



University Mission and Research Productivity: How do Defining Institutional Characteristics Affect Research Output?

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Carnegie Classification of Institutions of Higher Education**



Center for Postsecondary Research



European Forum for
Studies of Policies
for Research and Innovatio

Overview

- Backstory – IR, IU, & the CCIHE
- Classification Considerations
- Missions, rankings and research productivity



Backstory – Institutional Research

- IR Practitioners in U.S.
 - Recognized profession, ~4750 members with ~2000 at annual forum
 - Diverse manifestations paralleling U.S. HEI/Mission differentiation
 - Agenda driven by priorities, culture, and organizational arrangements of specific HEIs
 - Common trends now impacting the work

Borden, V. M. H. & Hosch, B. J. (in press). Institutional Research and Themes, North America. In J.C. Shin, P. Teixeira (eds.), Encyclopedia of International Higher Education Systems and Institutions, https://doi.org/10.1007/978-94-017-9553-1_586-1



Backstory – Institutional Research

- Priority Topics
 - Student progress and outcomes
 - Learning outcomes assessment
 - College costs and return on investment
- Technologies and Tools
 - Data governance
 - Analytics and visualization
 - Assessing causation
- Working relationships
 - Diversified organizational contexts
 - Collaboration



Backstory – Indiana University

- Statewide university with 7 campuses
 - 100,000 students total
 - Bloomington – (45,000) Big 10, traditional, residential, “flagship” campus
 - IUPUI – urban research university, mostly commuter, more diverse students by age and race/ethnicity and with most of the health faculties (Medicine, Dentistry, Nursing, etc.) (30,000)
 - Five “regional” campuses averaging 5,000 students, two have limited campus housing, all enroll a large percent of nontraditional (older, independent, single parents, etc.)



Discover why IU's eight campuses are your gateway to opportunity.

IU Northwest

2,100 IU Northwest students connected with the needs of the community by contributing more than 126,000 service learning hours.

IU South Bend

The IU South Bend Civil Rights Heritage Center and its Engman Natatorium Project received the 2014 Freedom Award from the Martin Luther King Jr. Indiana Holiday Commission.

IU Kokomo

Ranked by *U.S. News and World Report* as among the best regional campuses in the Midwest for 2013.

IPFW

A Carnegie Community Engaged University that has served the higher education needs of northeast Indiana for nearly 50 years.

IUPUI

IUPUI has been named one of the top 30 non-Historically Black Colleges and Universities for minorities in the US.

IU East

U.S. News and World Report ranked IU East as the Most Connected College or University in Indiana and 56th Most Connected in the Nation.

IU Bloomington

The *Princeton Review* lists IU among the nation's leading "Colleges with a Conscience," based on social responsibility and service learning.

IU Southeast

Named a Military Friendly School by *G.I. Jobs* and Victory Media Inc. for the past four years.



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SOLAR ECLIPSE AT IU

When to look* and what you'll see:



IU Bloomington

12:57-3:49 p.m. ET
Peak: 2:25 p.m.



IU Northwest

11:54 a.m.-2:43 p.m. CT
Peak: 1:20 p.m.



IUPUI

12:57-3:48 p.m. ET
Peak: 2:25 p.m.



IUPUC

12:58-3:49 p.m. ET
Peak: 2:26 p.m.



IU East

1:00-3:50 p.m. ET
Peak: 2:27 p.m.



IU South Bend

12:57-3:44 p.m. ET
Peak: 2:22 p.m.



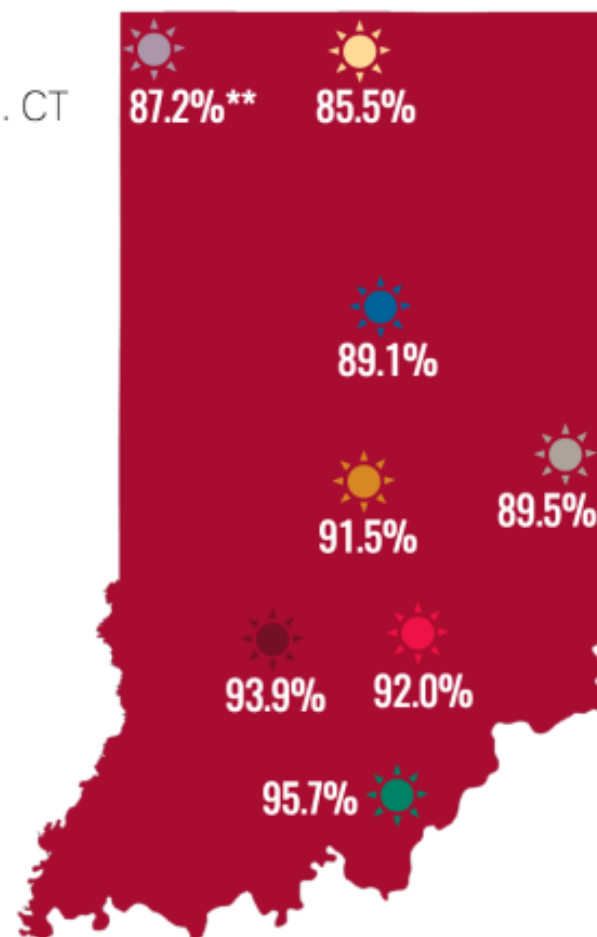
IU Kokomo

12:57-3:47 p.m. ET
Peak: 2:24 p.m.



IU Southeast

1:04-3:52 p.m. ET
Peak: 2:30 p.m.



*Don't look at the eclipse without proper eye protection, such as a certified solar viewer or a pinhole projector.

**Represents percentage of sun coverage.





Reporting of IUB and IUPUI across Rankings and Other Accountability Reporting Agencies

Ranking/Reporting Source	Bloomington	School of Med.	Rest of IUPUI
US News & World Report			
Best Colleges (undergraduate)	IUB reported separately	IUPUI/SoM as entity	
Best Graduate Schools		SoM Separate	IUPUI Separate
Global		IUPUI/SoM as entity	
ARWU (Shanghai Rankings)	Unknown		
Times Higher Ed	IU as a single entity (IUB/SoM/IUPUI)		
QS Top Universities	IU as a single entity (IUB/SoM/IUPUI)		
AAU Institutional Profile	IUB/SoM as entity		IUPUI Separate
Feds: National Center on Education Statistics	IUB separate	IUPUI/SoM as entity	
Feds: National Science Foundation	IUB separate	IUPUI/SoM as entity	
State: ICHE/Budget	IUB separate	IUPUI/Health	IUPUI/General

Inspired research correlating mission-related structural factors related to Times Higher Ed World Rankings and Academic Rankings of World Universities...



Backstory - Carnegie Classifications of Institutions of Higher Education (CCEIHE)

- Purposes

- ...identify categories of colleges and universities that would be relatively homogeneous with respect to the functions of the institutions as well as with respect to characteristics of students and faculty members

- Uses – Intended and Otherwise

- Federal reporting
- State government funding
- Grant/Association eligibility or requirements
- Teacher licensing
- German Doktor designation
- U.S. News & World Report Ranking Categories



McCormick, A. C. and Borden, V. M. H. (2017). Higher education institutions, types and classifications of. In J.C. Shin, P. Teixeira (eds.), Encyclopedia of International Higher Education Systems and Institutions, https://doi.org/10.1007/978-94-017-9553-1_22-1



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Critiques of the CCIHE

- HEIs are somewhat amorphous (the entity issue)
- Reliance on proxy measures
- A priori classifications, like CCIHE, require a stable industry so the criteria remain relevant
- There is more diversity within institutions than between them
- Encourages “mission creep” by virtue of the hierarchy of the research university category



Critiques of CCIHE (cont)

- Can be used for perverse purposes
 - Goodheart's law - Any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes
 - Campbell's law - when test scores become the goal of the teaching process, they both lose their value as indicators of educational status and distort the educational process in undesirable ways
- Idiographic approach requiring “expert judgement” that tends to preserve status quo
 - Nomothetic approaches avoid this but are subject to other significant limitations relating to available or collectable data



The “Competitors”

- Several US state and regional policy bodies have created similar but simpler groupings as pertinent to their purposes
- Zemsky et al. 5-category market based taxonomy of only bachelor's degree granting institutions 1997
- Brint et al. seven category based on judgments of college presidents
- Ruef & Nag empirical cluster analyses that had “softer edges” although was limited by available data
- U-Map – geared toward research universities using a dimensional approach but has significant data integrity problems



Why Has the CCIHE Survived?

- Balance between overly simplistic and too complex, especially at the general degree level
- Inclusive and non-voluntary, based on extent relatively reliable and valid data, collected by the federal government
- Has apparently been useful to state and federal government in their policy making, although use is quite sporadic
- U.S. News & World Report Rankings



Update History of the Carnegie Classification

- Carnegie Commission for Higher Education
 - 1973 – Initial release to public
 - 1976 – Update by original team
- The Boyer Years – Still episodic
 - 1987
 - 1994
- The McCormick / Zhao years – periodic and consistent
 - 2000 – Attempt to downsize Research/Doctoral to 2 categories
 - 2005 – Back to 3 R/D categories; introduce Associate's (14) categories; new “dimensional” classifications
 - 2010 – Chun-Mei Zhao implements without changes



The Basic and the Others

- Basic – legacy classification, primarily by degree level
- Five others introduced in 2005
 - Undergraduate Instructional Program Classification
 - Graduate Instructional Program Classification
 - Enrollment Profile Classification
 - Undergraduate Profile Classification
 - Size & Setting Classification
- Some IR practitioners use combinations of the classifications in peer benchmarking analyses



The IU-CPR Years, So Far

- 2015 – (Jan. 1) Classifications move to IU Center for Postsecondary Research
- 2015 – (Dec. 24) First CPR Update
 - Re-crafting Associate's Categories based on program and population mix
 - Decision to move to 3-year update cycle
- Moving to 3-year update cycle, starting 2018
- Run out of initial funding immediately after
- Positioning for future funding



