

The Features of World-Class Universities

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The Features of World-Class Universities

1. Introduction

As globalization intensifies the international competition in many aspects, the role of the university as the powerhouse for production of knowledge and innovative human resources has regained attention. In order to improve national competitiveness in strategic fields, Western countries have been shifting their higher education policy from concern for equity to excellence since the 1980s. A similar policy approach has been adopted by Asian- Pacific countries since the 1990s, and the pursuit of academic excellence as well as the building of world-class universities has become a national aspiration. To satisfy this craze for 'world classness', two surveys, one by Shanghai Jiao Tong University and one by the Times Higher Education Supplement (THES) have tried to rank the world's best universities. However, no one really knows what a world-class university is, and most of the discussions still remain at the conceptual level. In light of the heavy investments in pursuing academic excellence and the impact it may have on the development of universities, the article aims to address the question of "What is a world-class university?" by analyzing the features shared by most of the top-ranking universities in various areas of the world.

2. Research Method

This study firstly selects the top 100 universities ranked by Shanghai Jiao Tong University as the world-class universities. The reason why the THES ranking was not chosen as the basis for the selection of universities is that THES did neither explain why peer review, the first of the five indicators, is weighted at half of the total score nor how the 1,300 academics who took part in the peer review is selected.

According to the ranking conducted by Shanghai Jiao Tong University, the US houses 51 of the top 100 universities, followed by UK with 11 universities. The rest are to be found in European Continent (26), Asia Pacific (7), Canada (4) and Israel(1). While the Shanghai ranking has a rather complete set of data about the research performance of the high-quality universities, this study pays attention to other aspects of those universities including: total enrollment, undergraduate graduate ratio, number and percentage of international students, number of faculty, student faculty ratio, number of administrative and technical staff, faculty staff ratio, annual income and annual expenditures and annual income/expenditures per student.

Due to the absence of national bodies collecting above-mentioned data, the study gathers

data mainly from the websites of individual universities. To make comparison of top-ranking universities in various countries/regions more feasible, out of the top 100 universities, the study focuses on the top 10 private and top 10 public universities in the US, top 10 in the UK and 10 in European continent and the top 7 in the Asian-Pacific region. Other than the 10 universities in European continent, the universities in all the countries/regions are the institutions rated best by the Shanghai list. The selection of the institutions in the European continent is mainly subject to the availability of data in English.

3. The Top 10 Private American Universities

Table 1

Research performance of the top 10 private American Universities

SJTU Rank	Name	Total Score	Alumni	Award	HiCi	N&S	SCI	Size
1	Harvard Univ	100.0	98.6	100.0	100.0	100.0	100.0	60.6
2	Stanford Univ	77.2	41.2	72.2	96.1	75.2	72.3	68.1
5	MIT	72.4	74.1	78.9	73.6	69.1	64.6	47.5
6	California Inst Tech	69.0	59.3	66.5	64.8	66.7	53.2	100.0
7	Princeton Univ	63.6	61.0	76.8	65.4	52.1	46.8	67.3
9	Columbia Univ	61.2	77.8	58.8	57.3	51.6	68.3	37.0
10	Univ Chicago	60.5	72.2	81.9	55.3	46.6	54.1	32.7
11	Yale Univ	58.6	52.2	44.5	63.6	58.1	63.6	50.4
12	Cornell Univ	55.5	46.6	52.4	60.5	47.2	66.2	33.6
15	Univ Pennsylvania	51.8	35.6	35.1	61.2	44.6	72.6	34.0

Source: Shanghai Jiao Tong University (2004)

