisition of faculty, staff, and students of the highest quality.

Of particular interest in this conversation about university competition is a recognition that the changing economic circumstances of higher education has increased the differentiation in the research performance of institutions. The group of universities at the top level of competition have a much higher level of resources available to invest in their research mission than do other institutions. These resources allow high performing institutions to not only sustain quality undergraduate and graduate instructional programs and provide a wide range of services to their students, staff, local and state communities, and the nation, but also invest in the special facilities and support required to sustain large scale aggregate research accomplishments.

Along with many other observers, we have seen that over time the distance that separates the top level of research institutional resources from those of other institutions continues to be significant and growing and that while a few institutions do manage to move into the top levels of research performance, major additional resources are required to achieve this goal. Massive fund raising campaigns are but one symptom of the drive to acquire the money necessary to buy the competitive elements needed to stay within or within reach of the top levels of research performance. The essay that accompanies this edition of *The Top American Research Universities* highlights the large scale financial resources available to the top ten public and top ten private research universities that allow them to compete for the federal research funding that is the major component of external support for American university research.

The stable and reliable indicators contained in this report, along with the data available to the public on the Center for Measuring University Performance website (https://mup.umass.edu) allow universities to review their own placement within the context of the institutions included in this year's report and to construct alternative ways of measuring that performance. As is our custom, this year's report explains any adjustments we have made to the data to reflect changes in reporting agencies policies and practices and changes in institutional organization and structure.

We generally mail about 1500 copies of *The Top American Research Universities* to university leadership, libraries, and others interested in this topic. In addition, each year we receive about 300 hits per day on the website. Our staff responds to a significant number of queries from institutional research officers and others interested in the topic of research university competition and performance. Our staff also participates in a variety of academic meetings related to university performance and competition. As always, we rely on the advice, expertise, and experience of our Advisory Board.

We have been able to pursue this project consistently over the years thanks to the continuing commitment of our sponsoring institutions and the creative engagement of their academic and administrative staff, currently the University of Massachusetts Amherst and the University of Florida, and in the past including Arizona State University, as well as the support of the institutions where our staff is resident, the University at Buffalo, the University of Florida, and UMass Amherst.

The Staff of the Center for Measuring University Performance

November 2019

Staying at the Top: An Essay on the Comparative Advantage of America's Top Research Universities

John V. Lombardi and Diane D. Craig

Abstract: The complex system of American university education defies easy characterization, but the predominance of the top academic research institutions remains a stable element within a changing national higher education marketplace. The key requirement for success within this marketplace is the acquisition of talent and the ability to support this research talent with equipment, facilities, and personnel. A review of some indicators demonstrates that success in the university research competition requires sustained high levels of revenue available for investment in the elements of research performance. The difficulty of achieving this level of revenue is demonstrated by the remarkable ability of the top performers to maintain their position in the competition, and difficulty other institutions have in challenging this dominance.

While the national conversation about higher education swirls around controversial topics of all kinds, giving the impression of an industry in crisis, the overall operation of this industry remains reasonably stable. Change of course does occur, but much of it reflects the continued significance of a college education for large number of individuals, the constantly documented lifetime earnings advantage of a college education, and the significant demand for educational services from individuals older than 25, many of whom engage higher education online. Enrollment in traditional non-profit four-year institutions has risen steadily over the years and today stands at about 16 million undergraduate students with the best projections indicating a relatively stable number with perhaps some small growth over the next five years or so.

General Characteristics of the University Marketplace

It is useful in interpreting generalizations about college enrollment to recognize some characteristics of the distribution of both institutions and students as summarized below.

Institutions[i]

- Of the 2,340 four-year non-profit institutions, 32% are public and 68% are private.
- Among the 750 public institutions, 81% have enrollments of 2,500 or more students and 10% have enrollments over 30,000.
- Among the 1,589 private institutions[ii], 25% have enrollments of 2,500 or more students and 1% have enrollments over 30,000.

Students

Of the almost 16 million undergraduate students enrolled in 4-year non-profit institutions, just over 80% are enrolled in public institutions and just under 18% are in private institutions (Table 1). However, the nearly three million post-baccalaureate students in these institutions are divided much more evenly with about 53% in public institutions and 47% in private institutions.