History Chart

Original (1973) / 1976 / 1987	1994	2000	2005/2010	2015
Doctoral-Granting Universities Research Universities I Research Universities II Doctoral-Granting Universities I Doctoral-Granting Universities II	Doctorate-Granting Universities Research Universities I Research Universities II Doctoral Universities I Doctoral Universities II	Doctoral/Research Universities Doctoral/Research Universities - Extensive Doctoral/Research Universities - Intensive	Doctoral/Research Universities Research Universities (very high research activity) Research Universities (high research activity) Doctoral/Research Universities	Doctoral Universities Highest Research Activity Higher Research Activity Moderate Research Activity
Comprehensive Universities and Colleges Comprehensive Universities and Colleges I Comprehensive Universities and Colleges II	Master's (Comprehensive) Colleges and Universities Master's (Comprehensive) Colleges and Universities I Master's (Comprehensive) Colleges and Universities II	Master's Colleges and Universities Master's Colleges and Universities I Master's Colleges and Universities II	Master's Colleges and Universities Larger programs Medium programs Smaller programs	Master's Colleges and Universities Larger programs Medium programs Smaller programs
Liberal Arts Colleges Liberal Arts Colleges I Liberal Arts Colleges II	Baccalaureate Colleges Baccalaureate (Liberal Arts) Colleges I Baccalaureate Colleges II	Baccalaureate Colleges Liberal Arts General Baccalaureate/Associate's Colleges	Baccalaureate Colleges Arts & Sciences Diverse Fields Baccalaureate/Associate's Colleges	Baccalaureate Colleges Baccalaureate Colleges - Arts & Sciences Focus Baccalaureate Colleges - Diverse Fields Baccalaureate/Associate's Colleges Mixed Baccalaureate/Associate's Associate's Dominant
Two-Year Colleges and Institutes	Associate of Arts Colleges	Associate's Colleges	Associate's Colleges Public 4-year Primarily Associate's Private Not-for-profit 4-year Primarily Associate's Private For-profit 4-year Primarily Associate's Public Rural-serving Small Public Rural-serving Medium Public Rural-serving Large Public Suburban-serving Single Campus Public Suburban-serving Multicampus Public Urban-serving Single Campus Public Urban-serving Multicampus Public Special Use Private Not-for-profit Private For-profit Public 2-year colleges under 4-year universities	Associate's Colleges High Transfer-High Traditional High Transfer-Mixed Trad/Nontrad High Transfer-High Nontraditional Mixed Transfer/CareerTech-High Traditional Mixed Transfer/CareerTech-Mixed Trad/Nontrad Mixed Transfer/CareerTech-High Nontraditional High Career & Technical-High Traditional High Career & Technical-Mixed Trad/Nontrad High Career & Technical-High Nontraditional Special Focus - Two-Year Health Professions Technical Professions Arts & Design
Prof. Schools and Other Spec. Institutions Theological seminaries, Bible colleges and other institutions offering degrees in religion Medical schools and medical centers Other separate health profession schools Schools of engineering and technology Schools of business and management Schools of art, music, and design Schools of law Teachers colleges Other specialized institutions	Specialized Institutions Theological seminaries, Bible colleges and other institutions offering degrees in religion Medical schools and medical centers Other separate health profession schools Schools of engineering and technology Schools of business and management Schools of art, music, and design Schools of law Teachers colleges Other specialized institutions	Specialized Institutions Theological seminaries and other faith-related institutions Medical schools and medical centers Other separate health professions schools Schools of engineering and technology Schools of business and management Schools of art, music, and design Schools of law Teacher's colleges Other special-focus institutions	Special Focus Institutions Theological seminaries and other faith-related institutions Medical schools and medical centers Other health professions schools Schools of engineering Other technology-related schools Schools of business and management Schools of art, music, and design Schools of law Other special-focus institutions	Special Focus - Four Year Faith-Related Institutions Medical Schools & Centers Other Health Professions Schools Engineering Schools Other Technology-Related Schools Business & Management Schools Arts, Music & Design Schools Law Schools Other Special Focus Institutions
	Tribal Colleges and Universities	Tribal Colleges	Tribal Colleges	Tribal Colleges

The Future of CCIHE?

- Foundation funding most likely
 - Foundations have strong agendas
 - Research grant possibilities
 - The non-degree credential landscape (Lumina)
 - Comparative assessments with other systems (EU, China, elsewhere?)
 - Incorporating research metrics into the research activity index
 - Comprehensive focus on performance assessment
 - Supplementing the basic classification specifically for the purpose of accountability schemes



Classification & Performance Assessment

- To date - broad distinctions as related to...
 - Access to certain types of funds
 - Budgetary parameters
 - Distinctions as related to types of performance considered
 - Level of performance as related to student selectivity
 - Actual distinction of basis of performance
 - Elite institutions – graduate in 4 years; further education expectations
 - Access institutions – social mobility, populations served
- Going forward - ???
 - Current basis will not suffice

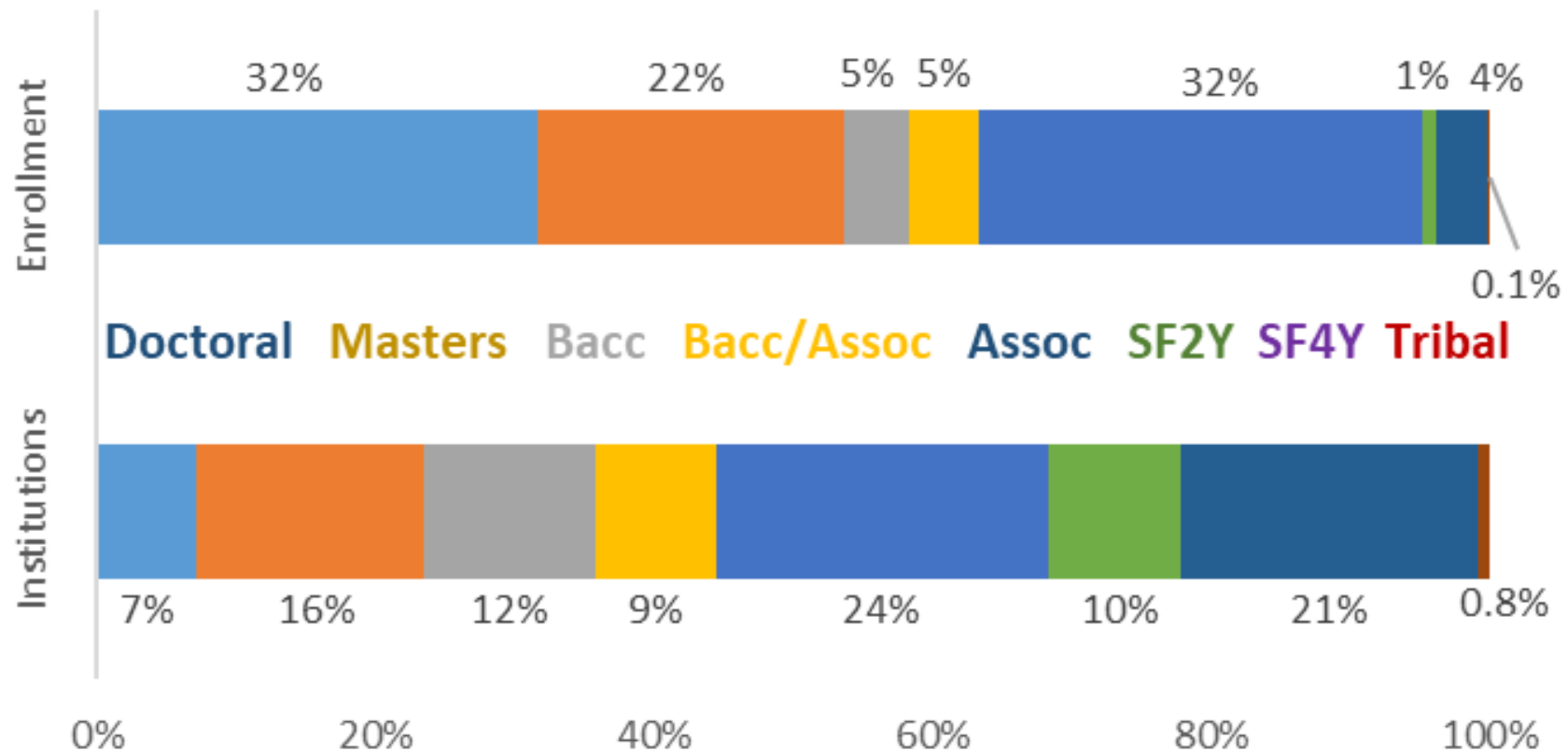


Basic Classification by Control

Category	Number of Institutions				Total Enrollment			
	Total	Public	non-profit	Private, for profit	Total	Public	Private, non-profit	Private, for profit
Doctoral Universities	334	196	122	16	6,469,991	4,685,549	1,403,803	380,639
Highest Research Activity	115	81	34	0	3,323,616	2,722,709	600,907	0
Higher Research Activity	107	76	31	0	1,691,059	1,362,536	328,523	0
Moderate Research Activity	112	39	57	16	1,455,316	600,304	474,373	380,639
Master's Colleges and Universities	763	273	426	64	4,505,453	2,472,206	1,611,340	421,907
Larger Programs	402	163	211	28	3,347,908	1,848,605	1,122,970	376,333
Medium Programs	215	68	129	18	789,022	422,479	337,147	29,396
Small Programs	146	42	86	18	368,523	201,122	151,223	16,178
Baccalaureate Colleges	572	100	424	48	956,928	302,237	624,881	29,810
Arts & Sciences Focus	246	27	218	1	409,682	66,822	342,611	249
Diverse Fields	326	73	206	47	547,246	235,415	282,270	29,561
Baccalaureate/Associate's Colleges	403	99	55	249	1,038,353	783,370	65,137	189,846
Mixed Baccalaureate/Associate's	254	36	46	172	406,352	203,006	60,481	142,865
Associate's Dominant	149	63	9	77	632,001	580,364	4,656	46,981
Associate's Colleges	1,113	899	28	186	6,524,819	6,388,471	16,274	120,074
High Transfer-High Traditional	166	155	9	2	1,477,288	1,472,562	4,132	594
High Transfer-Mixed Trad/Nontrad	127	125	2	0	1,308,139	1,307,512	627	0
High Transfer-High Nontrad	84	79	3	2	491,356	488,195	2,813	348
Mixed Trans/Career & Tech-High Trad	110	102	3	5	724,144	715,241	4,374	4,529
Mixed Trans/C&T-Mixed Trad/Nontrad	102	97	0	5	685,472	679,098	0	6,374
Mixed Trans/C&T-High Nontrad	130	120	0	10	828,743	826,577	0	2,166
High C&T-High Trad	87	55	3	29	279,923	245,398	988	33,537
High C&T-Mixed Trad/Nontrad	123	71	2	50	294,353	260,923	716	32,714
High C&T-High Nontrad	184	95	6	83	435,401	392,965	2,624	39,812
Special Focus Two-Year	444	10	52	382	204,321	9,027	12,415	182,879
Health Professions	267	6	23	238	127,910	4,377	5,179	118,354
Technical Professions	62	1	10	51	30,373	2,039	2,107	26,227
Arts & Design	41	0	9	32	17,005	0	2,006	14,999
Other Fields	74	3	10	61	29,033	2,611	3,123	23,299
Special Focus Four-Year	1,001	40	616	345	764,159	74,731	425,160	264,268
Faith-Related Institutions	308	0	308	0	97,143	0	97,143	0
Medical Schools & Centers	54	24	29	1	110,587	60,385	49,579	623
Other Health Professions Schools	261	5	135	121	195,996	4,751	101,067	90,178
Engineering Schools	7	1	5	1	11,452	2,798	8,128	526
Other Technology-Related Schools	70	0	5	65	42,207	0	17,168	25,039
Business & Management Schools	93	0	26	67	104,989	0	54,909	50,080
Arts, Music & Design Schools	137	4	57	76	151,593	4,089	60,779	86,725
Law Schools	36	6	24	6	23,587	2,708	16,438	4,441
Other Special Focus Institutions	35	0	27	8	26,605	0	19,949	6,656
Tribal Colleges	35	27	8	0	17,929	14,224	3,705	0
All Institutions	4,665	1,644	1,731	1,290	20,481,953	14,729,815	4,162,715	1,589,423