Table 2

Characteristics of the top 10 private American Universities

	Harvard Univ	Stanford Univ	MIT	Caltech	Princeton Univ	Columbia Univ	Chicago Univ	Yale Univ	Cornell Univ	Univ Penn
Has a medical school	yes	yes	no	no	no	yes	yes	yes	yes	yes
Total enrollment	19,789	14,454	10,320	2,172	6,673	23,650	13,400	11,359	20,334	19,265
Undergraduate	7,539	7,800	4,136	896	4,695	8,959	4,400	5,242	13,655	10,047
graduate	12,250	6,654	6,184	1,276	1,978	14,691	9,000	6,117	6,679	9,218
Undergraduate/graduate ratio	0.6:1	1.2:1	0.7:1	0.7:1	2.4:1	0.6:1	0.5:1	0.9:1	2.0:1	1.1:1
No. of international students	3,546	2,971	2,724	--	1,202	4,065	--	1,817	3,253	2,440
%of international students	18	21	26	--	18	17	--	16	16	13
no. of faculty (include research faculty)	2,000	1,749	1,581	1,147	1,146	3,224	2,160	3,236	3,241	4,238
Student faculty ratio	9.9:1	8.3:1	6.5:1	1.9:1	5.8:1	7.3:1	6.2:1	3.5:1	6.3:1	4.5:1
No. of staff	--	8,788	8,199	2,671	5,291	9,198	12,460	8,005	9,925	13,025
Faculty staff ratio	--	0.2:1	0.2:1	0.4:1	0.2:1	0.4:1	0.2:1	0.4:1	0.3:1	0.3:1
Annual income (US\$ billion)	2.6	2.3	1.8	--	0.9	2.1	1.1	--	1.9	--
Annual income per student (×US\$000)	131	159	174	--	135	89	82	--	93	--
Annual expenditures (US\$ billion)	2.6	2.3	1.8	--	0.9	2.1	--	1.7	1.9	4.3
Annual expenditures per student (×US\$000)	131	189	174	--	135	89	--	150	93	223

Source: university websites.

4. The Top 10 Public American Universities

Table 3

Research performance of top 10 public American Universities

SJTU Rank	Name	Total Score	Alumni	Award	HiCI	N&S	Sci	Size
4	UC - Berkeley	74.2	70.0	76.0	74.1	75.6	72.7	45.1
13	UC - San Diego	53.8	17.8	34.7	63.6	59.4	67.2	47.9
16	UC-Los Angeles	51.6	27.4	32.8	60.5	48.1	79.9	24.8
17	UC - San Francisco	50.8	0.0	37.6	59.3	59.5	62.9	48.8
18	Univ Wisconsin - Madison	50.0	43.1	36.3	55.3	48.0	69.2	19.0
19	Univ Michigan - Ann Arbor	49.3	39.8	19.3	64.8	45.7	76.7	20.1
20	Univ Washington - Seattle	49.1	22.7	30.2	57.3	49.6	78.8	16.2
25	Univ Illinois - Urbana Champaign	43.3	41.7	37.4	46.2	36.0	58.2	17.8
33	Univ Minnesota - Twin Cities	38.3	36.1	0.0	53.9	35.9	69.6	12.8
34	Univ Colorado - Boulder	37.8	16.6	29.8	43.7	38.3	47.5	27.4

Source: Shanghai Jiao Tong University (2004)

Table 4

Characteristics of top 10 public American universities

	UC Berkeley	UC San Diego	UC Los Angeles	UC San Francisco	Univ Wisconsin - Madison	Univ Michigan - Ann Arbor	Univ Washington - Seattle	Univ Illinois - Urbana Champaign	Univ Minnesota - Twin Cities	Univ Colorado - Boulder
Has a medical school	no	yes	yes	yes	yes	yes	yes	no	yes	no
Total enrollment	33,076	24,668	38,598	2,800	41,588	36,047	42,757	40,360	50,954	29,258
Undergraduate	23,206	19,872	25,715	--	28,583	24,828	30,921	29,294	34,281	24,710
graduate	9,870	4,796	12,883	--	13,005	11,219	11,836	11,066	16,673	4,548
Undergraduate/graduate	2.4:1	4.1:1	1.2:1	--	2.2:1	2.2:1	2.6:1	2.6:1	2.1:1	5.4:1
No. of international students	--	--	--	--	3,571	--	--	2,189	3,663	1,170
% of international students	--	--	--	--	9	--	--	5	7	4
no. of faculty (include research faculty)	1,889	--	3,326	--	2,060	5,007	3,360	3,312	--	2,090
Student faculty ratio	17.5:1	--	11.6:1	--	20.1:1	7.2:1	12.7:1	12.2:1	--	14:1
no. of staff	20,399	22,000	--	--	13,710	17,569	20,102	4,588	--	--
Faculty staff ratio	0.1:1	--	--	--	0.2:1	0.3:1	0.2:1	0.7:1	--	--
Annual income (US\$ billion)	0.9	0.6	0.8	0.4	1.7	1.2	2.2	--	1.3	0.8
Annual income per student (xUS\$000)	28	26	21	169	41	32	51	--	27	27
Annual expenditures (US\$ billion)	1.5	1.8	3.2	--	--	1.2	2.6	1.3	2.1	0.8
Annual expenditures per student (xUS\$000)	44	74	83	--	--	32	61	33	41	27