Table 1. 2017 Fall Enrollment at Four-Year Institutions

Institutional Control	Under-graduate	% of Total	Post-baccalaureate	% of Total
Public	13,100,953	82%	1,459,202	53%
Private	2,817,017	18%	1,289,460	47%
Total	15,917,970		2,748,662	

Source: Digest of Education Statistics, 2018, tables 303.70 and 303.80.

The Research University Marketplace

Of particular interest in this context are those universities NCES classifies into two groups based on the Carnegie Classification®, those with very high research and those with high research (Table 2). This is a group that coincides in many ways with those we identify at the Center for Measuring University Performance (MUP) as Top Research Universities, or those with an annual federal research expenditure of $40 million or more. Of the 219 institutions in these two NCES categories in Fall 2017, 120 (55%) have 20,000 students or more, and 64 (29%) have 30,000 or more. Public institutions make up 71% of the universities classified by NCES as having high or very high research performance. In terms of enrollment, the high to very high research universities have 5.2 million students, with the public institutions in these categories enrolling just over 4 million, or about 81%.

Table 2. Institutions with Very High or High Research Activity and Fall 2017 Enrollment

Institutional Control and Research Activity	No. of Institutions	Less than 20,000 students	20,000 to 29,999 students	30,000 or more students	Total Students
Public	155	50	47	58	4,211,036
Very High	81	4	26	51	2,844,803
High	74	46	21	7	1,366,233
Private	64	49	9	6	959,608
Very high	34	22	7	5	633,342
High	30	27	2	1	326,266
All Institutions	219	99	56	64	5,170,644
Very High	115	26	33	56	3,478,145
High	104	73	23	8	1,692,499

Source: Digest of Education Statistics, 2018, table 317.40.

In short, these institutions differ significantly by size and type, with public institutions serving the largest number of students although, overall, there are more private institutions than public institutions. It is not easy to generalize about students and institutions when the range of institutional size and their public or private character are significantly different.

Although much has been written about a possible crisis reflected in institutional failures, the number of four-year, not-for-profit colleges that have closed over the last seventeen years averages about five per year, and the most recent seven years saw the average number of closures at about the same rate, although there was a jump to 12 in 2016-17. For those institutions, their few remaining students, faculty, staff and their alumni and friends, these closures can be traumatic, but as a statistical measure of the industry's health, these institutions represent only a tiny fraction of four-year colleges and an even smaller fraction of total enrollment.

Table 3. Degree-granting Institution Closings

Academic Year	4-year Public	4-year Private
2010-11	0	6
2011-12	0	2
2012-13	1	2
2013-14	1	3
2014-15	0	3
2015-16	0	5
2016-17	0	12

Source: Digest of Education Statistics, 2018, tables 317.50.

Many observers also worry about the decline in the percentage of tenure-track full-time faculty at these four-year and above institutions. In the period between 1993-94 and 2017-18, the percentage of public 4-year doctoral institutions with tenure systems declined less than one percent from 100%, while public masters' institutions declined from 98% to 97% (Table 4). However, their private counterparts saw much greater declines, from 91% to 80% among doctoral institutions and from 77% to 59% among masters' institutions. Clearly the public institutions have held onto tenure systems more successfully than their private counterparts.

Table 4. Percentage of Four-year Institutions with a Tenure System, AY 1994-2018

Academic Year	Total Public Institutions	Public Doctoral Institution	Public Master's Institution	Total Private Institutions	Private Doctoral Institution	Private Master's Institution
1993-94	93%	100%	98%	66%	91%	77%
2003-04	91%	100%	98%	61%	87%	72%
2013-14	96%	100%	98%	62%	80%	63%
2017-18	95%	100%	97%	61%	80%	59%

Source: Digest of Education Statistics, 2018, table 316.80

Within those institutions with tenure systems, since 1993-94 the percentage of full-time faculty with tenure in doctoral public institutions has steadily declined from 55% to 42% in 2017-18, and by nearly three percentage points in just the past four years (Table 5). In contrast, among masters' public institutions, the proportion of tenured faculty has fluctuated over the past two and a half decades. There was a large decline between 1993-94 (61%) and 2003-04 (53%) but began to rebound in mid-2000s and peaked in 2013-14 at 55% before declining to a record low in 2017-18 of 53%. In the private institutions with tenure systems, during this same period, the percentages of full-time faculty with tenure declined from about 48% to 38% percent at doctoral institutions, with slower decline in recent years as compared to their public counterparts. Tenured faculty rates have remained relatively stable at private masters' institutions since 1993-94 (range of 49-52%).