Basic Classification by Control



U.S. Research Universities

Category	Number of Institutions				Total Enrollment			
	Total	Public	non-profit	Private, for profit	Total	Public	Private, non-profit	Private, for profit
Doctoral Universities	334	196	122	16	6,469,991	4,685,549	1,403,803	380,639
Highest Research Activity	115	81	34	0	3,323,616	2,722,709	600,907	0
Higher Research Activity	107	76	31	0	1,691,059	1,362,536	328,523	0
Moderate Research Activity	112	39	57	16	1,455,316	600,304	474,373	380,639

Category	Number of Institutions			Total Enrollment		
	Total	Public	Private, non-profit	Total	Public	Private, non-profit
Doctoral Universities	270	177	94	5,552,014	4,385,397	1,166,617
Highest Research Activity	115	81	34	3,323,616	2,722,709	600,907
Higher Research Activity	107	76	31	1,691,059	1,362,536	328,523
Moderate Research Activity	112	39	57	1,455,316	600,304	474,373



Research Activity Index

- Three research indicators
 - Science & Engineering Expenditures
 - Non-Science & Engineering Expenditures
 - Postdoctoral fellows and non-faculty PhD trained research staff
- Four doctoral education indicators
 - Research/Scholarship doctoral degrees in HUMANITIES
 - R/S Docs in SOCIAL SCIENCES
 - R/S Docs in STEM
 - R/S Docs in ALL OTHER (Professional fields)
- All seven aggregate and first three also per academic staff



Research Activity Index

- 7 aggregate and 3 per capita measures ranked to remove outlier effects
- Principal components analysis to determine weights

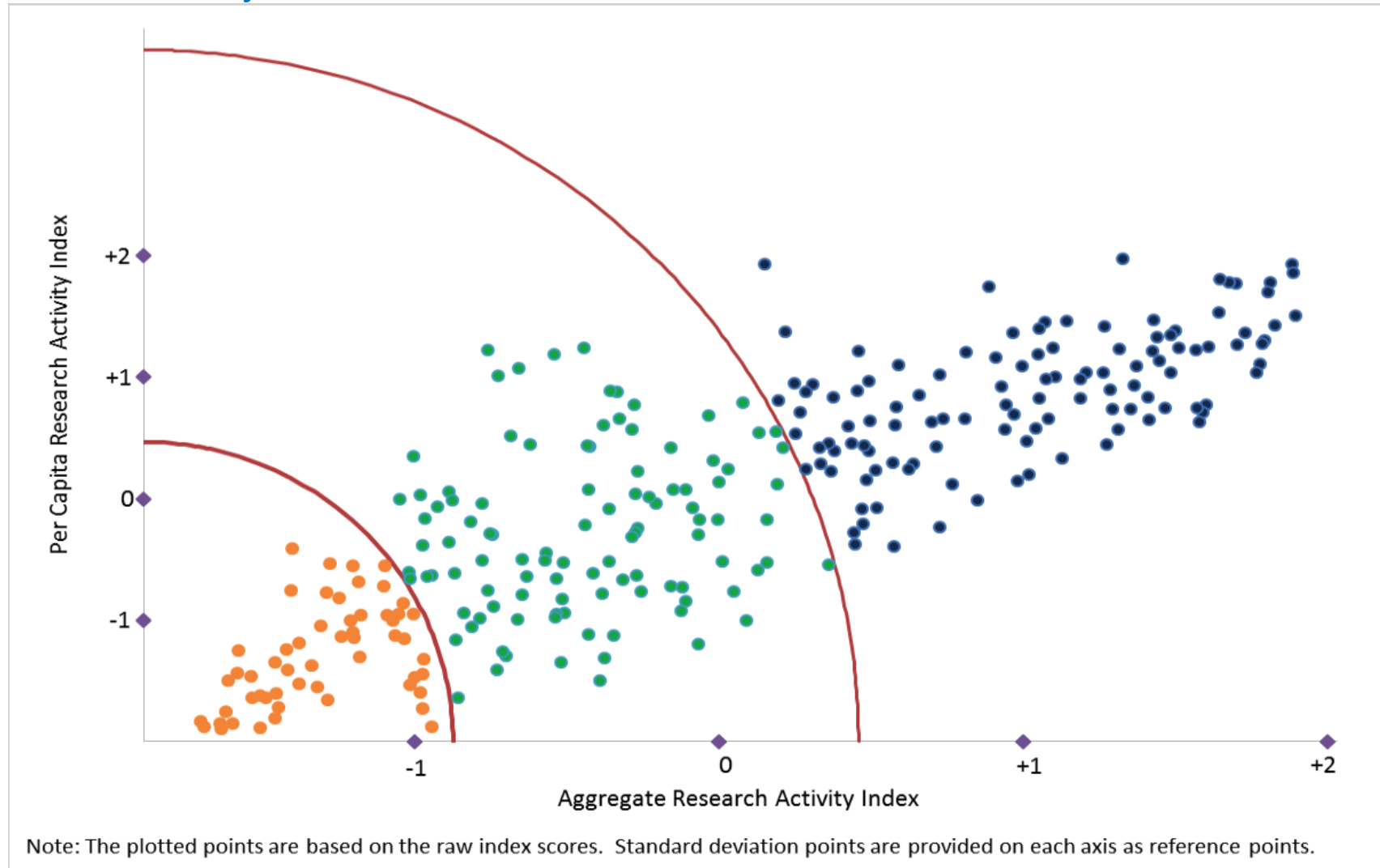
Aggregate analysis (first principal component explained 70% of the total variance)	
Doctorates: STEM	0.914
Research Staff	0.902
S&E R&D Expenditures	0.900
Doctorates: Social Sciences	0.873
Doctorates: Humanities	0.819
Non-S&E R&D Expenditures	0.791
Doctorates: Other Fields	0.616

Per-capita analysis (first principal component explained 71% of the total variance)	
Per-capita S&E R&D Expenditures	0.931
Per-capita Research Staff	0.928
Per-capita Non-S&E R&D Expenditures	0.614



Research Activity Index

Research Activity Index Results Based on Rank-order Data



Legend:

Blue: R1: Doctoral Universities - Highest research activity

Purple: R2: Doctoral Universities - Higher research activity

Orange: R3: Doctoral Universities - Moderate research activity

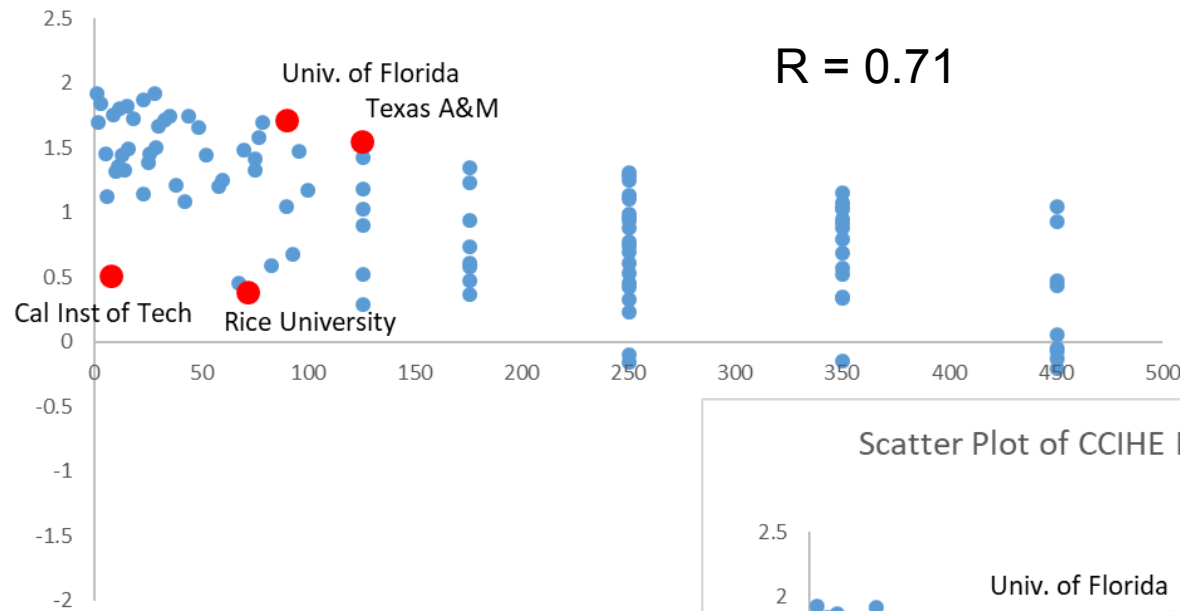


Research Activity Index (RAI) and Research Rankings

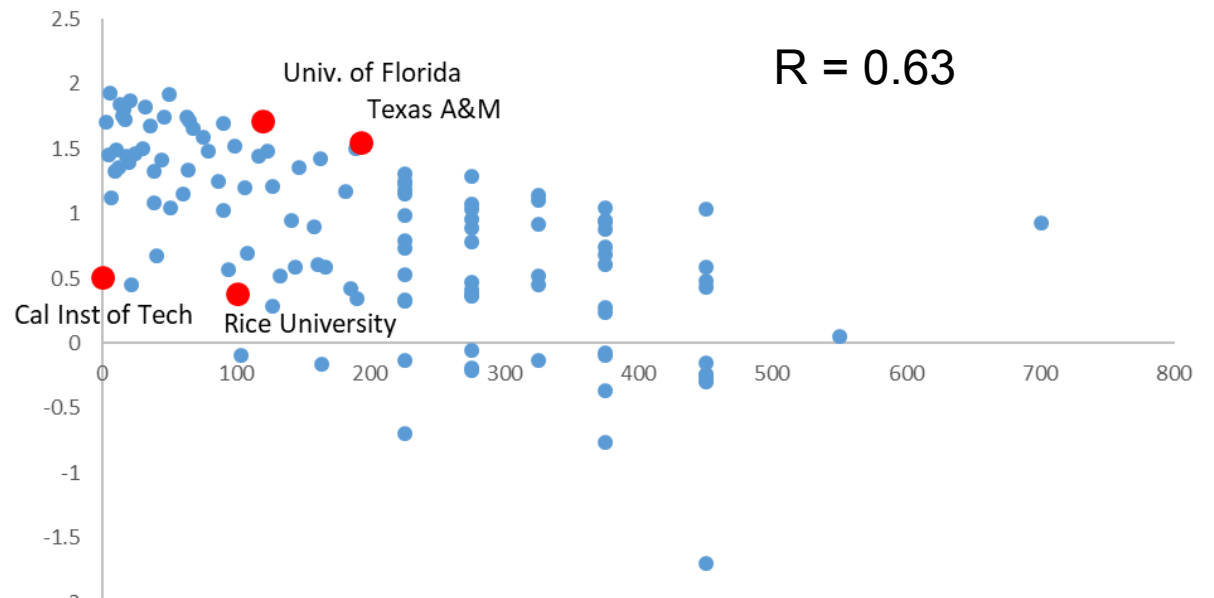
- Correlation between RAI and
 - THE WUR – 0.63
 - ARWU – 0.71

Research Activity Index (RAI) and Research Rankings

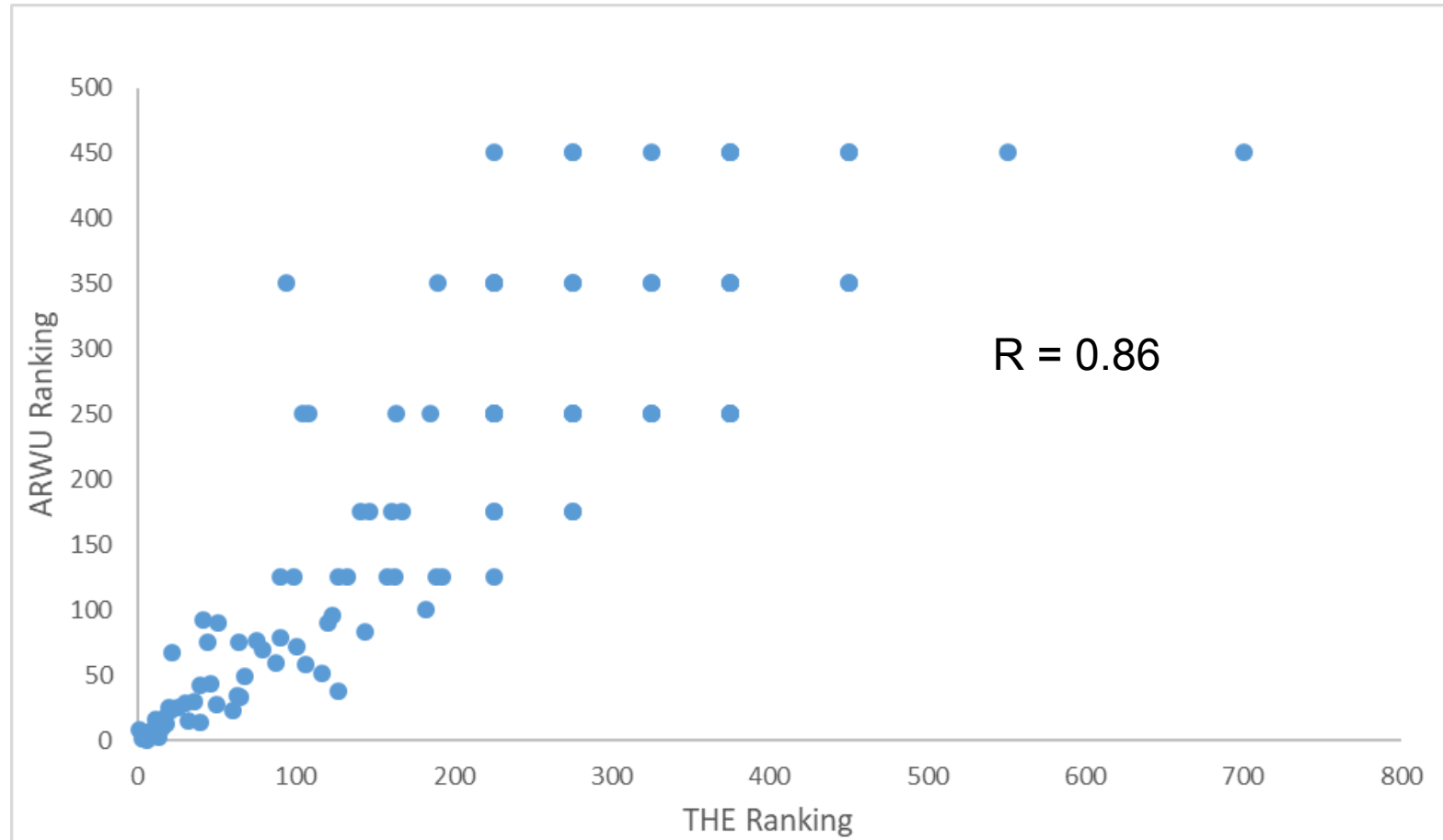
Scatter Plot of CCIHE Research Activity Index and ARWU Ranking



Scatter Plot of CCIHE Research Activity Index and THE Ranking



Scatterplot of ARWU (Y) and THE (X) Rankings



In Search of the Holy Invalidator

- Personal

- Experience reporting for complex multi-campus university
- More recent focus on Carnegie Classifications and role of diversity of institutional types in better serving national and state-level higher education needs

- Academic

- Impact of rankings on policy and practice, institutionally and nationally



Literature – Invalid measures with high impact

- Limited choice of reliable data for international comparisons
 - Hazelkorn (2015); Borden et al., (2013)
- Little evidence of construct validity
 - Ioniddis et al. (2007); Ostriker et al. (2011)
- Large impact on institutional and national policy and practice
 - Shin & Touskoushian (2011); Rauhvargers (2011)



Research Questions – Effect on ARWU/THE Rankings of...

1. Program mix

- Proportion of academic doctoral degrees in humanities, social sciences, STEM
- Presence of specific programs – agriculture and engineering

2. Organizational reporting arrangements of Medical Schools or Health Science Centers

3. Relative size of undergraduate to postgraduate programs

All in US context, so taking into account public vs. private control



Methods – Sample and Outcome Vars

- Extracted US Universities from Top 500 of ARWU and THE
 - Removed free-standing medical schools/health science centers from ARWU
 - Removed oddity: CUNY City College
- Outcome vars: ARWU and THE ranking (banded converted to midpoint)

	THE		Total
	Ranked	Not Ranked	
ARWU			
Ranked	108	29 (21%)	137
Not Ranked	16 (13%)		16
Total	124	29	153

Methods – Predictors

- Combined with IPEDS data to yield predictors
 - Program Mix
 - proportion of academic doctoral degrees (2013-14) in humanities, social sciences, STEM, other (Carnegie CIP Code Mapping)
 - Dummy variables for Engineering and Agriculture Programs
 - Relative size of undergraduate to postgraduate programs
 - Proportion of undergraduate to total degrees conferred



Methods – Predictors (cont.)

- Medical school / health science center arrangement
 - Component school with MD programs
 - Component school with other medical programs
 - Affiliated school not part of reporting arrangement
 - No component or affiliated school



Results – Univariate 1

Table 2. Correlations among the Rankings, Proportions of Academic Doctoral Degrees by Discipline Cluster, and Proportion of Undergraduate Degrees Conferred

	Rankings				Proportion of Academic Doctoral Degrees					
	ARWU		THE		Humanities		Social Science		STEM	
ARWU	1									
THE	0.859	**	1							
Humanities	0.201	*	0.122	ns	1					
Social Science	0.607	**	0.546	**	0.430	**	1			
STEM	0.673	**	0.640	**	-0.007	ns	0.664	**	1	
UG/TotDeg	-0.335	**	-0.472	**	0.099	ns	0.007	ns	-0.137	ns

*p<.05; **p<.01; ns=not significant

Note: direction reversed so association is to higher ranking (lower number)

Results – Regression Full Model ARWU

Table 4a . Regression ARWU Rank on Full Set of Predictors

Variable	B	SE(B)	Beta	t	sig.
(Constant)	124.9	113.1		1.10	0.272
Prop. of Humanities Doctorates	154.6	95.4	0.11	1.62	0.108
Prop. of Social Science Doctorates	261.5	87.6	0.26	2.98	0.003
Prop. of STEM Doctorates	205.0	32.7	0.50	6.27	0.000
Engineering Program Indicator	9.0	34.3	0.02	0.26	0.793
Undergrad Degrees as Pct of Total	-493.3	126.6	-0.23	-3.90	0.000
Public Institution (Private as Reference)	-76.4	18.8	-0.24	-4.07	0.000
MD -Granting Medical Program	2.2	21.7	0.01	0.10	0.920
Other Medical Degree Program	-31.4	29.0	-0.07	-1.09	0.280
Affiliated Medical School	-22.9	27.1	-0.06	-0.84	0.400

R^2 (adjusted)=.682; F(9,111)=26.48; p<.001



Results – Regression Full Model THE

Table 4b. Regression THE Rank on Full Set of Predictors

Variable	B	SE(B)	Beta	t	sig.
(Constant)	330.0	265.9		1.24	0.217
Prop. of Humanities Doctorates	44.3	102.7	0.03	0.43	0.667
Prop. of Social Science Doctorates	234.2	90.2	0.23	2.59	0.011
Prop. of STEM Doctorates	196.9	36.3	0.50	5.43	0.000
Engineering Program Indicator	-20.1	33.4	-0.04	-0.60	0.549
Undergrad Degrees as Pct of Total	-647.7	273.9	-0.16	-2.37	0.020
Public Institution (Private as Reference)	-104.1	20.1	-0.33	-5.19	0.000
MD -Granting Medical Program	19.8	22.1	0.07	0.89	0.373
Other Medical Degree Program	-43.8	30.2	-0.09	-1.45	0.149
Affiliated Medical School	-10.8	26.9	-0.03	-0.40	0.690