Source: university websites.

5. The Top 10 British Universities

Table 5
Research performance of Top 11 British Universities

JET Rank	THES rank	Name	Total Score	Alumni	Award	HiCi	N&S	SCI	Size
3	6	Univ Cambridge	76.2	100.0	93.4	56.6	58.5	70.2	73.2
8	5	Univ Oxford	61.4	64.4	59.1	53.1	55.3	65.2	59.0
23	14	Imperial College London	46.4	20.9	38.1	46.2	39.4	65.8	44.5
25	34	Univ College London	44.3	30.8	32.9	41.0	41.0	61.1	42.6
47	48	Univ Edinburgh	32.9	22.7	17.1	27.6	36.7	49.1	31.6
60	91	Univ Bristol	30.6	10.9	18.2	32.7	26.6	49.1	29.4
69	150	Univ Sheffield	28.8	23.5	14.4	23.1	28.8	46.2	27.7
77	96	King's College London	28.0	16.6	23.5	23.1	19.8	46.2	26.9
78	43	Univ Manchester	27.9	25.9	19.3	21.4	18.2	48.6	26.8
80	170	Univ Nottingham	27.0	15.4	20.4	23.1	20.1	45.1	25.9
93	126	Univ Birmingham	25.5	25.1	11.2	24.7	14.0	47.6	24.5

Source: Shanghai Jiao Tong University (2004)

Table 6
Characteristics of Top 10* British universities (1/2)

	Univ Cambridge	Univ Oxford	Imperial College London	Univ college London	Univ Edinburgh
Total enrollment	17,781	18,536	10,721	18,337	22,827
Undergraduate	11,751	11,938	7,483	11,669	16,963
graduate	5,967	6,598	3,238	6,668	5,864
Has a medical school	yes	yes	yes	yes	yes
Undergraduate/graduate	1.97:1	1.81:1	2.3:1	1.75:1	2.89:1
No. of international students	2,997	4,600	2,186	4,723	2,958
% of international students	17	25	20	26	13
no. of faculty (include research faculty)	--	1,346	2,856	4,080	--
Student faculty ratio	--	13.8:1	3.8:1	4.5:1	--
no. of staff	--	5,837	4,886	--	--
Faculty staff ratio	--	0.2:1	0.5:1	--	--
Annual income (US\$ billion)	0.9	0.9	0.8	0.9	0.7
Annual income per student (×US\$000)	50	47	72	49	31
Annual expenditures (US\$ billion)	0.9	0.8	0.8	0.9	0.7
Annual expenditures per student (×US\$000)	50	45	71	49	30

Source: university websites.

*King's College London is not listed due to unavailability of data.

