Higher Education Rankings: Robustness Issues and Critical Assessment

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Outline

- Motivation and objective of the study

- Overview of the two international university rankings

- Uncertainty Analysis

- Selected results

- Policy implications

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Motivation and Objective of the study

- **Two international university rankings (URs) yearly published**

  - *Very appealing*: university = multiple missions but with a single number, URs allow us to situate a given university in the worldwide context

  - *…*can lead to misleading conclusions

- **Questions: can we have confidence in university rankings?**

  - How much do the university ranks depend on the methodology (weighting scheme, aggregation, indicators)?

    ⇨ **Uncertainty analysis of the 2007 SJTU and THES rankings**

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  - SJTU ranking
  - THES ranking

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SJTU ranking

Criteria	Indicator	Weight
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	20%
	Highly cited researchers in 21 broad subject categories	20%
Research Output	Articles published in Nature and Science	20%
	Articles in Science Citation Index-expanded, Social Science Citation Index	20%
Academic performance	Academic performance with respect to the size of an institution	10%

METHODOLOGY

✓ - 6 indicators

✓ - Best performing institution =100 score of other institutions is calculated as a percentage of the top score.

✓ - Weighting scheme : chosen by rankers

✓ - Linear aggregation of the 6 indicators

PROS and CONS

✓ - 6 « **objective** » indicators

✓ - Focus on research performance, overlooks other U missions.

✓ - Biased towards hard sciences intensive institutions

✓ - Favours large institutions

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THES ranking

Criteria	Indicator	Weight
Research Quality	Academic Opinion: Peer review, 5,101 academics	40%
	Citations per Faculty: Total citation/ Full Time Equivalent faculty	20%
Graduate Employability	Recruiter Review: Employers' opinion, 1,471 recruiters	10%
International Outlook	International Faculty: Percentage of international staff	5%
	International Students: Percentage of international students	5%
Teaching Quality	Student Faculty: Full Time Equivalent faculty/student ratio	20%

METHODOLOGY

✓ - 6 indicators

✓ - z-score calculated for each indicator; then best performing institution =100; other institutions are calculated as a percentage of the top score.

✓ - Weighting scheme : chosen by rankers

✓ - Linear aggregation of the 6 indicators

PROS and CONS

✓ - Attempt to take into account teaching quality

✓ - Two expert-based indicators: 50% of total
- Subjective indicators
- Lack of transparency