R^2 (adjusted)=.664; $F(9,110)=24.21$; $p<.001$



Regression – Reduced Models

Table 5a. Final, Reduced Model for ARWU Rankings

Variable	B	SE(B)	Beta	t	sig.
(Constant)	131.3	112.9		1.16	0.247
<i>Prop. of Social Science Doctorates</i>	359.6	70.3	0.36	5.12	0.000
<i>Prop. of STEM Doctorates</i>	180.5	29.0	0.44	6.22	0.000
<i>Undergrad Degrees as Pct of Total</i>	-473.4	121.3	-0.22	-3.91	0.000
<i>Public Institution (Private as Reference)</i>	-88.0	18.1	-0.28	-4.87	0.000

$R^2(\text{adjusted})=.665$; $F(4,116)=57.53$; $p<.001$

Table 5b . Final, Reduced Model for THE Rankings



















Variable	B	SE(B)	Beta	t	sig.
(Constant)	292.7	253.8		1.15	0.251
<i>Prop. of Social Science Doctorates</i>	300.9	73.6	0.30	4.09	0.000
<i>Prop. of STEM Doctorate s</i>	177.3	32.4	0.45	5.47	0.000
<i>Undergrad Degrees as Pct of Total</i>	-610.2	267.0	-0.15	-2.29	0.024
<i>Public Institution (Private as Reference)</i>	-120.1	19.0	-0.39	-6.34	0.000

$R^2(\text{adjusted})=.643$; $F(4,115)=51.83$; $p<.001$



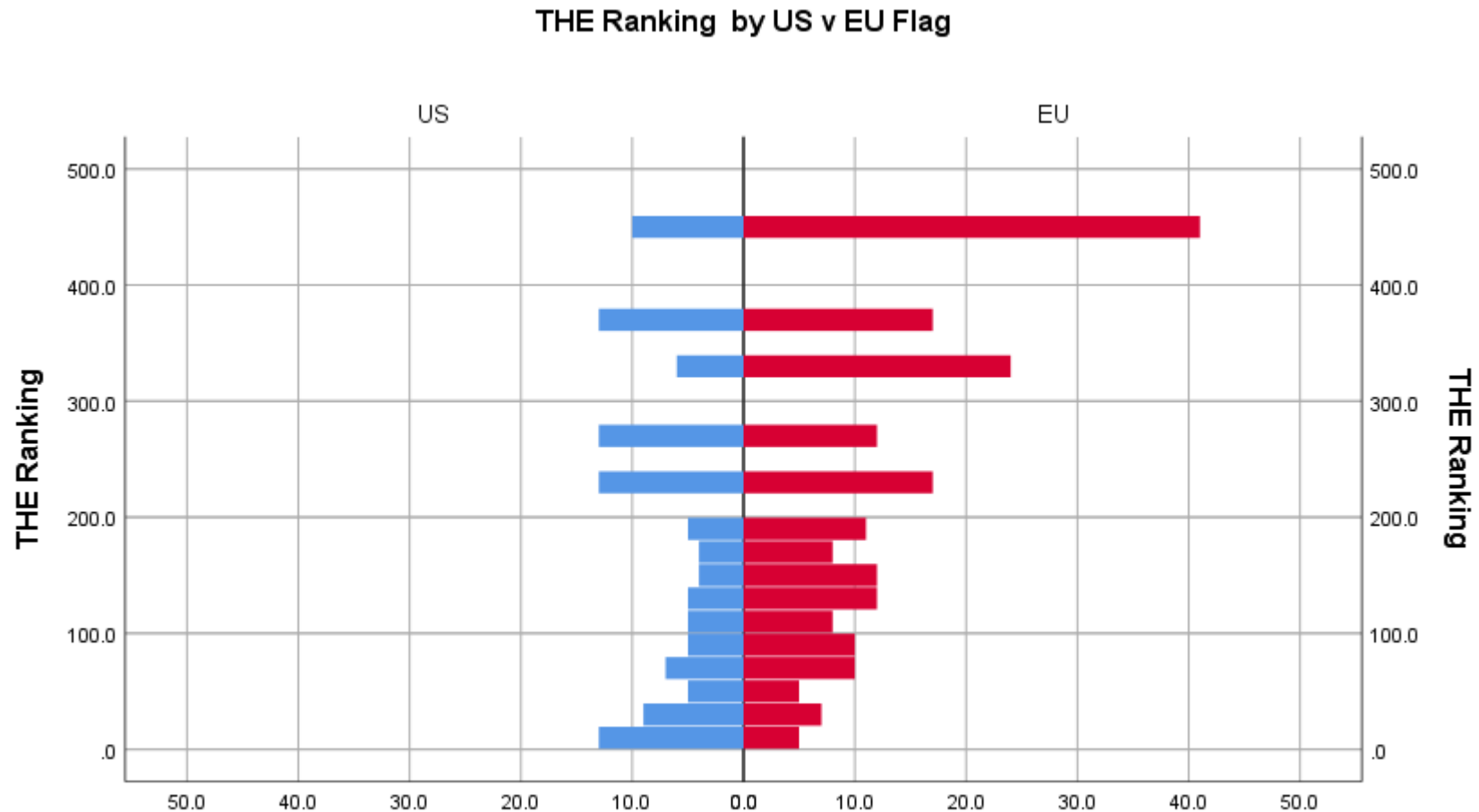
Extending the Analysis using ETER Data

- Adding to 117 US Universities
 - R1 & R2 institutions, ranked in Top 500 of THE or ARWU
 - 71 (61%) Public and 46 (39%) Private
- 198 European Universities

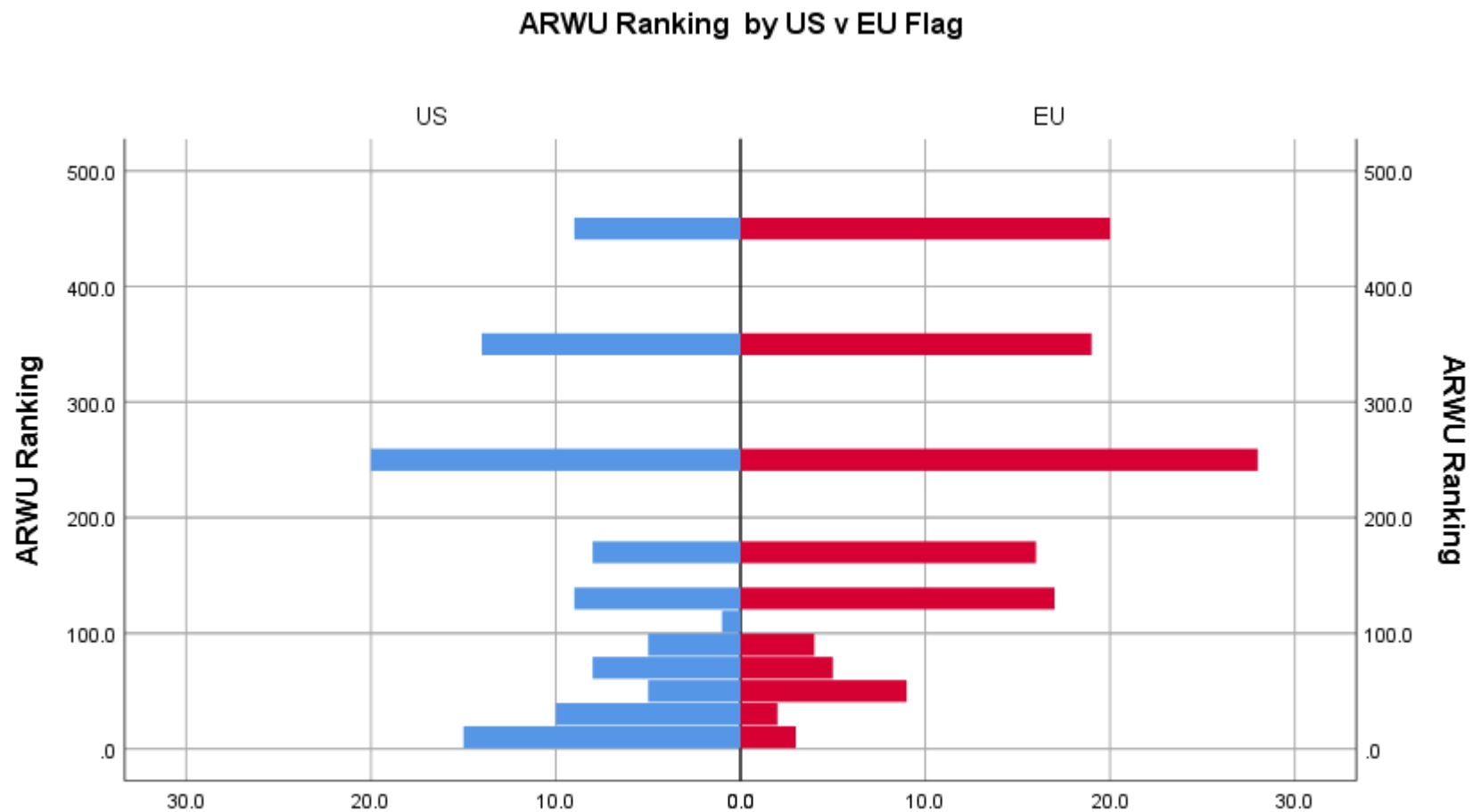
Country	N of Insts	
United States	117	
United Kingdom	48	
Germany	36	
Italy	31	
Netherlands	13	
Sweden	11	
Switzerland	10	
Spain	9	
Finland	8	
Austria	7	
Ireland	7	
Belgium	4	
Norway	4	
Portugal	4	
Czech Republic	3	
Cyprus	1	
Estonia	1	
Iceland	1	
Total	315	