Table 7

Characteristics of Top 10 British universities (2/2)

	Univ Bristol	Univ Sheffield	Univ Manchester	Univ Nottingham	Univ Birmingham
Total enrollment	16,140	19,587	25,746	29,856	24,900
Undergraduate	10,935	16,070	--	--	17,836
graduate	5,205	3,517	--	--	7,064
Has a medical school	yes	yes	yes	yes	yes
Undergraduate/graduate	2.10:1	4.57:1	--	--	2.52:1
No. of international students	--	3,820	4,489	--	4,303
% of international students	--	20	17	--	17
no. of faculty (include research faculty)	2,405	1,296	--	2,415	--
Student faculty ratio	6.7:1	15.1:1	--	12.4:1	--
no. of staff	1,284	4,273	--	2,835	--
Faculty staff ratio	1.9:1	0.3:1	--	0.9:1	--
Annual income (US\$ billion)	0.5	0.5	0.7	0.6	0.6
Annual income per student (×US\$000)	29	29	27	19	22
Annual expenditures (US\$ billion)	0.5	--	0.6	0.6	0.5
Annual expenditures per student (×US\$000)	29	---	26	19	21

Source: university websites.

6. The Top 10 European Continent Universities

Table 8

Research performance of Top 26 European Continent Universities

SJTU Rank	Name	Country	Total Score	Alumni	Award	HCI	N&S	SCI	Size
27	Swiss Fed Inst Tech	Switzerland	43.2	40.3	37.0	39.1	43.2	47.1	41.5
39	Univ Utrecht	Netherlands	34.9	30.8	21.4	31.5	29.9	58.1	22.1
41	Univ Paris 06	France	33.9	35.7	23.9	23.1	24.7	56.7	32.6
45	Tech Univ Munich	Germany	33.3	43.1	24.1	27.6	20.4	50.0	32.0
46	Karolinska Inst Stockholm	Sweden	33.0	30.8	27.8	32.7	21.6	49.8	21.5
48	Univ Paris 11	France	32.5	33.3	34.2	21.4	21.3	46.8	31.2
51	Univ Munich	Germany	32.4	37.2	21.1	12.4	32.0	56.0	31.1
57	Univ Zurich	Switzerland	31.1	12.6	27.3	21.4	30.3	48.9	29.9
59	Univ Copenhagen	Denmark	31.0	30.8	24.7	23.1	22.6	48.1	29.8
63	Univ Leiden	Netherlands	29.8	25.1	15.8	30.3	22.0	47.3	30.3
64	Univ Heidelberg	Germany	29.7	10.9	27.7	23.1	22.1	49.7	28.5

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SJTU Rank	Name	Country	Total Score	Alumni	Award	HiCi	N&S	SCI	Size
66	Moscow State Univ	Russia	29.5	51.5	34.9	0.0	8.1	58.5	28.3
68	Univ Oslo	Norway	29.2	25.9	34.1	19.5	17.2	42.1	28.0
72	Univ Helsinki	Finland	28.6	18.9	18.2	15.1	23.7	56.9	27.5
74	Uppsala Univ	Sweden	28.4	25.9	32.9	0.0	30.4	52.5	14.5
79	Univ Goettingen	Germany	27.4	38.8	20.4	17.5	18.2	42.8	26.3
82	Univ Strasbourg I	France	26.8	29.5	22.9	21.4	21.3	35.2	25.7
85	Ecole Normale Super Paris	France	26.5	47.9	25.0	17.5	18.2	29.6	25.4
86	Univ Vienna	Austria	26.3	25.1	15.8	8.7	22.0	54.5	25.3
88	Univ Freiburg	Germany	26.0	25.1	21.4	19.5	18.0	40.9	25.0
91	Univ Basel	Switzerland	25.8	25.9	17.5	21.4	24.2	35.5	24.8
92	Lund Univ	Sweden	25.6	29.5	0.0	26.2	22.0	54.0	11.2
93	Univ Roma - La Sapienza	Italy	25.5	16.6	15.8	12.4	24.3	57.4	7.9
95	Humboldt Univ Berlin	Germany	25.4	29.5	21.9	8.7	14.8	49.7	24.4
97	Stockholm Univ	Sweden	25.2	29.5	30.2	17.5	14.9	35.7	15.3
99	Univ Bonn	Germany	25.1	19.9	20.4	17.5	16.7	43.9	24.1

Source: Shanghai Jiao Tong University (2004)

Table 9

Characteristics of 10* universities in European Continent (1/2)