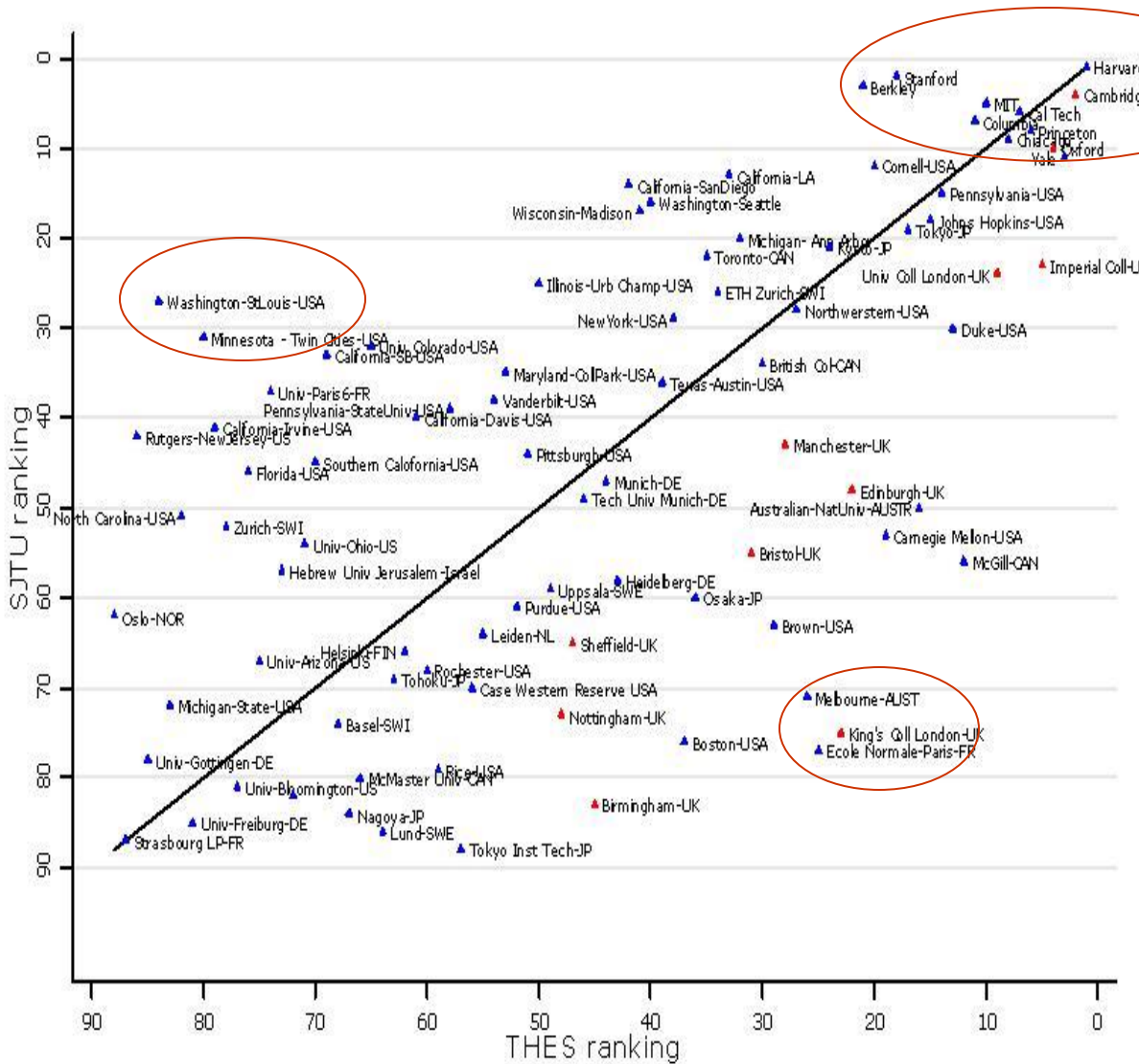✓ - Substantial yearly changes
✓ - Measures research quantity

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2007 THES and SJTU rankings : comparisons

✓ - Identify the same top 10 universities: Harvard, Cambridge, Princeton, Cal tech, MIT and Columbia

