The Top American Research Universities

2017 Annual Report

The Center for Measuring University Performance

John V. Lombardi
Craig W. Abbey
Diane D. Craig

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America's Research Universities: Is the Enterprise Model Sustainable?

John V. Lombardi and Diane D. Craig

INTRODUCTION

Since at least the second world war, the top American research universities, both public and private, have enjoyed remarkable success, not only in capturing significant shares of the federal dollars available to support research but also in expanding their influence and significance within the context of American higher education. This success is reflected today in multiple ways from the growing undergraduate population seeking admission to these institutions to the prestige conferred by multiple ranking publications of varying methodological quality.[1]

Indeed, almost all colleges and universities that aspire to any distinction at all support some variety of research enterprise, even if some are relatively modest in scale. A reflection of the almost universal significance of research achievement appears in the web pages and alumni publications of prestigious and highly selective liberal arts colleges whose claim to distinction rests primarily on the quality of their undergraduate educational programs but whose web pages nonetheless wax eloquent over the research accomplishments of their faculty.[2]

Yet over the past decades, as the financial circumstances of all colleges and universities have changed, with declining public tax-based support, increased tuition and fee structures, complex tuition discounting programs, sophisticated need-based financial aid mechanisms at the state and federal levels, and competition for fee-paying international students, some may worry that the research enterprises of these institutions may be at risk. This perception of possible risk reflects several circumstances particular to the university research enterprise.[3]

The Center for Measuring University Performance Staff

THE RESEARCH UNIVERSITY MODEL

University research, especially scientific research, with few exceptions, is an institutional loss leader. The revenue generated by research grants and contracts does not pay for the costs of producing the research. Indirect costs exceed any external reimbursement, and a wide variety of other research support provided by the university, whether for released time from teaching, unfunded facility, equipment and personnel costs, support structures for graduate students, or institutionally supported research work, receives no external funding. In a resource-constrained environment, some observers worry that the financial model that has supported the current scale of America's dynamic and productive research university environment cannot continue.[4]

However, even if the data may indicate that research generates an increasing net cost to institutions, it may not follow that all current research universities will reduce their commitment to research in pursuit of a more economically rational model of institutional finance. The most successful research universities, moreover, compete not to get rich but rather to generate the funds needed to accumulate the highest level of quality elements within their institutional boundaries as possible. The external marketplace for their goods and services serves primarily as a venue for acquiring the resources to continue expanding their internal quality.

Indeed, this characteristic of the research university model deserves more attention than it usually receives. These institutions function as quality engines, that is they operate to capture the largest amount of nationally competitive quality elements within their institutional boundaries. These quality elements include students, faculty, staff, facilities, and programs, but above all they seek to acquire research faculty and associated personnel. Research capable faculty and staff bring with them or attract a wide range of other quality assets, whether graduate students, competitive grants, research publications, post-docs, or high-level scientific staff. Because these high performing faculty are in short supply relative to the demand from many research-competitive institutions for their services, they can command a significant university investment. This investment is less about salaries or individual faculty compensation and more about facilities, support personnel, institutional research infrastructure, graduate student support, and availability of related high-quality faculty and programs. The prestige and significance of any research university is the result of the cumulative impact of these high performing people supported by the infrastructure and research-related personnel of the institution.[5]

For this reason, the primary indicator of research university success has generally been the annual amount of federally sponsored science and engineering research expenditures. This number is useful for this purpose not because it reflects a monetary accounting unit but because it reflects the annual research activity funded through the national peer review process of the various federal funding agencies. Annual federal expenditure data is a particularly useful indicator, as opposed to federal research awards, because it reflects annual direct activity on research billed to a federal research grant. It is also useful as a general proxy for the scale of institutional investment required to

sustain that level of federal research activity. This funding model for American research activity has some consequences for the way research institutions operate.

The model is based, in simplified terms, on a competition that pits individual faculty research proposals against each other in a peer reviewed context. These proposals are not institutional proposals but individual faculty proposals (although of course they all carry a substantial component of institutional support that underlies the quality and strength of the proposal). The awards when they come are primarily faculty awards, although they may have a wide range of linked institutional commitments. In practice of course, many individual proposals have multiple faculty participants, may well involve individuals from a number of institutions in a collaborative framework, and can include linkages to corporations or other outside entities. Nonetheless, the core competencies that drive the success of the research university are the high performing faculty and associated staff whose records of achievement and whose reputations validate the likelihood of a successful research result from the funding proposed.[6]

This model places a significant burden on the research university that must recruit and retain nationally significant faculty in order to build the capacity to compete successfully in the peer review process for the national grants that define research university success. The institution's investment is, in many cases, a high-risk investment. Although it may be advantageous to recruit faculty who already have funded federal research grants, the marketplace does not offer a sufficient number of these individuals to meet the demand, and as a result institutions must also recruit younger promising faculty whose work offers the expectation of a successful research career. Sometimes the promise is fulfilled, and sometimes it is not, so the institutional investment in promising high performing faculty carries a significant risk.

Research universities cover this risk in a number of ways. The most obvious is through the tenure process that attempts over a relatively short window of time to identify which newly hired faculty members will have the greatest likelihood of continued long-term future research success. Those that pass this review are deemed to be more likely to have a significant long-term competitive research career than those who do not pass. While this process lowers somewhat the risk associated with hiring and supporting a particular faculty member, the time for decision is relatively short, perhaps five years, so some significant risk remains. This risk is covered in a variety of ways by institutions, depending on their circumstances.