	ETH Zurich	Univ Utrecht	Univ Paris 06	Univ Paris 11	Univ Leiden
Total enrollment	12,626	24,628	30,000	30,000	16,614
Undergraduate	9,704	--	19,800	21,200	--
graduate	2,900	--	10,200	8,800	--
Has a medical school	no	yes	yes	yes	yes
Undergraduate/graduate	3.32:1	--	1.94:1	2.41:1	--
No. of international students	5,525	1,000	4,250	3,200	1,366
%of international students	20	4	14	11	8
no. of faculty (include research faculty)	--	2,883	4,000	1,800	1,423
Student faculty ratio	--	8.5:1	7.5:1	16.6:1	11.7:1
no. of staff	5,535	5,436	3,000	3,481	2,090
Faculty staff ratio	--	0.5:1	0.8:1	1.9:1	1.5:1
Annual income (US\$ billion)	0.8	0.8	--	0.6	0.5
Annual income per student (×US\$000)	64	34	--	19	32
Annual expenditures (US\$ billion)	0.9	0.8	--	--	0.5
Annual expenditures per student (×US\$000)	74	34	--	--	32

Source: university websites.

* the remaining 16 universities are not listed due to unavailability of data

Table 10

Characteristics of 10 universities in European Continent(2/2)

	Univ Helsinki	Uppsala Univ	Lund Univ	Stockhm Univ	Univ Bonn
Total enrollment	38,454	42,500	27,104	37,225	30,000
Undergraduate	31,304	40,000	23,646	35,000	--
graduate	7,150	2,500	3,458	2,225	--
Has a medical school	yes	yes	yes	yes	yes
Undergraduate/graduate	4.38:1	--	6.84:1	15.73:1	--
No. of international students	1,266	--	615	--	5,000
%of international students	3	--	2	--	6
no. of faculty (include research faculty)	3,546	3,850	2,825	2,940	3,530
Student faculty ratio	10.8:1	11.4:1	9.6:1	12.7:1	8.5:1
No. of staff	3,899	2,150	3,179	1,260	5,200
Faculty staff ratio	0.9:1	1.8:1	0.9:1	2.3:1	0.7:1
Annual income (US\$ billion)	0.6	0.6	0.7	--	--
Annual income per student (×US\$000)	16	14	27	--	--
Annual expenditures (US\$ billion)	0.6	0.6	0.7	--	0.4
Annual expenditures per student (×US\$000)	16	14	27	--	14

Source: university websites.

7. Top 7 Asian-Pacific Universities

Table 11

Research performance of the top 7 Asian-Pacific Universities

SJTU Rank	Name	Country	Total Score	Alumni	Award	HiCi	N&S	SCI	Size
14	Tokyo Univ	Japan	51.9	36.1	14.4	44.5	55.0	91.9	49.8
21	Kyoto Univ	Japan	48.3	39.8	34.1	40.0	37.2	77.1	46.4
53	Australian Natl Univ	Australia	31.9	17.8	12.9	41.0	31.4	43.6	30.7
54	Osaka Univ	Japan	31.5	12.6	0.0	26.2	31.2	72.1	30.2
69	Tohoku Univ	Japan	28.8	18.9	0.0	19.5	26.1	69.3	27.7
82	Univ Melbourne	Australia	26.8	15.4	14.4	21.4	19.2	53.0	25.8
97	Nagoya Univ	Japan	25.2	0.0	14.4	15.1	23.7	55.3	24.2

Source: Shanghai Jiao Tong University (2004)