✓ - Much greater variations in the middle to lower end of the rankings

✓ - Both SJTU and THES rankings: Europe is

lagging behind

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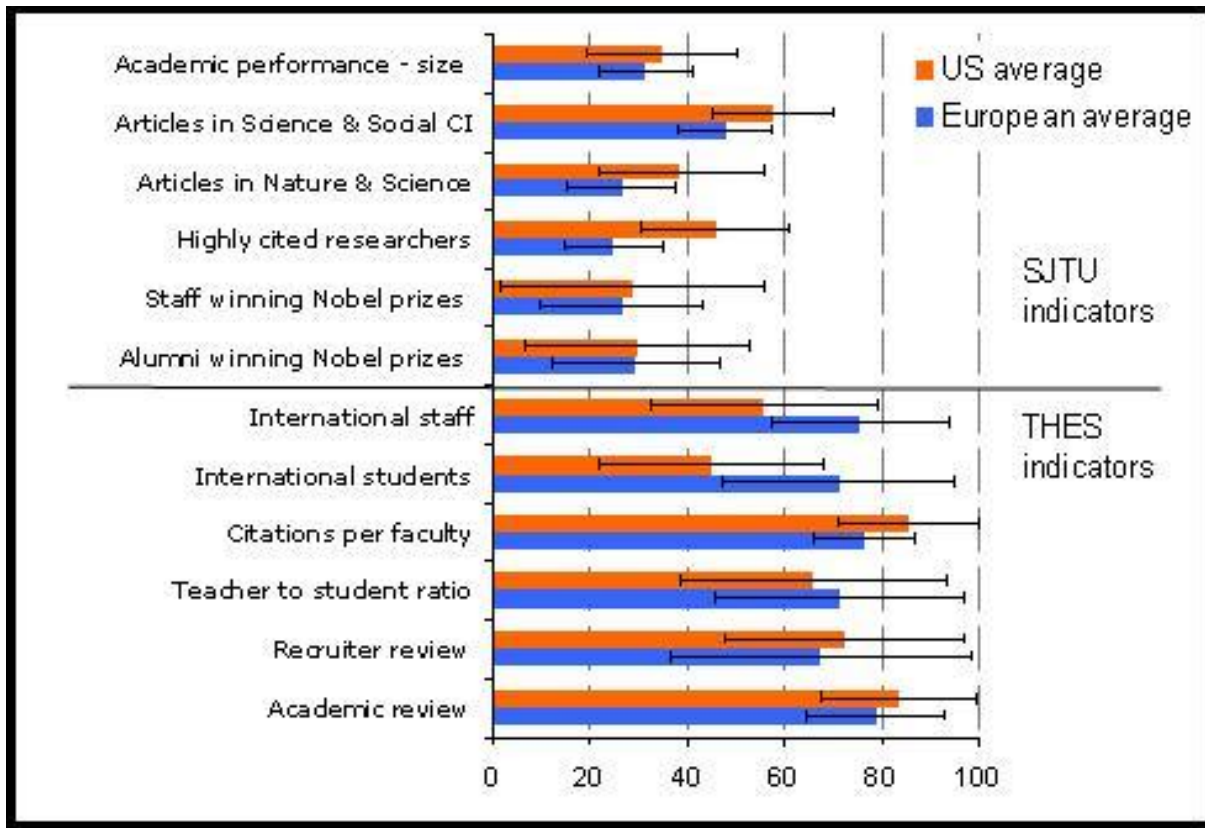DIRECTORATE-GENERAL
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US *versus* Europe

Europe is lagging behind in the final rankings...however

⇩

The average US university is **not necessarily superior** to the average European university for the 12 indicators unlike most of the current conceptions might suggest

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- **Overview of the two international university rankings**
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- **Uncertainty Analysis: empirical approach**

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Robustness analysis of SJTU and THES

- Ten steps to follows in the construction of a CI (JRC/OECD Handbook on composite, 2008): sensitivity analysis of the index = 7th step

- **SENSITIVITY ANALYSIS**: activate simultaneously different sources of uncertainty that cover a wide spectrum of methodological assumptions

70 scenarios
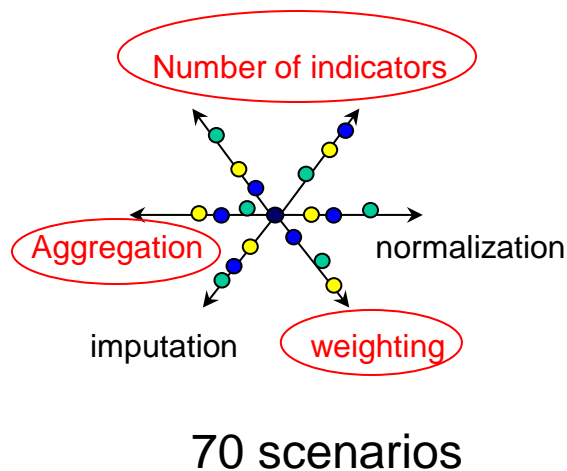
Assumption	Alternatives
Number of indicators	▪ all six indicators included or one-at-time excluded (6 options)
Weighting method	▪ original set of weights, ▪ factor analysis, ▪ equal weighting, ▪ data envelopment analysis
Aggregation rule	▪ additive, ▪ multiplicative, ▪ Borda multi-criterion