In institutions with substantial undergraduate populations teaching and other functions associated with extensive undergraduate and masters or certificate programs provide a useful occupational niche for faculty whose research potential may not have reached or no longer can be sustained at the anticipated level of productivity. By shifting faculty effort from research to teaching and other institutional support activities, high quality faculty whose competitive research strengths are not quite up to the national level, remain productive and their cost compensated by the work they do on behalf of the undergraduate, masters, or certificate programs.

This model is particularly relevant for the large public research universities whose research accomplishments have elevated many of them into the top levels of national and international competition. The size of the undergraduate student body and the growth of profitable masters and certificate programs serve public universities especially as a buffer against the risk associated with providing tenure to candidates early in their research careers. Large undergraduate and pre-doctoral student populations in public universities also provide other advantages. While tuition and fee revenue for undergraduates generally do not pay for the full cost of their education, in most states, public funding tends to be driven by calculations closely related to student credit hours or their derivatives. In addition, since institutions rarely discount masters and certificate tuition and fees, these programs more than pay their own way. Some infrastructure and other operating costs of the institution, subsidized by the undergraduate and non-PhD graduate student economy, also subsidize research infrastructure, whether related to buildings, core support of energy costs, basic accounting and other business services, security, legal, technology, and the like. The larger the university budget from all sources, the better able the institution will be to support the special costs of sustaining highly competitive research faculty. Further illustrating this process, private research universities have also grown their undergraduate and master's level programs in recent years.[7]

For all research universities, public or private, funding from annual gifts and endowment earnings also serve to cover unfunded costs, whether for educational or research expenses. Long a staple of the private institutional financial model, all public institutions now seek private funding with highly professional staffs and systems. They generate large amounts from annual giving and accumulate endowments that range into the billions of dollars. This support, too, is a required element of the research university financial structure, for without this revenue, the scale of institutional activity could not be sustained.

In short, the current research model seeks out all types of revenue to create a financial base capable of sustaining the substantial unfunded costs of highly competitive research faculty, staff, and facilities. This university quality engine, fueled by this financial base, seeks to acquire the highest level and volume of quality within its boundaries. It uses this engine to attract students, faculty, alumni, donors, granting agencies, foundations, and others to participate in and with the accumulated quality. These people engage primarily to participate in various ways with the quality assembled inside the boundaries of the institution. They individually receive various intellectual, social, or personal

benefits unique to each participant's needs and interests, and they use these primarily intangible benefits to enhance their marketability or significance outside the university.[8]

CHARACTERISTICS OF RESEARCH UNIVERSITIES

While it is useful to take a broad, high level look at the research university marketplace, such a perspective can lull us into imagining a more homogeneous world of universities participating in the research marketplace than exists in reality. The profiles of successful American research universities are significantly varied. Over the years we have explored a wide range of topics related to university competition and improvement through the work of The Center for Measuring University Performance (MUP), and we have tested a number of different perspectives for understanding this competition.

Given the American mania for ranking, we have looked in various ways at what we call the *Search for Number One*. This Quixotic effort to bring some rationality to the ranking conversation has been helped by many others in the field. We have all sought to impress on our colleagues and outside observers that any methodology that offers a rank ordering of institutions from Number One on down, using a variety of measures combined into a single index number is sure to be methodologically unsound and theoretically flawed.

There is no best university. What we have are clusters of similar universities that share many of the same characteristics, that compete with each other, sometimes improving over time and sometimes not, but all of whom operate within groups that are substantially and often indistinguishably similar. In America we struggle to determine what we mean by a "good" university, and since we cannot make up our minds, we collect data of varying quality and imagine that by using clever statistical methods we can turn incompatible data into a single golden number that will tell us that the number 5 university is twice as good as the number 10 university. This is magical thinking but immensely popular and profitable for those who pursue such alchemy.[9]

CHANGE AND STABILITY IN THE AMERICAN RESEARCH UNIVERSITY MARKETPLACE

Recognizing the many changes and much innovation taking place throughout American higher education, the sector of highly competitive research university remains nonetheless remarkably stable. In our latest annual report (2017), we have identified some 158 universities (public and private) with over $40 million in federal science and engineering expenditures in 2015. This group represents about 19% of the academic institutions spending federal research funds and captures about 92% of the federal research expenditures reported by all these institutions. This relationship with minor variations has remained stable for over at least a decade and a half.[10]

This stability is all the more remarkable given the many innovations and changes that have characterized the instructional and financial context of all of American higher education. Research universities constitute a special category among the many components of the American post-secondary marketplace. Their significance and visibility sometimes appear much greater than their participation levels in many parts of the higher education community. For example, out of the 2,317 four-year higher education institutions (excluding for profit enterprises), the top group of 158 research universities in our data used for this discussion constitutes only 7% of the institutions and enrolls something on the order of 3.6 million students, representing only about 28% of the 12.8 million students enrolled at all levels of public and private non-profit 4-year and above institutions. However, because they represent a highly visible and prestigious cluster of universities, many capturing exceptional visibility through their intercollegiate sports programs, and because their doctoral programs produce a constant stream of instructors and faculty throughout the higher education industry and with a significant presence in may sectors of the national economy, what takes place on these campuses often dominates the public conversation about higher education.[11]

There are many ways to highlight the stability of these research universities, and to recognize their long-standing significance within the post-secondary marketplace. The model of research university success that focuses on the capture of federal and other research dollars, the acquisition of highly qualified and productive faculty, and the development of other related assets, encouraged us to review the performance of the top research institutions over time to illustrate their success in maintaining their preeminence.[12]

THE PLACE OF THE TOP RESEARCH UNIVERSITIES IN THE RESEARCH MARKETPLACE

For this illustration we have taken our top group of academic research institutions in 2015 (defined by MUP as those with over $40M in annual federal research expenditures) and looked back in time to see if their dominant position remained stable over the last decade or so when much of the current conversation about institutional transformations and the restructuring of the academic marketplace has taken place. Some 158 fall into our top category of over $40M in 2015. We compare the performance of these 158 institutions, tracked back at intervals through 2003 on our measures, to the 962 institutions that spent any federal research funds within a five-year period between 2011 and 2015.