Table 5. Percentage of Full-time Faculty with Tenure at Four-year Institutions with a Tenure System, AY 1994-2018

Academic Year	Total Public Institutions	Public Doctoral Institution	Public Master's Institution	Total Private Institutions	Private Doctoral Institution	Private Master's Institution
1993-94	56%	55%	61%	50%	48%	52%
2003-04	50%	49%	53%	45%	40%	49%
2013-14	47%	45%	55%	44%	40%	52%
2017-18	45%	42%	53%	42%	38%	51%

Source: Digest of Education Statistics, 2018, table 316.80

However, these numbers depend significantly on the composition of faculty. Among full-time instructional faculty in 2016-17, 89% of those with the rank of Professor and 76% with the rank of Associate Professor have tenure at public doctoral institutions (Table 6). Among doctoral institutions in the private not-for-profit sector, 85% of the Professors and 63% of the Associate Professors have tenure. Among masters' institutions, both public and private universities have high levels of tenure among Professor ranks (98% for publics; 93% for privates) and Associate Professor (90% and 78%, respectively). The slightly higher percentage of tenure at masters' institutions, both public and private, and at all ranks, may reflect less emphasis on research productivity than at the doctoral institutions, although given the wide range of institutional characteristics among these institutions this can only be a guess without a more detailed study.

Table 6. Percentage of Full-time Faculty with Tenure at Four-year Institutions by Rank, AY 2017

Faculty Rank	Total Public Institutions	Public Doctoral Institution	Public Master's Institution	Total Private Institutions	Private Doctoral Institution	Private Masters' Institution
Professor	91%	89%	98%	88%	85%	93%
Aso Professor	79%	76%	90%	69%	63%	78%
Ast Professor	4%	1%	8%	3%	2%	5%
Instructor	10%	1%	2%	0%	0%	0%

Source: Digest of Education Statistics, 2018, table 316.80

Tenure is clearly still a major element of faculty work and careers at these institutions but with significant variations by institutional type, and probably by research intensity. It is likely that the existence of strong union presence at many public institutions may well have helped sustain the tenure systems at higher levels at these universities, although the research intensity of the institutions is also likely to have a significant influence on the prevalence of tenure as most research competitive faculty seek positions on the tenure-track. Also, as these data only apply to full-time instructional faculty, they do not account for the prevalence of contingent teaching faculty or research staff on various forms of term contracts who are usually not part of the tenure system.

The Top American Research Universities: Scale of Operations

These general characteristics of the higher education institutional marketplace prompted a review of the enrollment characteristics of the MUP's top research institutions. At a glance, enrollment at these highly competitive research universities has grown over the years, with a 7% increase in total undergraduate enrollment and a 4% increase in total graduate enrollment between 2012 and 2016. This leads to a possible competitive advantage to scale in the effort to acquire the top faculty, staff, and students that translate into sustained success in research funding. Moreover, these institutions all have outstanding brand identification reflected in the high selectivity they exhibit in their undergraduate application processes. Scale is important, as the difficulty of sustaining top research performance continues to increase with constantly expanding requirements for enhanced equipment, facilities, support personnel, and administrative services to manage the complex and highly regulated research environment.

Institutions grow in other ways too, as they develop ever-expanding commercial initiatives based on their research productivity and enhance the services they provide students, faculty, staff, and their surrounding communities. A reasonably high level of participation by students is an advantage as their substantially discounted tuition and fees nonetheless contribute a significant portion to institutional revenue. Moreover, in public institutions, larger student populations often translate into increased state support, and in all institutions, larger student bodies in the long run produce larger alumni groups that, in turn, eventually generate larger annual giving and endowments.

Some indicators of enrollment growth within the domain of our top research universities illustrate this perspective, recognizing from the review of general enrollment indicators above, that the changes in enrollment while significant for individual institutions in different circumstances, are overall, rather modest. This illustration shows enrollment in terms of the competitive group of top research universities, defined here by the MUP project as those with at least $40 million in annual federal research expenditures. Excluding standalone medical schools and specialized institutions, there are 129 institutions (public and private) that meet this criterion. In addition, within this group, public and private institutions belong to two smaller groups: the top 10 public and the top 10 private institutions ranked by their annual federal research expenditures, that allow a perspective on the characteristics of the most research competitive institutions compared to the performance of the rest of the high performing public and private research universities.