EU-US Comparisons on Rankings and Predictors



EU-US Comparisons on Rankings and Predictors



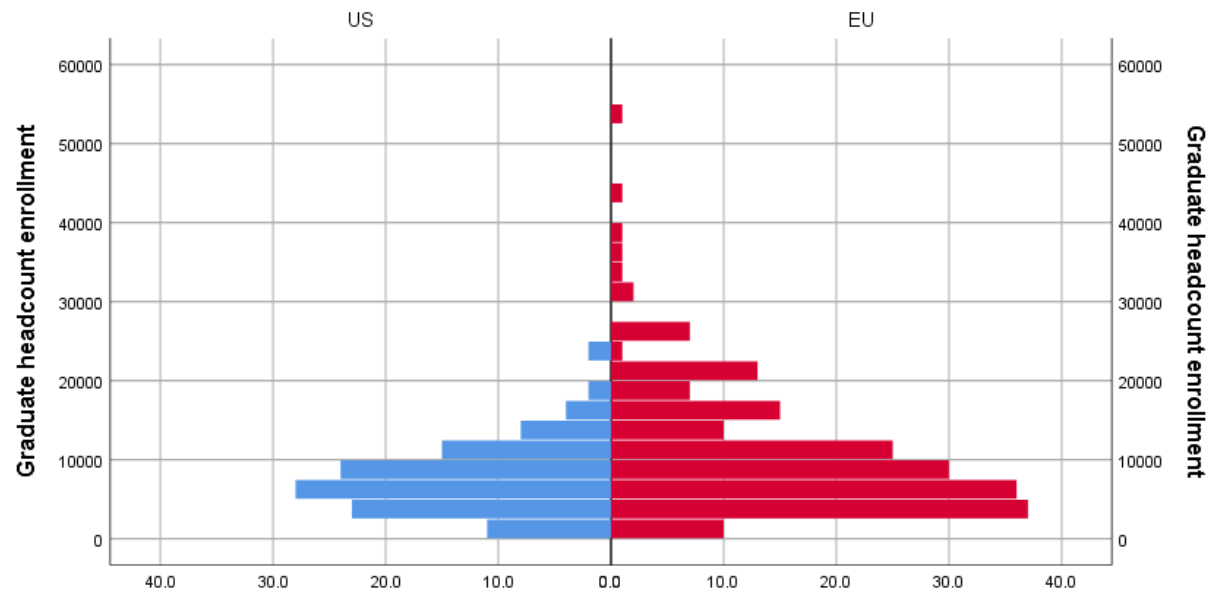
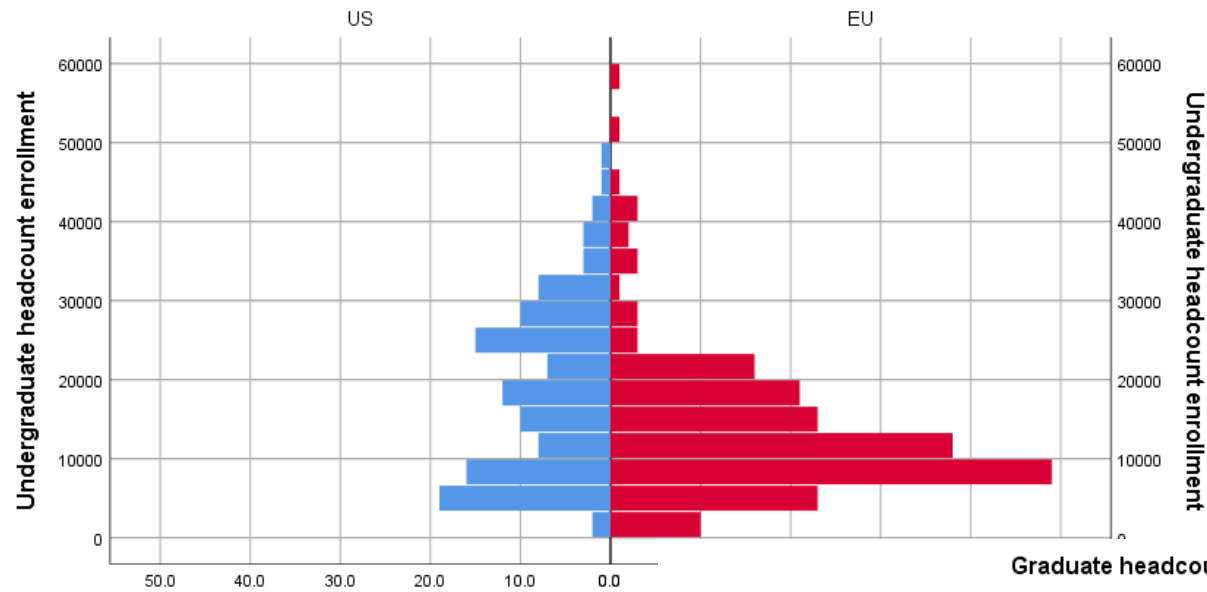
Mean Differences Between US and EU

Measure	US (N=117)	EU (N=198)	Standard Deviation		sig.
			US	EU	
Outcomes					
THE Ranking	195	248	141	142	0.001
ARWU Ranking	176	235	142	135	0.002
Prospective Predictors					
Enrollment Mix					
Total headcount enrollment	26,164	24,720	13,577	16,023	0.415
<i>Undergraduate headcount</i>	18,359	13,690	10,955	9,266	0.000
<i>Graduate headcount</i>	7,804	11,030	4,586	8,168	0.000
<i>Percent Undergrad headcount</i>	68%	56%	0.14	0.15	0.000
<i>Percent Grad headcount</i>	32%	44%	0.15	0.14	0.000
Degree Level Mix					
Associate's	32	127	89	301	0.001
<i>Bachelor's</i>	4,425	2,623	2,611	1,782	0.000
<i>Master's</i>	2,294	1,937	1,594	1,481	0.046
Doctoral	355	369	222	298	0.650
Total	7,106	5,057	3,641	3,194	0.000
<i>UG degrees as percent of total</i>	62%	54%	0.15	0.14	0.000
Percent associate's	1%	2%	0.03	0.05	0.006
<i>Percent bachelor's</i>	61%	51%	0.15	0.12	0.000
Percent master's	33%	37%	0.14	0.11	0.003
<i>Percent doctoral</i>	5%	9%	0.04	0.11	0.000
Degree Program Mix					
Humanities doctorates	47	30	41	55	0.005
Social Sciences doctorates	40	28	27	43	0.008
<i>STEM doctorates</i>	189	127	135	156	0.000
<i>Other doctorates</i>	79	184	63	177	0.000
<i>Percent Humanities</i>	12%	8%	0.09	0.08	0.000
Percent Social Science	12%	8%	0.07	0.10	0.001
<i>Percent STEM</i>	53%	32%	0.18	0.27	0.000
<i>Percent other</i>	23%	52%	0.16	0.34	0.000