In our data we start with federal research expenditures as reported by NSF and adjusted by the MUP staff to ensure a consistent single-campus comparison. In recent years, NSF guidelines have more closely matched our definition

of single campus institutions for reporting purposes, thereby reducing the number of adjustments we needed to make. Table 1 below illustrates that the top academic institutions, representing 19% of the research university pool, captured a stable share of federal research from 2003 through 2015 at 90% to 92%.[13]

Total research expenditures include both federal and non-federal funds (state and local and other sourced expenditures reported by institutions, some of which are peer reviewed and some of which are not). These resources reflect a larger pool of funds, many from local and state sources, and their distribution offers a profile similar to the more competitive federal research expenditures as illustrated by the following Table 2. Over time, the percent share of the top institutions has declined from 25% in 2003 to 18% in 2015, likely the result in part of intense competition from less research-intensive institutions with good access to local and state funds and in part the consequence of an increase in the number of institutions from which data are collected.

Because a strong institutional financial base is necessary for the support of highly competitive research universities, we have used endowment assets as a proxy for institutional wealth. This is of course only an indicator since a number for the true wealth of institutions is exceptionally difficult to acquire in any consistent or comparable fashion. Nonetheless, this indicator offers an illustration of the ability of these institutions to capture a strong position within the domain of private fund raising for endowment at a steady 75% of all endowment assets recorded for institutions that participate in the research marketplace despite making up less than one-fourth of the research university population as is illustrated in Table 3 below. Not surprisingly, the data on annual giving shows a similar pattern.[14]

Faculty quality is another indicator of research university competitive success. While it is difficult to identify fully reliable measures of the achievements of university faculty in a comparative context, we have two indicators that serve to highlight the concentration of nationally recognized faculty in research institutions. One is the number of National Academy members in each institution. As the following table illustrates, National Academy members are heavily concentrated in the top research group as we might expect. A steady proportion of 97% of the National Academy members are in the over $40M group, although only 68% of the institutions in this group have faculty with these distinc-

Table 1. Federal Research

Institutions Reporting Any Federal Research in 2011-2015	2015 (in 000s)	Percent Share	2011 (in 000s)	Percent Share	2007 (in 000s)	Percent Share	2003 (in 000s)	Percent Share
Total Federal Research Expenditures	$36,815,202		$39,614,834		$30,374,171		$24,700,369	
Over $40M Group*	$33,730,208	92%	$35,496,476	90%	$27,194,103	90%	$22,182,180	90%
Number of Institutions with Federal Research	853		879		667		627	
Over $40M Group	158	19%	158	18%	157	24%	156	25%

*Institutions with more than $40 million in 2015 federal research expenditures.

Table 2. Total Research

Institutions Reporting Any Federal Research in 2011-2015	2015 (in 000s)	Percent Share	2011 (in 000s)	Percent Share	2007 (in 000s)	Percent Share	2003 (in 000s)	Percent Share
Total Research Expenditures	$65,024,118		$61,832,669		$49,374,619		$39,971,165	
Over $40M Group	$58,639,298	90%	$54,560,851	88%	$43,887,088	89%	$35,556,791	89%
Number of Institutions with Any Research	874		890		670		631	
Over $40M Group	158	18%	158	18%	157	23%	156	25%

Table 3. Total Endowment and Annual Giving

Institutions Reporting Any Federal Research in 2011-2015	2015 (in 000s)	Percent Share	2011 (in 000s)	Percent Share	2007 (in 000s)	Percent Share	2003 (in 000s)	Percent Share
Total Endowment Assets	$498,497,085		$384,567,427		$388,083,120		$211,499,504	
Over $40M Group	$374,223,994	75%	$287,447,059	75%	$290,816,235	75%	$153,511,476	73%
Number of Institutions Reporting Endowment	707		695		678		664	
Over $40M Group	154	22%	154	22%	153	23%	152	23%
Total Annual Giving	$32,068,451		$24,803,431		$23,556,287		$18,642,760	
Over $40M Group	$25,138,592	78%	$18,853,365	76%	$17,197,735	73%	$13,327,450	71%
Number of Institutions Reporting Giving	614		629		621		630	
Over $40M Group	153	25%	153	24%	144	23%	148	23%

tions as is illustrated in Table 4. This is a reflection of the concentration of National Academy members in a small number of institutions. About half of these individuals are in the 14 institutions that have over 100 National Academy members.

A second faculty indicator includes faculty who have received a variety of scholarly awards (outlined in detail on the MUP website and in the annual publication). These awards are for distinction in a wide range of fields, not just those in the sciences and engineering. Again, the over $40M institutions capture around 79% of the faculty awards even though they represent only 35% of all institutions having faculty with these awards as seen in Table 5. Of particular note here, 271 institutions not in the over $40M group nonetheless have high quality faculty who win these awards.

These indicators of quality concentration within the top research institutions focus primarily on elements associated with what we could call the published research enterprise. That is, the activities of the university's people that end up as published books and articles contributing to the advancement of knowledge. Much of that is identified by the proxy of federal research and other elements associated with the faculty who are the primary drivers of this work. At the same time, however, these institutions sustain undergraduate enterprises, often of large size, and compete with other research institutions as well as liberal arts colleges for outstanding students. Again, data on the quality of incoming students is elusive, but the selectivity of colleges is often linked to the scores on the SAT or its equivalent. While of course the SAT has many defects as an indicator of likely undergraduate student success it does serve as a surrogate indicator of institutional undergraduate selectivity.