Between 2010 and 2016 the mean undergraduate enrollment for the top 10 public research institutions has grown by a little over 2%. The rest of the public research universities saw about the same enrollment growth of about 3%. In the case of the private research universities in our group, the top 10 grew their average undergraduate enrollment by 10% with the average of the rest of the private research institutions growing at about 11%. However, the size of the undergraduate populations of these institutions diverge substantially by their public and private status. The top 10 public institutions in 2016 had an average undergraduate student body of 24,739 while the rest of the public research universities had an average undergraduate student body of 24,670. The top 10 private institutions had an average of 8,579 undergraduates while the rest of the private universities had 8,379 headcount enrollment.

Table 7. Mean Undergraduate Headcount Enrollment, 2010-2016

Institutions with over $40M Federal Research	2010	2011	2012	2013	2014	2015	2016	2010-16 Net Change	2010-16 Percent Change
Top 10 Publics	25,923	26,113	26,349	26,732	27,089	27,382	27,924	2,001	8%
Rest of Publics (N=81)	21,948	22,307	22,567	22,916	23,335	23,799	24,346	2,397	11%
Top 10 Privates	8,374	8,409	8,528	8,581	8,612	8,638	8,579	205	2%
Rest of Privates (N=28)	8,095	8,075	8,190	8,161	8,284	8,304	8,325	230	3%

Graduate student enrollment provides an additional perspective, particularly significant for these top performing research universities. During the recent seven-year period from 2010-2016 the average graduate student headcount enrollment for the top 10 public institutions increased by 5% or 598 students, while the rest of the public research universities in our group grew by only 3% or 176 students. Private institutions experienced greater enrollment gains over this time period. The average graduate student headcount of top 10 private research universities grew by about 13%, an increase of 1,546 students, while the rest of the private universities in our group grew by about 6%, or an increase of 384 students (Table 8).

Table 8. Mean Graduate Headcount Enrollment, 2010-2016

Institutions with over $40M Federal Research	2010	2011	2012	2013	2014	2015	2016	2010-16 Net Change	2010-16 Percent Change
Top 10 Publics	11,055	11,087	11,117	11,053	11,172	11,352	11,652	598	5%
Rest of Publics	6,864	6,886	6,786	6,830	6,864	6,895	7,039	176	3%
Top 10 Privates	12,258	12,524	12,584	12,757	12,972	13,369	13,804	1,546	13%
Rest of Privates	6,325	6,425	6,540	6,419	6,511	6,581	6,709	384	6%

Note that top 10 public and private research universities have significantly larger average graduate populations than the rest of the research universities in their group. This difference reflects the higher research intensity of the top 10 public and top 10 private institutions with the increased emphasis on graduate education and research.

Although, on average, both the public and private institutions have grown in the size of their undergraduate and graduate populations, the average public institution has a much larger undergraduate student body, reflecting the public character of their missions and organization, the requirements of their states for access to quality higher education, and the relatively common link between enrollment and state funding.

However, while the general trends in growth and student-body size are evident, caution in generalizing is warranted because the variation in undergraduate and graduate enrollment is substantial among these institutions. Private high performing research universities in our group of 129 institutions range from NYU's reported 2016 fall headcount total enrollment of 50,550 to Cal Tech's 2,240. Public universities, while generally recruiting substantially larger undergraduate student populations than their private counterparts, also show some significant variations. The range here is quite large from the 97,849 reported for the multiple locations of Arizona State University to the fall headcount enrollment of 8,283 at the University of Alaska Fairbanks.

These differences clearly indicate that enrollment size responds to a wide range of incentives and opportunities. In the case of the public institutions, in particular, local considerations of a state's population, the rural-urban balance, the state's commitment to funding the institution, the relationship of funding models to enrollment considerations, and the competition with nearby states all have an impact on enrollment. While all these institutions compete for students nationally and internationally, some are much more centered on their state's residents, even to the extent of limits on out of state enrollment. Others respond to the political concerns for access to the state's flagship institutions and other high-quality state universities. As a result, while increased enrollment has many advantages, the elements that contribute to an individual institution's enrollment numbers are highly variable and require close analysis of individual institutional history and policies. In addition, the organization of state institutions varies, and in some instances, students from statewide programs, fully integrated online programs, and off-campus facilities increase the reported enrollment numbers.