- Estimate the **FREQUENCY of the university ranks** obtained in the different simulations

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Legend:
Frequency lower 15%
Frequency between 15 and 30%
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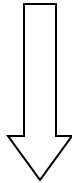
THES: simulated ranks

THES (70 scenarios)

	Rank 1-5	Rank 6-10	Rank 11-15	Rank 16-20	Rank 21-25	Rank 26-30	Rank 31-35	Rank 36-40	Rank 41-45	Rank 46-50	Rank 51-55	Rank 56-60	Rank 61-65	Rank 66-70	Rank 71-75	Rank 76-80	Rank 81-88	Original THES score	Original THES rank	Common THES rank
Harvard Univ	100																	100	1	1
Univ Cambridge	81	17																97.6	2	2
Univ Oxford	90	9																97.6	2	2
Yale Univ	35	64																97.6	2	2
Imperial Coll London	66	27																97.5	5	5
Princeton Univ	27	56	17															97.2	6	6
California Inst Tech	23	43	23	10														96.5	7	7
Univ Chicago	9	86	6															96.5	7	7
Univ Coll London	36	41	16	6														95.3	9	9
Massachusetts Inst Tech (MIT)	26	14	24	14	19													94.6	10	10
Columbia Univ		19	34	20	21													94.5	11	11
McGill Univ		50	30	14														93.9	12	12
Duke Univ		6	21	19	16	11	9	7										93.4	13	13
Univ Pennsylvania		16	46	37														93.3	14	14
Johns Hopkins Univ			20	14	23	33		7										92.9	15	15
Australian Natl Univ		14	37	31	14													91.6	16	16
Tokyo Univ			7	16	14	10	14	23	10									91.1	17	17
Stanford Univ		9	20	16	24	11	10											90.6	19	18
Carnegie Mellon Univ			43	40	13													90	20	19
Cornell Univ			10	27	24	24	11											90	20	19
Univ California - Berkeley	7	7	30	40	14													89.7	22	21
Univ Edinburgh			11	50	29	7												88.8	23	22
King's Coll London		7	40	10	24	7	9											88.2	24	23
Kyoto Univ				13	16	13	6	13	11	10	6	9						87.2	25	24
Ecole Normale Super Paris				14	33	24	9											87.1	26	25
Univ Melbourne			11	27	35	21												85.9	27	26
Northwestern Univ				17	40	41												85	29	27
Univ Manchester			17	29	19	20	6	10										84.7	30	28
Brown Univ				14	40	39												84.5	32	29
Univ British Columbia					26	30	30	9										84.3	33	30
Univ Bristol			11	24	20	24	10	7										84.1	37	31
Univ Michigan - Ann Arbor					20	40	24	7										83.8	38	32
Univ California - Los Angeles				6	6	17	11	10	13	7	6	19						82.8	41	33
Swiss Fed Inst Tech - Zurich			13	14	23	13	19	11	6									82.5	42	34
Univ Toronto			6	6	13	14	7	19	10	11	6							80.6	45	35
Osaka Univ						7	14	16	7	7	10	14	14	6				80	46	36
Boston Univ					11	34	40	6	6									79.7	47	37
New York Univ						19	33	20	7	9	7							77.8	49	38
Univ Texas - Austin					7	6	13	19	20	6	16	7	6					77.1	51	39
Univ Washington - Seattle							19	9	19	20	19	10						76.7	55	40
Univ Wisconsin - Madison						14	17	17	23	11	10							76.7	55	40
Univ California - San Diego						7		11	6	7	6	6	16	21	17			76.3	58	42
Univ Heidelberg					13	36	29	10	10									75.5	60	43
Univ Birmingham				13	19	16	19	17	6	6								74.1	65	44
Univ Munich					16	24	19	17	10	9	6							74.1	65	44
Tech Univ Munich					16	24	14	17	9	6					7			73.9	67	46
Univ Sheffield				13	13	21	17	10	9	7								73.7	68	47