In our observation of research universities it appears likely that many high performing research faculty and staff not only seek institutions that can support their research ambitions but likely prefer to participate in the life of institutions with high quality students. The following table provides a glimpse into the differential attractiveness of research universities for high SAT students. Note, however, that in this case the research university advantage is relatively less impressive, as many colleges with minimal research profiles nonetheless capture a significant number of high SAT applicants. The over $40M group has an SAT advantage of only 145 points over institutions outside this group, a premium of around 13%. See Table 6 below. Not all universities that fall into our group of research institutions require or provide SAT data, so these numbers should only be taken as general indicators.

Table 4. National Academy Members

Institutions Reporting Any Federal Research in 2011-2015	2015	Percent Share	2011	Percent Share	2007	Percent Share	2003	Percent Share
Total Academy Members	4,747		4,350		3,937		3,584	
Over $40M Group	4,590	97%	4,204	97%	3,818	97%	3,479	97%
Number of Institutions with Members	214		210		197		186	
Over $40M Group	146	68%	147	70%	142	72%	133	72%

Table 5. Faculty Awards

Institutions Reporting Any Federal Research in 2011-2015	2015	Percent Share	2011	Percent Share	2007	Percent Share	2003	Percent Share
Total Faculty Awards	2,391		2,450		2,489		2,370	
Over $40M Group	1,896	79%	1,914	78%	1,976	79%	1,848	78%
Number of Institutions with Awards	415		433		422		442	
Over $40M Group	144	35%	148	34%	148	35%	149	34%

Table 6. Median SAT Score

Institutions Reporting Any Federal Research in Past Five Years	2015	Net Difference	2011	Net Difference	2007	Net Difference	2003	Net Difference
Average Median SAT	1102		1103		1095		1107	
Over $40M Group	1247	145	1231	128	1210	115	1207	100
Number of Institutions Reporting SAT	693		765		782		692	
Over $40M Group	125		126		129		127	
Percent Premium for Over $40M Group		13%		12%		11%		9%

Scale is an important element underlying research university success, in large part because sufficient scale helps spread the costs of research support and infrastructure over a larger number of projects, faculty, and research programs. Many research institutions have significant undergraduate student bodies whose numbers drive resources and support the teaching and other work associated with instruction that often provide an employment buffer for faculty whose research productivity may have declined but whose intellectual vitality remains strong. In many cases, as well, research faculty with highly successful programs and full funding nonetheless teach students at the undergraduate and graduate level, and offset some costs associated with their faculty salaries.

As the following table illustrates, the top research universities have over a third of the undergraduate and graduate students enrolled in all the institutions with any federal research expenditures. These top institutions have a somewhat lower percentage of undergraduates than the entire group, but a higher percentage of graduate students. However, the top research universities have about three times the median size of undergraduate population and about four times the median size of graduate population than the group as a whole. See Table 7.

Reflecting this emphasis on graduate education, the next table shows the expected distribution of degrees, with the top institutions in the over $40M group producing the smallest percentage of associate degrees, over a third of the bachelor's degrees, almost half the master's degrees, just over half the professional degrees, and over three quarters of the doctorate degrees. Since the over $40M group is just under one-fifth of the institutions included in this illustration, it is clear that they make a major impact on the degree production of all institutions with any participation in the federal research competition. See Table 8.

IMPACT OF THE CONTEMPORARY CONTEXT FOR HIGHER EDUCATION

These illustrations highlight the distinctiveness of the top American research universities within the context of the US higher education marketplace. They help us understand that general concerns about the trends and transformations affecting post-secondary schooling do not necessarily affect all institutions in the same way. Some vulnerabilities highlighted in the popular press do not apply to these institutions. Unlike many business enterprises, universities and especially research universities are generally long-term

Table 7. Student Enrollment

Institutions Reporting Any Federal Research in 2011-2015	2015 Total Students	2015 Total Undergraduates	2015 Total Graduate	Percent Undergraduate	Percent Graduate
Total Students	9,352,140	7,219,690	2,132,450	77%	23%
Over $40M Group	3,578,592	2,534,000	1,044,592	71%	29%
Percent Share for Over $40M Group	38%	35%	49%		
Median Fall Enrollment	5,826	4,743	1,412	81%	24%
Over $40M Group	23,104	17,498	5,926	76%	26%

Table 8. Degrees

Institutions Reporting Any Federal Research in 2011-2015	2015 Associate's	2015 Bachelor's	2015 Master's	2015 Doctorate	2015 Professional
Total Degrees	38,056	1,535,078	546,001	61,468	89,367
Over $40M Group	4,778	598,434	253,081	46,103	47,066
Percent Share for Over $40M Group	13%	39%	46%	75%	53%
Median Degrees	39	993	347	48	145
Over $40M Group	30	3,799	1,332	244	307

operations, and except for the smallest, usually private, colleges they are not at risk of economic collapse. Only a few non-profit institutions, especially small private colleges, heavily dependent on tuition revenue and without significant endowment, face the risk of imminent failure. The table included here provides a sense of the scale of institutional failures in recent years. Although these occurrences occasion much comment, the numbers, within the context of over 2,400 four-year institutions is not large as is clear in Table 9 below. [15]

Nonetheless, the major research institutions, while at no risk of failure and operating stable competitive enterprises, struggle constantly with the challenge of maintaining the scale of their operations through continuous adjustments on the margin. They engage in constant innovation, pursue opportunities of every kind made available by expanding technological capabilities, seek economies in operation through outsourcing, pursue revenue opportunities wherever they can be found, and constantly adjust their undergraduate programs to continue to capture the best possible students while expanding the diversity of their student bodies.[16]

Taken as productive organizations, research universities manage a wide range of product lines of dramatically varying profitability. Some generate net costs to the institution such as research and, for most institutions, intercollegiate sports. Some generate profits for the college such as undergraduate enrollment for public institutions with state funding and significant alumni support, stock market returns for private universities and private fund raising for all institutions. Of the characteristics that define these institutions, their resiliency over the years in the face of financial challenges is perhaps one of the most interesting.