Table 12

Characteristics of the top 7 Asian-Pacific Universities

	Tokyo Univ	Kyoto Univ	Osaka Univ	Tohoku Univ	Nagoya Univ	Australian Natl Univ	Univ Melbourne
Has a medical school	yes	yes	yes	yes	yes	yes	yes
Total enrollment	28,350	22,103	19,931	17,247	16,537	10,152	32,869
Undergraduate	15,466	13,275	12,229	10,616	10,233	7,370	25,074
graduate	12,884	8,828	7,702	6,631	6,304	2,782	7,795
Undergraduate/graduate	1.2:1	1.4:1	1.6:1	1.6:1	1.6:1	2.7:1	3.2:1
No. of international students	2,085	1,253	1,048	1,054	1,194	2,096	7,619
% of international students	7	6	5	6	7	21	23
no. of faculty (include research faculty)	4,165	2,957	2,436	2,589	1,831	1,246	2,362
Student faculty ratio	6.8:1	7.5:1	8.2:1	6.7:1	9.0:1	8.2:1	13.9:1
No. of staff	3,357	2,345	2,028	2,359	1,703	2,046	3,319
Faculty staff ratio	1.2:1	1.3:1	1.2:1	1.1:1	1.1:1	0.6:1	0.7:1
Annual income (US\$ billion)	0.7	0.4	0.5	0.4	0.4	0.4	0.7
Annual income per student (×US\$000)	26	20	23	24	20	39	21
Annual expenditures (US\$ billion)	2.6	1.3	1.1	2.4	0.9	0.4	0.7
Annual expenditures per student (×US\$000)	78	58	56	67	54	41	20

Source: (1) Japanese universities: websites

(2) Australian universities: DEST Higher education statistics.

8. A Summary of Institutional Characteristics

Table 13

Characteristics of top-ranking universities

	Average of Top 10 American Private Universities	Average of Top 10 American Public Universities	Average of Top 10 British Universities	Average of 10 European Universities	Average of Top 7 Asian-Pacific Universities
Total Score	67.0	49.8	40.1	30.7	34.9
Alumni	61.9	31.5	34.0	28.9	20.0
Award	66.7	33.4	32.4	23.4	12.9
HiCi	69.8	57.9	35.0	22.2	29.7
N&S	61.1	49.6	33.9	24.9	32.0
Sci	66.2	68.3	54.8	49.9	66.0
Size	53.1	28.0	38.5	25.0	33.5
% of having a medical school	70	70	100	80	100
Student enrollment	14,142	34,011	20,443	28,915	21,027
Undergraduate/graduate	1.1:1	2.8:1	2.5:1	5.7:1	1.8:1
% of international students	18.1	--	19.4	8.5	11
no. of faculty (include research faculty)	2,372	3,006	2,400	2,978	2,506
Student faculty ratio	6.0:1	13.6:1	9.4:1	10.8:1	7.6:1
Faculty staff ratio	0.3:1	0.3:1	0.8:1	1.3:1	1.1:1
Annual income per student (×US\$000)	127	47	38	29	24
Annual expenditures per student (×US\$000)	148	50	38	30	52

- 1) The world-class universities are all public universities except for those in the US, which covers both public and private universities. Most of these universities are comprehensive universities with a wide range of subject coverage..

The top ranking universities offer students a full array of courses and the balanced education highly valued by economically and socially better-off students. Only a few of the best universities are specialist institutions, and some of them (such as MIT) now runs far beyond technology.

- 2) Although research quantity of the top-ranking universities is important, the crucial factor which makes the institutions prominent internationally is the quality and significance of academic research.

As shown by Table 13, most of the top-ranking universities across the world come very close in the indicator of citation (SCI & SSCI), which mainly measures the quantity of research output. The actual difference of these universities is the indicators which show the research quality (for example, the alumni and faculty winning Nobel Prize, Fields Medal and number of HiCi and N&S papers.) . This can be observed in the scores of the top-ranking American private universities. These institutions, nine of ten ranked best in the world in Shanghai list, perform less well in citation than their public counterparts. The indicators make them prominent are HiCi and N&S, which stress the quality and significance of research output rather than quantity.

- 3) Most of the world-class universities have medical schools. Institutions that have a significant commitment to biomedical science tend to have a competitive advantage than institutions that are more committed to other subject areas.

Medical schools offer another point of comparison between institutions. Seventy percent of the top American universities, eighty percent of the European universities and all of British and Asian-Pacific universities have medical schools. A common perception holds that institutions with medical schools have an advantage in research competition. The data do not demonstrate that the existence of a medical school alone guarantees a internationally competitive research university. However, a medical school gives universities a competitive advantage in winning a share of the significant sums that many governments put to biomedical and life science projects.