- **Harvard, Cambridge, Oxford**: in the top 5 for more than 80 % of simulations

- **Yale**: in the top 5 in the orignal THES but more likely between the 6th and 10th position

- Impact of assumptions: much stronger for the middle ranked universities:

Kyoto U: orignal rank 24th but could be ranked anywhere between the 21st and 65th position

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THES: indentification of sensitive or non-representative ranks

- **High sensitivity** *to the methodological assumptions* if simulated rank range ≥ 22, (roughly 1/4 of the positions in the classification)

59 universities whose simulated rank is *highly sensitive* to the methodological assumptions

University	Country	THES rank	Range of ranks	
Univ British Columbia	Canada	30	[26	50]
Univ Toronto	Canada	35	[11	58]
McMaster Univ	Canada	64	[49	80]
Univ Helsinki	Finland	62	[37	70]
Univ Paris 06	France	74	[44	87]
Univ Strasbourg 1	France	87	[47	88]
Univ Heidelberg	Germany	43	[33	55]
Univ Munich	Germany	44	[32	62]
Tech Univ Munich	Germany	45	[27	67]
Univ Freiburg	Germany	81	[57	88]
Univ Goettingen	Germany	85	[54	88]
Hebrew Univ Jerusalem	Israel	73	[46	88]
Tokyo Univ	Japan	17	[15	46]
Kyoto Univ	Japan	24	[22	63]
Osaka Univ	Japan	37	[34	74]
Tokyo Inst Tech	Japan	58	[44	70]
Tohoku Univ	Japan	63	[40	79]
Nagoya Univ	Japan	67	[49	83]
Univ Leiden	Netherlands	56	[38	63]
Univ Oslo	Norway	88	[58	88]
Uppsala Univ	Sweden	48	[42	78]
Lund Univ	Sweden	64	[42	74]
Swiss Fed Inst Tech - Zurich	Switzerland	34	[13	41]
Univ Basel	Switzerland	68	[25	83]
Univ Zurich	Switzerland	80	[36	86]
King's Coll London	UK	23	[9	35]
Univ Manchester	UK	28	[13	38]
Univ Bristol	UK	31	[13	40]
Univ Birmingham	UK	45	[23	58]
Univ Sheffield	UK	47	[23	65]
Univ Nottingham	UK	49	[20	67]
Massachusetts Inst Tech (MIT)	US	10	[2	25]
Duke Univ	US	13	[8	60]
Johns Hopkins Univ	US	15	[12	36]
Stanford Univ	US	18	[4	37]
Univ Michigan - Ann Arbor	US	32	[22	46]
Univ California - Los Angeles	US	33	[23	70]
New York Univ	US	38	[37	68]
Univ Texas - Austin	US	39	[23	63]
Univ Wisconsin - Madison	US	40	[28	60]
Univ Washington - Seattle	US	41	[35	62]
Univ California - San Diego	US	42	[31	78]
Univ Illinois - Urbana Champaign	US	50	[41	71]
Univ Pittsburgh - Pittsburgh	US	51	[32	70]
Purdue Univ - West Lafayette	US	51	[27	68]
Vanderbilt Univ	US	53	[29	74]

THES rank not representative of the plurality of scenarios

Unreliable/ non-representative: if
$|Common\ rank - simulated\ median\ rank| > 13$, (roughly 1/7 of the positions in the classification)
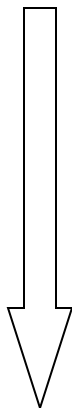
University	Country	THES rank	Median rank
Univ Strasbourg 1	France	87	71
Tokyo Univ	Japan	17	31
Kyoto Univ	Japan	24	42
Osaka Univ	Japan	37	53
Uppsala Univ	Sweden	48	64
Univ Nottingham	UK	49	33
Univ California - San Diego	US	42	66
Pennsylvania State Univ - Univ Park	US	57	71
Univ California - Davis	US	61	75
Michigan State Univ	US	83	62