For private institutions, it is also difficult to make firm generalizations about the rationale for any particular university undergraduate size. Historically, many major private research universities sought to keep their undergraduate populations relatively small to create the experience of an elite liberal arts college, but over time, some of the benefits of larger undergraduate and graduate populations have clearly prompted institutions to expand their reach. In some instances, the need to diversify and internationalize the student body has encouraged the expansion of student opportunities. In others, the net tuition/fee revenue recovered has proved to be an important financial resource even if endowment and annual giving are nonetheless required to pay the full cost of a student's education. Without a careful individual examination of an institution's history and circumstances, it is difficult to offer generalizations that will serve to capture the success of Cal Tech and the scale and research achievements of NYU.

The Top American Research Universities: Revenue

The net tuition generated by an institution's total enrollment offers a likely incentive to increase the number of undergraduate and graduate students at most universities. In exploring this relationship, the different rules used by public and private universities in accounting for the various discounts students receive for different forms of financial aid makes comparisons between public and private institutions problematic. Nonetheless, it is possible to see trends in the growth of enrollment related revenue even if public-private comparisons are challenging.

One way to approach the issue of revenue is to look at the sum of the average revenue reported for two or three major components of research university financing: net tuition and fees, estimated discretionary income generated by a university's endowment (calculated at a standard payout of 4.4% of endowment assets), and for public institutions, the contribution of state appropriated funds (Table 9). For our group of institutions, the combination of these revenue elements has increased steadily over the past seven years.

Table 9. Mean Selected Revenue Streams for Top Research Universities*

Revenue Sources	2010	2011	2012	2013	2014	2015	2016	2010-16 Percent Change
Top 10 Publics								
Mean Tuition & Fees	$496,664	$541,674	$591,357	$633,618	$661,596	$693,794	$728,927	47%
Mean State Approp.	$375,694	$366,033	$309,012	$324,176	$337,504	$340,191	$352,645	-6%
Mean Endowment (4.4%)	$94,907	$111,995	$110,446	$121,325	$141,832	$148,960	$146,070	54%
Mean Total Top 10 Publics	**$967,265**	**$1,019,702**	**$1,010,815**	**$1,079,119**	**$1,140,932**	**$1,182,945**	**$1,227,642**	**27%**
Rest of Publics (N=81)								
Mean Tuition & Fees	$231,213	$255,323	$282,446	$298,859	$313,233	$330,923	$348,775	51%
Mean State Approp.	$223,635	$223,189	$207,442	$206,652	$225,313	$231,946	$236,597	6%
Mean Endowment (4.4%)	$27,072	$32,108	$32,955	$37,423	$44,135	$44,170	$43,697	61%
Mean Total Rest of Publics	**$481,920**	**$510,620**	**$522,843**	**$542,934**	**$582,681**	**$607,039**	**$629,069**	**31%**
Top 10 Privates								
Mean Tuition & Fees	$449,841	$482,494	$510,478	$542,227	$573,790	$607,948	$645,959	44%
Mean Endowment (4.4%)	$409,323	$478,861	$477,321	$515,455	$590,394	$614,806	$604,667	48%
Mean Total Top 10 Privates	**$859,164**	**$961,355**	**$987,799**	**$1,057,682**	**$1,164,184**	**$1,222,754**	**$1,250,626**	**46%**
Rest of Privates (N=28)								
Mean Tuition & Fees	$315,099	$332,250	$352,011	$372,006	$390,816	$407,927	$422,807	34%
Mean Endowment (4.4%)	$108,619	$127,338	$125,944	$136,092	$156,510	$161,974	$155,596	43%
Mean Total Rest of Privates	**$423,718**	**$459,588**	**$477,955**	**$508,098**	**$547,326**	**$569,901**	**$578,403**	**37%**

* Dollars in thousands.

Next, we compare the relative advantage of the top 10 universities on these selected revenue sources to the rest of the top research universities in our group of 129. In Table 10, we show the net difference between the top 10 average value and the rest of the institutions average value. Of particular interest for the issue of comparative advantage, note that by 2016 the average top 10 public institution has $598.6 million more to spend from these three revenue sources than does the average other top public research university in this group. Private universities show similar and even larger advantages, with a $672.2 million advantage over their research peers in 2016.