A rational model of university operation that focused on return on investment or some other measurable utility function derived from commercial business enterprises would surely underestimate the value of the intangible products of the institutions that help explain their long-term behavior. It is possible that the stress of the current financial condition of American higher education will change the commitment to research that currently characterizes many institutions, but how these changes could produce a major re-framing of the American higher education marketplace is not yet clear.

LIKELY RESTRUCTURING OF THE HIGHER EDUCATION MARKETPLACE

In addressing these issues, it is important to emphasize again that American higher education is composed of quite distinct sectors. While they may have fuzzy boundaries, they are nonetheless substantially different in their organization, personnel composition, financial structures, opportunities, and expectations. Each of these sectors will respond to the current and likely future financial and demographic constraints by readjusting their operational models to meet changing public and private expectations in significantly different ways. Some will reconfigure their activities to acquire the efficiencies of sophisticated technologies and generate revenue by capturing currently under-served populations with low cost high volume enterprises. The traditional model of tenured professors defining the substance of the academic enterprise is already seriously modified at many institutions below the most prestigious and the ability of many universities to sustain a significant research presence will decline. Demographic trends will also have an impact although NCES projects continued stability and growth in the college age population through 2025.

Perhaps the most significant impact on the higher education marketplace will be the continued challenge in the public sector as states struggle to find sufficient revenue to meet their many required obligations, leaving in many cases little discretionary tax-based income for colleges. In any event, over time, the current higher education marketplace will continue to evolve into distinct operational sectors following different priorities (whatever their public relations rhetoric), with considerable turmoil at the boundaries. A wide range of quantitative indicators illustrate how much of that transformation is already well underway, even though the process is obscured by a media focus on elite institutions competing for small advantages among themselves and on exemplary or crisis driven individual institutional cases.

Table 9. Closures Among 4-Year Non-Profit Postsecondary Institutions

Year Closed	Public	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
Six-Year Total	**2**	**21**

The top American research universities will continue their dominance of the upper end of the higher education spectrum. The current model as described here is surely sustainable. Those already among the top 150 to 200 institutions will likely continue to prosper although a few at the lower edges of this group may find it difficult to continue to keep pace with the top producers. Their faculty will remain highly tenured and predominately full-time although we may see various types of rolling term contracts for faculty in some fields. Moreover, it is possible that the context for major fund raising, a critical element in the financial structure of all major research universities, will encounter political difficulties as legislators seek the elimination of various tax deductions that have benefited research universities as a means to generate revenue that would support the campaigns to reduce tax rates on businesses and individuals.[17]

Another group of primarily public, comprehensive universities with some significant research presence will also prosper by diversifying into a wide range of occupational, masters, and technology enabled programs. They will have substantial undergraduate programs, extensive masters and certificate programs, and many professional programs. They will sponsor research in some areas but not at the intensity of the top universities. Their faculty will become more heavily contingent with the development of a variety of term contract faculty arrangements, in most cases developed through extensive negotiations with unions.

A group of smaller public and private institutions will struggle to maintain sufficient enrollment to prosper. They will expand into masters and certificate programs, seek economies with extensive outsourcing of a wide range of university services, and continue the trend to increasingly contingent faculty. They will experiment with various tuition/fee arrangements and discount and financial aid processes. Some private institutions in this group may fail and close or be absorbed by competitors, but the public institutions on the margin will more likely be consolidated into larger system entities rather than disappear.

A special category of small prestigious and heavily endowed private colleges will continue to prosper with an emphasis on highly qualified tenured faculty, elaborate programs and facilities, and high demand from students. These elite institutions will also continue to compete with the top research universities (public and private) for the most qualified undergraduate students. Many will also develop master's programs in many areas.

These categories will be very confusing at the boundaries, and many institutions will compete partially in one category and partially in another. However, in every case, the American higher education marketplace is likely to continue the trend that emphasizes the spread between elite institutions and non-elite institutions, between primarily academic and primarily occupationally centered institutions. Throughout, the controversies over elitism, diversity, inclusion, employability, and cost will remain a constant subtext in all discussions about the US higher education industry.[18]

Recent work has highlighted the economic basis for these changes, illustrating through sophisticated modeling the relationships between enrollment, tuition, other funding sources, and institutional expense categories. Such a model clearly shows that while the research university elite is likely to be able to continue to dominate the top echelon of name brand higher education, other institutions will find it increasingly difficult to compete within the tradition model defined by the research university sector. Major change will surely characterize those institutions below the top prestige institutions, with much creativity, innovation, new styles of instruction, higher investments in technology enable instruction, and an increased emphasis on occupational specialties within the traditional college and master's degree curricula.[19]

None of the innovations taking place below the top university level are likely to challenge the dominance of the major institutional performers. Any innovation that offers an opportunity for increased revenue or enhanced brand value, that reaches a new and profitable audience, will in almost all cases be immediately adopted and branded by a high prestige institution, often allowing the top institutions to siphon off some of the highest value transactions associated with these new ventures. This has occurred already with the evolution of some forms of distance education, and has been characteristic of high value, high priced niche certificate programs.