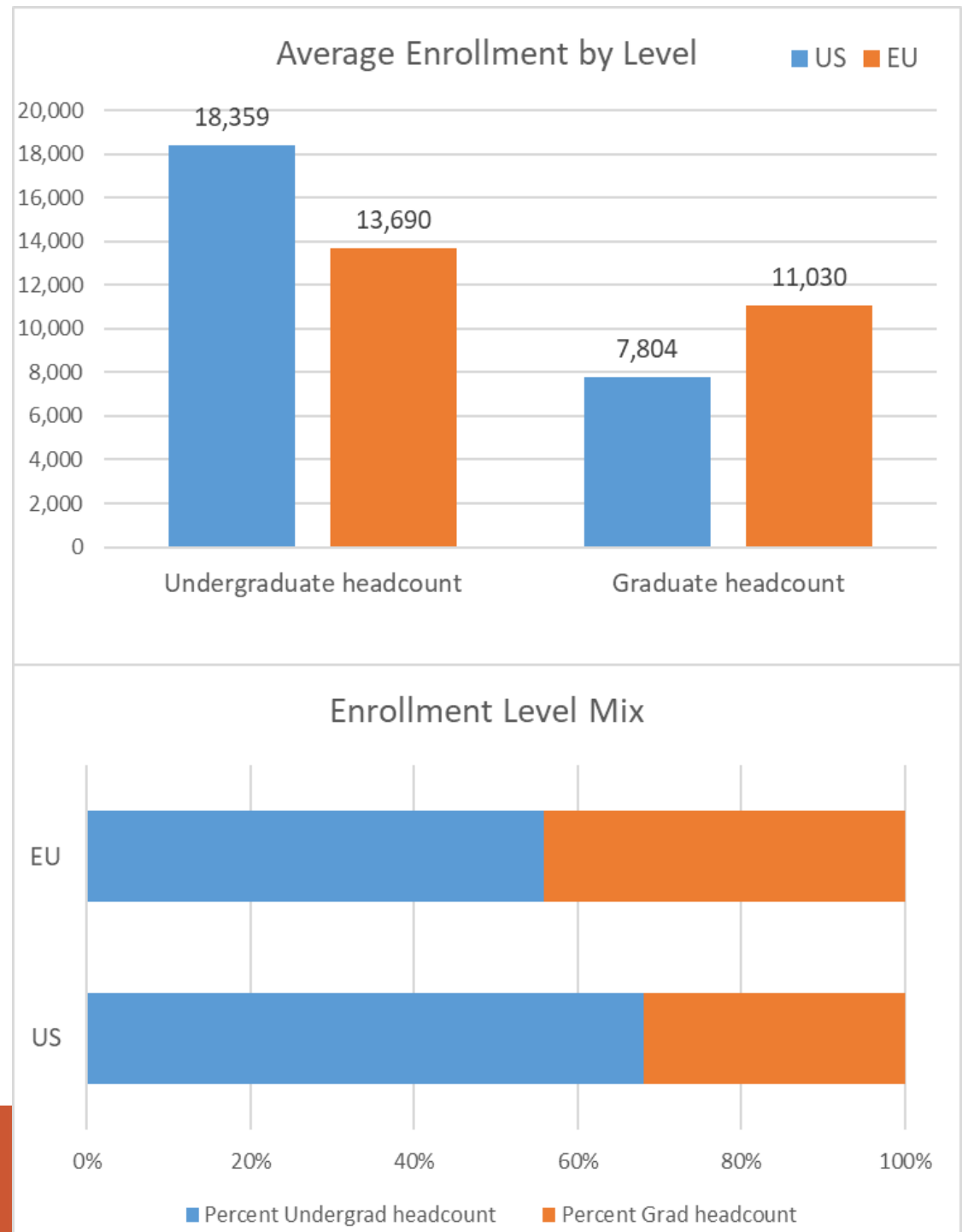
Undergraduate and Graduate Headcount*

Undergraduate headcount enrollment by US v EU Flag

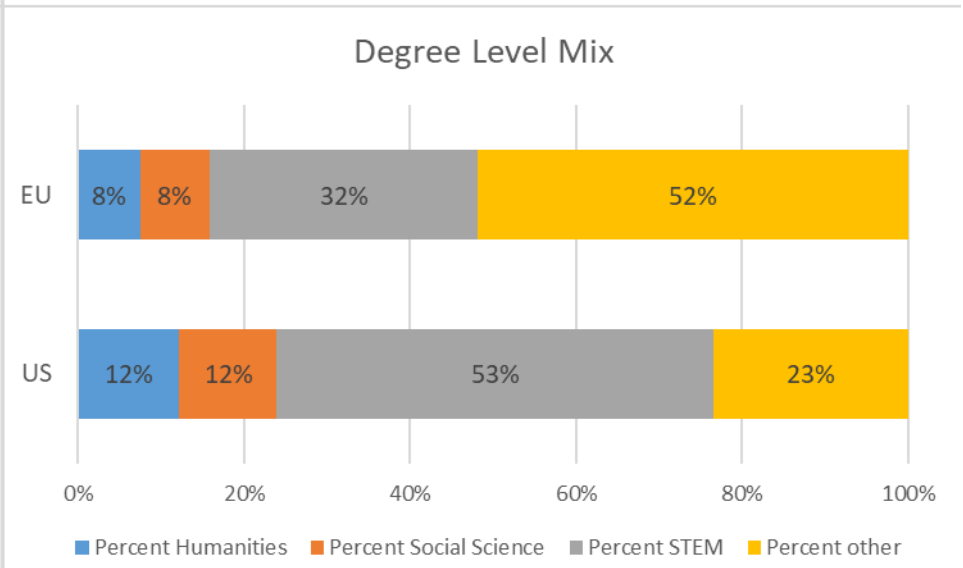
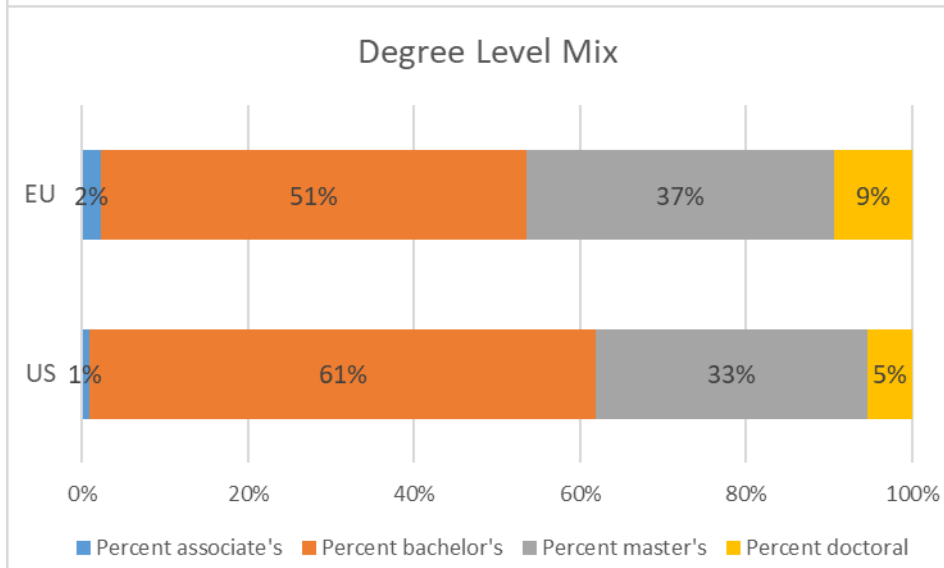
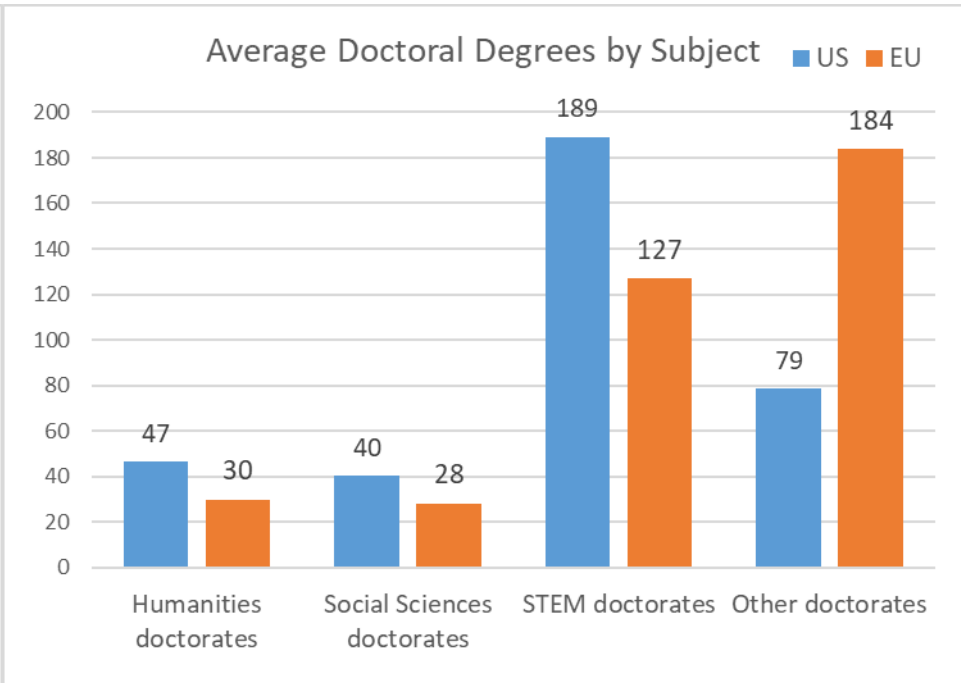
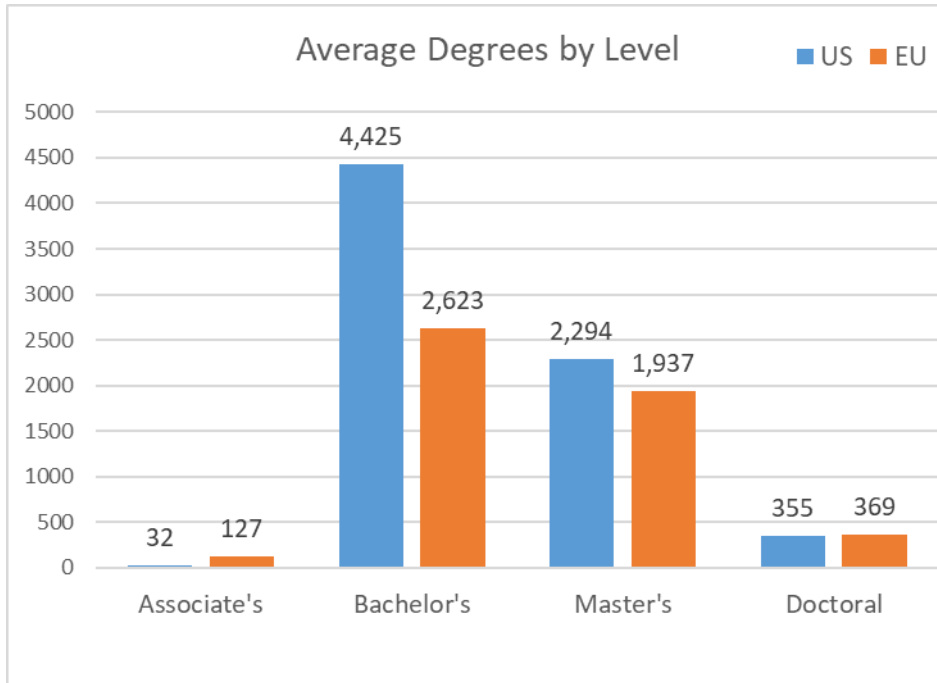


*Open University removed

**US Institutions,
are not larger
on average, but
they have a
greater
proportion of
undergraduate
students**



Aside from conferring more baccalaureate degrees, average degrees are similar at other levels. The US confers a larger concentration of degrees in STEM fields, EU in Professional fields



Exploratory Linear Modeling in SPSS

- US and EU separately and then combined
- THE Ranking and ARWU Ranking Separately
- Crude model with
 - Total headcount
 - Percent undergraduate headcount
 - Percent master's and doctoral degrees
 - Number of PhDs in each subject area
 - Percent PhDs in three of four areas (leaving out professional/other)
 - Control for US



US Model on THE Ranking

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.876 ^a	.767	.741	72.0134

	B	Std. Error	Beta	t	Sig.
(Constant)	-344.0	218.0		-1.58	0.118
Total headcount enrollment	0.0009	0.001	0.082	0.80	0.426
UG HCT as percent of total	815.3	199.6	0.812	4.08	0.000
Percent master's degrees	658.4	188.0	0.652	3.50	0.001
Percent doctoral degrees	318.9	287.8	0.085	1.11	0.270
Humanities doctoral degrees conferred	-1.00	0.51	-0.292	-1.97	0.051
Social Sciences doctoral degrees conferred	-0.88	0.71	-0.170	-1.24	0.220
STEM doctoral degrees conferred	-0.29	0.11	-0.272	-2.66	0.009
Other doctoral degrees conferred	-0.05	0.23	-0.024	-0.23	0.818
Humanities proportion of doctoral degrees	-114.1	177.9	-0.069	-0.64	0.522
Social Science proprtion of doctoral degrees	13.8	195.1	0.006	0.07	0.944
STEM proportion of doctoral degrees	-180.3	73.1	-0.234	-2.47	0.015
Control(US)	-60.1	24.3	-0.208	-2.48	0.015



US Model on ARWU Ranking

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.853 ^a	.728	.692	78.8709

	B	Std. Error	Beta	t	Sig.
(Constant)	-343.5	258.6		-1.33	0.187
Total headcount enrollment	-0.0010	0.001	-0.129	-1.10	0.275
UG HCT as percent of total	846.8	231.2	0.872	3.66	0.000
Percent master's degrees	739.7	214.5	0.750	3.45	0.001
Percent doctoral degrees	8.0	325.5	0.002	0.03	0.980
Humanities doctoral degrees conferred	-1.02	0.64	-0.297	-1.59	0.114
Social Sciences doctoral degrees conferred	-0.97	0.97	-0.186	-1.01	0.318
STEM doctoral degrees conferred	-0.27	0.13	-0.247	-2.08	0.040
Other doctoral degrees conferred	0.17	0.32	0.076	0.52	0.601
Humanities proportion of doctoral degrees	-119.2	243.0	-0.071	-0.49	0.625
Social Science proprtion of doctoral degrees	-0.6	367.9	0.000	0.00	0.999
STEM proportion of doctoral degrees	-162.3	119.2	-0.192	-1.36	0.177
Control(US)	-50.5	29.5	-0.173	-1.71	0.090