10 universities whose THES rank is not representative of the simulated scenarios

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Legend:
Frequency lower 15%
Frequency between 15 and 30%
Frequency between 30 and 50%
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Note: Frequencies lower than 4% are not shown

SJTU: simulated ranks

SJTU (70 scenarios)

	Rank 1-5	Rank 6-10	Rank 11-15	Rank 16-20	Rank 21-25	Rank 26-30	Rank 31-35	Rank 36-40	Rank 41-45	Rank 46-50	Rank 51-55	Rank 56-60	Rank 61-65	Rank 66-70	Rank 71-75	Rank 76-80	Rank 81-88	Original SJTU score	Original SJTU rank	Common SJTU rank
Harvard Univ	100																	100	1	1
Stanford Univ	87	13																73.7	2	2
Univ California - Berkeley	100																	71.9	3	3
Univ Cambridge	96																	71.6	4	4
Massachusetts Inst Tech (MIT)	81	19																70	5	5
California Inst Tech	27	61	11															66.4	6	6
Columbia Univ	11	89																63.2	7	7
Princeton Univ		71	19	10														59.5	8	8
Univ Chicago		56	44															58.4	9	9
Univ Oxford		87	13															56.4	10	10
Yale Univ		50	50															55.9	11	11
Cornell Univ		27	73															54.3	12	12
Univ California - Los Angeles		11	86															52.6	13	13
Univ California - San Diego			43	51														50.4	14	14
Univ Pennsylvania			83	16														49	15	15
Univ Washington - Seattle				89	9													48.2	16	16
Univ Wisconsin - Madison			43	56														48	17	17
Johns Hopkins Univ			13	59	26													46.1	19	18
Tokyo Univ			11	30	46	13												45.9	20	19
Univ Michigan - Ann Arbor			11	16	20	16				6				20				44	21	20
Kyoto Univ				39	59													43.1	22	21
Imperial Coll London				26	61	13												43	23	22
Univ Toronto				19	60	21												43	23	22
Univ Coll London				23	74													42.8	25	24
Univ Illinois - Urbana Champaign				34	44	21												42.7	26	25
Swiss Fed Inst Tech - Zurich				6	29	27	34											39.9	27	26
Washington Univ - St. Louis					33	63												39.7	28	27
Northwestern Univ						89	11											38.2	29	28
New York Univ						10	66	24										38	30	29
Duke Univ						14	20	30					21	11				37.4	32	30
Univ Minnesota - Twin Cities						9	19	24	11				19	14				37	33	31
Univ Colorado - Boulder							31	47	19									36.6	34	32
Univ California - Santa Barbara							19	16	21	10			19					35.8	35	33
Univ British Columbia							6	80	14									35.4	36	34
Univ Maryland - Coll Park							9	49	43									35	37	35
Univ Texas - Austin								20	47	19	7							34.4	38	36
Univ Paris 06								33	37	21	9							33.8	39	37
Vanderbilt Univ								51	29	11	6							33.6	41	38
Univ California - Davis								14	13	10	9			6			31	32.7	43	39
Pennsylvania State Univ - Univ Park								9	21	7	9	6		6	10	17	11	32.7	43	39
Univ California - Irvine								6	11	23	14	10		13	11		6	32.5	45	41
Rutgers State Univ - New Brunswick								6	19	27	19	17		7				32.1	47	42
Univ Manchester								9	41	37	13							32	48	43
Univ Pittsburgh - Pittsburgh								13	13	26		6			7	23		31.9	49	44
Univ Southern California									11	13	13		11	20	14		6	31.4	50	45
Univ Florida								13	17	19			13	13	14			31.1	51	46
Univ Edinburgh								24	34	24	10	6						30.8	53	47
Univ Munich								9	6	27	21	20	14					30.8	53	47
Tech Univ Munich								23	23	19	11	7	11					30.6	56	49

▪ **Harvard, Stanford, Berkley, Cambridge, MIT**: in the top 5 in the original SJTU and in more than 80% of the simulations