Table 10. Mean Revenue Advantage of Top Public and Private Research Universities Over the Rest of Top Universities*

Revenue Sources	2010	2011	2012	2013	2014	2015	2016	2010-16 Total
Top 10 Public Net Advantage								
Mean Tuition & Fees	$265,451	$286,351	$308,911	$334,759	$348,363	$362,871	$380,152	$2,286,858
Mean State Appropriations	$152,058	$142,844	$101,570	$117,524	$112,191	$108,244	$116,048	$850,480
Mean Endowment (4.4%)	$67,835	$79,887	$77,491	$83,902	$97,697	$104,790	$102,373	$613,975
Top 10 Public Mean Advantage	**$485,344**	**$509,082**	**$487,972**	**$536,184**	**$558,251**	**$575,905**	**$598,573**	**$3,751,312**
Top 10 Private Net Advantage								
Mean Tuition & Fees	$134,742	$150,245	$158,468	$170,222	$182,974	$200,021	$223,152	$1,219,824
Mean Endowment (4.4%)	$300,704	$351,524	$351,378	$379,363	$433,883	$452,832	$449,071	$2,718,755
Top 10 Private Mean Advantage	**$435,445**	**$501,768**	**$509,845**	**$549,585**	**$616,857**	**$652,853**	**$672,223**	**$3,938,576**

* Dollars in thousands.

Note that the combination of these revenue sources, on average, for the public and private institutions demonstrates relatively close levels of advantage. The average top 10 public institutions' advantage includes state appropriations but this is offset by the average top 10 privates' significantly higher earnings on endowment. The comparative advantage demonstrated here is visible not only for the 2016 year but also throughout the period 2010-2016. This simple exercise suggests the private and public top 10 research institutions accumulated a substantial revenue advantage over the rest of the institutions within their group.

The Top American Research Universities: The Comparative Advantage

Universities do many things in addition to instruction, research, and various forms of public service. They generate money from more than the sources we highlight here in order to subsidize the pursuit of federally funded research. In the aggregate, it is the money universities can generate over and above the cost of operating a baseline institution that permits the substantial investment required to compete nationally among the best research institutions.

The exercise in this essay does not offer a complete view of the revenue advantage held by the top institutions, nor does it address how individual institutions choose to invest their funds. Some institutions have complex, expensive educational programs for undergraduates, others use large much less expensive distance education programs to capture revenue in both undergraduate and graduate programs. Whatever they do, however, all of these top institutions have grown their enrollment, generated more funds from tuition and fees, and sought ever high amounts of endowment. Private institutions generate substantially more revenue from the payout on their larger endowments than do their public counterparts, and even recognizing the differences in accounting rules between public and private institutions, it would appear that the public institutions, between net tuition and fees and the contributions of state appropriations, along with the earnings on their endowments, generate a total comparative advantage within a range similar to that of their private top 10 counterparts.

These comparative advantages have another consequence in creating entry barriers to the top levels of university research competitiveness. Out of the 945 universities that the MUP Center classifies as research universities because they have reported any federal research expenditures in the past five years (2012-16), only 161 (including standalone medical and specialized institutions) compete at the significant level of $40M in annual federal research expenditures. These spend something on the order of 90% of all university-based annual federal research expenditures. The large and growing cumulative advantage of the top 10 in this group would appear to indicate that it will become more and more difficult to maintain large-scale research enterprises at top competitive levels.[iii]

These generalizations, however, only provide a framework within which the highly evolved competition for research talent and funding plays out. The presence or absence of a research oriented medical school, the existence of a land grant mission, the size of the international student population, the balance in public institutions between in-state and out-of-state students, the extent of profit generating distance education and short term certificate programs, the reliance of an institution on tenured/tenure-track or contingent faculty, and the success of university-corporate joint ventures all have an impact on the revenue made available to support the development of a competitive research enterprise.

Maintaining Elite Research Performance

It seems likely, that over the next decade or so, the comparative advantage of these top institutions will continue to grow, recognizing that the current environment depends on today's scale, organization, and operation of the federal research agencies and their peer review systems. Predicting the future is always risky, although the structure, organization, and performance of America's top research universities have demonstrated remarkable stability and continued strength in the face of multiple national fiscal crises and substantial shifts in American attitudes towards college and advanced study.