Finally, it is important to reemphasize that American higher education is a very stable industry with institutions with long histories and deep constituencies. While much is written about crisis and the challenges of rapid change, the American higher education industry has weathered a wide range of cultural, economic, political, and demographic changes over its long history with remarkable staying power. Even as the critiques about the value and cost of an American higher education multiply, the demand for a college education continues to rise. The simple lifetime earnings premium that a college education provides individuals guarantees that even as the higher education industry adapts tomorrow as it did yesterday to many changes in its environment, it will remain a core component of the American economic system.[20]

1 The Center for Measuring University Performance (MUP) has had a continuing interest in the process of university rankings. See the following series of papers from the MUP Center on this topic: Diane D. Craig and John V. Lombardi. "The Best American Research Universities, Rankings: Four Perspectives, *The Top American Research Universities* (TARU) (2013), Craig and Lombardi; "Measuring Research Performance: National and International Perspectives," TARU (2012); Lombardi, "In Pursuit of Number ONE," *TARU* (2010); Lombardi and Elizabeth D. Capaldi," Rankings, Competition, and the Evolving American University," *TARU* (2007); Lombardi, Craig, Capaldi, and Denise S. Gater, "The Myth of Number One: Indicators of Research University Performance, *TARU* (2000). Institutional selectivity is variously measured, sometimes by rejection/acceptance rates (with the possibility of institutional manipulation) and more commonly by median SAT (or equivalent) scores of admitted students. For data on SAT for research universities see: "SAT Scores (2003-2013)," MUP website [http://mup.umass.edu]. See also Gater, "The Competition for Top Undergraduates by America's Colleges and Universities," *TheCenter Reports* (May 2001) [http://mup.umass.edu/publications].

2 The following quotes from some of these websites are illustrative (emphasis added). From the Williams College website [https://employment.williams.edu/faculty/ (10/20/2017)] we have this general statement: "The members of Williams College's accomplished and diverse faculty are strongly committed to original **research** and artistic creation and to teaching undergraduates from a rich variety of backgrounds and experiences." The Amherst College website highlights this competitive context with the following general statement and some characteristic faculty profiles [https://employment.williams.edu/faculty/ (10/20/2017) "Amherst College faculty are foremost authorities in their fields, yet are exceptionally approachable." Amherst College Faculty Profiles: on a Professor of Economics: "Her **research** focuses on public health and social impacts of environmental pollution, malpractice and physician behavior, factors influencing judicial decision-making, and other topics in applied microeconomics. " On an Assistant Professor: "my **research** focuses on the intersection of market culture, institutions and state formation during this transitional period, in particular the relationship between court and commerce in the Low Countries where the aforementioned issues came together in dramatic and critical fashion." On another Professor:"My **research** focuses on Latin American cinema, and my contributions to the field include a book on Cuba's foremost film director … and the first comprehensive history of Latin American narrative cinema …" Another Professor: "Most of my research involves algebraic geometry, which is the field of mathematics that studies geometric objects by means of algebra. Some aspects of my work are very abstract, while others are more computational and applied. "Similar credentials are offered online [https://www.oxy.edu/faculty (10/20/2017)] for the faculty of a west coast competitor, Occidental College Professor: "Environmental Economist whose **research** falls into three areas: recycling, evaluation of environmental programs, and energy and climate policy." Associate Professor: "Her **research** interests include synapse formation, axon transport, and regulation of neuronal microtubules. She uses a combination of genetic, molecular biology, and cell biology techniques to study nervous system development using the nematode C. elegans as a model organism." Professor: "...**Research** areas are computational aerodynamics, scientific computation, numerical analysis, mathematical modeling of physical phenomena, and applying mathematics to 'real world' situations. He has published several articles in various peer-reviewed journals," [https://www.oxy.edu/faculty (10/20/2017)]

3 On state support see *State Higher Education Finance (SHEF) FY 2017*, State Higher Education Executive Officers, 2018; and Ingrid Schroeder, et al. *Federal and State Funding of Higher Education: A Changing Landscape*, (Pew Charitable Trusts, 2015). Of particular interest is the current controversy over funding the University of California System, see: Kevin Cook, "A Long-term View of Higher Education Funding," Public Policy Institute of California (August 16, 2018) and John Aubrey Douglass and Zachary Bleemer, "Approaching a Tipping Point? A History and Prospectus of Funding for the University of California," University of California, Berkeley, August 20, 2018. On tuition and fees over time see: "Tuition and Fees, 1999-2000 to 2012-2013," *Chronicle of Higher Education*, (October 24, 2012). For the current structure of tuition discounting see: *NACUBO 2017 Tuition Discounting Study*, National Association of College and University Business Officers, (Washington, DC, 2018); Lucie Lapovsky, "Phantom Dollars: Findings from 1996 NACUBO Tuition Discounting Survey," *NACUBO Business Officer*, March 1997; Sandy Baum, Lucie Lapovsky, and Jennifer Ma, *Tuition Discounting: Institutional Aid Patterns at Public and Private Colleges and Universities, 2000-01 to 2008-09* (The College Board, 2010). An example of the controversies over university debt load see Charlie Eaton, et al. "Swapping our Future: How Students and Taxpayers are Funding Risky UC Borrowing and Wall Street Profits" in "Critical Approaches to Financialization (*Berkeley Journal of Sociology*, 57, 2013), pp. 178-199; and Josh Freedman, "The Hidden College Problem: When Universities, Not Just Students, Take On Debt," Forbes (March 19, 2014). See also Robert C. Lowry, "Subsidizing Institutions vs. Outputs vs. Individuals: States' Choices for Financing Public Postsecondary Education," *Journal of Public Administration Research and Theory*, (2016). A labor union perspective on public funding for higher education is in *A Decade of Neglect. Public Education Funding in the Aftermath of the Great Recession*, AFT (2018).