▪ **Toronto, Kyoto, Imp Coll London:** between 21 and 25 in 60% of cases and in the original SJTU ranking

▪ - Impact of assumptions: strong for instance for **U Southern California**

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SJTU: indentification of sensitive or non-representative ranks

- **High sensitivity** *to the methodological assumptions* if simulated rank range ≥ 22,
  (roughly 1/4 of the positions in the classification)
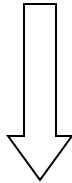
52 universities whose simulated rank is **highly sensitive** to the methodological assumptions

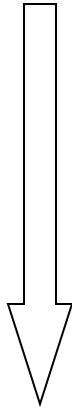| University	Country	SJTU rank	Range of ranks	
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McGill Univ	Canada	55	[36	80]
Univ Helsinki	Finland	67	[49	72]
Univ Strasbourg 1	France	88	[52	88]
Ecole Normale Super Paris	France	77	[39	87]
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Univ Goettingen	Germany	79	[46	87]
Univ Heidelberg	Germany	58	[41	73]
Tech Univ Munich	Germany	49	[31	60]
Univ Munich	Germany	48	[29	55]
Hebrew Univ Jerusalem	Israel	57	[36	65]
Tokyo Inst Tech	Japan	86	[62	87]
Nagoya Univ	Japan	84	[62	88]
Tohoku Univ	Japan	69	[52	84]
Osaka Univ	Japan	60	[48	81]
Univ Leiden	Netherlands	64	[42	71]
Univ Oslo	Norway	62	[38	80]
Lund Univ	Sweden	86	[65	88]
Uppsala Univ	Sweden	59	[37	77]
Univ Basel	Switzerland	74	[43	78]
Univ Zurich	Switzerland	52	[39	65]
Univ Birmingham	UK	83	[63	86]
King's Coll London	UK	76	[58	86]
Univ Nottingham	UK	73	[55	82]
Univ Sheffield	UK	65	[47	70]
Univ Bristol	UK	56	[41	65]
Indiana Univ - Bloomington	US	82	[59	88]
Rice Univ	US	80	[46	83]
Texas A&M Univ - Coll Station	US	78	[65	88]
Boston Univ	US	75	[61	86]
Michigan State Univ	US	72	[58	87]
Case Western Reserve Univ	US	70	[45	81]
Univ Rochester	US	68	[45	72]
Univ Arizona	US	66	[50	87]
Brown Univ	US	63	[45	71]

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SJTU rank not representative of the plurality of scenarios

Unreliable/ non-representative: if
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of the positions in the classification)

University	Country	SJTU rank	Median rank
Ecole Nomale Super Paris	France	77	62
Univ Basel	Switzerland	74	59
Rice Univ	US	80	66
Univ Southern Califomia	US	45	62
Pennsylvania State Univ - Univ Park	US	40	54
Univ Califomia - Davis	US	39	56

6 universities whose SJTU rank is not representative of the simulated scenarios

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- High volatility of the rank for more than half of the U with both THES and SJTU rankings

- THES ranking: less robust than the SJTU ranking

- An hybrid approach that use the 12 indicators of the THES and SJTU together provides a more reliable average rank of the institutions.

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- ▪ Uncertainty Analysis: empirical approach

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- ▪ What should we conclude?

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What should we conclude?

- While indicators and league tables are enough to start a discussion on higher education issues, they are not sufficient to conclude it.

- The THES and SJTU rankings **should not be used** to discuss about the determinants of university performance (Aghion et al., 2008) or **to deliver policy messages** on educational issues.
    - Assigned university rank largely depends on the methodological assumptions made in compiling the two rankings.

- **A multi-modeling approach** can offer a representative picture of the classification of university performances: **allows to rank institutions in a range bracket**.
    - Better than assigning a specific rank which is not representative of the real performance of the university.

- Assessment of the universities performance based on the hybrid set of the twelve indicators used in the THES and SJTU rankings provides a more reliable average rank of the institutions.

- The compilation of university rankings should always be accompanied by a robustness analysis.

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