Indeed, medical schools tend to be big money –spinners and attract talented students and faculty. As the Shanghai list awards a fifth of its points on the basis of articles published in Science and Nature, and another fifth on HiCi, thereby conferring a big advantage on universities with strengths in biomedicine and other areas of science. Universities without medical schools often have to have significant investments in

biomedical research in departments of biology, microbiology, bioengineering, and similar disciplines.

- 4) In most of the world-class universities, the number of undergraduate students is larger than that of graduate students.

Apart from the private universities in the US, where undergraduate and graduate students have an almost equal share in the student body, in other universities, the number of undergraduate students exceed that of graduate students by some distance. The undergraduate graduate ratio of the universities in European continent is even as high as 5.7: 1. The size of a high-quality institution's undergraduate enrollment may respond to many pressures. In some instances, public universities grow in response to governmental mandates for increased public access to undergraduate education. In other instances, the growth of undergraduate students reflects the funding strategies taken by universities. As public universities in most countries are funded based on formulas related to enrollment size, and the revenue of undergraduate education usually exceeds its direct cost, undergraduate education is therefore regarded as profit center. The revenue generated from undergraduate education becomes an important source of subsidy for quality research. Outstanding research performance, in its turn, becomes an advantage in competing for research-minded students and research grants. This revenue synergy between teaching and research helps to explain the relatively large size of undergraduate students at most of the world-class universities.

- 5) The student faculty ratio is relatively low in most universities.

Apart from American public universities in which the student faculty ratio is nearly 14: 1, the student faculty ratio of European and Asia Pacific universities is less than 11: 1, and it is as low as 6: 1 in top private universities in the US. It is apparent that universities have to be well-staffed to attract best students who are looking for personalized instruction and research-minded faculty who are looking for chances to escape from heavy teaching loads to be able to engage in research.

- 6) Most universities have sufficient administrative and technical personnel to support teaching and research.

The faculty staff ratio in all of the top-ranking universities is smaller than 1.2: 1. The ratio is even as small as 0.3:1 in the American universities. It shows that to excel in teaching and research, the faculty has to be provided with administrative and technical support. In other words, it will be a waste of talent if the faculty has to devote part of their time and energy to the minutiae of daily routine.

7) The world-class universities enjoy substantial funds.

Institutions such as the top American private universities have enormous financial advantages over other universities. Although staying ahead in world ranking is not simply a matter of money, it is reasonable to infer that the prominence of these institutions is closely associated with the fact that the annual expenditures per student in these schools reach a hard to challenge USUS\$144, 000. The annual expenditures per student of other top-ranking universities range from USUS\$52,000 to USUS\$30,000.

Money make it possible for the institutions to support plant, equipment, personnel and the university environment that are required to attract quality student and faculty. As competitive university research operates at the outside edges of human knowledge, the competition among universities for critical talent and resources is fierce, rich institutions have more chances in moving ahead in the process of discovery. Generally speaking, all things being equal, the more money the university can invest effectively in the competition for quality, the better it will become.

References

- Shanghai Jiao Tong University (2004. Academic Ranking of World Universities Ranking Methodology. Retrieved February 20, 2005, from <http://ed.sjtu.edu.cn/rank/2004/Methodology.htm>
- The Times Higher Education Supplement (2004. World University Rankings. London: the author.