EU Model on THE Ranking

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.693 ^a	.481	.450	105.4736

	B	Std. Error	Beta	t	Sig.
(Constant)	575.9	71.4		8.07	0.000
Total headcount enrollment	0.0010	0.001	0.136	1.82	0.070
UG HCT as percent of total	-116.6	69.8	-0.123	-1.67	0.096
Percent master's degrees	-368.8	85.3	-0.286	-4.32	0.000
Percent doctoral degrees	-316.9	98.0	-0.254	-3.23	0.001
Humanities doctoral degrees conferred	0.49	0.44	0.188	1.12	0.264
Social Sciences doctoral degrees conferred	-0.30	0.58	-0.092	-0.53	0.598
STEM doctoral degrees conferred	-0.50	0.10	-0.543	-5.05	0.000
Other doctoral degrees conferred	-0.31	0.08	-0.381	-4.00	0.000
Humanities proportion of doctoral degrees	-469.0	165.1	-0.272	-2.84	0.005
Social Science proportion of doctoral degrees	-36.3	157.1	-0.025	-0.23	0.818
STEM proportion of doctoral degrees	80.0	51.1	0.153	1.56	0.120



EU Model on ARWU Ranking

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.696 ^a	.484	.433	101.5000

	B	Std. Error	Beta	t	Sig.
(Constant)	563.0	107.4		5.24	0.000
Total headcount enrollment	0.0000	0.001	-0.038	-0.38	0.705
UG HCT as percent of total	-71.4	105.0	-0.072	-0.68	0.498
Percent master's degrees	-409.0	109.2	-0.323	-3.75	0.000
Percent doctoral degrees	-339.1	195.5	-0.216	-1.74	0.086
Humanities doctoral degrees conferred	0.56	0.50	0.262	1.11	0.269
Social Sciences doctoral degrees conferred	-0.51	0.65	-0.188	-0.78	0.434
STEM doctoral degrees conferred	-0.42	0.12	-0.548	-3.41	0.001
Other doctoral degrees conferred	-0.22	0.09	-0.309	-2.35	0.020
Humanities proportion of doctoral degrees	-407.1	250.6	-0.213	-1.62	0.107
Social Science proptrtion of doctoral degrees	12.8	223.4	0.008	0.06	0.955
STEM proportion of doctoral degrees	151.7	79.3	0.303	1.91	0.058



Stronger Models for Predicting THE v. ARWU; Different Models for US v. EU

	B	Std. Error	Beta	t	Sig.		B	Std. Error	Beta	t	Sig.
(Constant)	-344.0	218.0		-1.58	0.118	(Constant)	-343.5	258.6		-1.33	0.187
Total headcount enrollment	0.0009	0.001	0.082	0.80	0.426	Total headcount enrollment	-0.0010	0.001	-0.129	-1.10	0.275
UG HCT as percent of total	815.3	199.6	0.812	4.08	0.000	UG HCT as percent of total	846.8	231.2	0.872	3.66	0.000
Percent master's degrees	658.4	188.0	0.652	3.50	0.001	Percent master's degrees	739.7	214.5	0.750	3.45	0.001
Percent doctoral degrees	318.9	287.8	0.085	1.11	0.270	Percent doctoral degrees	8.0	325.5	0.002	0.03	0.980
Humanities doctoral degrees conferred	-1.00	0.51	-0.292	-1.97	0.051	Humanities doctoral degrees conferred	-1.02	0.64	-0.297	-1.59	0.114
Social Sciences doctoral degrees conferred	-0.88	0.71	-0.170	-1.24	0.220	Social Sciences doctoral degrees conferred	-0.97	0.97	-0.186	-1.01	0.318
STEM doctoral degrees conferred	-0.29	0.11	-0.272	-2.66	0.009	STEM doctoral degrees conferred	-0.27	0.13	-0.247	-2.08	0.040
Other doctoral degrees conferred	-0.05	0.23	-0.024	-0.23	0.818	Other doctoral degrees conferred	0.17	0.32	0.076	0.52	0.601
Humanities proportion of doctoral degrees	-114.1	177.9	-0.069	-0.64	0.522	Humanities proportion of doctoral degrees	-119.2	243.0	-0.071	-0.49	0.625
Social Science proprtion of doctoral degrees	13.8	195.1	0.006	0.07	0.944	Social Science proprtion of doctoral degrees	-0.6	367.9	0.000	0.00	0.999
STEM proportion of doctoral degrees	-180.3	73.1	-0.234	-2.47	0.015	STEM proportion of doctoral degrees	-162.3	119.2	-0.192	-1.36	0.177
Control(US)	-60.1	24.3	-0.208	-2.48	0.015	Control(US)	-50.5	29.5	-0.173	-1.71	0.090

	B	Std. Error	Beta	t	Sig.		B	Std. Error	Beta	t	Sig.
(Constant)	575.9	71.4		8.07	0.000	(Constant)	563.0	107.4		5.24	0.000
Total headcount enrollment	0.0010	0.001	0.136	1.82	0.070	Total headcount enrollment	0.0000	0.001	-0.038	-0.38	0.705
UG HCT as percent of total	-116.6	69.8	-0.123	-1.67	0.096	UG HCT as percent of total	-71.4	105.0	-0.072	-0.68	0.498
Percent master's degrees	-368.8	85.3	-0.286	-4.32	0.000	Percent master's degrees	-409.0	109.2	-0.323	-3.75	0.000
Percent doctoral degrees	-316.9	98.0	-0.254	-3.23	0.001	Percent doctoral degrees	-339.1	195.5	-0.216	-1.74	0.086
Humanities doctoral degrees conferred	0.49	0.44	0.188	1.12	0.264	Humanities doctoral degrees conferred	0.56	0.50	0.262	1.11	0.269
Social Sciences doctoral degrees conferred	-0.30	0.58	-0.092	-0.53	0.598	Social Sciences doctoral degrees conferred	-0.51	0.65	-0.188	-0.78	0.434
STEM doctoral degrees conferred	-0.50	0.10	-0.543	-5.05	0.000	STEM doctoral degrees conferred	-0.42	0.12	-0.548	-3.41	0.001
Other doctoral degrees conferred	-0.31	0.08	-0.381	-4.00	0.000	Other doctoral degrees conferred	-0.22	0.09	-0.309	-2.35	0.020
Humanities proportion of doctoral degrees	-469.0	165.1	-0.272	-2.84	0.005	Humanities proportion of doctoral degrees	-407.1	250.6	-0.213	-1.62	0.107
Social Science propotion of doctoral degrees	-36.3	157.1	-0.025	-0.23	0.818	Social Science propotion of doctoral degrees	12.8	223.4	0.008	0.06	0.955
STEM proportion of doctoral degrees	80.0	51.1	0.153	1.56	0.120	STEM proportion of doctoral degrees	151.7	79.3	0.303	1.91	0.058



Combined Model on THE Ranking

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.691 ^a	.477	.447	104.7762

	B	Std. Error	Beta	t	Sig.
(Constant)	451.3	105.5		4.28	0.000
Total headcount enrollment	0.0001	0.001	0.009	0.12	0.905
UG HCT as percent of total	-60.8	89.5	-0.068	-0.68	0.497
Percent master's degrees	-301.6	89.3	-0.273	-3.38	0.001
Percent doctoral degrees	-350.6	178.7	-0.178	-1.96	0.051
Humanities doctoral degrees conferred	0.65	0.43	0.254	1.53	0.127
Social Sciences doctoral degrees conferred	-0.87	0.57	-0.254	-1.52	0.130
STEM doctoral degrees conferred	-0.41	0.09	-0.460	-4.56	0.000
Other doctoral degrees conferred	-0.26	0.09	-0.302	-3.05	0.003
Humanities proportion of doctoral degrees	-505.6	178.0	-0.295	-2.84	0.005
Social Science proprtion of doctoral degrees	178.6	196.5	0.097	0.91	0.364
STEM proportion of doctoral degrees	65.3	58.5	0.116	1.12	0.265
US v EU Flag	95.4	18.8	0.338	5.06	0.000



Combined Model on ARWU Ranking

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.715 ^a	.511	.492	102.6980

	B	Std. Error	Beta	t	Sig.
(Constant)	468.8	69.7		6.72	0.000
Total headcount enrollment	0.0017	0.001	0.176	3.06	0.002
UG HCT as percent of total	-62.2	62.5	-0.068	-1.00	0.320
Percent master's degrees	-301.7	68.7	-0.259	-4.39	0.000
Percent doctoral degrees	-273.9	91.8	-0.181	-2.98	0.003
Humanities doctoral degrees conferred	0.54	0.36	0.192	1.53	0.127
Social Sciences doctoral degrees conferred	-0.69	0.47	-0.184	-1.48	0.141
STEM doctoral degrees conferred	-0.46	0.08	-0.480	-6.06	0.000
Other doctoral degrees conferred	-0.34	0.07	-0.367	-5.07	0.000
Humanities proportion of doctoral degrees	-519.3	127.6	-0.311	-4.07	0.000
Social Science proprtion of doctoral degrees	119.3	127.8	0.074	0.93	0.351
STEM proportion of doctoral degrees	6.2	39.6	0.011	0.16	0.877
US v EU Flag	62.3	14.6	0.209	4.27	0.000



Exploratory Linear Modeling in SPSS

- US and EU separately and then combined

- US only

Model Summary

		Coefficients ^a					Adjusted R Square	Std. Error of the Estimate
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.		
		B	Std. Error	Beta				
1	(Constant)	66.984	102.508		.653	.515	.712	75.8617
	UG HCT as percent of total	278.056	102.766	.277	2.706	.008		
	Master's degrees conferred	.012	.008	.138	1.453	.149		
	Humanities doctoral degrees conferred	-.749	.534	-.218	-1.402	.164		
	Social Sciences doctoral degrees conferred	-1.279	.739	-.249	-1.730	.087		
	STEM doctoral degrees conferred	-.277	.108	-.264	-2.555	.012		
	Other doctoral degrees conferred	-.076	.224	-.034	-.338	.736		
	Humanities proportion of doctoral degrees	-23.373	188.838	-.014	-.124	.902		
	Social Science proportion of doctoral degrees	277.488	182.395	.128	1.521	.131		
	Proportion other doctoral degrees	228.055	75.656	.256	3.014	.003		
	Percent doctoral degrees	-172.316	277.190	-.046	-.622	.536		
	Control(US)	-47.332	23.681	-.164	-1.999	.048		

a. Dependent Variable: THE Ranking



European Forum for
Studies of Policies
for Research and Innovation

Predictor Importance



European Forum for
Studies of Policies
for Research and Innovation