In this context, it is helpful to remind ourselves of the remarkable stability of the top research universities that hold their advantage in the competition over many years. Of the top 10 public and private institutions we examined here, six of the publics and eight of the privates have been in the top 10 in federal research since 2010. Although four public and two privates left the top ten at least one time over those seven years (2010-2016), they fell no further down than 12th place. The institutions that took their place rose over those years from no lower than 13th. The competition at the very top of the research competitive institutions takes place among a relatively small group of high performing institutions.

Conclusion

In short, while there is much to discuss about American higher education institutions, the wide range of institutional type and characteristics argue for caution in making generalizations about the higher education industry as a whole. Even if confining the discussion to undergraduate education or graduate education, research, or individual graduate economic success, the wide range of characteristics that define the individual institutions make clear the difficulty of simple answers to questions about these academic enterprises. By focusing on particular subsets of institutions that compete in the same marketplace, as the MUP Center does, this exercise offers some help in understanding the trends and overall characteristics of the institutions in the high performing research university subset.

The success of these high performing research universities highlights the growing challenges facing academic research institutions. As the data summarized here show, there is no way to compete in this top marketplace without substantial resources, and the cost of that competition continues to rise. The ever increasing cost of the research enterprise itself, with expensive equipment, underfunded grants, high personnel costs, increased competition for funding, and rising bureaucratic and regulatory requirements, clearly indicate that the number of universities able to compete at the upper end of this distribution of research universities will likely remain small, and many aspiring research institutions may well find the competition far too rich for their resources.

Research is a luxury good for most universities because however calculated, the cost of performing research significantly exceeds the revenue it generates. As a result, research is a loss leader in higher education in almost all institutions, and while some significant revenue is possible from enterprises and activities associated with successful research institutions, this added benefit is rarely sufficient to complete the subsidies required for performing the university's research. The tendency to focus on scientific research, moreover, often obscures the significant subsidy required to sustain the non-science and non-grant funded research activities of most comprehensive institutions.

As a result, research universities seek revenue from other sources to support the deficits generated by large dynamic research enterprises. Massive fundraising campaigns, elaborate efforts to expand profit-generating distance education, expansion of undergraduate and graduate student bodies to produce enrollment driven surpluses, state financial support, expansion of revenue generating medical enterprises, all these sources and others are required to sustain the top brand name institutions. At the same time, many of these sources face limits to future expansion, whether from resistance to tuition increases, reluctance of states to pay more, declining potential student populations, and reductions in overall grant or foundation funding relative to the cost of research.

While many colleges and universities will continue to support some stellar research activities, primarily to validate their claims to participation in the elite enterprise associated with academic excellence, the scale of investment most universities will be able to sustain is likely to shrink as the competition from the top performers continues to drive the cost of participation in this marketplace upward and the availability of surpluses to support these costs declines for most institutions.[iv]

There are many benefits for a university subsidizing a modest research enterprise, primary among them is the enhanced prestige and brand value provided by the existence of some stellar research faculty and programs. The general belief that research is a premier product of the very best universities, in America and the world, makes some research investment likely for many institutions that, while they will not compete among the top American research universities, may well be able to support quality research programs on a smaller and narrower scale.

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i Digest of Education Statistics, 2018, table 317.20.

ii Refences to private institutions in all tables and text in this article includes only private, nonprofit institutions.

iii A recent Chronicle of Higher Education article highlights this pressure to compete at the highest levels and its impact on the bond ratings of some private research universities. See Dan Bauman, "How Chasing Prestige is Starting to Strain Some Elite Institutions," *Chronicle of Higher Education*, November 14, 2019.

iv We have discussed various elements of these themes elsewhere. See for example, John V. Lombardi and Diane D. Craig, "America's Research Universities: Is the Enterprise Model Sustainable?" *The Top American Research Universities,* 2017; William B. Rouse, Lombardi, Craig, "Modeling Research Universities: Predicting Probable Futures of Public vs. Private and Large vs. Small Research Universities," *Proceedings of the National Academy of Sciences,* (119, 2018); and Lombardi and Craig, "American Research Universities in an Era of Change: 2006-2015," *The Top American Research Universities,* 2016.

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ISBN 9780985617080