4 Heidi Ledford, "Keeping The Lights On. Every Year, the US Government Gives Research Institutions Billions of Dollars Towards Infrastructure And Administrative Support. A Nature Investigation Reveals Who Is Benefiting Most," Nature (19 November 2014) [http://www.nature.com/news/indirect-costs-keeping-the-lights-on-1.16376] *Basic Scientific and Engineering Research at U.S. Universities, AAU Data and Policy Brief* (February 2015, No 1) [https://www.aau.edu/sites/default/files/AAU%20Files/AAU%20Documents/BasicResearchPaper-FINAL.pdf]

5 Lombardi, Craig, Capaldi, Gater, Sarah L. Mendonça,"Quality Engines: The Competitive Context for Research Universities," *The Top American Research Universities, 2001 Annual Report*.

6 Federal expenditures is but one of nine measures used and The MUP Center has produced these data since its first publication as described in Lombardi, Craig, Capaldi, and Gater, "The Myth of Number One: Indicators of Research University Performance," *TARU* (2000) cited above. Over the years we have revisited these indicators, and viewed the data from different perspectives. See for example Lombardi, Capaldi, Denise S. Mirka, Craig W. Abbey, "Deconstructing University Rankings: Medicine and Engineering, and Single Campus Research Competitiveness," (*TARU*, 2005 Corrected). See also the review of the results of including non-Science and Engineering federal funding in a measure of research university competitiveness in Craig and Lombardi, "Tracking Academic Research Funding: The Competitive Context for the Last Ten Years," *TARU* (2014). In the Source Notes and Data Notes included in each edition of the *Top American Research Universities* [http://mup.umass.edu] we provide a discussion of the validity of the data used in these publications and web-based data tables as well as a review of any data adjustments made. For some considerations on the various data elements for measuring research university performance see: Gater, "Using National Data in University Rankings and Comparisons," (TheCenter Reports, June 2003); Gater, "A Review of Measures Used in U.S. News & World Report's America's Best Colleges" (TheCenter, Summer 2002); Gater and Lombardi, "The Use of IPEDS/AAUP Faculty Data in Institutional Peer Comparisons," (TheCenter Reports, 2001).

7 Of the 158 academic institutions in our top group of over $40M in federal research expenditures in our most recent report (2017, reflecting 2015 expenditures), 70 percent or 110 are public [http://mup.umass.edu/University-Data].

8 It is exceptionally difficult to get good comparable data on university finance. Public and private institutions report their results differently, accounting standards vary, state funding structures for public institutions also differ by state with some items carried as state general obligations in some places and on the institution's books in others. While it is clear that money matters and research universities require a substantial financial base to compete effectively, some creative estimates are necessary to approximate an analysis. We attempted such an analysis in Lombardi, Craig, Capaldi-Phillips, and Gater, "University Organization, Governance, and Competitiveness," *The Top American Research Universities, 2002 Annual Report*. In this experiment, which also included a discussion of the impact of institutional organizational structure, we could illustrate the close relationship between university wealth and competitive research performance.

9 In addition to the items in note 1 above, the following offer some perspective on the challenges associated with various ranking schemes. See for example: Christopher Claassen, "Measuring University Quality," *Scientometrics* (2015, 104); Shari L. Gnolek, Vincenzo T. Falciano, and Ralph W. Kuncl, "Modeling Change and Variation in U.S. News & World Report College Rankings: What Would It Really Take to be in the Top 20?" *Research in Higher Education* (May 2014); Ellen Hazelkorn, "Reflections on a Decade of Global Rankings: What We've Learned and Outstanding Issues," *European Journal of Education* (9:1, 2014); Andrejs Rauhvargers, "Global University Rankings and their Impact: Report II European University Association," 2013; *IREG Ranking Audit Manual*, IREG Observatory on Academic Ranking and Excellence. International Ranking Expert Group, Warsaw, Poland (November 2011); Michael Sauder and Wendy Nelson Espeland, "The Discipline of Rankings: Tight Coupling and Organizational Change," *American Sociological Review* (74, 2009).

10 The apparent stability of the top research university group does not, however, mean that they are exempt from competition among themselves. In a study published in the MUP 2011 annual report we explored a number of the elements characterizing the competition within this top group and charted the changes in the indicator of federal research expenditures over time. In that study it is clear that the barriers to dramatic changes in the composition of this group are quite significant. Craig and Lombardi, "Moving Up: The Marketplace for Federal Research in America," *The Top American Research Universities, 2011 Annual Report*.

11 The total number of students is taken from NCES *Digest of Education Statistics*, 2016 Tables and Figures, Table 317.40, for Fall 2015. The number of students in the top research universities is taken from the IPEDS 2015 Fall Enrollment Survey. Note that NCES uses the Carnegie Classifications for research universities (see the note to the table cited above from NCES) which is similar to our own Top American Research Universities, but not identical. In the 2003 MUP annual report, we produced a thorough analysis of "The Sports Imperative in America's Research Universities" (Lombardi et al., MUP, 2003) The general analysis and conclusions of this report remain even more relevant today as the significance of the intercollegiate sports enterprise continues to expand and research universities appear determined to capture a predominant place in this domain.

12 For another related perspective on the stability of America's top research universities see Lombardi and Craig, "American Research University in an Era of Change: 2006-2015," *The Top American Research Universities, 2016 Annual Report*.