American Universities

1. Harvard Univ: <http://www.news.harvard.edu/glance/>
2. Stanford Univ: <http://www.stanford.edu/home/stanford/facts/>
3. MIT: <http://web.mit.edu/facts/index.shtml>
4. California Inst Tech: <http://www.caltech.edu/at-a-glance/>
5. Princeton Univ: <http://www.princeton.edu/pr/facts/profile/04/>
6. Columbia Univ: <http://www.columbia.edu/cu/opir/facts.html>
7. Univ Chicago: <http://www.uchicago.edu/uchi/about/>
8. Yale Univ: <http://www.yale.edu/oir/factsheet.html#General20Information>
9. Cornell Univ: <http://www.cornell.edu/about/facts/stats.cfm>
10. Univ Pennsylvania: <http://www.upenn.edu/about/facts.php>
11. UC - Berkeley: <http://www.berkeley.edu/>
12. UC - San Diego: <http://www.ucsd.edu/>
13. UC - Los Angeles: <http://www.ucla.edu/>
14. UC - San Francisco: http://www.ucsf.edu/about_ucsf/profile.html
15. Univ Wisconsin - Madison: <http://www.uc.wisc.edu/profile/quickfacts.html>
16. Univ Michigan - Ann Arbor: <http://www.umich.edu/~oapainfo/contents.html>
17. Univ Washington - Seattle: <http://www.washington.edu/newsroom/profile/>
18. Univ Illinois - Urbana Champaign: <http://www.publications.uiuc.edu/info/facts.html>
19. Univ Minnesota - Twin Cities: http://www1.umn.edu/twincities/01_abt_gen.php#1
20. Univ Colorado - Boulder: <http://www.colorado.edu/explore/ataglance.html>

British Universities

1. Univ Cambridge: <http://www.cam.ac.uk/cambuniv/pubs/factfig/>
2. Univ Oxford: <http://www.ox.ac.uk/aboutoxford/facts/#staf>
3. Imperial Coll London: http://www.imperial.ac.uk/publications/annual_report00-01/
4. Univ Coll London: http://www.ucl.ac.uk/images/annual_report_final.pdf201.pdf
5. Univ Edinburgh: <http://www.ed.ac.uk/annualreview/>
6. Univ Bristol: <http://www.bris.ac.uk/university/facts/>
7. Univ Sheffield: <http://www.shef.ac.uk/about/facts.html>
8. Univ Manchester: <http://www.man.ac.uk/about/publications/AnnualReport2003.pdf>
9. Univ Nottingham: <http://www.nottingham.ac.uk/about/>
10. Univ Birmingham: <http://www.about.bham.ac.uk/index.htm#international>

European Continent Universities

1. ETH-Zurich: http://www.ethz.ch/about/bginfos/annualreports/2003_eth_statistics_en.pdf
2. Univ Utrecht:
<http://www.uu.nl/uupublish/homeuu/homeenglish/aboututrechtuniv/factsandfigures/4473main.html>
3. Univ Paris 06: <http://english.upmc.fr/UK/info/UPMC20-20A20few20Statistics/010103>
4. Univ Paris 11: <http://www.u-psud.fr/anglais.nsf/in-brief.htm!OpenPage>
5. Univ Leiden: <http://www.figures.leiden.edu/>
6. Univ Helsinki: <http://www.helsinki.fi/inbrief/index.htm>
7. Uppsala Univ: <http://info.uu.se/fakta.nsf/sidor/figures.in.idB4.html>
8. Lund Univ: http://www.lu.se/upload/LUPDF/Lund_University/vb_2003_eng.pdf
9. Stockholm Univ: <http://www.su.se/organisation/presentation/english/figures.php3>
10. Univ Bonn: http://www.uni-bonn.de/en/The_University/The_University_of_Bonn_at_a_glance.html

Asian-Pacific Universities

1. Tokyo Univ: http://www.u-tokyo.ac.jp/index/b00_e.html
2. Kyoto Univ: http://www.kyoto-u.ac.jp/english/enotice/e05_koho/document/facts_2004.pdf
3. Osaka Univ: <http://www.osaka-u.ac.jp/jp/about/outline.html>
4. Tohoku Univ: <http://web.bureau.tohoku.ac.jp/international/FactsAndFigure/FactsAndFigure.html>
5. Nagoya Univ: <http://www.nagoya-u.ac.jp/out/toukei/>
6. Australian National Univ: http://unistats.anu.edu.au/Summary/Stats_Cards/card04s.pdf
7. Univ Melbourne: http://www.upo.unimelb.edu.au/upo_historical_stats.html