13 Federal research expenditure data is influenced by the fields for which congress appropriates money to federal agencies. Over the recent decades, the investment in medically related research has been the dominant field above all others. Of the almost $70 billion in Federal R&D obligations estimated for 2017 about $33 billion is in life sciences areas. Institutions with research intensive medical centers or standalone academic medical centers have an advantage in the competition for this large segment of federal research funds. See: Table 19. Federal obligations for research, by detailed field of science and engineering: FYs 2015–17 at [https://ncsesdata.nsf.gov/fedfunds/2015/html/FFS2015_DST_019.html]. However, not all academic institutions with medical schools benefit since many medical schools are not research intensive. For a discussion of the impact of medical schools on university research funding see "University Rankings: Medicine and Engineering, and Single Campus Research Competitiveness," (2005 Corrected) cited in note 6 above.

14 For a discussion of the challenges involved in calculating institutional wealth see note 9 above. NCES data on the financial structure of colleges and universities has many difficulties, most indicated in the notes to the tables published there. Of particular concern are the expenditure data, much used in the popular press and key to the often cited work of the Delta Cost Project of the American Institutes for Research (Washington, DC, 2017). The accounting systems of the individual universities on which the NCES and Delta Cost Project expenditure data are based, do not have sufficient detail or consistency between public and private institutions to support clear analysis of institutional expenses by such categories as instruction and research. See: Ozan Jaquette, and Edna Parra, "The Problem with the Delta Cost Project Database," *Research in Higher Education*, (March 30, 2015).

15 The specter of college failure is of such interest in large part because so few actually die. In recent years the number of small college failures has attracted considerable attention from the higher education press as is evident in the following selection of articles: Kellie Woodhouse, "Mills College Struggles with Financial Difficulty, Faculty Unrest as President Calls it Quits," *Inside Higher Ed* (May 12, 2015); Dawn Lyken-Segosebe and Justin Cole Shepherd. "Learning from Closed Institutions: Indicators of Risk for Small Private Colleges and Universities," *Higher Education Leadership and Policy Studies*, Vanderbilt University, (July 2013); Stephen R. Porter, "Why do colleges fail? An Analysis of College and University Closings and Mergers, 1975-2005," Department of Educational Leadership and Policy Studies, Iowa State University, 2009; Lawrence Biemiller, "Is Sweet Briar's Closure a Warning Sign for Other Small Colleges?" *The Chronicle of Higher Education* (March 3, 2015); Biemiller, "Survival at Stake In the Aftermath of the Recession, Small Colleges Adapt to a New Market," *The Chronicle of Higher Education* (March 2, 2015); Eric Kelderman,."The Plight of the Public Regional College," *The Chronicle of Higher Education* (November 19, 2014); Ry Rivard." Public HBCUs, Facing Tests on Many Fronts, Fight for Survival," *Inside Higher Ed* (June 24, 2014); Scott Jaschik, "Deal Will Save Sweet Briar College," *Inside Higher Ed* (June 20, 2015); Kellie Woodhouse, "Enrollment Declines Drove Closure of Marian Court College," *Inside Higher Ed* (June 18, 2015); Beth McMurtrie,"Why Is It So Hard to Kill a College?" *The Chronicle of Higher Education* (June 29, 2015); Amemona Hartocollis, "At Small Colleges, Harsh Lessons About Cash Flow," *The New York Times* (April 29, 2016); James Rushing Daniel, "Crisis at the HBCU," *Composition Studies* (44.2, 2016). The table is drawn from Table 317.50 of the NCES *Digest of Education Statistics*, 2016 highlights the issue of college closing, a primarily private, small college phenomenon.

16 One of the key indicators of the challenge of maintaining the financial base of the highly competitive research universities is the expansion of ambitious fund raising campaigns. Although private universities have been in the many million to billion dollar campaign business for many years, the top public research universities, recognizing the weakness of their state funding base, have also developed outstanding fund raising organizations over the past decades. Today, multi-billion dollar comprehensive fund raising campaigns are the norm for public research universities. See Rick Seltzer, "Colleges And Universities Set High Targets in Latest Fund-Raising Campaigns," *Inside Higher Ed* (October 17, 2017).

17 Many institutions seek to participate at the highest levels of research performance and to improve their status within the research university environment. See for some commentary on this subject, Gary A. Olson, "What Institutions Gain From Higher Carnegie Status," *The Chronicle of Higher Education* (July 29, 2018); Eric Kelderman, "Is Climbing the Carnegie Research Rankings Worth the Price Tag?" *The Chronicle of Higher Education* (July 29, 2018).

18 The research universities also find themselves in a constant conversation on improving the quality and effectiveness of their graduate programs, with initiatives proposed that will no doubt raise the costs of graduate education, at least in the STEM fields, substantially. See Alan Leshner and Layne Scherer, Eds., *Graduate STEM Education for the 21st Century*, A Consensus Study Report of the National Academies of Science, Engineering, and Medicine (2018).

19 On modeling and predicting university futures see William B. Rouse, *Universities as Complex Enterprises: How Academia Works, Why It Works These Ways, and Where the University Enterprise Is Headed*. John Wiley & Sons (2016) and the forthcoming article mentioned above William B. Rouse, John V. Lombardi, and Diane D. Craig, "Modeling Research Universities: Predicting Probable Futures of Public vs. Private and Large vs. Small Research Universities" in the *Proceedings of the National Academy of Sciences* (ca. 2018).

20 The conversation about the constant institutional adjustment to challenges is reflected in two items from the higher education press: Eric Kelderman, "A Regional Public University Scales Back Its Research Ambitions," *The Chronicle of Higher Education* (October 20, 2011) and Lee Gardner "Public Regional Colleges Never Die. Can They Be Saved?" *The Chronicle of Higher Education* (April 30, 2017).

The Top American Research Universities

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